

Annual Report 2002-03

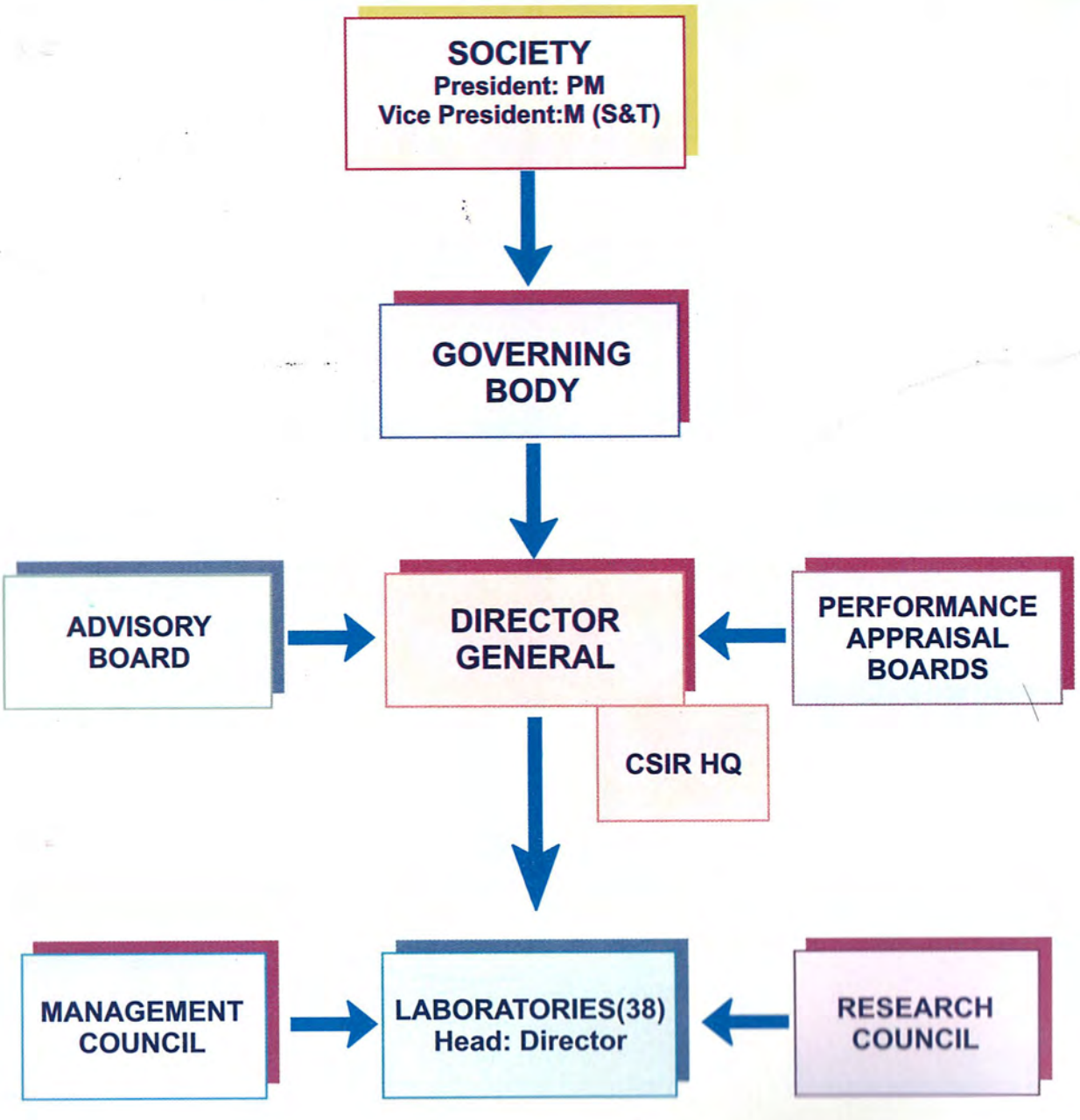
DIAMOND JUBILEE YEAR

CSIR INDIA

1942 – 2002

Council of Scientific & Industrial Research
Rafi Marg, New Delhi

CSIR ORGANISATIONAL STRUCTURE



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CSIR INDIA
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Council of Scientific & Industrial Research
Rafi Marg, New Delhi- 110001

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Cover Photo: The first prototype of Light Transport Aircraft-SARAS designed & fabricated by NAL- rolled out on 4th February, 2003

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Overview

The Council of Scientific & Industrial Research (CSIR), a premier R&D organization completed 60 years of its service to the nation. The Council continued to provide scientific & industrial R&D of value not only for India's sustained socio-economic development but for meeting its strategic needs as well. The Annual Report 2002-2003 highlights the significant S&T contributions in the sectors of Aerospace Science & Technology; Biological Sciences & Technology; Chemical Sciences & Technology; Engineering Sciences & Technology; Food Science & Technology; Information Science & Technology; Leather Science & Technology; Material Science & Technology; Physical and Earth Sciences & Technology; and Science & Technology for the Society. It also includes Central Management Activities, Headquarter Activities and Dateline CSIR.

Creating massive knowledge networks

A key feature of CSIR's performance during the year 2002-03 was the creation of major and innovative knowledge networks across and beyond CSIR laboratories. Not too long ago, most CSIR laboratories had acted as single units with several laboratory based programmes. CSIR's massive network on 'bioactive molecules' launched three years ago began the process of leveraging the benefit of networking by bringing together 20 CSIR laboratories and several other institutions. This philosophy was carried forward with vigour. The following were the new and continued initiatives.

Tenth Five Year Plan (2002-07)

CSIR evolved its Tenth Five Year Plan (TFYP) to further its efforts in providing scientific & industrial R&D that maximizes the economic environment and societal benefits for the people of India. The approach for TFYP was to foster the organizational values of: excellence in science; global competitiveness in technology (based on high science); local relevance in tune with socio-cultural and economic ethos; and innovation in activities ranging from science to technology and management to financing. The plan was focused on six schemes viz., National Laboratories; National S&T Human Resource Development; Intellectual Property and Technology Management; R&D Management Support; New Millennium Indian Technology Leadership Initiative

(NMITLI); and a new scheme on Infrastructure, Renovation and Refurbishing. The activities under the scheme 'National Laboratories' are focussed under 55 networked projects. Such massively networked programmes across the whole of CSIR were conceptualized for the first time. These are in three categories namely, Steering Committee identified mission mode programmes; CSIR Working Group identified mission mode programmes; and core network programmes. An allocation of Rs. 2430 crore was made for the Tenth Five Year Plan of CSIR .

New Millennium Indian Technology Leadership Initiative (NMITLI)

NMITLI continued its efforts with the thrust to harness national potential in Science and Technology to realize the vision of a resurgent India by partnering with Indian industry to achieve global leadership position in select niche areas. Concerted efforts were made to synergise the best competencies of publicly funded R&D institutions, academia and private industry. In a short span of less than three years, 25 path setting technology projects have been crafted with an enviable network of industries, academia and publicly funded R&D institutions. These involve partnership of over 50 industries and 150 R&D institutions. During the year, eleven new projects were launched. These included 5 industry initiated and 6 nationally evolved projects in which 27 research institutions and 14 industrial firms were partnering.

The significant achievements include: Identification for the first time, of contrasting chemotypes from over hundred accession of *Withania somnifera* collected from across the country; Launching of a next generation bioinformatics software, "Bio-Suite" which is a comprehensive, portable, modular and scalable software having more features than any existing commercial product; a new pharmacophore is being developed towards IND filing under the project on "Latent M. tuberculosis: new targets, drug delivery system, bioenhancers and therapeutics"; identification of potential leads for ambient preservation of hide and for dehairing of goat skin - these leads are being further pursued to develop a chemical free environmental friendly technology for leather processing; development of a high performing catalyst for desulphurising diesel from 2500 ppm to <50 ppm - the catalyst is now scheduled for testing at a plant scale; designing and fabrication of a new Liquid Crystal Display device for flat Panel Display System with two orders of magnitude faster switching time, a higher contrast ratio, symmetric and wide viewing angle; and development of a novel process for (S) 3-hydroxy-g-butyrolactone - a versatile intermediate using maltose and maltodextrin, as raw materials.

Contributing to Indian industry

CSIR continued to provide a strong support to Indian industry. The major achievements included successful commercialization of process for: conversion of Naphtha to Gas and Gasoline (NTGG); catalyst for speciality polymeric materials based on zirconium tetrachloride; lacidipine process; methane sulphonic acid process;

Precipitated Calcium Carbonate (PCC) etc. The industrial production based on CSIR processes and products is estimated to have risen to about Rs. 5800 crore during 2002-03.

Catalyzing civil aviation industry: SARAS roll out

CSIR has been rendering yeoman service to the Indian aerospace sector. Its contributions and excellence are acknowledged not only nationally but internationally as well. The light transport aircraft programme achieved a significant milestone on 4th February 2003 when its first prototype of SARAS rolled out. The prototype was named VT-XSD - SD in honour of Dr. Satish Dhawan, a doyen of aerospace field and former Chairman of National Aerospace Laboratories (NAL) Research Council at whose instance NAL's Civil Aviation activities were initiated. Major testing activities have been completed for SARAS in preparation of the first flight. It needs to be emphasized that a first journey that began with a Light Combat Research Aircraft in National Aerospace Laboratories, was taken forward to the series of HANSA aircrafts, resulting finally into an all composite aircraft HANSA-3, that was test certified in 2001, and is productionised and taken to Indian skies already. The Republic Day parade on 26th January 2003 proudly carried a float on HANSA-3, signifying India's first small steps into civil aviation industry.

National Policy Setting: CSIR's inputs for

CSIR had privilege to contribute to framing of two important policies during the year, namely auto fuel policy and policy on drug regulatory issues & spurious/ substandard drugs. The committees for the purpose were chaired by DG,CSIR. For these two domains of national importance, the knowledgebase available in CSIR system, was of substantial help in examining highly technical and complex issues and providing need based solutions The auto fuel policy took a holistic view of the diverse aspects of emissions, auto technologies and auto fuel quality on one hand and social costs, security of fuel supply and absorptive capacity on the other. The policy tried to provide a practical and balanced approach to meeting of these challenges. Likewise, the policy on drug regulatory issues and spurious drugs too, provided far sighted directions to bring diverse systems in the domain upto international standards. It dealt with the regulatory issues of products of ISM, therapeutic foods and dietary supplements, medical devices, diagnostics etc. It also addressed the issues of clinical research, an emerging opportunity for India.

Traditional knowledge: efforts for protection and value addition

CSIR lead the Team India initiative for setting up the first ever Traditional Knowledge Digital Library (TKDL). The TKDL would provide a search interface to retrieval of traditional knowledge information on international patent classification

(IPC) and keywords in multiple languages. At global level it would act as a bridge between 'Sanskrit Slokas' and a patent examiner .

CSIR's programme on discovery, development & commercialisation of new bioactives and traditional preparations completed its first phase. It has 52 leads under various stages of development, for diverse diseases namely cancer, ulcer, tuberculosis, immunomodulation, parkinsonism etc. The programme now has under its network 20 CSIR laboratories, 12 universities and 3 systems of Indian system of medicine i.e. Ayurveda, Siddha and Unani. The effort now is focussed towards filing new chemical entities, which will lead to entirely new and novel therapeutics .

Science & Technology for the Society

As a socially conscious organization CSIR continued its efforts to provide the S&T needed for the masses. During the year it adopted villages to promote employment generation on one hand and developed diverse technologies to add to quality of life on the other hand. These technologies include: ceramic membrane based removal of arsenic and iron from contaminated ground water; pesticide removal unit for producing potable water free from organic pollutants; lead-free Jaipur blue pottery; setting up of Reverse Osmosis (RO) based desalination plants in villages; marine sanitation device for "Kettuvallom" etc. In an unique endeavour, CSIR catalyzed commercial cultivation of geranium in Uttaranchal through community participation. In this end to end mission farmers have been trained not only for cultivation of geranium but also for extraction of oil and making value added products.

Restructuring and reorganising CSIR

CSIR is a live organization. It has continuously strived to respond to the changes in the external environment by restructuring and reorganizing itself. CSIR now has 38 laboratories (as against 39 in 2001-02) and 47 extension/field/regional centres (as against 80 in 2001-02). It has responded to the emerging opportunities in genomics and information and communication technology by two major initiatives:

- **Renaming of Centre for Biochemical Technology (CBT):** Centre for Biochemical Technology became a full fledged research centre of CSIR on 1st April, 1993 after sixteen years of its inception in 1977 as an affiliated Centre. From 1997 onwards there was a change of direction in CBT, which raised its ambition. The center added a major network activity on "Functional genomics" realizing that human and other genome sequencing, will transform biology and medicine forever and will open up a new chapter for biochemical technology as it enters the "Genome era". CBT charted a new path, which completely changed its trajectory. Its activities were thus directed towards multidisciplinary research in the areas of genomics, molecular medicine, bioinformatics and environmental biotechnology of high scientific impact, leading to technology development and

services relevant to society. The centre has created a large network involving many clinicians from various hospitals & medicinal institutions. CBT thus rapidly got transformed from a small laboratory working in narrow areas of biochemical research to a largely networked laboratory. This was achieved by utilizing the existing scientific strength of CBT and introducing two new areas "Molecular human Genetics' and Genome Information".

The Performance Appraisal Board (PAB) of CBT recognized that CBT was emerging as a distinctive Institute with its new R&D programmes viz., comparative genomics, proteome analysis, in-silico drug target discovery, and novel screens for drug target development. In view of aforesaid, PAB recommended a change in the name of the centre to reflect its new mandate closely. In view of the suggestion given by the PAB, the emerging scenario and also looking at the future of the biomedical research, an appropriate name of the CBT was recommended by the Research Council of CBT as Institute of Genomics & Integrative Biology (IGIB). The change in name was agreed to. This name would not only reflect the present position and the new content of R&D but also will give focus to diverse activities.

- **Evolving of NISCAIR:** National Institute of Science Communication and Information Resources (NISCAIR) came into existence on 1st October, 2002 following the merger of the erstwhile National Institute of Science Communication (NISCOM) and erstwhile Indian National Scientific Documentation Centre (INSDOC). The mandate of NISCAIR will be to: provide formal linkages of communication among the scientific community in the form of research journals in different areas of S&T; disseminate S&T information to general public, particularly school students, to inculcate interest in science among them; develop human resource in the field of science communication, library and information science, documentation, and S&T information management systems and services; harness information technology applications in information management with particular reference to science communication and modernizing libraries; act as a facilitator in furthering the economic, social, industrial, scientific and commercial development by providing timely access to relevant and accurate information; and collaborate with international institutions and agencies having objectives and goals similar to those of NISCAIR.

Setting up of Recruitment & Assessment Board (RAB)

CSIR Governing Body in its 151st meeting had inter alia considered and approved of the modification of the Recruitment & Assessment Promotion rules for Group IV Scientists in CSIR. These rules provided for the setting up of a Recruitment & Assessment Board (RAB). Accordingly, the RAB of CSIR was established in June 2002 to organize the assessment & recruitment of the CSIR scientists centrally to bring in uniformity across the laboratories and among the subject clusters.

Leading the national IPR movement

CSIR continued efforts to make its presence felt in the domain of intellectual property rights. The foreign patent filing was at 728; 25.5% increase from that of last year's figure of 580. The Indian patent filing was 421 besides acquiring of 35 copyrights and 2 trademarks (Details in Annexure I & IA). During 2002-03, 145, US patents were granted to CSIR, representing 69% of the US patents granted to Indians in India. Besides, CSIR assumed number one position in the top 50 PCT filing list published by World Intellectual Property Organization (WIPO) for the year 2002. CSIR shared this position with Samsung - the Korean technological and industrial giant.

Maintaining high quality science base

CSIR continued to maintain its high quality science base. Its publication record was impressive during 2002-03. In SCI journals it published 1826 research papers (the number was 1700 in 2001-02), with an average impact factor of 1.66. It continued to contribute about 12% to 15% of the SCI research papers published from India and is the leader among the national laboratory system.

The high quality research is evident from the papers listed in journals of international repute with impact factor of 5 and above shown in Annexure II. The acknowledgement of these contributions were also evident from CSIR scientist getting elected to US National Academy of Engineering (an honor coming to an Indian in India after 1989 for the first time) and also CSIR scientists getting the prestigious S.S. Bhatnagar Prize as well as elected to all the national academies of science and engineering.

Overall performance during the year

The External Cash Flow (ECF) for the period was Rs.270 crore as against Rs.264 crore during last year. The foreign patent filing was 728, that stands as all time high in the history of CSIR. The Indian patent filing was 421, besides acquiring 35 copyrights and 2 trademarks. CSIR shared number one position with Samsung – the Korean technological and industrial giant in the top 50 PCT filing list published by World Intellectual Property Organisation (WIPO) for the year 2002. The papers contributed were 2012 with AVGIF 1.64.

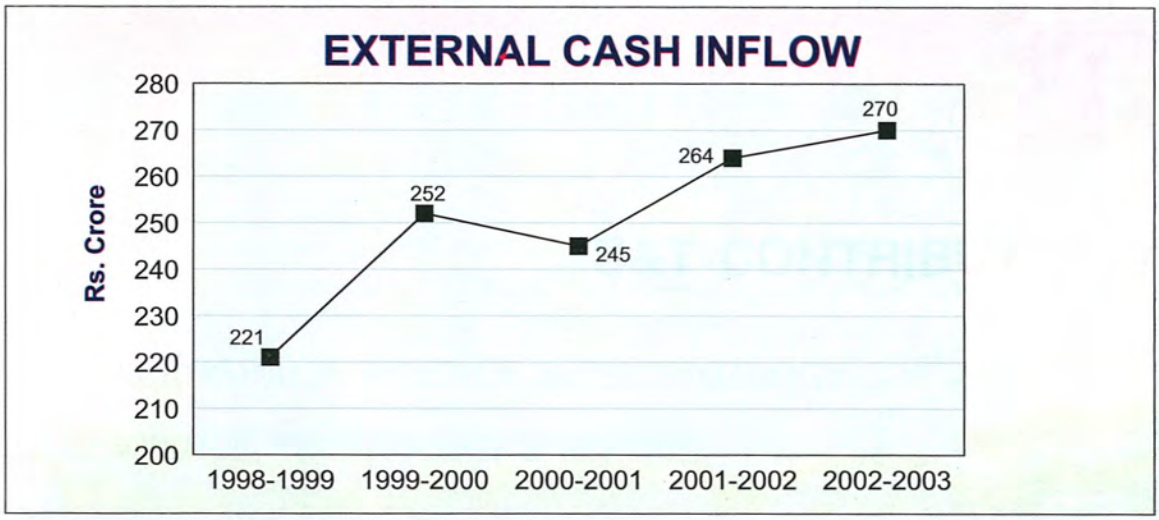
RESOURCE BASE

1. Infrastructural	Number
* Laboratories/Institutes	38
* Extension/ Field/ Regional Centres	47
2. Human	
* Total staff	20,673
• Total S&T staff	15,220
• Scientists (Group IV)	5,185
• Technical (Group III)	3,119
• Technical (Group II+I)	6,916
* Total administrative & non-technical	5,453
3. Financial	Rs. Crore
* Government budgetary support	1009.65
• Government plan allocation	412.00
• Government non-plan allocation	597.65
* Extra budgetary resource generation	
• From contract R&D and consultancy	247.14
• Miscellaneous receipts (non-R&D)	33.64
• Laboratory reserves	90.16

PERFORMANCE

1.	**Science Output**		
	* Papers contributed	Numbers	
	• Number	2012	(1700)
	• Average Impact Factor	1.64	(1.696)
	* Patents		
	• Filed in India	421	(410)
	• Filed abroad	728	(580)
	• In force in India	676	(767)
	• In force abroad	533	(341)
2.	**Technological Output**		
		Numbers	
	* New knowhow licensed	42	(26)
	* Licensing agreements executed	129	(110)
3.	**National S&T Human Resource Development**		
		Numbers	
	* Research Fellows/Associates supported	5934	(4741)
	* Emeritus Scientists in position	110	(118)
	* Pool Scientists (SRAs) in position	202	(210)
	* Research schemes supported	734	(1090)
4.	**Contribution to Economy**		
		Rs. Crore	
	* Industrial production based on CSIR knowhow	5800	(5400)
	* Saving in productivity accruing through CSIR R&D efforts	300	(250)
5.	**Resource Mobilisation**		
		Rs. Crore	
	* External cash inflow	270	(264)

Figures parenthesized correspond to the previous year 2001-2002


EXTERNAL CASH INFLOW
Rs. Crore
280
270
260
250
240
230
220
210
200
221
252
245
264
270
1998-1999
1999-2000
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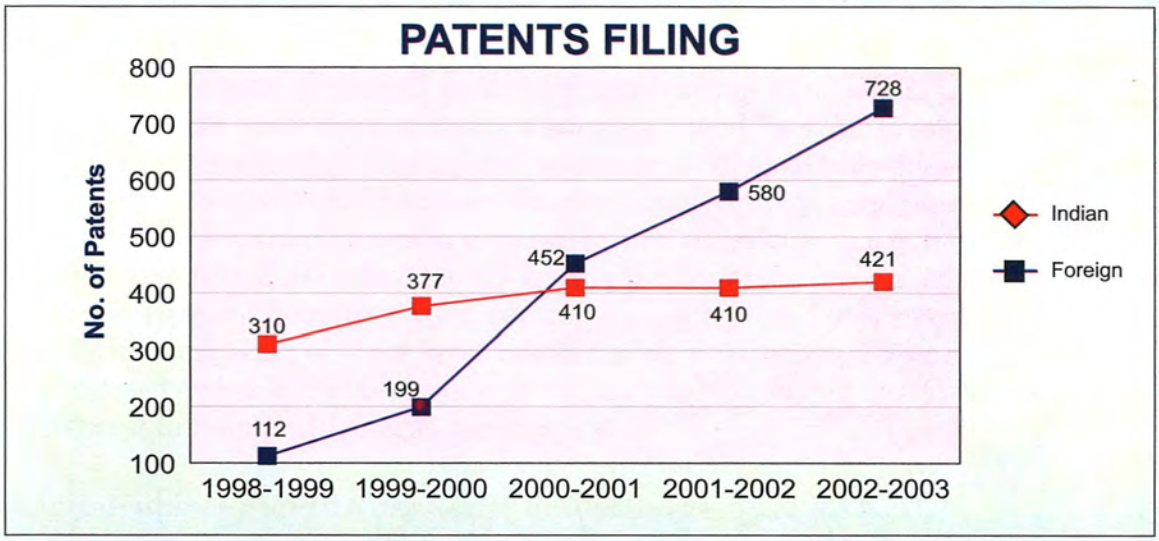
2001-2002
2002-2003


PATENTS FILING
No. of Patents
800
700
600
500
400
300
200
100
310
377
410
410
421
112
199
452
580
728
Indian
Foreign
1998-1999
1999-2000
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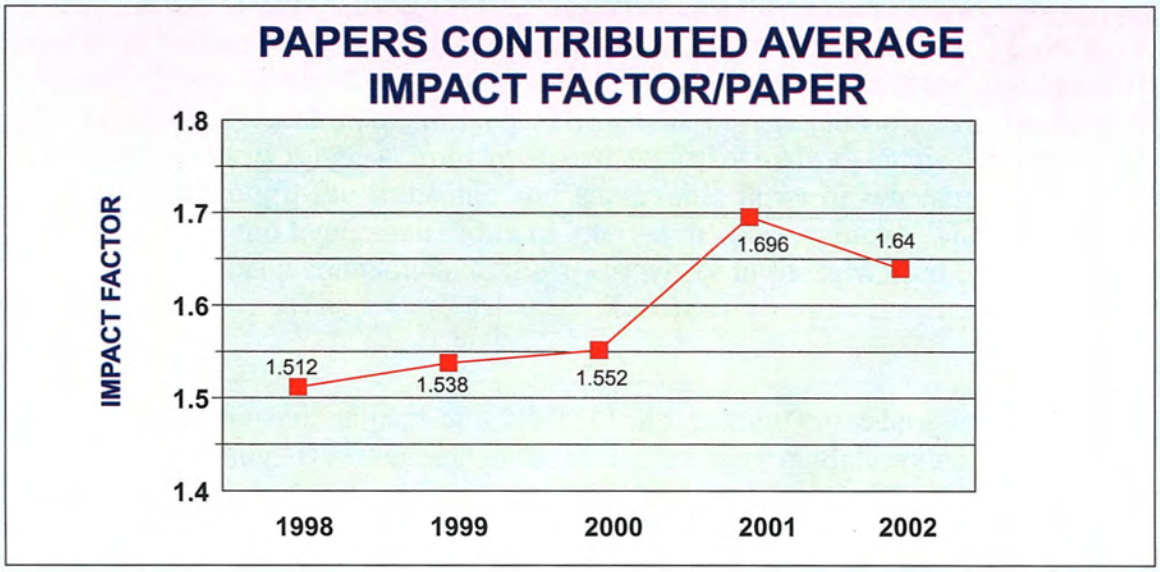
2002-2003


PAPERS CONTRIBUTED AVERAGE IMPACT FACTOR/PAPER
IMPACT FACTOR
1.8
1.7
1.6
1.5
1.4
1.512
1.538
1.552
1.696
1.64
1998
1999
2000
2001
2002

1

S&T CONTRIBUTIONS

1.1 AEROSPACE SCIENCE & TECHNOLOGY

1.1.1 SCIENCE, TECHNOLOGY & SERVICE

Separation control by bubble flow energization

The phenomenon of separation in fluid flow leads to a variety of problems including loss of performance. Hence all successful aerospace designs aim at minimizing and controlling flow separation. A novel strategy adopted by NAL involved active flow control using tangential blowing inside the separation bubble (dead air zone) to suppress flow separation. This is an unconventional technique and offers the promise of controlling separated flows in general. In this technique, inactive flow inside the bubble is energized as opposed to energizing the boundary layer ahead of separation as in the classical boundary layer control approach. This bubble flow energization results in elimination of shear layer reattachment and improved flow characteristics. Having succeeded in this technique, NAL now plans to extend this to configurations of interest to future civil aircraft designs.

Computational Fluid Dynamics (CFD) software

The growth of CFD software at NAL has reached a state of functional utility. It has been contributing to design and development efforts in aerospace. CFD tools have been adding synergistically to wind tunnel testing and flight testing in the development of superior aerodynamic configurations. These tools have demonstrated its usefulness in the entire velocity range — from low-speed, typical of hydrodynamic flows for naval applications through the transonic and supersonic flows of relevance to aircraft configuration to the hypersonic flows of interest to space vehicles. The capabilities developed have been comparable to those elsewhere in the advanced countries.

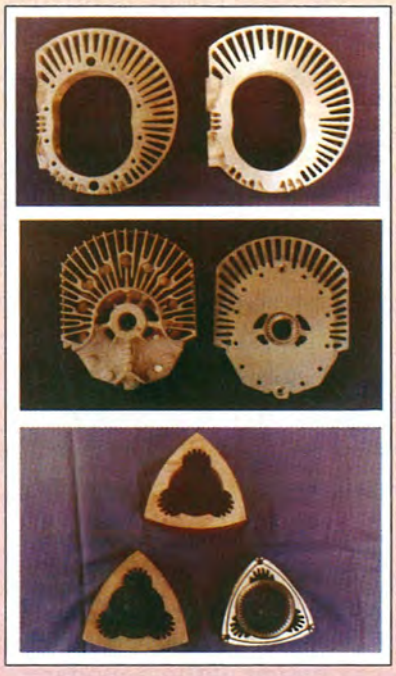
Flosolver

NAL has achieved, as part of a NMITLI programme considerable progress in monsoon modelling. Development of the boundary layer module which incorporates the heat flux scaling of Narasimha and team has been undertaken. The thermodynamic process in the tropics is an active field of research at present and the integration of

the new insights of the related mechanism into NMITLI mesoscale weather code provides international competitiveness. Computational experiments coupled with available field data have already shown significant results including identification of the fact that a large region of low wind regime exists and therefore its proper modelling is extremely important. Major successes in hardware include two new versions of the FloSwitch, viz., Beta 1 Pentium Switch with a 32 bit data path and Beta 2 Pentium Switch with a 64 bit data path using the processor @50 MHz.

Wankel engine studies

Wankel engine is a rotary piston engine, which has a demonstrated advantage for aeronautical applications over gas turbine (initial cost and fuel economy) and over the reciprocating engine (high specific power and smoothness of operation). NAL's initiative in Wankel technology began with solving the cooling problems and successful applications to powered hang glider. Following this, a full development activity was taken up including the development of software packages for thermodynamic cycle analysis, thermal analysis and stress estimation in various engine components, sophisticated machining procedures for side plates, trochoid, rotor & gears and vendor development for specific components. The indigenous components have been assembled and run successfully on a bought-out NR 731 engine at full load and speed. Technology is now established for the design, analysis and prototype manufacture of air-cooled Wankel engines.



NAL has developed technology which can be used to manufactue prototype air-cooled wankel engines that increases efficiency of the engine by consuming less fuel and gives high specific power

Advanced flow diagnostics

- **Density measurements in high speed flows using Background Oriented Schlieren (BOS):** Knowledge of density field is vital for understanding high-speed aerodynamic problems. BOS is a new optical technique proposed by Deutsche Luft und Raumfahrt (DLR) Germany which has the potential to provide quantitative information of density in a compressible flow medium. The density measurements using BOS in a simple flow at high speeds have been fully validated at NAL. The method has been applied to flows at Mach 2.0 over bodies having standard shapes and the results verified against those available in literature. After obtaining the integrated density field, a filtered back-projection technique (FBPT) was employed for the first time in the country to successfully obtain the density field in one plane. Comparison of density field obtained by this method with others was excellent. BOS will now be applied to capture density field in other standard high speed flows like jet flow and viscous flows. These flow configurations have strong relevance to NAL projects as well as national aerospace programmes. The use of FBPT holds promise for application to non-axisymmetric flows as well.
- **Development of pressure sensitive paints for wind tunnel applications:** Surface pressure measurements on wind tunnel models are of fundamental importance in experimental aerodynamics. The Pressure Sensitive Paint (PSP) technique is a new experimental method for the quantitative measurement of surface pressure on wind tunnel models which has some important advantages over the conventional methods. The main advantage of PSP is that it is non-intrusive and it has a high spatial resolution. NAL has developed this technique to a level of maturity, where this can be applied to wind tunnel measurements. The PSP formulations are of proprietary nature and are prohibitively expensive. Hence, NAL has also taken the initiative to develop the paint formulation and has successfully developed three formulations, NAL GI, NAL G2 and NAL G3.

Design of brittle ceramic structures by probabilistic approach

NAL has initiated a research programme on the structural design of brittle ceramics. The objective of this programme is to study various probabilistic design methodologies used for brittle ceramics and to develop a computer code for predicting the probability of failure for ceramic components subjected to thermo-mechanical loads. Currently, two computer programmes have been developed as a part of this effort, one of which processes the material strength test data and computes the Weibull Modulus and Weibull Stress for volume and surface flaw analysis. The other programme essentially functions as a post processor for finite element analysis software. Based on the stress analysis results, this programme computes the probability of failure of a ceramic component under different conditions. The results of these programmes compare well with those obtained using software developed in

the USA (NASA-CARES) which were denied to Indian Institutions due to sanctions imposed by the US Government.

Co-curing and co-bonding technique

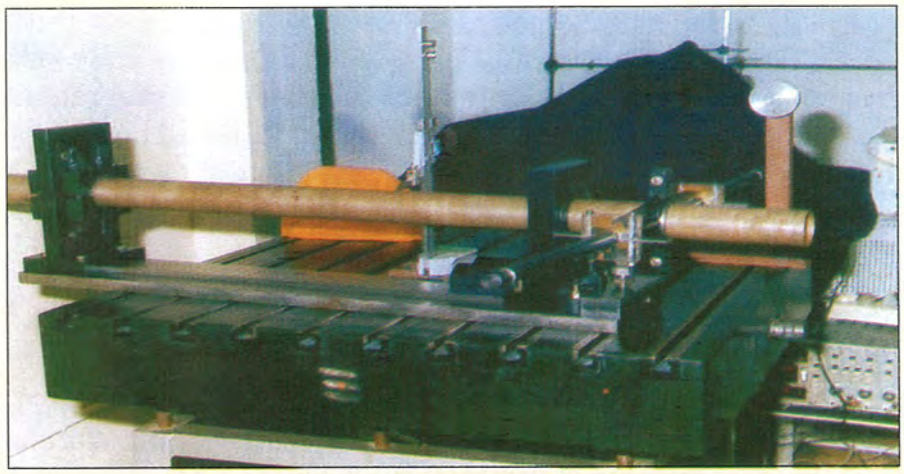
In order to bring down the life cycle cost of the aircraft and provide an added advantage to those arising due to the fact that composites are insensitive to fatigue loads and are corrosion resistant, it is necessary to minimize the number of components and fasteners. NAL has developed indigenous co-cured and co-bonded technologies to achieve this. It is a state-of-the-art technology which was not available to the country at any cost from anywhere in the world. Using this technology, major primary structures of LCA namely, fin, rudder and large number of parts of centre fuselage have been developed as also to develop the control surfaces of SARAS aircraft. This breakthrough in composite structural technology is prompting many innovative composite design concepts to emerge in aircraft industry to leverage the maximum advantage from the potential use of composite materials.

Multi-layer superlattice coatings

Multi-layer superlattice coatings of transition metal nitrides, also known as third generation hard coatings have been successfully prepared at NAL using reactive DC magnetron sputtering process. The Cu/Ni multi-layer system gave a wealth of information regarding the science and technology of superlattice formation. The layering of two materials on nanometer scale significantly improved the mechanical properties as well as thermal and chemical stability of the coatings. Based on this work a variety of ceramic/ceramic multilayer systems are being studied. These include TiN/CrN, TiN/NbN, TiN/VN etc. These materials are expected to exhibit hardness as high as 60 GPa or more.

Helicopter technology

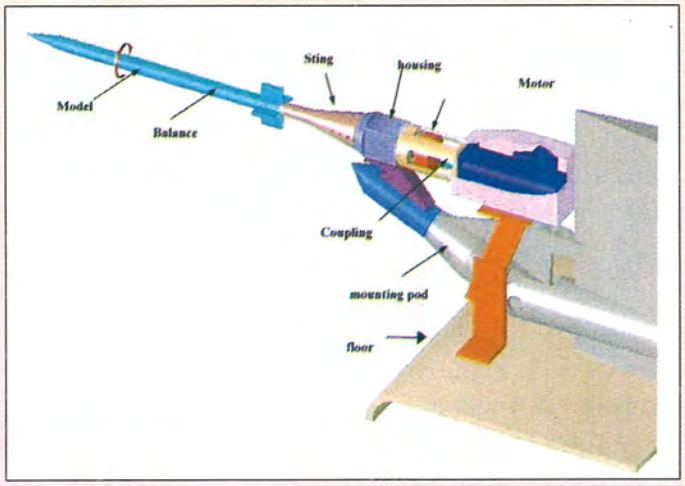
NAL has made significant contribution in the helicopter technology area. These contributions include a specialized technique for taper machining of hollow shafts, through chemical milling routes and design and development of hollow power transmission shafts, which would reduce the weight of the shaft considerably. Both technologies have undergone extensive testing and successfully met the acceptance criteria. In addition, NAL has been providing extensive material testing and characterization support, as well as life extension work related to the helicopter programmes of the country.



NAL has developed technologies and established an extensive material testing facility with a view to reduce the weight of shaft considerably for helicopter torque shaft testing

Test rig to measure roll damping on aerospace vehicle models

Some rockets and missiles are designed to spin about their longitudinal axes to obtain enhanced stability. Design of such vehicles requires a knowledge of the magnitude of the rolling moment generated due to spinning. This parameter, called roll damping, can be measured by conducting wind tunnel tests. NAL has designed and developed a special test rig to measure the roll damping on models of spin-stabilized aerospace vehicles. This has been installed and it has fully validated the system using standard models. Subsequently, roll damping data have been generated on two sounding rocket models of interest to ISRO over a Mach number range of 0.5 to 3.8 for a range of roll rates, selected angles of attack and fin deflections. The generated data will be useful for estimating the performance of the space vehicle during flight.



NAL developed and acquired the capability of developing Roll-damping test rig to estimate the performance of space vehicle during flight

Life extension of MiG 21Bis aircraft

NAL has completed successfully the first phase of the programme on Total Technical Life Extension (TTLE) on MiG 21Bis aircraft. Based on the results of this programme (executed in association with IAF, HAL and the certification agency - CEMILAC), it was possible to recommend an extension of flight life by 1000 hours. This forms a valuable input to the IAF's military fleet.

Air traffic management and simulation

Air traffic is growing at a rapid rate in the developed countries and at a medium rate in developing countries. Traffic management has been, therefore, recognized world over as an important area of thrust. It is a thrust area of particular significance to the civil aviation sector. Hence, NAL initiated R&D work in association with the Institute of Flight Guidance of DLR Germany. At NAL, preliminary work on Air Traffic Management was started using the Software 'SIMMOD PLUS'. For the first time in India, the activity of modelling and simulation to predict possible ground and airspace delay has been initiated. Predictions have been made for current and future traffic scenarios, expected to be handled by the Bangalore airport. NAL's studies suggest that air traffic control and airport authorities need to take important steps to keep the flight delays within acceptable limits, as the traffic increases.

Integrated Facility for Carbon Fibre And Prepregs (IFCAP)

NAL's major initiative (jointly with DRDO) to establish an Integrated Facility for Carbon Fibre and Prepregs (IFCAP) has made rapid progress. The installation of all systems has been completed. System integration and commissioning trials are in progress. On completion, this facility will fill a critical gap in meeting the strategic material requirements of the nation.

Support to aerospace programmes

NAL provided extensive aerodynamic testing support to various national aerospace programmes during the year. This included over 1400 blowdowns in the 1.2m X 1.2m trisonic tunnel. The failure analysis group provided extensive expert services to different agencies for analysing failures related to the aerospace and industrial sectors. Acoustic Test Facilities provided crucial acoustic testing and certification inputs to the space programmes of ISRO. All the space systems launched during the year were tested and qualified by ATF. Extensive services were provided towards characterization of composite materials (hot wet and room temperature) to the National Programmes, particularly LCA. Similar services were also provided to the Advanced Light Helicopter (ALH) programme of HAL. The wind energy group provided valuable advice on wind resource assessment and microsifting of wind energy system to a number of private and public sector agencies. Reaves Curing Chamber, procured by Vikram Sarabhai

Space Centre (VSSC), Thiruvananthepuram, had become non-functional due to the non-availability of service. NAL provided total revamping services to VSSC to make the chamber fully functional and updated a few systems as well.

1.1.2 HUMAN RESOURCE DEVELOPMENT

Extramural Human Resource Development

- About 30 R&D professionals participated in the NAL-UNI lecture series programme entitled "discrete time signal processing and its applications".
- A special course on mechanical behaviour of shape memory and superelastic materials & their applications was conducted at NAL by Prof. Jan Van Humbeeck from Catholic University, Belgium. The course was attended by 50 researchers and professors from leading research organizations like ISRO, IISc, IITs, other universities, DRDO Laboratories apart from NAL.
- A comprehensive course of 40 lectures on computational fluid dynamics was organized for the benefit of the scientists. About 50 participants from NAL, ADA, GTRE, HAL and students from the IISc took part.
- A special course for SC/ST personnel from outside NAL was also organized as part of the welfare efforts.
- Under a special arrangement with Birla Institute of Tech & Science, Pilani a batch of their final year students participated in NAL programmes.
- About 400 students of engineering from different universities did their dissertation projects in NAL.
- Over 450 staff members were deputed to about 110 specialized conferences/ symposia/workshop to enable exposure and upgradation of knowledgebase.

1.1.3 RECOGNITION & AWARDS

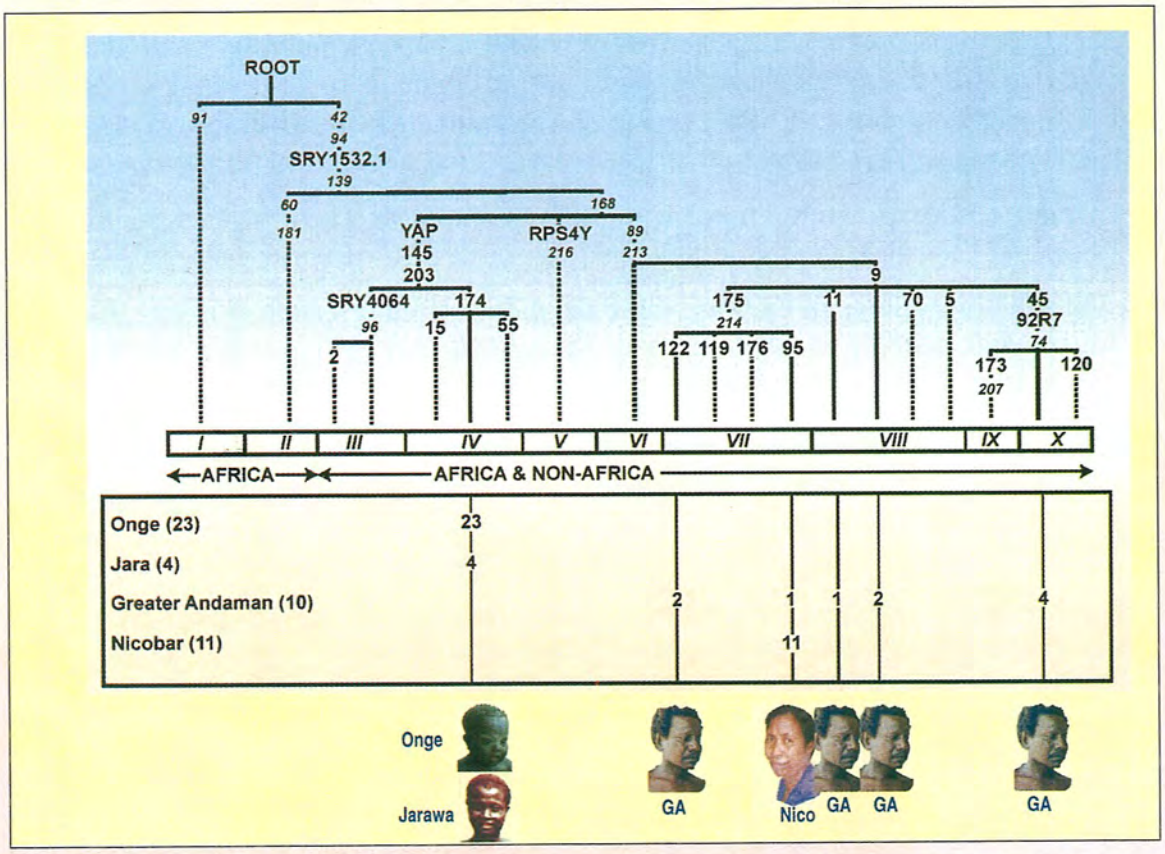
CSIR Young Scientist Award in Engineering Sciences	Dr. Manoj T. Nair, NAL
CSIR Technology Prize for Business Development and Technology Marketing	M.S. Ramachandra, NAL
Sir C.V. Raman Young Scientist Award for Outstanding Achievements in the field of Aerospace Science/Engineering	Dr. R. Ramachandra Rao, NAL
DRDO Award for Path breaking research/ outstanding technology development	Shyam Chetty, NAL

1.2 BIOLOGICAL SCIENCES & TECHNOLOGY

1.2.1 SCIENCE, TECHNOLOGY & SERVICE

Human genome diversity

Scientists at CCMB continued their efforts for obtaining the genetic information about various castes and tribal populations of India to construct haplotypes, which in turn will help to construct the evolutionary trees. About 1500 DNA samples of unrelated



The tree was constructed by using 28 binary markers that define 21 African and non-African haplogroups. The bold vertical lines indicate the distribution of the six binary haplotypes observed in Andamanese. The dashed lines indicate the remaining unobserved haplotypes. The 23 markers typed are indicated in large font. The remaining markers, shown in smaller font, provide phylogenetic context. The sample size and haplotypes observed are indicated.

individuals (mostly male) using Y-chromosome (6 STRs and upto 20 SNPs) and mitochondrial markers (HVRI, HVRII and 9bp intergenic region) were analyzed. CCMB study on tribal populations of Andaman and Nicobar Islands had attracted International attention. It was demonstrated that the Onge and the Jarawa represent a unique subtype of haplo group D not described so far in the world population. The presence of a hitherto unidentified sub-set of the mtDNA Asian haplogroup M, and the Asian-specific Y chromosome group D, testify that the Andamanese have closer affinities to Asian than African populations and therefore are the descendants of early Paleolithic colonizers of South East Asia—the hunter gatherers and the first migrants moved out of Africa about 60,000-100,000 years ago. The questions remain: How then these so-called Andamanese reached Andaman? And are there any tribes in Indian mainland, which, show resemblance with Andamanese and therefore shed light on the root of migration? To answer these questions, studies on tribal population of Indian mainland were conducted. It was found that YAP (Y-Alu Polymorphism) insertions were present in 27 individuals out of 47 samples in Dungri Bhil from Gujarat, west coast of India, as observed in their earlier studies in Onge tribes of Andaman and Nicobar Islands. SNP analysis of the above populations was in progress. In contrast to Andamanese, the Nicobarese have genetic affinities to groups widely distributed today throughout Asia, thus, the Nicobarese should presumably descend from 'Neolithic Agriculturists'. These studies may throw some light on the mystery of our own origins.

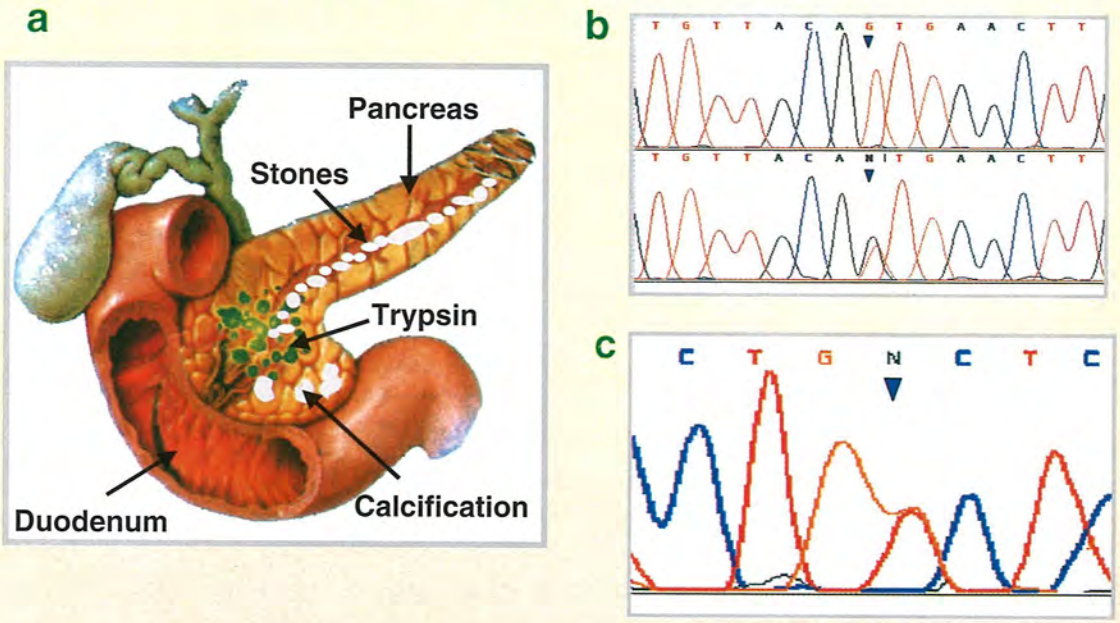
Genome-wide analysis of microsatellite repeats in humans

A large proportion of higher eukaryotic genome is repetitive in nature. Scientists at the CCMB are interested in finding the function of these repetitive sequences in genome. CCMB, in collaboration with Ingenovis, a division of i-labs (an IT company), Hyderabad, using the genome sequences available in public domain created a database of microsatellite repeats for human genome for easy access to such repeats for analysis and for its use in understanding their biological significance. From this analysis, they are able to identify about 2135 known or predicted genes that are associated with atleast one triplet repeat type. These transcripts will be candidate genes for analysis of triplet repeat expansion and a possible association with disease phenotypes.

Genetic analysis of pancreatic disorders: detection of a novel mutation in Indian population

Pancreatitis is a complex disease with heterogeneous etiologies. Tropical calcific pancreatitis (TCP) is peculiar to India and is associated with an early age of onset and high incidence of diabetes mellitus. CCMB investigated 68 patients of tropical calcific pancreatitis comprising 44 without diabetes and 24 with diabetes (FCPD) for mutations in cationic trypsinogen (PRSS1) and pancreatic secretory trypsin inhibitor (SPINK1) genes, and also performed a genotype-phenotype correlation. In contrast to established

Different genotype-phenotype correlation in Tropical Calcific Pancreatitis



(a) Autodigestion of pancreas due to premature activation of trypsin leads to calcification, stone formation and chronic pancreatitis (b) N34S mutation in SPINK1 gene reduces the trypsin inhibitory capacity of SPINK1 and was identified in majority of patients with Tropical Calcific Pancreatitis (c) Additionally, a novel mutation –215G>T in SPINK1 gene was also identified in some patients.

notion, the study could not detect any mutation in the PRSS1 strongly suggesting that cationic trypsinogen gene mutations may not have a role in TCP in our population. Mutated SPINK1 was detected in about half the patients with a founder mutation N34S in majority of the patients. A novel mutation –215G>T in compound heterozygote status with N34S was detected in 3 FCPD patients. This mutation has been included in the Human Gene Mutation database (HGMD). In contrast to a recent report, CCMB has identified SPINK1 mutations in both FCPD and TCP patients without diabetes in similar frequency. The median age of onset for TCP patients without diabetes was significantly earlier than that of FCPD patients. Comparison of parameters like the age of onset, presence or absence of diabetes mellitus and age of its onset between SPINK1 N34S heterozygous, homozygous patients did not show any significant difference. CCMB conducted studies suggested that variability in the phenotype of tropical calcific pancreatitis may be related to a different genotype. It also stresses on a common genetic basis for tropical calcific pancreatitis with additional genetic/ environmental factors responsible for the variability of phenotype in FCPD and TCP patients without diabetes.

Relevance of DNA conformations in Alzheimer's disease

Alzheimer's disease is a challenging neurodegenerative disorder. It has complex neuropathology. CFTRI has observed a new neuropathological event, B to Z-DNA conformational transition in hippocampal region of Alzheimer's Disease (AD) brains. The circular dichroism spectra of severely affected AD DNA showed a typical left-handed Z-DNA conformation whereas normal, young and aged brain DNA have the usual B-DNA conformation. Moderately affected AD DNA has modified B-DNA conformation (B-Z intermediate form). The altered conformation of DNA will have tremendous implications in understanding gene expressions. Studies on DNA triplet repeats namely $(CCG)_{12}$, (which are involved in neurodegeneration) showed B to Z-DNA conformational transitions in the presence of Aluminium and longer triplet repeats attaining Z-DNA conformation is the novel finding and a new mechanism has been proposed on switching off FMR 1 gene in X-Fragile syndrome. These findings have provided new insight in understanding the mechanism of cell death in brain.

Mutational analysis of tumour suppressor genes and tumour proto onco genes of primary human malignant mesotheliomas

Human malignant mesothelioma is drug resistant. ITRC, in a collaborative study with Germany, obtained samples of human malignant mesothelioma from the European Registry of Pathology and screened them for gene mutations of the tumour proto onco genes N-ras, K-ras, CDK4 and tumour suppressor gene p53, $p16^{INK4a}$ and nf2. Screening was conducted for point mutations and microdeletions/microinsertions in exons 1-16. In the tumour suppressor gene nf2, located on chromosome 22, one tumour (7%) a 10 basepair microdeletion of exon 10 was detected by SSCP and subsequently characterized in detail by sequencing. Deletion of the second nf2 allele in laser-microdissected regions of the 10 bp mutation-harbouring tumour was demonstrated by DGGE analysis. Simultaneous comparative genomic hybridization (CGH) analysis showed losses of chromosome 22 in 38% of the tumours. DGGE and CGH also revealed intra-tumour heterogeneity in the microdissected specimen. For the first time it has been indicated that disarrangement and loss of nf2 may be involved in the formation of a subset of mesotheliomas. These studies will help in understanding the disease process, treatment and development of gene therapy. The work was in progress to identify the involvement of other genes in human mesothelioma.

Molecular genetics of asthma/atopy associated genes: Identification of polymorphisms in IFN and STAT6 genes involved in asthma pathogenesis

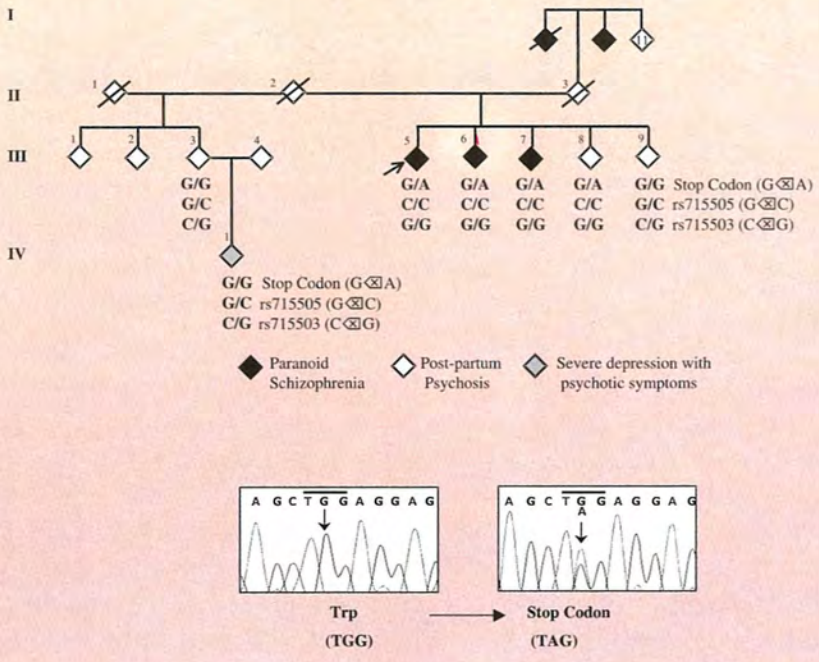
Asthma is a multifactorial complex genetic disorder where many predisposing genes contribute towards the pathogenesis. Atopic asthma is manifested with clinical symptoms such as bronchial hyper-responsiveness, elevated serum IgE levels, wheezing, etc. A number of genetic and environmental factors have been implicated in the disease progression. Earlier studies on the pathophysiology of asthma

demonstrated the central role of T cells in the initiation of the inflammatory process. In asthma, it has been shown that IFN negatively regulates the Th2 response by down regulating the IL4 cytokine. In addition, cell adhesion molecules and chemokines play key roles in the immunopathogenesis of asthma. The association of a CA repeat marker in IFN gene with asthma and total serum IgE levels in the North Indian population was investigated. The distributions of allele sizes were found to be significantly different between patients and controls. Alleles 10 and 11 were found to be over represented in individuals having asthma, whereas alleles 13 and 15 were less likely in asthmatic individuals. Research at IGIB indicated that the CA-repeat polymorphism in the *interferon gamma* gene was significantly associated with total serum immunoglobulin E. Twenty six single nucleotide polymorphisms (SNPs) spanning a total of 147kb region in *STAT6* and *IL4RA* genes have been identified. Fourteen novel SNPs were found in Indian population. The encoded proteins of these two genes are part of a single signalling pathway and therefore, functional polymorphisms in these genes could potentially lead to higher risk and susceptibility to atopic disorders.

Association of a biallelic CAG repeat marker with schizophrenia and bipolar disorder

Schizophrenia (SZ) and bipolar affective disorder (BPAD) are complex genetic disorders with a worldwide prevalence of ~1%. Amongst the several chromosomal

First Nonsense Mutation observed in Synaptogyrin 1 Gene in a Family with Schizophrenia



regions implicated by independent linkage studies, chromosome 22 has been the most intensely studied for both schizophrenia and BPAD. IGIB has demonstrated association of a biallelic CAG repeat marker on 22q11-13 with schizophrenia and bipolar disorder. A candidate gene *Synaptogyrin 1* (SYNGRI) within 2Mb of 22CH3 was selected. Involved in the regulation of neuronal exocytosis, SYNGRI is an attractive candidate for schizophrenia and bipolar disorder. It is a 37 kb gene with six exons. Sequencing of all the six exons and flanking splice junctions in probands from 20 densely affected SZ and BPAD families has been done at IGIB, as well as ethnically matched normal individuals. In one schizophrenic proband, a heterozygous mutation resulting in a nonsense codon (G105A, encoding Trp27Ter) was found in the second exon of this gene. This heterozygous mutation was also found in two affected and one asymptomatic sibling of this proband. The RT-PCR and Northern blot analyses revealed that the exon 2 containing transcript of *Synaptogyrin 1* gene was indeed expressed in brain.

Functional genomics approach for pathway modulation in Mentha sp.

The critical step in the biosynthetic pathway of *Mentha* is from pulegone to menthone to menthol. But pulegone is also converted to isomenthone in *Mentha arvensis* and to menthofuran in *Mentha piperita*. These two components affect the price of the oil. Similarly, the Indian piperita fetches less price compared to the American type due to the compositional differences of menthol, menthone and other minor components. The pulegone reductase activity for the synthesis of isomenthone from pulegone was found to be increasing with decrease in menthol biosynthesis during cloudy weather in *Mentha arvensis*. The differentiation in protein expression pattern of trichomes of normal and cloud/rain induced plants was confirmed through 2D electrophoresis by comparing the proteins of the trichomes isolated during normal as well as cloudy weather. The study was conducted in the variety 'Saksham' of *Mentha arvensis*. This is likely to provide molecular basis for pathway manipulation to develop designed crop of *Mentha piperita* in future.

Based on the sequence of menthofuran synthatase ID AF346833 forward and reverse primers were synthesized at CIMAP. The forward primer bears Hind III site and the reverse primer bears Sal I restriction enzyme site. The DNA samples of 'Kukrail' (a released variety of *Mentha piperita*) was amplified using the specific primers and the amplified fragment was isolated, restricted with Hind III and Sal I restriction enzymes and cloned in pBluescript II SK (+). One clone was selected having the insert fragment of approximately 1.6 Kb. The end sequence was comparable to the reported menthofuran synthetase gene. This gene from *Mentha piperita* 'Kukrail' can be used in future for modulation of the biosynthetic pathway for menthofuran synthesis.

Preparation of neurotrophic chemotherapeutic agents

In amyloid biochemistry to decode the mechanism of spontaneous formation of toxic aggregates of amyloid peptides in the physiological conditions is one of the

unsolved problems. Studies at CLRI have shown that under conditions of forced molecular crowding, toxic beta sheets of prion peptides are formed with ease. It is also observed that helical turns formed in the hydrophobic sequences of another amyloid forming Ab peptides act as main stabilizing force in the propagation of amyloid structures. For the first identified sequences with helical turn propensity in amyloid fragment has been identified and shown that they take stable helical turn conformation in monomeric and aggregated form. Based on the results, helix nucleating regions i.e. Ala-lle-llel-Gly-; Ala-Val-Val-Gly-; and Lys-Leu-Val-Phe-Ala- have been selected as lead molecules for the development of anti amyloid molecules. These peptides will be coupled incorporated with lysine based dentrimer. The vehicle for the delivery across the blood brain cross over is 20 residue peptide Pegylin [Pegylin–Lys dentrimer-(Boc-Ala-lle-lle-Gly-)$_n$; Pegylin–Lys dentrimer-(Boc-Ala-Val-Val-Gly)$_n$; and Pegylin–Lys dentrimer-(Lys-Leu-Val-Phe-Ala)]$_n$.

Bioavailability enhancers – from ancient wisdom to modern therapeutics

A new concept of enhancement of drug bioavailability/bioefficacy based on clues from Ayurveda has been conceptualized at RRL, Jammu. The development of plant based bioavailability/bioefficacy enhancers is targeted for drugs which are: poorly bioavailable; given for longer period of time; and highly toxic and expensive. Based on systematic investigations on 'Trikatu' a reputed formulation (containing Piper *spp* and *Zingiber officinale*) prescribed for a number of ailments in Indian traditional medicine, piperine, a pure alkaloid molecule from Piper spp., having bioavailability/bioenhancing activity have been isolated. Piperine was studied in detail with anti-TB drugs. The major outcome has been the development of a formulation containing 50% reduced dose of rifampicin while retaining the therapeutic efficacy at par with standard (450 mg) dose of rifampicin. Reduced dose formulation (Rifampicin + Piperine) has gone through phased multicentric clinical trial upto Phase III. Permission has been obtained from DCG (I) to increase the size of patient population as per RNTCP guidelines. Based on clues from Ayurveda, three more plants [coded as 0200, 0194 and 0173] were taken up for detailed investigation. One fraction from a plant has shown promising bioavailability enhancing effect when combined with rifampicin. The active fraction was found to enhance the bioefficacy of rifampicin against Mtb. *In vitro* and *in vivo* studies have shown that the active bioenhancer in combination with rifampicin caused 2 log reduction in the MIC of rifampicin. A chemically characterized pure, active compound has been isolated from the active fraction having bioavailability enhancing activity.

Wildlife conservation: assisted reproduction in wild animals

Decimation of wildlife due to habitat destruction and poaching has led to fragmentation of populations of wildlife. This apparently has a very significant effect on the breeding efficiency of the animals. Scientists at the CCMB have standardized

techniques for semen collection, semen cryopreservation and artificial insemination in the spotted deer as a model for the endangered deers and in the Blue Rock Pigeon as a model for birds. Using these techniques, it has been possible to achieve successful artificial inseminations in deer and pigeon which resulted in birth of young ones.

Carbohydrates, a versatile tool for combinatorial synthesis

Carbohydrates have extensive potential to generate vast library of compounds both as chemotherapeutic agents and as biological tools particularly artificial receptors because of the availability of large number of functional sites as well as chiral centres. CDRI has recently designed and synthesized libraries of glycoconjugates of the general formula X1-X2-carbohydrate having a bifunctional amino acid with or without functionality in the side chain at position X2 and aromatic, heteroaromatic or other amino acids at X2 position. These compounds were screened for DNA topoisomerase inhibitory and antitubercular activities, providing new leads in these areas. The glycosylated amino acids were further used in the synthesis of a variety of C-nucleosides by coupling with isocyanates or isothiocyanates on a Sieber amide resin and finally with diazabicyclo undecene, a hindered organic base as catalyst, for cyclisation as well as cleavage from the resin. These nucleosides are more stable towards enzymatic degradation and associated with anticancer, antibacterial, antiviral and antileukemic activities.

Isoxazole-carboxaldehyde, a novel scaffold to study Baylis-Hillman chemistry

Isoxazole is an important heterocycle as it forms part of scores of biodynamic molecules and natural products and serves as building block for construction of new molecular systems. The Baylis-Hillman reaction, a C-C bond forming reaction has attracted the global attention of various research groups because of its immense synthetic potential to afford multifunctional products that can lead to wide spectrum of heterocycles and natural products. In the era of combinatorial chemistry, this reaction gains further significance as the densely functionalized products obtained from it can be tailored and diversified for building up of chemical libraries of privileged scaffolds in solution and on solid phase in appropriate manner. This is a reaction between an electrophile i.e. usually an aldehyde and an activated alkene in the presence of a Lewis base or Lewis acid. With the objective of developing isoxazole-based chemical libraries through solution and solid phase, for the first time CDRI found that substituted 5-isoxazolecarboxaldehyde is one of the fastest reacting substrates for Baylis-Hillman reaction. This led to some interesting observations such as formation of ether and hemiacetal during DABCO-mediated and $TiCl_4$-mediated Baylis-Hillman reaction, respectively. Also methodologies to obtain azides and substituted phenols from the Baylis-Hillman chemistry have been developed. These isoxazole-

derivatives furnished through Baylis-Hillman chemistry have elicited good biological response in the area of antithrombotics and antihyperlipidemics.

Oenostacin: the plant based antibiotic shows activity against vancomycin resistant Staphylococcus epidermidis strains

CIMAP had earlier isolated a novel compound 'Oenostacin' from *Oenothera biennis* (Evening Primrose), which inhibited the growth of *Staphylococcus epidermidis,* the causal organism of infectious endocarditis. Amoxycillin and vancomycin are the drugs of choice for treating such infections. Vancomycin is recommended for high-risk patients and in cases where the patients are allergic to amoxycillin/penicillin antibiotics. Resistance to vancomycin is already reported in many staphylococci resulting in serious medical complications. The drugs that exhibit potency against staphylococci group of organisms, therefore, should also be active against vancomycin resistant strains. Hence, the activity of oenostacin was tested against the laboratory derived vancomycin resistant strains of *S. epidermidis*. Over 20 Van-R strains were developed by NTG induced mutagenesis and evaluated. The results showed that the resistant strains were also sensitive to Oenostacin at a level comparable to that of the



Oenostacin – an antibacterial compound from *Oenthera biennis* patented in US and isolated by CIMAP

wild type. A US patent has been granted to an antibacterial composition comprising oenostacin from *Oenothera biennis*.

Anti-cancer activity of lignans isolated from the heartwood of Himalayan yew

The Himalayan yew (*Taxus wallichiana* Zucc.) is a tree growing on both sides of Himalayas. In contrast to the European yew *(Taxus baccata* L), it has a remarkable history of medicinal use. In continuation to CIMAP's studies on the isolation of anticancer compounds from *T. wallichiana*, anticancer activity has been detected for three lignans isolated from the heartwood of the plant. These three lignans, characterized as taxiresinol, isotaxiresinol and (-) secoisolariciresinol on the basis of their spectral characteristics, were active against colon adenocarcinoma cell lines in MTT assay. Isotaxiresinol and secoisolariciresinol were most active against Caco-2 cell line with an IC_{90} value of 0.08 µg/ml in MTT assay and 0.056 and 0.251 mg/ml respectively in clonogenic assay. However, these two lignans were inactive against other cell lines. Isotaxiresinol was equal to or even better than standard reference compounds such as taxol and doxorubicin against colon adenocarcinoma (Caco-2) in both the assay systems. Taxiresinol was active against ovary teratocarcinoma and breast adenocarcinoma cell lines albeit at higher concentration. The anthracycline derivative doxorubicin and microtubule depolymerization inhibitor Paclitaxel (Taxol^{R}) (Sigma Chem. Co., St. Loius, USA), both established anticancer agents, were included as standard reference drugs.

Commercialisation of natural streptokinase

Streptokinase is a vital, life-saver injectable protein drug that saves upto 40% of human lives after heart attacks if given within a few hours of the onset of chest pain. The Indian sub-continent has been recognized by the WHO as a highly vulnerable population pool for cardiac problems, with nearly 20 million patients in India alone that are suffering from heart-related maladies. Till now, streptokinase has been wholly imported at high prices in India from MNCs of the West. The technology for its production was developed at IMT and transferred in the year 2000-2001 to M/s Cadila Pharmaceuticals Ltd., Ahmedabad. The drug is now being indigenously produced for the first time. As a result, the price of even the MNC-produced brands have been 'forced' to be reduced by about 30%, resulting in a major saving to the Indian consumer. IMT's process is high-yielding (approx. 70% yields) and delivers drug of exceptionally pure quality (> 99% SK protein) that is safe toxicologically and stable for extended periods of time.

Local contraceptive cream

Reetha saponins developed by CDRI for use as spermicide has been granted marketing permission by DCGI and negotiations for licensing to industry are in progress. The product named Consap by CDRI can be used safely as a local

(intravaginal) contraceptive. The spermicidal constituent of the Consap cream are the total saponins of *Sapindus mukorossi* incorporated in a cream with appropriate excipients. Repeated intravaginal application of Consap cream in rabbits and rhesus monkeys does not cause any local irritation/pathological lesions and no saponins could be detected in the blood of rhesus monkeys even after application of 25% cream for 90 days indicating no systemic absorption and safe profile of the contraceptive cream. Its contraceptive efficacy has been confirmed through clinical trials.

Improved process for production of vasicine: A bronchodialator from Adhatoda vasica

Adhatoda vasica (family Acanthaceae) is commonly known as "Arusa", "Vasaka" or "Malabar nut". It is an evergreen perennial shrub and is a well known drug in Ayurveda for the treatment of respiratory complaints and diseases like, cough, asthma and cold. The most studied chemical component from the plant is vasicine. It shows bronchodialatory activity both *in vitro* and *in vivo*, comparable to theophylline. CIMAP has developed a simple, economic and quick process suitable for commercial production of vasicine.

Development and delivery of therapeutic agents through novel drug delivery systems for non healing ulcers

CLRI has developed a drug-impregnated scaffold by impregnating drug loaded microspheres into known concentration of solution of collagen *in situ* and subsequently initiating fibril formation. The average particle size of the drug loaded microspheres were of 300-370 mm with 3% total drug entrapment. Release characteristics were observed for 96 hours and controlled release of SSD was achieved. The results of *in vitro* drug release studies and *in vitro* antibacterial susceptibility studies indicated that SSD was released from the microspheres impregnated collagen scaffold in a controlled fashion. It is thus capable of controlling infection for extended time period.

Gene prediction software for prokaryotes

Genedecipher is envisaged as a peptide library based gene prediction software for prokaryotes. The effort is based on the hypothesis that nature has utilized a restricted number of peptides during evolution. This is apparent from the fact that the difference between theoretically possible peptides and that are actually observed grow exponentially as the length of the peptide increases. The software developed by IGIB is designed to "predict protein coding regions" in the given nucleotide file. It is written in C language and is far more optimized than the previously written PERL code. The programme is tested to identify genes in *E.coli* without using *E.coli* peptide library. Genes specific to *E.coli* as well as highly conserved genes of the microbe have been identified.

Leishmania donovani antigens encapsulated in liposomes

Studies at IICB on leishmania donovani promastigote membrane antigens (lag) encapsulated in positively charged liposomes have shown to induce very significant levels of protection against experimental visceral leishmaniasis. The protectively immunized animals exhibited profound delayed type hypersensitivity and antibody responses. The extent of protection induced by the same antigens, however, varied depending on the charge of the vesicles. Investigations included human vaccine trials with killed promastigotes and immunization of mice with attenuated, killed crude parasite fractions as well as purified recombinant antigens and their DNA. While presently there is no effective form of immunoprophylaxis against this disease, the impressive recent advances in this area may soon result in the development of a safe and effective vaccine.

Infectivity and virulence of Leishmania donovani promastigotes

Infectivity studies in hamsters and BALB/C mice showed that promastigotes isolated in B-M199 were several folds more infective than those obtained from M199. Comparison of the infectivity and virulence of promastigotes of AG83, with a recent isolate of kala-azar, SL94, harvested under similar conditions, revealed greater infectivity of SL94 for both macrophages and animal models.

O-acetyl sialic acid specific IgM in childhood acute lymphoblastic leukaemia

Studies at IICB have revealed an enhanced surface expression of O-acetylated sialoglycoconjugates (O-AcSGs) on lymphoblasts concomitant with high titres of IgG in childhood Acute Lymphoblastic Leukaemia (ALL). Antibody specificity towards O-AcSGs was confirmed by selective binding to erythrocytes bearing surface O-AcSGs, decreased binding with de-O-acetylated BSM and following pretreatment with O-acetyl esterase. Competitive inhibition ELISA demonstrated a higher avidity of IgM for O-AcSG than IgG. Flow cytometry demonstrated the diagnostic potential of purified O-AcSA IgM as binding was specific with ALL patients and minimal with other haematological disorders and normal individuals. It therefore may be adopted as a non-invasive approach for detection of childhood ALL. It has been concluded that carbohydrate epitopes having terminal O-AcSA a2®6 GalNAc determinants induce disease specific IgG and IgM, potentially useful molecular markers for childhood ALL.

Biocontrol combination against lepidopteran insects

A synergistic biocontrol composition comprising of alcohol extract from the parts of plant *Albizia lebbeck* and *Bacillus thuringiensis* δ-endotoxin acetone powder killing

the lepidoptaran insects was developed with the objective to prevent the emergence of resistant insects due to sole application of the insecticidal compounds. The dose requirements of the plant extract and δ-endotoxin acetone powder were significantly low compared to the individual application of the components to achieve the same level of killing of the insects. Further, it was observed that application of δ-endotoxin first followed by ethanolic extract reduces the pupation percentage compared to application of extract followed by δ-endotoxin. This is in addition to the finding of synergistic combination for simultaneous application. The effect of reduced pupation may be due to the weakening of digestive system by initial δ-endotoxin application. The synergistic composition has an edge over individual sole application of either δ-endotoxin or the ethanolic extract as the killing percentage increases tremendously. Considering the low cost nature, easy availability, preparation, application and non-persistent biological nature, the composition and the process of application will definitely have an edge over other biological formulations.

Mycoparasite tolerant Claviceps purpurea variants identified

Ergot is the sclerotial form of the parasitic fungus *Claviceps purpurea* growing on rye plants and optimum production of ergot on rye can be achieved through best combinations of host-parasite interaction. Ergot alkaloids (ergotamine, ergometrine, ergotoxin, etc.) are important alkaloids used by pharmaceutical industry worldwide. These and their derivatives have extensive uses in gynaecology, migrane, orthostatic circulatory disturbances, hypertension, Parkinsonism, etc. The attack of mycoparasites like *Cerebella andropogonis* (Ca), *Fusarium palidoroseum* (Fp), *Fusarium avenaceum*, *Fusarium graminearum* and *Cladosporium cladosporioides* threatens the developing ergot sclerotia, causing more than 50% damage to ergot yield and alkaloid content. Mycoparasite tolerant variants have been identified at CIMAP through the DBT-sponsored *Jai Vigyan* National Science & Technology Mission Programme. This would help increasing the production of ergot alkaloids needed for import substitution.

A novel source of dwarfing gene identified in opium poppy

Damage due to lodging caused by high velocity winds and irrigation at maturity is a long standing problem in shallow rooted—long stature opium poppy plants. Dwarf genetic stocks evolved through induced mutation breeding and interspecific hybridization could not offer desirable latex yield. Efforts to reduce plant height in the existing long stature cultivars, resorting to their cross breeding programme with the dwarf genotypes, has not yet been successful primarily due to unbreakable linkage of dwarfing gene(s) with undesirable genes in the dwarf genotypes. During the course of genetic improvement through induced mutagenesis, an extremely dwarf mutant (Accession VE-01) having much brevity in its dwarfing gene transfer to high yielding genotypes (Vivek and SG35-II) of the same species (*Papaver somniferum*) as well as

of other species (*P. setigerum*) was recovered in true bred forms in M_3 generation of variety Vivek treated with 0.4% EMS. Observations indicated that the dwarfing trait did not transmit from the parent to the hybrid contrary to the intermediate inheritance mechanism of quantitative genetics. This unusual result (in F_1) obtained at CIMAP gives an indication to the cumulative role of certain factors in reducing plant height. The major interest with the dwarf mutant VE-01 is that it allows dwarfing gene transfer in a cross hybridization programme to reduce plant height of the hybrid to a desirable extent without entailing reduction in its capsule size.

A new approach for *in vitro* selection of menthol rich genotypes

In Mentha *in vitro* selection clones for tolerance to menthol, which is the end product of the biosynthetic pathway, has been carried out at CIMAP to generate menthol rich cultivars. It has been done with the rationale of lifting the feedback toxicity of metabolic end product. The clones developed were found to tolerate 80 mg/ml menthol (tertiary level screening) and were found to contain the highest amount of menthol per g leaf biomass. Using this method the relationship between the primer OPT 04, menthol tolerance and high menthol content character of the genotype was established. Stemming out from this, the cultivar 'Saksham' was developed for release by CIMAP for superior performance.

Rashtrapati Bhawan adopts medicinal and aromatic plants

CIMAP developed a herbal garden, stretching over 4000 square meter at the Rashtrapati Bhawan. H.E. Hon'ble President of India, Dr. A.P.J. Abdul Kalam, inaugurated the garden by planting the first sapling of Sandalwood (*Santalum album*).



Hon'ble President Dr. A.P.J. Abdul Kalam planting a sapling of chandan (*Santalum album*) in herbal garden developed by CIMAP at Rastrapati Bhawan

Dr. R.A. Mashelkar, Director General CSIR, on the occasion, planted a sapling of Sarpgandha (*Rauvolfia serpentina*). Dr S.P.S. Khanuja, Director, CIMAP and the scientists and technical staff involved in the development of the garden were also present during the ceremony. About 40 species of medicinal and aromatic plants including commercially and industrially important, rare and endangered species have been planted in the first phase. The project, conceived by the President himself, aims to conserve important medicinal and aromatic plant species and educate children and visitors as well about the huge potential of such plants for india.

Chromium induced apoptosis

The ability of Cr (III), Cr (V) and Cr (VI) to induce apoptosis of lymphocytes has been demonstrated at CLRI. Involvement of signalling messengers such as reactive oxygen species (ROS) and Src-family tyrosine kinases leading to apoptosis is being investigated. The modulation of p53 levels and cyclin-dependent kinases (CDKs) during various stages of exposure to chromium is an important area, which may hold clues about the change from apoptotic to transformed state of the cells. Gaps in knowledge with relevance to Src-family tyrosine kinases in apoptosis due to a number of physiological stimuli such as H_2O_2, HOCL, NO, Fas, CD-3 antigen as well as other metals have been identified and are being investigated.

Identification of new hydrogen producers through computational genomics

Screening of 92 microbes reported in KEGG was conducted at IGIB for these two principal enzymes. The organisms reported have the ability to utilize a wide range of industrial wastewaters and leach insoluble metal sulfides. They also have magnetotactic ability and could dehalogenate and degrade environmental pollutants. The anaerobic treatment of wastes yields biogas and hydrogen. It has the dual advantage of energy generation as well as stabilization of waste.

Alkaneutre process

The capability of certain bacterial isolate to neutralize the alkalinity has been exploited at IGIB for treating beverage industry effluents. The developed process completely eliminates the use of chemicals and brings down the pH from 12.0 to 7.0. It is highly economical and safe over the existing process which is based on chemical consumption. This will replace the existing use of chemicals which otherwise incurs a huge amount of money. The Alkaneutre is being upscaled.

A new natural source of high valued rose oxides

Rose oxides along with high content of citronellol were identified for the first time by IHBT in the essential oil of *Dracocephalum heterophyllum* – a high altitude cold

desert plant. Citronellol and rose oxides are being used extensively in the perfumery industry and these two essential oil isolates are the alternative sources of base materials to the perfumery industry. The plantation of *D. heterophyllum* is presently under trial cultivation and its agrotechnologies practices are being worked out for large-scale cultivation.

Improved seed germination in Podophyllum hexandrum Royle

In nature, the germination of *Podophyllum* is highly restricted. IHBT has developed a protocol for promoting germination of *Podophyllum* seeds under *in vitro* conditions. Germination rate of over 80% has been obtained through this method and a nursery has been established for raising quality planting material. The rhizomes of *Podophyllum hexandrum* are rich in podophyllotoxins and have anticancer and antitumour properties. The podophyllotoxins are lignans whose semi-synthetic derivatives-etoposide (VP-16-213) and teniposide (VM-26) are approved drugs for the treatment of testicular and lung cancer. The present technology is likely to ensure its large scale plantation both *in situ* and *ex situ*.



Podophyllun hexandrum – source of anti-cancer and antitumour drugs—protocol for fast germination (rate over 80%) of *podophyllum* seeds developed by IHBT

Development of diagnostics for viruses infecting carnations

IHBT has developed and standardized detection strategies for viruses from carnation. The method involves antibody based detection and RT-PCR techniques. Adopting this strategy, the carnation viruses namely carnation *etched ring virus*, *carnation mottle virus*, *carnation ring spot virus*, *carnation vein mottle virus*, *carnation necrotic fleck virus* and *carnation Italian ring spot* virus were detected for the first time in India. The information generated will help in raising disease free material for production of quality flowers. This is also important from the quarantine point of view. Presently, efforts are being made to characterize and clone these viral genes.

Microwave induced process for the preparation of substituted 4-vinyl phenols

A new microwave induced process has been developed by IHBT for the synthesis of substituted 4-vinyl phenols. 4-vinyl phenols (No.3739) and 4-vinyl guacos (no. 2675) are FEMA approved flavouring agent which are known for spicy, apple, rum roasted and clove like flavors. Synthetic preparation methods are tedious. Microwave assisted method is a rapid and economical process and results in development of a highly purified product in large quantities.

Microbial association in cold desert

Situated at a strategic location, IHBT has access to rarely ventured land of cold desert—Lahul and Spiti. Studies carried out to assess the lesser known microbial diversity of the region revealed a vast array of microbial populations associated with plants like *Hippophae rhamnoides, H. tibetana, Dactylorhiza hatageria, Ephedra gerardiana, Rosa webbiana* and *Arnebia euchroma*. The microbes identified included: Arbuscular Mycorrhizal Fungi, viz. *Aculospora sorbiculata, Glomus mossae, G. globiferum, G. clarum*; fifty-eight isolates of bacteria; and hundred and sixty six isolates of fungi belonging to *Acremonium, Aspergillus, Aureobasidium, Chrysosporium, Colletotrichum, Geotrichum, Gliocladium, Paecilomyces, Papulospora, Penicillum, Torula, Trichoderma, Tricothecium, Mucor,* and *Fusarium* spp. The information generated will help in understanding the fundamental functioning of the ecosystems at degraded sites under cold desiccating and stressful milieu of Spiti valley.

Enhancing production of high valued essential oils

Characterized planting materials of geranium and lavender were given to the farmers along with the standard cultural practices. The two distillation units designed and installed by IHBT at Fatehpur and Salooni are being extensively used by the farmers as a central processing facility for distillation of geranium and lavender oil respectively. Several progressive entrepreneurs have undertaken the cultivation of aromatic crops and have set up distillation units with IHBT technology and expertise.

Also the farmers of the region are showing interest in adopting agro and processing technology of high value aromatic crops like Damask rose, Wild Marigold, Geranium and Lavender. Quality planting materials of these crops are supplied to farmers and training programmes are organized from time to time for their benefit. As a result of the efforts of the Institute, 10 kg damask rose oil worth Rs. 20 lakh, 3000 kg wild marigold worth Rs 6 lakh, 15 kg of geranium oil worth Rs 60 thousand and 3 kg lavender oil worth Rs 75 thousand were produced only from North India.



Lavender – an excellent source of Lavender oil introduced by IHBT

Geographic Information System

IHBT has set up Geographic Information System (GIS). The facility is useful for environment impact assessments; land use planning; management of bio-resources; agricultural development; monitoring ecological changes; and enhancement in measuring environmental parameters and mapping topographic features, monitoring changes in space and time and modeling environmental features and deriving alternatives of actions and processes. This information will be used to prioritize future research and development endeavours.

Synthesis of carbohydrate dendrimers

Dendrimer chemistry is one of the frontier areas of research due to its importance in biological, material and other branches of science. Carbohydrate dendrimers have special significance by virtue of their biochemical behaviour such as lectin binding

properties. Dendrimers having such complexity are rare. This work at IICB describes an expedient approach to internally functionalised chiral dendrimers incorporating furanoside skeletons. A dendrimer incorporating pentose units in the interior and hexose units in the periphery is built up on a 1, 3, 5-trisubstituted aromatic core by using 1,2,5,6-di-isopropylidene glucose as the carbohydrate precursor and a 3, 5-disubstituted aromatic unit as the branching block. The carbohydrate moiety also provides internal functionalities in the form of hemiacetal moiety of the furanoside ring. The contribution will make possible the synthesis of carbohydrate dendrimers, which could be functionalised and coupled through conjugation to biologically important molecules such as peptides leading to the development of materials with novel biological properties.

Sanguinarine - Triplex DNA structures

Triplex DNA structures are known to play a role in the gene expression and recombination and also have potential application as antisense inhibitor of gene expression. The instability of triplex structure under normal physiological condition is a critical limitation that restricts their uses *in vivo*. The present strategy is to aim at enhancing triplex stability using various intercalating agents. IICB reported for the first time that sanguinarine binds more tightly to triplex structures than to duplex. IICB has reported for the first time the thermodynamic aspects of sanguinarine-triplex DNA complexation. It reveals that the process of binding of sanguinarine to C.GxC$^+$ triplex is exothermic and enthalpy driven while that to T.AxT triplex is endothermic and enthalpy driven. The present work on thermodynamics of sanguinarine-triplex stabilization has further supported the scope for the use of this plant alkaloid for purpose of gene regulation and gene therapy.

Stabilization and improvement of catalytic activity of a lower molar mass cellobiase by cellobiase-sucrase aggregation in the culture filtrate of T. clypeatus

Protein protein interaction is an important arena in proteomic research. IICB has identified a new mode of such interaction where extracellular enzymes of a fungus *T.clypeatus* improved its catalytic activities and stabilities by forming aggregates with other enzymes co-produced by the fungus. The biological significance of such heterologous protein-protein interaction observed for a long time was first reported by IICB.

Strain for the production of recombinant Staphylokinase

Staphylokinase, a fibrinolytic protein, secreted from *Staphyloccocus aureus*, has recently been established as a potent fibrin-specific clot buster. A recombinant system for the high level production of SAK has been developed for the production of this

potent thrombolytic protein and its analogs exhibiting better functional properties. In order to understand molecular basis of plasminogen activation function, the functional relevance of its charged loop structure has been studied. It provided insight into the interaction of SAK plasmin activator complex with the substrate plasminogen during plasminogen activation. A recombinant system for the high level production of this clot-buster has been developed. It may provide a recombinant system that may be commercially viable if upgraded at higher scale/fermentation level.

Role of CD80 and CD86 in the activation of B cell and B cell lymphoma

Studies at IMT have led to proposing a novel concept of bi-directional costimulation. It has been demonstrated that costimulation through CD80 molecule specifically inhibits the proliferation and IgG secretion by LPS-stimulated B cells and B cell lymphoma through up-regulating the expression of pro-apoptotic molecules caspase-3, caspase-8, Fas, FasL, Bak, and Bax and down-regulating the levels of anti-apoptotic molecule Bcl-xL. The study established the role of costimulatory molecules in understanding the regression of lymphomas and in the development of a strategy for controlling the growth of cancer cells.

Bioremediation of pesticide

With the ban on several organochlorine pesticides worldwide, there has been increased emphasis on organophosphate pesticides. IMT has been able to effectively demonstrate removal/bioremediation of PNP to the extent of ~90% from contaminated soil by adding a PNP-degrading bacterium *Arthrobacter protophormiae* RKJ100 to the contaminated soil in microcosm experiments in the laboratory. Besides, the complete pathways for the degradation of PNP, 4-nitrocatechol and *o*-nitrobenzoate have also been elucidated which have been included at the University of Minnesota biocatalysis/biodegradation database. Efforts were underway to provide understanding of the above pathways at a molecular level.

Immunosensor system for environmental pollutants

IMT has developed an ultra-sensitive immunosensor system for specific and sensitive detection of environmental pollutants. It measures the biomolecular interactions on transducer surface and is capable of detecting analyte concentrations upto nano-molar range. The immunosensor system utilizes piezoelectric crystals (10 MHz, AT-cut) as a sensor transducer, and combines a specific biological recognition component to detect and identify the target molecules in solution. The process is based on the measurement of small change of mass, resulting from formation of antibody-antigen complex on piezoelectric crystal surface. The piezo-immunosensor enables detection of concentrations and also monitors interactions between molecules in real time without using any labels such as enzyme, fluorophores, radio-isotopes

etc. This sensor can detect the interactions between biomolecules such as protein-protein, antibody-antigen, enzyme-substrate, protein-nucleic acid etc. The surface of the crystal is chemically modified for covalent binding of the ligand to give higher stability and reproducibility.

Result of Microbial degradation of endosulfan

Endosulfan (CAS No. 115-29-7) is a broad-spectrum chlorinated-cyclodiene insecticide which is extremely toxic to fish and aquatic invertebrates, moderately to bird species, and has been shown to be mutagenic to bacteria, yeast, and mammalian cells. It is listed as a hazardous substance because of its abundant use, migration in the environment, persistence, and toxicity and the disposal of its wastes is controlled by Federal Regulations (Toxicological profile of endosulfan, U.S. Department of Health, 2000). ITRC has studied the degradation of endosulfan by a bacterial co-culture, consisting of two different strains of *Bacillus* sp that have been deposited in the Microbial Type Culture Collection & Gene Bank (MTCC). The degradation of both the isomers of endosulfan was accompanied by the formation of the metabolites, endosulfan diol and endosulfan lactone, as seen by TLC, GC, and GC-mass spectroscopy. ITRC studies for the first time demonstrated microbial degradation of endosulfan isomers accompanied by a decrease in its toxicity to the test organism *Tubifex tubifex* Müller. The isolated microorganisms offer significant potential for the bioremediation of contaminated soils and waters, and safe disposal of endosulfan-wastes.

Association of lead with prostrate cancer

ITRC conducted studies to evaluate the possible association of environmental exposure with lead as a risk factor for prostrate pathology. Blood lead level was determined in patients suffering from prostrate cancer (PCA) and benign hyperplasia (BPH) and compared with those in a control group living in the similar socioeconomic environment. The blood lead levels were significantly higher in PCA and BPH cases in comparison to normal ($P<0.05$). Blood levels of zinc and copper were significantly lower in PCA and BPH cases when compared with controls ($P<0.05$). In all the three groups, a statistically significant positive correlation between lead and thiobarbituric acid reactive substances (TBARS) measured as malondialdehyde and negative correlation between blood lead and antioxidants GSH level, indicative of possible generation of reactive oxygen species, were also observed after adjusting for age as a possible confounders. However, positive association between blood lead and TBARS was relatively higher in PCA patients than in BPH and normal. The study conducted seems to suggest that environmental exposure of aging males to lead may be a risk factor for prostrate cancer and/or benign prostrate hyperplasia possibly through generation of reactive oxygen species and/or reducing the level of zinc which acts as a cellular growth protector. It provides for the first time, a new insight into

understanding the phenomenon of environmental exposure of aging males to lead. Further studies in this regard were in progress.

Reversal of Vinca alkaloid induced P-glycoprotein mediated multidrug resistance by Indole-3-carbinol

The over expression of mdr-1 gene transcript P-glycoprotein (P-gp), responsible for multiple drug resistance (MDR), is a major obstacle in cancer chemotherapy. P-gp acts as an energy dependent drug efflux pump, reducing the intracellular concentration of structurally unrelated drugs. Modulators of P-gp function are reported to restore the sensitivity of MDR to such drugs. In a study conducted by ITRC the P-gp modulatory potential of Indole-3-Carbinol (I3C) using *in vitro* and *in vivo* models was evaluated . I3C is a well known chemo preventive agent present in cruciferous vegetables, reported to possess many medicinal properties including antimutagenic and anticarcinogenic activities. For *in vitro* studies, K562 leukemic cells were made resistant (K562/R) towards the cytotoxicity of vinblastine (VBL) by progressive adoption of the parental sensitive K562 cell to VBL. Cross-resistance of K562/R was found between Vincristine (VCR), Doxorubicin and other antineoplastic agents. A non-toxic concentration of I3C enhanced the cytotoxic effects of VBL and another vinca alkaloid. The results showed that I3C decreased the induced levels of P-gp in resistant cells back to the normal levels as analysed both qualitatively and quantitatively by western blotting and immunocytochemistry. Furthermore, *in vivo* combination studies showed that I3C effectively inhibited the vinca alkaloid induced P-gp over expression in mouse hepatocytes. Quantitation of immunostained tissue sections with image analysis showed at reduction in P-gp levels was up to the extent of ~80% for both VBL and VCR included drug resistance. I3C can serve as a novel, non-toxic modulator of P-gp expression and can be used as a dietary adjuvant for the reversal of MDR. Studies to delineate the mechanism were in progress.

Mechanism of oxidation of Phenol on Ni(II) mixed ligand complex modified electrode

ITRC has synthesized and characterized Ni(II)–cyclame thiocyanate complex and for using it as a carbon paste electrode modifier for oxidative detection of phenol. The electroactive mixed ligand complex behaves as a fast electron mediator and exhibits reversible redox peaks. The mixed ligand complex of nickel, when incorporated in the graphite paste electrode, is sensitive to detect phenol as low as 10 ppb in solution. The technique has the potential for sensing/monitoring of phenol released in the ecosystem from polluting industries. This knowledge can be applied for developing technology for detection of other phenolic compounds.

Multi enzyme based potentiometric sensor for estimation of creatinine

A process for the estimation of creatinine, with the help of two enzymes immobilized in creatinine reactor followed by potentiometric estimation of urea with a urea biosensor has been developed at ITRC. Creatinine has become an important clinical analyte that is used for the determination of renal glomerular filtration rate and kidney dysfunction and muscle disorder. The reference ranges for serum/plasma creatinine and urine creatinine are 35-140 mM and during disorder or disease conditions, the creatinine level may rise to >1000 mM. The device developed is cost effective and non-hazardous. Quantification of creatinine is possible by using it without any interference of other chemicals or ions in biological samples. It can detect upto 0.1mM in the aqueous samples. A patent has been filed for the development.

Phytochemical and genomic diversity in *Withania somnifera*

Withania somnifera (Ashwagandha) is a medicinal plant, used commonly in Indian traditional healthcare system. A large number of withanolides have been identified in its roots and leaves and attributed several bioactive properties. In collaboration with RRL, Jammu and CIMAP, NBRI undertook studies supported under the NMITLI programme of CSIR and revealed important aspects related to chemotypic and genomic diversity. More than 100 accessions collected from different native geographical zones in India were analysed. Several contrasting chemotypes were identified as promising for developing cultivars and designer plants for specific applications. Studies on the genes involved in the synthesis of withaferin A (an anti inflammatory and immunosuppressive molecule), sitoindosides (antistress activity) and withanolide D (antitumour activity) have revealed interesting results in *Withania*.

Chemical evaluation of biodiversity in neem

NBRI evaluated neem germplasm in the country. More than 40 provenances and nearly 1000 individuals from different states were collected and evaluated for phenotypic and major active metabolites of neem (azadirachtins, solanin, nimbin). The azadirachtins were quantified. There were wide variation in oil and azadirachtin content among different provenances. Azadirachtin A ranged from 556.9 to 3030.8 mg kg^{-1} kernel whereas azadirachtin B was in the range between 43.1 to 590.6 mg kg^{-1} kernel among the provenances investigated. Analysis of variance among various neem provenances showed significant difference in oil content, azadirachtin A, total azadirachtin (A+B) and A:B ratio. There were individuals with high and low azadirachtins within a single provenance; and this trend was observed in all the provenances selected from five afro-climatic regions of the country.

Development and release of new chrysanthemum varieties

Four new varieties of chrysanthemum developed by NBRI through open pollinated seedling selection have been released for commercial exploitation. These new varieties are:

- **NBRI Indiana:** is yellow pompon type, small flowered, suitable for mini and pot culture. It has profuse branching, long, erect stem, lush green leaves, uniform bloom, opening in late November, easy to multiply by suckers and cuttings.
- **NBRI Kusum:** is yellow open disc, small flowered, single Korean type chrysanthemum, good for pot culture.
- **NBRI Little Darling:** is terracotta pompon type, small flowered, mini chrysanthemum. It is a unique genetic strain with dwarf, bushy, compact round shape, profuse blooming habit in early December. The plant habit and shape is most attractive for 'mini culture'.



Introduction of new dwarf strain of chrysanthemum 'little darling' by NBRI: suitable for mini culture

- **NBRI Mini Jessie:** is cineraria type mini chrysanthemum. It is a unique genetic strain with dwarf bushy, compact round shape and profuse blooming habit. The plant habit and shape is most attractive for 'mini culture'.

Biological control agents as growth enhancer

A technique for the management of collar rot disease of betelvine (causal organism: *Sclerotium rolfsii*) has been developed at NBRI by using formulations of *Trichoderma*

spp. and *Pseudomonas fluorescens*. The field application of the formulations of these BCAs not only reduced the disease incidence significantly but also enhanced the crop yield under *in vivo* conditions. Corm rot and yellows disease of gladiolus caused by *Fusarium oxysporum* f. sp. *gladioli* is an important disease of gladiolus resulting in heavy losses. An integrated approach for the management of this disease has been developed by NBRI using *Trichoderma harzianum* and Chlorothalonil in combination. The application of this synergistic technique reduced the disease significantly.



(a) Damage of leaf and stem by collar rot disease (b) Absence of the disease in the leaf and stem caused by ***sclerotical wilt*** —formulation developed by NBRI

Biologically derived HIV-1 protease inhibitors

First biologically derived molecule that inhibits HIV-1 protease has been isolated at NCL. The mechanism by which this inhibitor acts makes it especially robust to mutations of HIV. The inhibitor isolated has an amino acid sequence that shows no similarity to existing inhibitors, and represents an exciting new class of inhibitors with important implications for AIDS therapy. HIV requires an enzyme called HIV-1 protease in order to multiply. Thus, this enzyme is an excellent target for developing drugs against the virus. Studies indicate that drugs that inhibit HIV-1 protease

(protease inhibitors), in combination with another group of drugs called reverse transcriptase inhibitors, dramatically reduce the levels of HIV in blood. While a large number of synthetic inhibitory compounds targeting the HIV-1 protease have been reported, not much is currently known about biomolecule-inhibitors from micro-organisms. It has been demonstrated at NCL that an aspartic protease inhibitor, ATBI isolated from a bacterium, the alkalothermophilic Bacillus sp. that thrives in adverse environments, shows inhibition against recombinant HIV-1 protease. The sequence homology of ATBI exhibited no similarity with the reported peptidic inhibitors of HIV-1 protease. ATBI exhibits a unique, non-competitive mode of inhibition that distinguishes it from other inhibitor molecules. Detailed studies of the mechanism by which ATBI acts suggest that the binding of ATBI impairs the flexibility of the flaps on the HIV-1 protease. The proposed binding interaction with the backbone of the flaps of HIV-1 protease eliminates the probability of drug resistance by single mutation. Thus, spontaneous single-point mutations in the active site of HIV-1 that drastically deteriorate the performance of other inhibitors might not affect the potency of ATBI. Another significant advantage offered by ATBI over the majority of existing peptidic inhibitors is its increased bioavailability due to its water- loving or hydrophilic nature.

Vegetation protocol for reclamation of crude oil contaminated soil

In oil fields, during drilling, gathering, transporting etc. some quantity of crude oil always gets spilled over the neighbouring land. The spilled crude oil causes serious threat to the flora and fauna at the drill site. The soil once contaminated takes years together to have the natural plant succession initiated. RRL, Jorhat has developed a protocol for regeneration of vegetation neighbouring the drill sites. Emphasis was laid on the growth and development of neem plant in such soils. The ONGCL-ERBC (SEM), Sivasagar, was provided the protocol, to be used at one of their drilling sites. The growth of vegetation was made possible with the application of RRL protocol in crude oil contaminated soil.

NEW FACILITIES

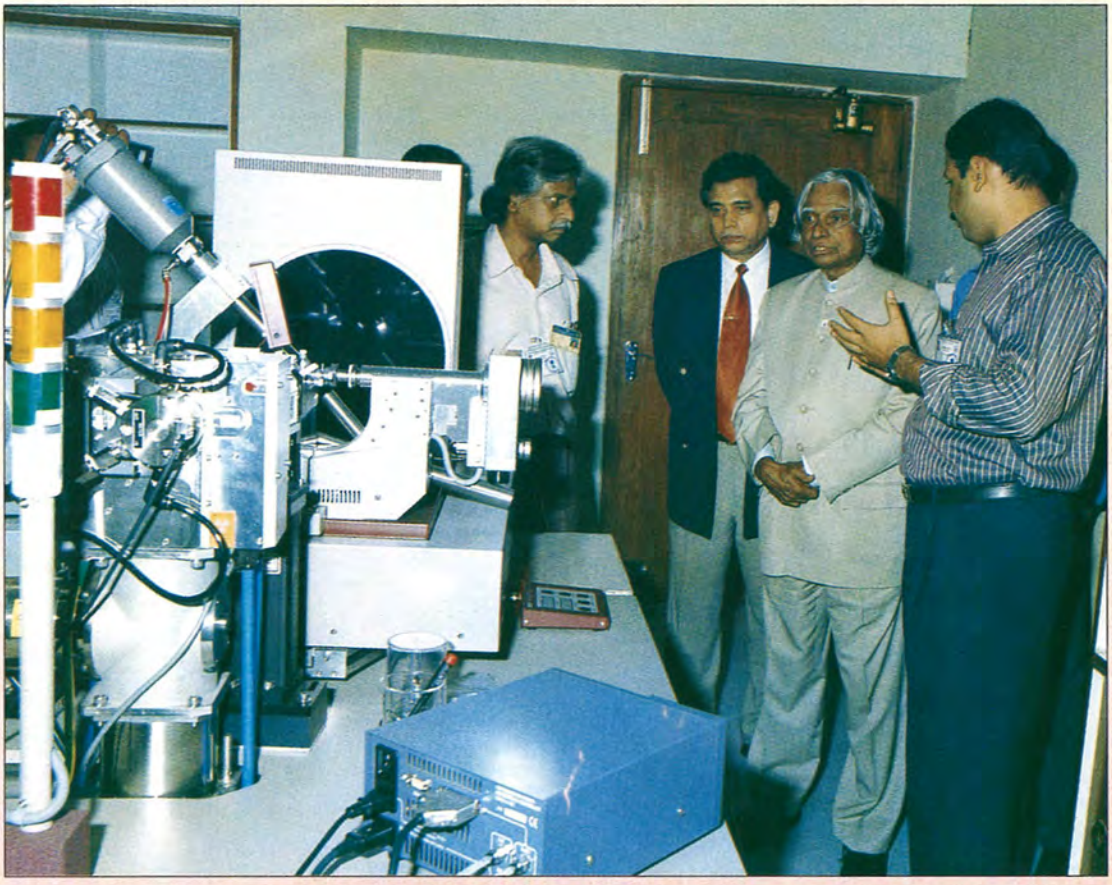
Structural Biology Facility

1.2.2 HUMAN RESOURCE DEVELOPMENT

CCMB

- An International Hands-on Training Course on "Proteomics & DNA Micro array" was organized wherein 20 persons working in the field participated.

- Summer Training: About 25 M.Sc. students were chosen at national level for hands on research training. They spent about 10 weeks working as trainees in various laboratories with a stipend and free accommodation. On successful completion of their course, they were awarded certificates.
- Training through collaboration: 25 M.Sc. students have carried out their 6 months project work in area of human genome diversity in tribal populations. Students from Barkatullah University, Sardar Patel University, Loyola College, APS University, Poorvanchal University, Allahabad Agricultural University and Jiwaji University collected blood samples from Tribal population of the respective place and carried out the project at CCMB as part of their training. The blood samples were deposited at CCMB. The results are published jointly. By this programme CCMB could collect numerous blood samples of diverse population.



Hon'ble President Dr. APJ Abdul Kalam visiting newly created X-ray Crystallography facility at CCMB

- Indo-US Cytometry Workshop: Fifty participants from all over India took training in advanced cytometry techniques; emphasis was given on use of flow cytometry in cell and tumour biology.

CDRI

- Training was imparted to students from Birla Institute of Technology and Science (BITS), Pilani. It was six months training programme wherein 20 students underwent training in various R&D disciplines.
- Two scientists from NBRI and RRL, Thiruvananthapuram were trained at CDRI in the field of sophisticated instruments and medicinal chemistry.
- More than two hundred post-graduate students from Indian Universities and sponsored personnel were trained in the field of tissue culture, medicinal chemistry and biochemistry.
- WHO sponsored fellows, one each from Myanmar and Bhutan were imparted training in screening, pharmacological & toxicological evaluation and quality control procedures for traditional and herbal medicines.

CIMAP

- CIMAP Winter School with its national standing imparted training to 16 researchers/scholars in the area of Biotechnology.
- Forty-eight M.Sc. students from eighteen different universities all over the country undertook 2-6 month trainings for their M.Sc. project work in the relevant areas of research.
- Under the Indo-Sudan bilateral collaborative project in biotechnology an Asst. Professor, Dept. of Agrotechnology, National Centre for Research, Khartoum, Republic of Sudan, received training.
- A representative of Dept. of Traditional Medicine, Ministry of Health, Govt. of Union of Myanmar, was imparted training on the cultivation and preservation of herbal drugs.
- Thirty-seven participants sponsored by Adityapur Industries Association, Jamshedpur were provided training under a consultancy package.
- CIMAP conducted seven training and demonstration programmes covering cultivation, processing and marketing aspect of various medicinal and aromatic plants in five states namely U.P., Karnataka, Uttaranchal, Chhattisgarh and Maharashtra and trained 243 persons. The trainees represented various sectors like, farming, industry and public and private funded organizations. As per the feedback the impact of these programmes has been encouraging in terms of boosting production, spread of cultivable area, adoption of high yielding varieties and employment generation.
- CIMAP co-ordinated the activities of CPYLS programme for the states of Uttar Pradesh and Uttaranchal. The programme at CIMAP was organized on 9th and 10th December. The programme at CIMAP was inaugurated by Dr. S.K. Joshi,

former Director general, CSIR. Meritorious students of class XI of different boards of UP & Uttaranchal participated in the programme.

IGIB

- **Bioinformatics:** PG-Diploma in Bioinformatics was launched with M/s Informatics (India) Ltd. and M/s Informatics. Forty masters' students in life sciences and computer applications were given interactive classes on bioinformatics. A collaborative agreement have also been signed with Chembiotek Research Pvt. (The Chatterjee Group) for human resource development in bioinformatics.
- **Workshop on allergens:** Educational workshops (biannual) to educate medical practitioners on allergens are conducted systematically at IGIB alongwith Vallabh Bhai Patel Chest Institute.
- **Training course:** Short term training/summer training of M.Sc. students of various Universities towards partial fulfillment of their degree course organised. About 60 students have undergone training.
- **Collaborative programmes with ACBR:** Scientists of the Institute are involved in selection and teaching/guiding M.Sc. and Ph.D. students of Dr. B.R. Ambedkar Centre for Biochemical Research (ACBR), University of Delhi. They conduct classes and provide laboratory facilities and are involved in evaluation procedure. Every year about 20 students of ACBR work at IGIB for their project and summer programme. 18 scientists of IGIB are visiting faculty to ACBR.
- **CPYLS Programme:** The programme for the year was organized. Top-ranking students from Senior Secondary School of Delhi, were invited for visiting the labs of the Institute and get an exposure to the scientific world. This is to encourage students to take up science as a career.
- **Ph.D. Programme:** The institute has a sizable number of Ph.D. students who pursue their doctoral studies under the scientists. Presently about 74 JRF/SRF students were working on cutting edge research projects. Four students were awarded Ph.D. degrees during the year.

IHBT

- **Training on aromatic & medicinal plants, commercial floriculture and marketing for income generation:** Five days training programme on production of aromatic & medicinal plants, commercial floriculture and marketing for income generation was organized. Twenty trainees working under IWDP (Kandi) projects from five different northern states received training on processing and cultivation of medicinal and aromatic plants. The training will help them in adopting medicinal and aromatic crops as alternative farming and producing high quality essential oil.

- **Training programme for small tea growers:** Various training programmes for small tea growers of Assam and Tamil Nadu were conducted. The teams were exposed to different aspects of R&D on tea husbandry and tea manufacture. The training programme enabled the participants to understand the problems faced by the tea industry and generated the spirit to work closely for upliftment of the national tea industry.
- **CSIR Programme on Youth for Leadership in Science (CPYLS):** CSIR Programme on Youth for Leadership in Science for meritorious students of Himachal Pradesh was organized. Twenty students participated in the programme and were exposed to R&D infrastructure and activities of the Institute. The programme excited the young minds on basic science.

IMT

- Summer Training Programme for M.Sc. (Biotechnology) students from various universities was conducted; 29 students underwent this training. Winter Training Programme for M.Sc. (Biotechnology) students from Universities of Simla and Tejpur was also conducted during the year.
- International Depositary Authority conducted a workshop on "Exploration of Microbial Diversity—A Polyphasic Approach". Twelve university teachers/ scientists from eleven states participated in the workshop.

ITRC

- A refresher course on role of Bioinformatics in Biological Research was organized by ITRC. It was part of the series of 'Course in Bioinformatics' at different Bioinformatics Centres in the country sponsored by Department of Biotechnology. The course was aimed to introduce the concept of bioinformatics and its applications in biological research to the participants. The faculty for the above course included scientists from CDFD, Hyderabad, IMTECH, Chandigarh and ITRC, Lucknow. The participants were from various educational and research institutions. They were greatly benefited with the state-of-the-art knowledge on the subjects.

NBRI

NBRI conducted:

- Ten days training-cum-workshop on 'standardization of herbal drugs'. It was sponsored by Mahatma Gandhi Institute for Rural Industrialization (MGIRI, Wardha). Practical training was imparted on various aspects related to production and standardization of herbal drugs/products to KVIC units;

- Training on post harvest technology of medicinal & aromatic plants. The training was imparted with special reference to sodic soils, their conservation in Gene Banks, digitization of database and biotechnological aspects for improvement of yield and quality.
- Programme on dehydration of flowers and foliage and floral craft for general public. This helped in employment generation and fetching extra income to rural people. Awareness was created regarding dehydration technology and the commercial potentiality of dehydrated flower and foliage and floral craft in domestic and international market.
- Training programme on 'leadership development' with special emphasis on biofertilizers and biopesticides'. 40 participants of Avadh Grameen Bank attended the training jointly organized with NABARD.

1.2.3 RECOGNITION & AWARDS

'Purvanchal Ratna' award by VBS Purvanchal University, Jaunpur	Dr. Lalji Singh, CCMB
Antarctic Award for excellence in the field of Biological Sciences, DOD, Govt. of India Elected Fellow of the Zoological Society of London	Dr. S. Shivaji, CCMB
Vigyan Ratna Award, U.P. Government	Dr. B.S. Srivastava, CDRI
Ranbaxy Research Award in computer aided drug design and syntheses of new chemical entities for CNS and CVS disorders	Dr. A.K. Saxena, CDRI
Young Scientist Award 2002 by the Government of Uttar Pradesh	Shri Sudeep Tandon, CIMAP
Fellow of the National Academy of Agricultural Sciences	Dr. S.P.S. Khanuja, CIMAP
Professor Umakant Sinha Memorial Award for 2002-2003 by the Indian Science Congress Association	Dr. Ajit Kumar Shasany, CIMAP
Rajib Goyal Prize in the area of Life Sciences Ranbaxy Research Award for the year 2001 in the field of Medical Sciences & Medical Research	Prof. S. K. Brahmachari, IGIB
Rajib Goyal Prize for Young scientist in Biological Sciences All India Biotech Association Award	Dr. Y. Singh, IGIB

FICCI Award	Prof. S. Bhattacharya, IICB
CSIR Technology Award for Biological Sciences & Technology	Drs. Samir Bhattacharya, Ranjan Bhadra, Bikash C. Pal and Krishna Das, IICB
National biotech product & process development and commercialisation award	Dr. Girish Sahni, IMT
CSIR Technology Award (Process Technology Shield) for indigenous development of a technology for natural streptokinase	Dr. Amit Ghosh, Dr. Girish Sahni, Dr. U.C. Banerjee, Dr. Naresh Kumar, Mrs. Paramjit Kaur and Mr. Anil Jaryal, IMT
VASVIK award for the year 2000 in the area of Biological Sciences & Technology	Dr. Girish Sahni, IMT
Fellow of National Academy of Medical Sciences, India	Dr. P.K. Seth, ITRC
Equator Initiative Prize 2002 at Earth Summit, Johannesburg, South Africa Prof. Bal Dattatraya Tilak Memorial Lecture Award by Indian National Science Academy.	Dr. P. Pushpangadan, NBRI
All India Biotech Association Award (2001-02) for outstanding contributions in the field of agricultural biotechnology	Dr. R. Tuli, NBRI
VASVIK Industrial Research Award- 2000	Dr. G. N. Qazi, RRL, Jammu

1.3 CHEMICAL SCIENCES & TECHNOLOGY

1.3.1 SCIENCE, TECHNOLOGY & SERVICE

Removing noise from data signals

NCL has devised new algorithms to filter and de-noise data. The algorithm takes data and extracts underlying patterns that might be obscured by noise. For example, temperature, pressure, velocity data obtained while monitoring a chemical reactor are typically very noisy and therefore, it is difficult to meaningfully interpret the signals in the form they are obtained. However, application of NCL's noise removal algorithms reveals hidden features even in such data and provide insight into process and reactor behaviour. This algorithm is broadly applicable and the NCL team has demonstrated its use for a wide variety of phenomena from classical chemical engineering reactors such as the stirred-tank, fluidized bed and bubble column reactors, to data from flow experiments on polymer solutions and conductivity measurements on surfactant solutions. A US patent has been granted for the development. The power of this analytical tool has excited researchers worldwide and the development has been cited in a variety of research papers. It offers significant advantages over conventional methods to remove noise from data. Conventional methods of filtering data are unable to capture sudden changes in data, such as pressure fluctuations or sudden changes in temperature. The NCL de-noising algorithm could be automated.

Novel route to Ibuprofen

NCL has developed the first heterogeneous catalysts for preparation of aryl propanoic acids. These acids are important intermediates in the synthesis of blockbuster nonsteroidal anti-inflammatory drugs such as Ibuprofen and Naproxen. Aryl propanoic acids are prepared by the hydrocarboxylation of aryl olefins or alcohols. The current Hoechst-Celanese process for the synthesis of Ibuprofen uses a palladium (Pd) catalyst in solution, (viz. a homogeneous catalyst). This process requires a highly corrosive acid promoter and works at high pressures (16-35 MPa). Earlier efforts at NCL had led to significantly improving this process by developing a novel homogeneous palladium complex catalyst that worked at lower pressures (around 3 MPa) and yet showed significant enhancement over the Hoechst-Celanese catalyst in the catalytic activity and regioselectivity for Ibuprofen. However, all homogeneous catalysts suffer from difficulties in separation and reuse. To overcome this limitation, NCL combined their catalyst with solid silicate supports, (viz. a heterogeneous support) to produce the first heterogeneous hydrocarboxylation catalyst. It has been

shown that a Pd complex (Pd-Pyca) anchored to mesoporous silicates like MCM-41 and MCM-48 exhibits high conversions and selectivities for a variety of aryl olefins and alcohols. The catalytic efficiency of the heterogeneous catalysts in terms of activity and selectivity is very high compared to previously reported heterogeneous catalysts by conventional methods. With TOF (turn over frequency) values of these anchored heterogeneous catalysts in the range of 415 - 465 h^{-1} and high regioselectivity of >98%, these catalysts have immense potential for use in industrial carbonylation reactions.

Trifunctional catalyst

IICT has developed new immobilized catalysts stabilized in nanoclays and nanozeolites for organic transformations. A unique trifunctional catalyst anchored to silica/clay/polymer matrix has been developed to execute Heck reaction followed by asymmetric dihydroxylation (AD) and in situ oxidation of N-methyl morpholine to generate the oxidant NMO for AD in one-pot. A highly efficient "tight fit" immobilization of α-chymotrypsin in mesoporous MCM-41, with a loading of protein (w/w) wherein the effective enzyme activity 6.5% (w/w), has been achieved for the first time.

Biotransformations

Chemo-enzymatic methodologies have been developed at IICT for the preparation of 3-aryloxy-3-phenylpropyl amine, a key intermediate for antidepressant drugs and 5-(1-aminoethyl)-2-(cyclohexyl methoxy) benzamide, an important intermediate for Src-SH2 inhibitor. A one-pot lipase catalysed synthesis of enantiomerically pure secondary alcohols from carbonyl compounds and a new protocol for lipase-mediated resolution have also been developed. Efficient methods have also been developed to use lipases and phospholipases for the preparation of hydroxy and saturated fatty acid rich phospholipids from vegetable oils.

Non-glycerol based cationic transfection lipids

Several new structural analogues of non-glycerol based cationic transfection lipids containing two 2-hydroxyethyl head-group functionalities have been designed and synthesized. Two cationic lipids in these new series were found to be more efficient in transfecting cells than DMRIE, one of the most extensively used commercially available cationic transfection lipids. IICT's results do indicate that too-strong lipid-DNA interactions might result in weaker transfection efficiency for non-glycerol based cationic lipids. In addition, novel cationic lipids based on lactic acid were also synthesized and evaluated for gene transfection.

New Centres for Bioactives - Safety and Functional Evaluation (BIOSAFE) & Health of Pharmaceuticals - Evaluation (HOPE)

IICT has established the "BIOSAFE" Centre for functional evaluation of bioactives and the "HOPE" Centre for evaluation of health of pharmaceutical preparations as

per Indian Drugs and Cosmetics Act. The "BIOSAFE" Centre will cater to need of in-house as well as industry sponsored programmes associated with the development of new bioactive molecules of commercial importance and will be used for the generation of animal pharmacology and toxicology data as required by schedule 'Y' of Drugs and Cosmetics Act 1940 and Rules 1945. The "HOPE" Centre is recognized by the Andhra Pradesh State Drugs Control Administration. It will assess the quality of drugs and cosmetics employing state-of-art testing facilities. A wide range of tests in accordance with IP, BP, USP and various regulatory standards can be conducted at this centre.

Synthesis and characterization of novel metal complexes

A new chromium(III) complex [Cr(5-chlorosalprn) $(H_2O)_2$]ClO_4 has been prepared and characterized at CLRI by electrospray ionization mass spectrometric (ESIMS) analysis and other spectroscopic techniques. Single crystal XRD reveal that the complex assumes a *trans* diaquo structure [Cr($C_{17}H_{18}Cl_2N_2O_4$)]ClO_4. H_2O. The effect of phenyl ring substituent on the rate of formation of $[O=Cr^{v}]^{+}$ has been investigated. The bimolecular rate constant for the formation of $O=Cr^{v}$ species by the [Cr(Schiff base) $(H_2O)_2$]CiO_4 where Schiff-base = salprn (1) and 5-chlorosalprn (2) with PhOl was compared. In case of 2, the rate was found to be faster by an order of magnitude at pH – 4 compared to 1. The introduction of chloro substituent on the phenyl ring not only influences the rate of redox reactivity but also the pKa values of aquo ligands of the complexes.

Novel synthesis of mono- and bis(2,3-fused perhydrooxazol-4-one) systems

The unstable isomünchnones generated from the α-diazoimides have efficiently been trapped using oxygen nucleophiles in the presence of rhodium(II) acetate catalyst. This forms a facile tandem cyclization-nucleophilic addition method to 2,3-fused perhydrooxazol-4-one 1 and bis(2,3-fused perhydrooxazol-4-one) 2 skeletons with the option to vary its substituents and ring sizes in good to excellent yields and the formation of upto two cyclic rings, four C–O bonds are achieved in a single step. This synthetic process developed at CSMCRI forms a facile entry into the new family of 2,3-fused perhydrooxazol-4-one 1 and bis(2,3-fused perhydrooxazol-4-one) 2 systems with the atom economy. It will be applied to synthesize dentrimers with this multiple bonds formation technique.

Aerobic oxidation of tertiary nitrogen compounds to N-oxides

IIP has achieved for the first time oxidization of a variety of tertiary nitrogen compounds to their corresponding N-oxides in excellent yields using molecular oxygen as the sole oxidant in presence of catalyst. Oxidation of tertiary nitrogen compounds is an important synthetic transformation, as N-oxides find wide application as oxidants

and offer functional group manipulation and structural modification possibilities, which are not accessible by other methods. Aerobic oxidation of other substrates is being studied to develop new oxidative synthetic methodologies.

Catalyst for deep catalytic cracking

IIP has developed a catalyst of deep catalytic cracking. It would be used for cracking of residues to maximize the production of light olefins such as propylene and isobutylene. Highly dealuminated zeolite with strong acid sites, low unit cell size has been used as one of the ingredients in catalyst recipe. Catalyst has been found suitable for high severity FCC operation for olefins maximization. The yield of gaseous hydrocarbon was found as high as 40% with higher content of C_3/C_4 olefins, from heavy feedstocks. The development work was undertaken in collaboration with Centre for High Technology (CHT).

Making plastics biodegradable

An ingenious technique to convert high-volume, commonly used plastics into biodegradable materials, has been developed at NCL. It is demonstrated that bacteria could be induced to degrade commodity plastics such as polyethylene, polypropylene and polystyrene. Each year the global polymer industry produces around 100 million tons of polyethylene, polypropylene and polystyrene. These low-cost, durable materials are used in a variety of applications ranging from plastic shopping bags to bottles, sheets and styrofoam cups. After use, these polymeric objects are typically discarded and they enter the waste stream. Here, the durability of the polymers poses a grave problem as they do not degrade and remain in the environment. The increasing volumes of polymer production and consumption make this resistance to degradation a serious ecological hazard. The problem is addressed by chemically attaching a small number of sugar molecules to polystyrene. Bacteria readily attack the sugar molecules (sucrose, glucose, or lactose) and, in the process, they seem to break up the otherwise-resistant polystyrene. As little as a few percent of sugar incorporated onto the polystyrene chain dramatically increases the rates of polymer degradation, while leaving other desirable properties of the polymer substantially unchanged. This novel method represents a significant improvement over previous attempts where chemicals (additives) were added to the polymer to enhance degradation. These additives were toxic in nature, leached out of the waste and adversely affected the performance of other additives added to improve the properties of the polymer. Further work in this regard was in progress.

Biomimetic approach to nano-particles for diagnostics and therapeutic use

The utility of monodispersed superparamagnetic (SPM) iron oxide particles in biopolymeric matrices for a range of biomedical applications has been highlighted. Conventionally, sub-micron (100-300nm) ferrimagnetic iron oxide particles

precipitated from non-solvent or from supersaturated solution are dispersed into different synthetic media to form a composite film; role of macromolecules remains limited as a dispersant. Interfacing an external magnetic field during its synthesis is also known to bring about a dramatic modulation in the size, shape and assembly of nanoparticles. However, the processes fail to yield expected results when dealt with SPM particles in the size range that is below a single domain (1-10nm). Biomimetic synthesis has helped solve some existing synthesis problems, like the synthesis and self-assembly of several nanocrystalline inorganic systems in pre-organized synthetic and biopolymer matrices. Studies at NML have demonstrated the self-assembly of highly oriented array of SPM iron oxide particles that are biomimetically precipitated in protein and synthetic polymeric matrices under the influence of an external magnetic field. The role of biomimetic synthesis in synthesizing mono-disperse hydroxy-apatite particles as well as polymer hydroxyapatite composites for various applications in orthopaedic treatment was demonstrated. The contribution is based on the understanding of the nature's way of synthesizing functional materials and their translation to materials engineering for synthetic systems to be used as advanced materials. The work contributes towards the understanding of macromolecular interactions with selective cations leading not only to controlled nucleation and growth but also their self-assembly to form long range structures with and without an external stimulus like magnetic field. The studies also demonstrate that how an external field leads to the selective nucleation of a specific polymorph as a result of reduced entropy of the system. Based on the above results it is planned to go for the clinical trials with superparamagnetic iron oxide and hydrooxyapatite particles. This will be carried out in collaboration with other agencies like Atomic Energy and Department of Biotechnology.

Three-component reactions under thermal and microwave irradiation

The indolizines and dihydropyrimidinones are synthesized in a one-pot reaction via three component reactions (3-CR) in excellent yields. The synthesis of biologically active indolizines continue to attract the attention of organic chemists. However, these strategies in general involved multi-step synthesis employing two component reactions and do not represent the goal of an ideal synthesis. On the other hand the dihydropyrimidinones have emerged as backbone of several calcium channel blockers (nifedipine), anti-hypertensive agents and marine derived alkaloids having HIV inhibitor activities. A fast solid phase synthesis of 1,5-diketones via Michaeal addition was achieved and employed at RRL, Jorhat for synthesis of a novel class of 1',2'-diazepino[17,16-d'] steroids. The contribution made in these studies have established the viability of a three component reaction (3-CR) involving a 1,3-dipolar cycloaddition reaction between an in situ generated dipole using microwave energy and a Biginelli condensation using metal catalyst. The strategies provide the first successful example of the application of this approach and an access to fast one-pot synthesis of indolizines and dihydropyrimidinones which otherwise are accessible only through multi-step

synthesis. The methodologies denote a new class of 3-CR and an advancement of Biginelli condensation reaction, which are expected to be general routes for the facile, one-pot combinatorial synthesis of a wide range of indolizines and dihydropyrimidinones.

Conductive hydrogel

CECRI has developed a conductive hydrogel. It is a component of disposable ECG electrode and provides ready adhesion for measurements in diagnostic tools. This biologically acceptable polymer is cost effective and is resourced from a cheaper source. It is unique as the conductive gel could be converted into a laminate, sheet or film meeting the device configuration. The cross-linking chemistry of the gel has been fine-tuned with a new set of reactions. This product provides longer shelf life when appropriately protected and is free from the spontaneous drying and other problems associated with the conventional gel. The process for conductive hydrogel production has been licensed for commercial exploitation.

Gold plating on aluminium alloy components

The cover plates of momentum Wheel Assembly and Reaction Wheel Assembly used in INSAT and IRS satellites are made of AA 6351 Aluminium alloy. These components are to be plated with gold as per ISRO specifications. A plating facility for carrying out this work was set up at CECRI and gold plating of IISU components was in progress. Feasibility study regarding gold plating on AA 6351 and AA 2024 alloys was taken up initially for IISU, Thiruvananthapuram. After successful development of plating procedure, the components were plated and sent to IISU for testing. The quality of plating was found to be satisfactory for space applications as per ISRO specifications. Based on this a gold plating facility was set up at CECRI to carry out plating to the requirements of IISU.

Scratch resistant coating on plastic by sol-gel processing

A process has been developed at CGCRI for making abrasion resistant coatings on polycarbonate sheets and ophthalmic lenses based on UV curable inorganic-organic hybrids (epoxy methacrylate-silica) loaded with boehemite nanoparticles. The method has also been used for depositing inorganic-organic hybrid coatings doped with gold and silver nanoclusters respectively on polycarbonate substrates for application as abrasion-resistant coloured coatings and nonlinear optical materials. The composite sols were prepared from GLYMO, TEOS, MEMO and the corresponding metal salts ($HAuCl_4$ and $AgNO_3$ for AuAg). Dual organic functionality i.e. heat sensitive epoxy and photosensitive methacrylate ester groups were used. The hydrolysis-condensation of alkoxy groups and polymerization of epoxy and methacrylate groups formed the composite matrix. The coatings became hard and reddish-purple in the case of Au

and yellow in the case of Ag after UV irradiation followed by heat-treatment at 100°C. The polymerization of epoxy groups occurred at the sol stage in presence of an epoxy polymerization initiator, methyl imidazole, while UV irradiation simultaneously helps to polymerize methacrylates, strengthen the silica network and generates metal nanoclusters in the film. UV-VIS spectra of the coated films showed clear peaks at 530 nm and 445nm due to the surface plasmon resonance of Au and Ag nanoclusters respectively. A TEM also confirmed the presence of spherical metal nanoclusters in the films. TEM micrograph of the Au-nanocluster doped film showed the presence of spherical (about 9-10 nm diameter) Au nanoclusters in the inorganic-organic film. The coated polycarbonates show high abrasion resistant property compared to that of the uncoated substrates.

Novel heterocyclic compounds

CLRI has synthesized novel heterocyclic compounds viz. 4-aryl-8-(4-(aryl)-3a,4,5,9b-tetrahydrochlopenta[^{c}]quinolin-8-ylmethyl)-3a,4,5,9b-tetrahydro-3^{h} cyclo penta [^{c}]quinolines. This is the first report for the imino Diels Alder reaction of Schiff's bases derived from 4,4'-diaminodiphenylmethane. A simple and facile route for the synthesis of pyrazolodihydroquinoline derivatives from tetrahydroquinolone-hydroazones has been developed.

Synthesis, characterization and reactivity ratio studies on new sulfide copolymers containing ethylbenzene units

Polysulfide polymers possess excellent thermal stability, weatherability, solvent resistance, and oil resistance, etc. They are used as coatings, adhesives, sealants, insulators and as coating agents. These polymers are commercially synthesized by condensing an organic dihalide with sodium polysulfide. Efforts at CLRI have led to enhance the solubility of monosulfide polymers in common organic solvents by introducing kink structure in the form of ethyl benzene unit. The phenyl substituents restricted the close packing of the polymer chain resulting in increasing in the amorphous content of the copolymers. New copolysulfide polymers based on ethylene dibromide (EDB) with styrene dibromide (SDB) and Na_2S in the presence of phase transfer catalyst such as tetrabutylammonium bromide (TBAB) has been synthesized. The copolymers have been characterized.

Redox switchable NIR dye derived from ruthenium-dioxolene-porphyrin systems

CSMCRI has synthesized $Ru(bpy)_2(sq)$-derivatives, covalently linked to porphyrin-core. They show very high e values (>59000 $dm^3mol^{-1}cm^{-1}$) in the NIR region which exhibit fast switching between on/off-states depending on the redox state of the coordinated dioxolene functionality. The fast response property in picosecond time

scale for switching between on/off-states imparts a novel molecular function in these complexes. These derivatives are ideally suited for probable use in redox switchable NIR dyes and sensors for optoelectronic devices.

Novel adsorbent for oxygen, nitrogen and argon separation from air

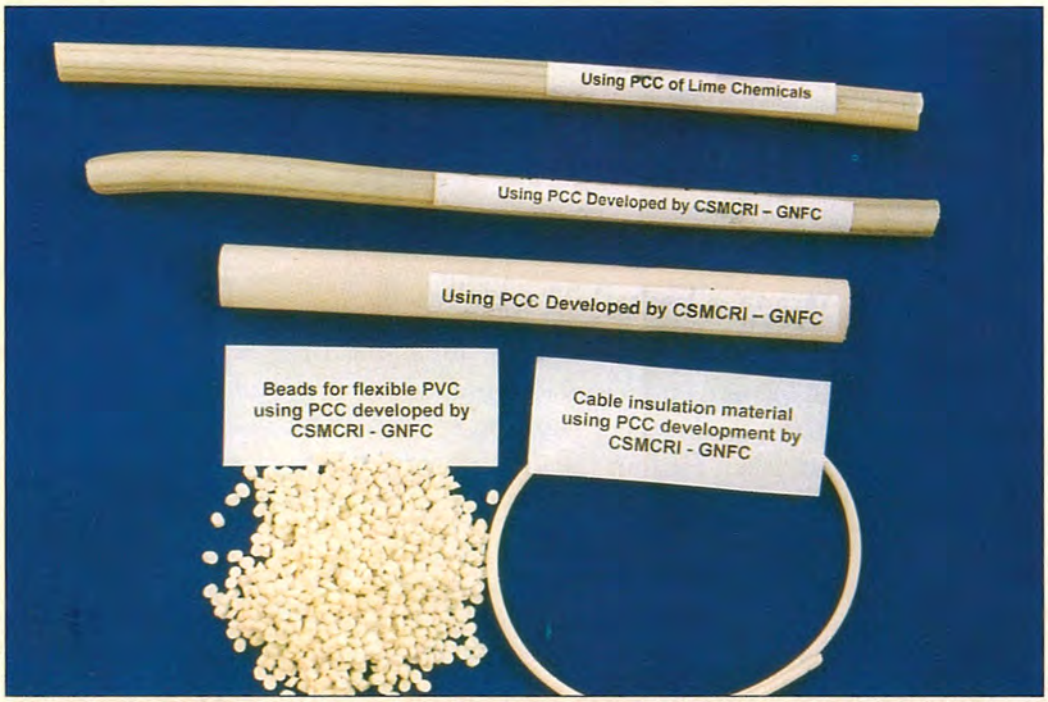
A novel zeolite based adsorbent for separation of oxygen, nitrogen and argon from air has been developed at CSMCRI. Some of the commercially significant features of the adsorbent are: high adsorption capacity for N_2 almost 1.5 times compared to the best capacity values reported for similar zeolites; and high selectivity for nitrogen from its mixture with oxygen compared to reported selectivity of 3-4 for similar zeolite. It is the first zeolite based adsorbent showing selectivity for N_2 as well as Ar over O_2. A PCT application has been filed for the development which offers a new technique of developing adsorbent by cluster formation inside zeolite cavities.

Biopigment: production C-Phycocyanin

CSMCRI has developed a process for production of high value fluorescent pigment, C-Phycocyanin (C-PC), from a strain of *Spirulina platensis*. Important innovations in the protocol for cultivation, harvesting, extraction and purification have yielded high purity C-PC with 10% yield on dry weight basis. The absorption spectral data show, that the CSMCRI product has similar absorbance at 620 nm as the product from Sigma, when both spectra are recorded with similar concentrations of C-PC (0.14 mg/ml). The ratio of absorbances at 620nm & 280nm, which indicated the extent to which protein impurities are present, is also comparable for the two products. A key factor behind the high purity of product obtained is membrane processing of crude extract. The membrane of appropriate molecular weight (M.W.) cut off developed for this purpose in the Institute enabled the undesirable low M.W. proteins and other impurities to be eliminated. C-Phycocyanin, is a high value product and has possible applications in areas like food, pharmaceutical, cosmetics, immunodiagnostics, flow cytometry, etc.

Precipitated Calcium Carbonate (PCC)

CSMCRI has developed a process for production of Precipitated Calcium Carbonate (PCC) from calcium carbonate rich by-product of nitrophosphate plant. The product obtained is rubber, PVC, paint and toothpaste grade. The unique features of the process are that it produces calcium carbonate from inorganic powder having average particle size of 50 micron, and an alternate raw material to natural lime stone for producing PCC is established. The knowhow has been transferred to a fertilizer industry. The industry is generating around 300 tpd of calcium carbonate rich inorganic by-product out of which around 200 tpd is presently not finding any use. In addition to production of about 30,000 tpa of PCC for various applications, the process



Pipes, beads for flexible PVC etc. – eco-friendly products developed using precipitated calcium carbonate (PCC), a by-product of fertilizer industry (CSMCRI & GNFC)

developed will allow the company to recover a valuable chemical worth Rs.1 crore per year from this by-product (presently unused). Two PCT applications have been filed covering the innovation. The development will be useful to all the fertilizer industries having nitrophosphate plants where the problem of disposal of inorganic byproduct is faced.

Low sodium salt from bitterns

The intake of low sodium salt in place of pure sodium chloride is being recommended to patients suffering from hypertension. Presently no technology exists for the production of low sodium salt directly from brines. CSMCRI has developed a process for the recovery of low sodium salt (a mixture of sodium chloride and potassium chloride) from bitterns, byproduct of salt industry. A PCT application has been filed for the development. The present innovation thus contributes greatly towards development of an entirely new technology. Hitherto, low sodium salt is produced by mixing sea salt with potassium chloride. Against this the present invention provides a simple route for the recovery of low sodium salt directly from bitterns, which obviates the drawbacks of the known processes.

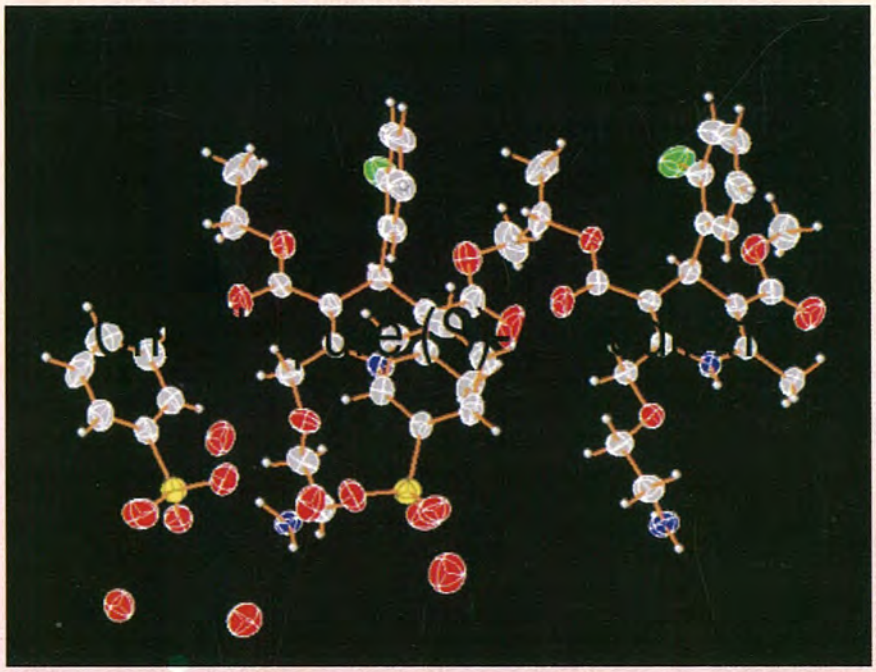
Photochemistry for materials and new molecular entities

Several 9-anthraceneacrylic esters were synthesized at IICT in order to study photochemical E(trans)-Z(cis) isomerization. This E-Z isomerization phenomenon has

application in molecular electronics and also as opto-mechanical and opto-electrical switching storage devices. Several 3-arylallyl acetates and E-3-(1-naphthyl)-2-propene-1-ol were synthesized for studying ionic photo-dissociation. This photo-dissociation has application in polymers & electronics viz. cationic polymerization; cross linking depolymerization; surface imaging by acting as photo acid generator; depolymerization; and surface imaging by acting as photo acid generator.

Chirally-pure anti-hypertensive drug: (S)-Amlodipine

Asomex-2.5, the first chirally pure anti-hypertensive drug launched in the Indian market has been manufactured by using a patented technology developed at NCL. Amlodipine, the molecule on which Asomex-2.5 is based is chiral, viz. it has "handedness". The NCL process uses a cheap and naturally occurring resolving agent to separate out (S)-Amlodipine with a chemical and optical purity exceeding 99.5%. This is a significant improvement over the Pfizer process that uses costly and unnatural D-tartaric acid for resolution. Asomex-2.5 has been used in clinical trials. The chirally pure (S)-Amlodipine does not lead to any of the adverse side effects observed for treatment with the racemic mixture. In addition, Asomex-2.5 has been observed to lower the patient's LDL cholesterol level.



Asomex 2.5-NCL developed a better process than the one being used commercially by Pfizer and patented in US, the first chirally pure anti-hypertensive (amlodipine) drug with no adverse side effects

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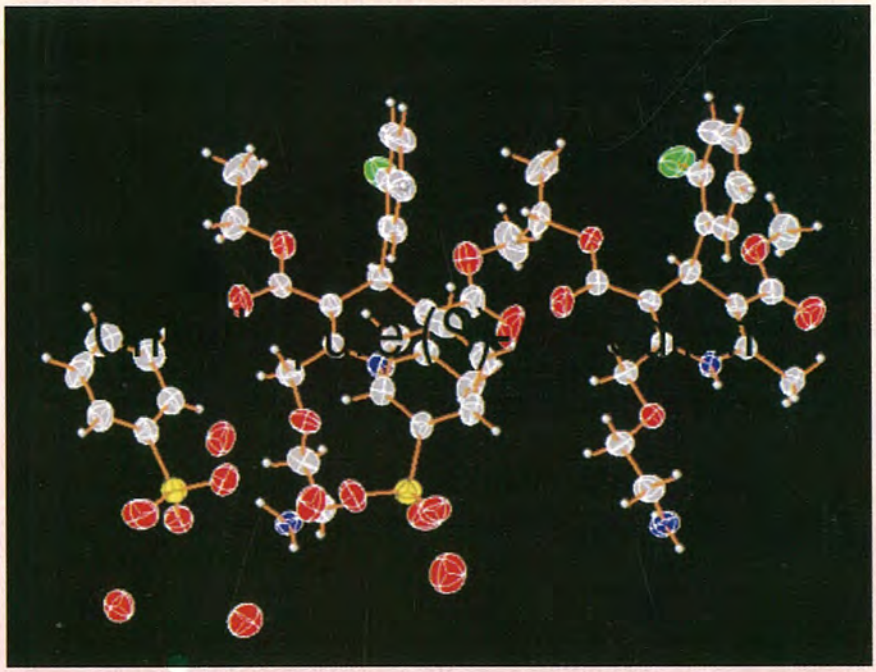

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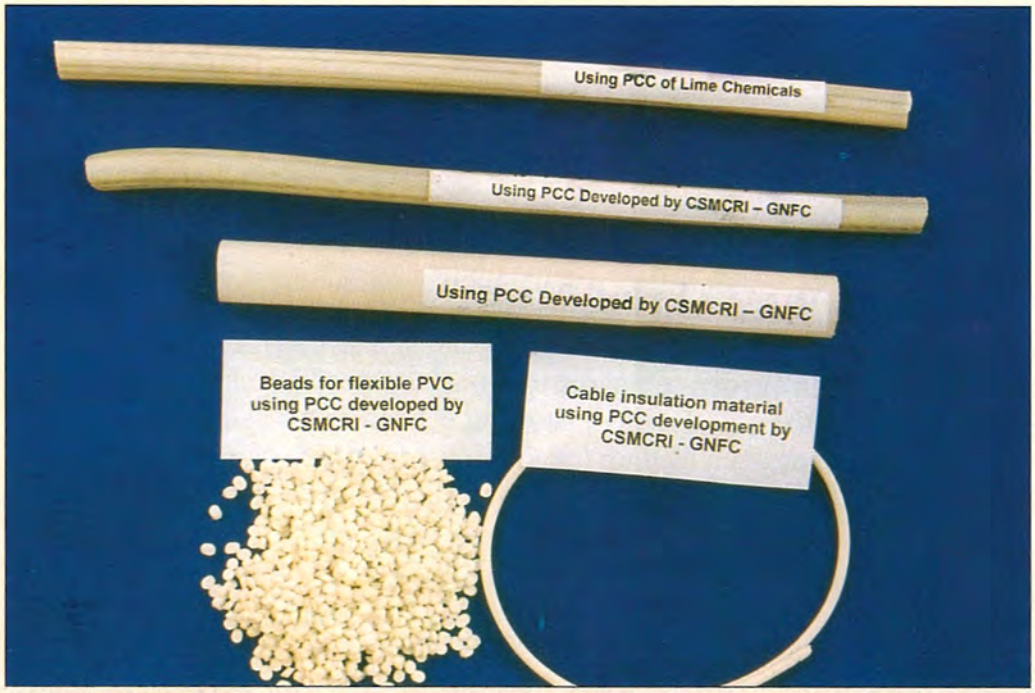

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Process development/demonstration at IICT

IICT developed and demonstrated successfully several processes during the year which included:

- Catalyst for speciality polymeric materials based on zirconium tetrachloride was demonstrated and released on 100 g/batch size (3 consecutive batches) to NFC, Hyderabad;
- Hydroxy Ethyl Cellulose (HEC) process with a viscosity in the range of 200-300 Cp at 5% concentration (Grade-I) on scale of 20 g/batch demonstrated and released to M/s Pidilite Industries, Mumbai;
- Lacidipine process on a scale of 50 g/batch (3 consecutive batches) was demonstrated and released to M/s Cadila Pharmaceuticals Ltd., Ahmedabad;
- Lambda cyhalothrin process was demonstrated on a pilot plant scale of 3 kg/batch (3 consecutive batches) to M/s Isagro (Asia) Agrochemicals, Mumbai;
- 3-Furaldehyde process was demonstrated and released on 50 g/batch scale to M/s Standard Products Manufacturing Company, Hyderabad to upgrade and modernize the bulk drug industry; and
- Methane sulphonic acid process for the conversion of methyl mercaptan—a bad smelling pollutant effluent gas into a value added product (methane sulphonic acid) was demonstrated to M/s SMS Pharmaceuticals Ltd., Medak, A.P. in their commercial Ranitidine drug manufacturing plant.

NTGG process – a commercial success

IIP has developed a process for conversion of Naphtha to Gas and Gasoline (NTGG) The process is based on a novel zeolite catalyst, which selectively converts the C5-C6 rich feed stocks to LPG and high octane and low benzene gasoline with very low dry



NTGG plant commissioned at Vaghodi, Gujarat process of which is developed jointly by IIP and GAIL

gas yield. The catalyst and the process were developed jointly by IIP & Gas Authority of India Ltd. (GAIL). IIP prepared the basic engineering package, based on which GAIL started the detailed engineering and construction activities in June 2000 for setting up demonstration unit at Vaghodia, Gujarat. The plant has been successfully commissioned this year. On-spec LPG and gasoline was produced in the first run itself in a record time of under four hours. The Vaghodia unit has demonstrated the technology successfully and valuable data is being collected for its further scale up and development. A US patent has been granted and four patents are filed in India on NTGG and related processes by IIP.

Catalytic aerobic oxidation of secondary alcohols to ketones and 2-naphthols to binaphthols

Oxidation of secondary alcohols to carbonyl compounds is conventionally carried out by Chromium and Manganese based reagents producing copious amount of heavy metal wastes. In the recent years aerobic oxidation of secondary alcohols to ketones by using metal catalysts such as hydrated $RuCl_3$, $RuO_2.H_2O$ has been described in the literature. However, these procedures suffer from drawbacks like use of expensive metal catalysts and oxidation of only activated alcohols. IIP has developed a new methodology for the aerobic oxidation of secondary alcohols to ketones using cobalt phthalocyanine as catalyst and methyltrioxorhenium catalyzed oxidative coupling of 2-naphthols to 1,1'-bi-2-naphthols. Oxidative coupling of 2-naphthols is an important synthetic transformation as 1,1'-bi-2-naphthols are widely used as chiral inducers in synthetic organic chemistry. The methodology developed could oxidize a variety of activated and non activated secondary alcohols to corresponding ketones with molecular oxygen using cobalt phthalocyanine as the catalyst.

Aziridination of alkenes

Metal catalyzed reactions of in-situ generated nitrenes with olefins is an efficient and practical method for the preparation of aziridines and has received increasing attention in the recent years. In this context Ph I = NTS has been widely used as a nitrene processor for aziridination of alkenes, in the presence of several transition metal based catalysts. However, Ph I = NTS is expensive and yields iodobenzene in equimolar amounts. Efforts at IIP have lead to aziridination of alkenes using N-iodo-N-potassio-p-toluene sulphonamide (TsNKI) as a cheap and convenient nitrene precursor. It is an important synthetic transformation as azeridines find broad utility as electrophils and as synthetic intermediates in the preparation of pharmaceuticals and agrochemicals.

Improved Soaker Visbreaking technology

IIP developed Soaker Visbreaking technology in use for the reduction of viscosity

and pour point of fuel oils. The process is also used for upgrading of residual fraction. Six commercial units based on the technology are under operation. Efforts at IIP in collaboration with EIL and UICT have led to further improvement in the technology, which would provide following benefits: increased conversions due to uniformity in temperature and flow profile; decrease in coke deposition in soaker and furnace coils and hence reduction in frequent shutdowns; and increase in selectivity towards middle distillates. The process is energy conserving, the benefits to the user will thus be of the order of Rs. 50 lakh per annum for the plant of 1MMT capacity in saving of fuel oil. In addition, overall throughput will also increase, as the run length will increase, enhancing the productivity.

Pressure Swing Adsorption (PSA) process for helium

IIP has developed a process for the recovery of Helium from low helium bearing gas mixtures such as natural gas. In India helium requirements presently are being met through imports, notably from the United States, which is currently the world's largest supplier. It is essential to develop technology for extraction of helium from indigenous sources in view of its strategic importance. Helium is present in small amounts in some of the natural gases, found in Rajasthan area, in gas emanations from thermal springs in West Bengal and in off gases from monazite sands processing operations in Kerala. The PSA technology developed is a step towards indigenous capability development for extraction of this strategically important material. The process involves a two stage PSA operating at ambient temperatures and uses commercially available adsorbents. The process is able to enrich helium from concentration levels of around 4 mol% to around 85 mol% with a recovery of 75%. The two stage PSA uses different cycles in each stage designed to maximize helium purity and recovery. The process is being scaled up.

Shear stability test rig for hydraulic oil

The hydraulic oils are widely used to transmit power and motion in the hydraulic systems used in the earth moving equipment. These oils are subjected to very high pressures and velocities in these hydraulic circuits causing very high shear of the oil molecules. The shearing of oil causes deterioration of equipment performance due to lowering down of oil quality. The shearing of hydraulic oil is dependent on nature of oil. For studying the shear stability performance of hydraulic oil, IIP has installed a test facility. In this equipment the oil is subjected to very high shear. The degradation of oil is measured through change in the oil quality. At present this is the only facility available in South-East Asia.

Biosynthesis of nanoparticles using fungi

The controlled synthesis of nanoparticles over a range of sizes and chemical compositions has emerged as an extremely important area of nanotechnology. Inspired

by the exquisite inorganic nano-scale structures generated by micro-organisms of NCL has demonstrated the synthesis of silver and gold nanoparticles of good monodispersity within the cells of a fungus, *Verticillium*. It is found that treatment of the fungal biomass with aqueous ions of gold chloride ($AuCl_4^-$) resulted in reduction of the metal ions and intra-cellular formation of gold nanoparticles. The formation of gold nanoparticles is visible to the eye in terms of the biomass turning purple in color. Thin section TEM analysis of the *Verticillium* cells showed that the particles were fairly monodisperse and bound to both the cell wall and the cytoplasmic membrane. It is believed that reduction of the metal ions is due to reductases present on the fungal cell wall/on the cytoplasmic membrane.

Green route to antidepressants

Manufacture of drugs with complex chemical structures typically involves complicated multi-step reactions. These reactions use hazardous reagents and eco-unfriendly solvents and, have very low yields, viz. only a small amount of the final purified product is recovered despite using large quantities of starting materials. NCL has developed a high-yield route to a new generation antidepressant, Venlafaxine. The novel process uses mild reaction conditions; substitutes hazardous reagents with cheap, relatively non-hazardous chemicals and; the key step is performed in water rather than in an eco-unfriendly organic solvent. The NCL process is a four-step reaction that employs two novel patented schemes. This process introduces significant improvements in the first two steps over what is currently practiced. The process gives high yield and it is anticipated that ongoing research will further improve the yield.

2-Methylallyl sulfonic acid sodium salt and 2-acrylamido-2-methyl-1-propane sulfonic acid

These are speciality monomers that find applications in the acrylic fiber industry for imparting dye-affinity to the fiber. Polymers prepared by using later monomer (ATBS) are also extensively used in the Enhanced Oil Recovery (EOR). Similarly it is used in water treatment chemical and in preparation of specialty polymers. M/s Vinati Organics Limited (VOL), Mumbai, sponsored the project to NCL for development and transfer of the technology for these two monomers. NCL successfully developed the process for both the monomers. It was successfully demonstrated to VOL on the bench scale as well as on the pilot scale. Special equipments were identified for some of the steps also and trials for these were conducted at vendor's site. Basic Engineering Package for 750 TPA SMAS and 1000 TPA ATBS was also delivered and comprehensive assistance to the detailed engineering firm was provided during engineering, procurement and construction phases of the project. The plant was commissioned with the assistance of NCL at the identified site.

Preparation of alumina membrane for micro and ultra-filtration

NML has designed and prepared a very thin disc type ceramic membrane (0.3-0.8 mm thickness, 25-30 mm diameter) made of pure alumina. It is suitable for micro-filtration applications. A sol coating was applied to the disc to form an ultra-filtration membrane. The pore size of the membrane varies in the range of 0.1-0.7 μm and porosity in the range 25-55% by optimising the experimental parameters. The most important factor for determining the pore size of the membrane was found to be the initial particle size distribution of the ceramic powder. Firing temperature and soaking time are other crucial parameters affecting volumetric porosity. Water permeability through the membrane under suction and under positive pressure is comparable with that of ceramic membranes prepared by conventional methods. A very sharp drop in the pore size distribution pattern around 0.4 μm indicates that no pores larger than this exist. This implies that all particles with radius > 0.4 μm are trapped in the membrane, providing excellent separation efficiency. Results of microbial separation tests confirmed the possibility of micro-organism separation through these membranes.

Fabrication of in-situ dense Al_2O_3-ZrB_2 and Al_2O_3-ZrB_2-TiB_2 composite

Incorporation of high temperature boride particulates to improve the properties of ceramic matrix composite is of recent interest. Amongst the various borides, zirconium diboride (ZrB_2) is an important material and the addition of zirconium diboride to alumina is expected to demonstrate high mechanical strength, hardness, fracture toughness and impact resistance. The alumina matrix dispersed with Zr diboride becomes electrically conducting, which makes the composite machinable by EDM. The investigation at NML emphasised the fabrication of in-situ Al_2O_3-ZrB_2 and Al_2O_3-ZrB_2-TiB_2 composite by SHS dynamic compaction technique. The process developed for making such in-situ composite using cheaper raw materials such as oxides of the components and one of the constituent as metal powder. A range of composites based on alumina with zirconium diboride and titanium diboride at different volume percent could be manufactured through the process. The high-density composites in the range of 93% to 98% of that of theoretical density could be obtained with controlled grain growth. The grain growth could be controlled to very fine size of the order of 1-5 μm to submicron level, which is required for obtaining high strength composites. The process is fast; in-situ reaction and densification takes only few seconds to get a good dense composite.

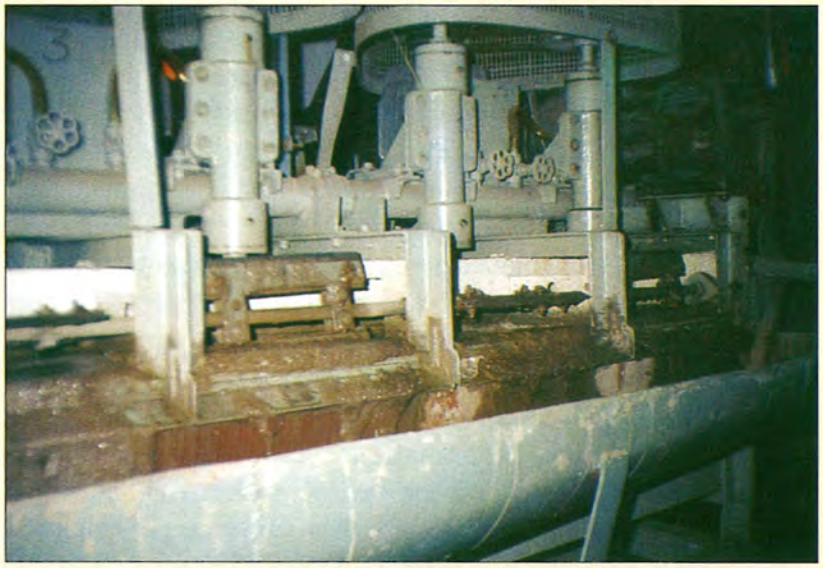
Determination of micro-mechanical parameters of primary heat transport system piping material of Indian PHWR (SA333 Gr.6 Carbon Steel)

The nucleation of voids, their growth and coalescence followed by fracture are important manifestations of various stages of ductile fracture in metallic engineering materials. Exogenous inclusions and endogenous second phase particles are mainly responsible for void initiation. These phenomena are dependent on the state of stress

and plastic strain. Studies on these phenomena are important to understand damage mechanisms and fracture toughness parameters such as Jic and J-R curve. Different damage mechanisms have been used at NML for numerical analysis of the ductile fracture process. One such model is due to Gurson, popularly known as Gurson-Tvevergaad-Needleman's model. This model makes use of a number of parameters related to void nucleation, growth and coalescence during large-scale plastic deformation. For useful application of this model for a particular grade of steel, it is needed to have elaborate and painstaking experiments to monitor the progression of various void related phenomena in specimens, which have been subjected to tensile loading to various levels. Gurson model are generated for steel of SA333 Gr. 6 (base metal and weld metal), which is a pressure vessel steel for the Indian Pressurised Heavy Water Reactors. Following are the parameters: (a) Initial condition without loading-void vol. fraction (f_n), (b) Saturated nucleation conditions – void vol. fraction (f_n), means strain (e_n) and standard deviation of mean strain (S_n), (c) Void coalescence condition – void vol. fraction (f_c) and (d) Rupture condition – void vol. fraction (f_F). The generation of parameters of micro-mechanical model for numerical simulation of ductile tearing of PHT piping material of Indian Pressurised Heavy Water Reactor and the studies on these phenomena are significant and important contributions to understand damage mechanism and fracture toughness parameters such as Jic and J-R curve. Further studies on different materials (SS304/HSLA-100/SA-515) to understand the micro-mechanism of fracture and development of model for damage mechanism was under progress.

Beneficiation and zinc extraction studies on Ganesh-Himal zinc-lead ore from Nepal

A rich mineralisation of zinc and lead is located in the Ganesh-Himal region of Nepal. M/s Nepal Metal Company Ltd. (NMCL), Kathmandu has been interested in exploitation of the deposit. At the instance of NMCL, earlier bench scale beneficiation and zinc extraction studies were carried out using NML's patented process. Encouraged with the results it was proposed to undertake beneficiation and large batch zinc extraction studies on Ganesh-Himal lead-zinc ore sample, in order to study the feasibility of the process. The scope of the investigation includes characterisation, bench/pilot scale beneficiation, preparation of zinc sulphide concentrate and large batch hydrometallurgical extraction of zinc. About 5 tonnes of lead-zinc ore sample (low & high grade) was received for the proposed studies. Bench scale flotation studies were carried on the blended sample, assaying 13.45 % Zn and 3.53 % Pb. The zinc rougher float assayed 49.31 Zn with over 80 % recovery. Cleaning of the rougher flotation product resulted in cleaner zinc sulphide concentrate assaying 55.68 % Zn, considered suitable for hydrometallurgical extraction of zinc. Pilot scale trials were also conducted and sufficient quantity of zinc sulphide concentrate was produced for the subsequent hydrometallurgical extraction of zinc. Based on the process know-how and the data provided by NML techno-economic feasibility of the process is being



Pilot plant set up in Nepal for beneficiation and zinc extraction of Ganesh-Himal lead-zinc ore based on NML patent

carried by M/s Metallurgical and Engineering Consultants (India) Ltd., Ranchi for the commercial exploitation of the lead-zinc ore deposit. The project is sponsored by South Asian Development Fund, Kathmandu, Nepal.

Improved process for fabrication of in-situ synthesis and consolidation of Al_2O_3-ZrB_2-TiB_2 composites

NML has developed a process for the in-situ synthesis and consolidation of Al_2O_3-ZrB_2-TiB_2 composites of approximate 93-97% density. It uses cheaper raw materials compared to conventionally used metal powders and high temperature furnaces are not required. The product obtained is electrically conducting with resistivity in the range of 300-800 micro ohm centimetre. The composite target for nano and hard coatings of Ti-Zr-Al-B-O system by sputtering can be fabricated by this process. The manufacturers of cutting tools, wear resistant components, and high temperature components will be benefited with this development.

Metallurgical study of broken rail pieces and other items from accident site at Sarai Banjara

The Inquiry Commission headed by Justice Saghir Ahmad, Northern Railway has commissioned NML to carry out metallurgical and chemical tests on selected (by the railways) pieces of components collected at the site of accident that took place at Sarai Banjara, Punjab in December 2000. The requirement on NML, as suggested by the commission, has been to find out the possible cause of material/component failure(s) that might have contributed to the occurrence of the accident. NML received a total of 31 samples consisting of 45 pieces (41 rail fragments, 2 coupler body

fragments, 1 brake block fragment and 1 unbroken knuckle) for the purpose of the investigation. The investigation was carried out and the final report has been sent to the Inquiry Commission.

A novel bio-physico technology for the treatment of industrial effluents

A novel electro-flotation process has been developed by NML for the treatment of effluents. The innovative feature of this process is the controlled generation of micron-sized bubbles used for flotation of suspended particle matter through electrolytic dissociation of water. An additional feature of this process for the treatment of effluents is the *in situ* generation of oxygen that results in a substantial decrease of the biological and chemical oxygen demands of the effluent. A pilot scale electro-flotation cell to treat 0.7 to 1 m^3/hr tannery effluent was designed, fabricated and commissioned in the common effluent treatment plant at Chennai. Above 95% reduction in suspended solids, 60-75% COD and 60-73% BOD could be achieved at pilot scale. This process has shown superiority over conventional chemical treatment presently adopted. The technology has been demonstrated to the tanners. Several of them have expressed keen interest in adopting the technology. Pilot scale trials were in progress in various tanneries.

Polymetallic nodule

RRL,Bhubaneswar has developed a flow sheet for processing the ocean nodules through hydrometallurgical route. A pilot plant for testing the entire flow sheet has been put up by EIL-HZL at C.R.D.L of HZL, Debari, Udaipur with the assistance of the laboratory. The process would be further scaled up on the basis of the data generated through trial runs at the plant.

Improving the performance of graphite beneficiation plant

Tamil Nadu Minerals (TAMIN) have in operation a graphite beneficiation plant of 200 tpd capacity. The plant since inception could not achieve the target grade of 96% F.C. and 92% recovery from a feed of around 14% F.C. The grade and recoveries are reported to vary between 90-92% and 65-70% respectively.

RRL, Bhubaneswar is assisting TAMIN in improving the grade of graphite and its recovery. A detailed exercise was carried out based on which RRL has suggested certain modifications in the plant and methodology as a first step. TAMIN followed them and as a result the recovery could be substantially improved to around 80% at 96% F.C. Although recovery could be augmented substantially there is still inconsistency in the plant performance. RRL is now making necessary efforts to achieve the desired consistency in grade and recovery by imparting the training on column flotation and other unit operations to the plant staff.

Advanced centre for iron ore processing

The requirement for uniform quality of pig iron and sponge iron demands meticulous efforts for iron ore processing. The ores and agglomerates prepared from iron ore fines should meet the stringent quality standard for both physical and metallurgical properties. RRL,Bhubaneswar has set up an iron ore processing centre which is equipped with modern sophisticated equipments for determination of important physical and metallurgical properties. This Centre will be of immense help to many iron and steel industries of Orissa and neighbouring states to evaluate the quality of raw materials and ore samples.

A broad spectrum antibiotic from soil Streptomyces

RRL, Jorhat has isolated a bioactive microbial metabolite 2-methylheptylisonicotinate, a broad spectrum antibiotic from a soil *Streptomyces* sp. The novel molecule endowed with both antifungal and antibacterial activity was structure elucidated as a natural analogue of antituberculotic drug isoniazid. The molecule was found active while bioassayed *in-vitro* against wide range of pathogens at RRL Jorhat and CDRI against *Mycobacterium tuberculosis* H37Rv. (in-vitro), the causal organism of second most killer disease TB. Agriculture application of the antibiotic as biocontrol agent was proved by its effectiveness against dominant fungal diseases of some economically important plants such as Cabbage, Mustard, Brassica and Radish. The isolated novel molecule was found to be three times more potential compared to standard isoniazid. The natural antibiotic may prove to be most effective potential drug not only to check the alarming rate of TB occurrence due to HIV epidemic but also to control subsequent secondary fungal infection in TB patient which aggravates the situation.

Application of soil microorganism in biotransformation reaction

RRL, Jorhat has employed soil micro-organism *Pseudomonas fluorescens* RRLJ 134 for a facile 1,5-rearrangement of N-acetyl group of steroidal and non-steroidal formyl enamides as well as for efficient cleavage acetates to alcohols. Fluorescent pseudomonads are the most extensively studied bacterial biocontrol agents for a diverse range of soil-borne diseases, their potential in biotransformation reactions has received little attention. On the other hand, an acyl group is a frequently used protective group for alcohols and there has been continued search for mild and efficient methods for the cleavage of esters employing enzymes and Lewis acid catalysts. Attempts made in the laboratory to utilize soil microorganisms in bio-organic transformations led to a facile 1,5-rearrangement of the N-acetyl group of β-formyl enamides as well as cleavage of the esters catalysed by *P. fluorescens* strain RRLJ 134.

Extraction of natural dyes from the plant sources

RRL, Jorhat has isolated pigments from *Morinda angustifolia* and established its chemical structure. It is amorindone type of compound containing an anthaquinone group. The dyeing properties of the pigment have been evaluated. Silk and cotton fabrics can be dyed with this colour component with and without using different mordants to obtain a wide range of colours with fair to good wash and light fastness. Thus, the dye so extracted may be an alternative to synthetic dye for dyeing of silk and cotton. The yield of colour component varies from 10% to 20.9% depending on duration of extraction (30-240 min). Fair to good fastness properties are obtained on fabrics when dyed with 3% of colour component at 2% concentration of mordants.

1.3.2 HUMAN RESOURCE DEVELOPMENT

CECRI

CECRI offers a variety of courses to scientific and technical personnel employed in industries, government and academic institutions. These courses are designed to impart necessary knowledge and skills. During the year 26 industry oriented technology courses were conducted on various subjects like: instrumental methods of analysis; water treatment technology; waste water treatment technology; recovery of silver from photographic waste; lead acid battery technology; valve regulated lead acid battery; corrosion science & engineering; and industrial metal finishing. These courses were structured as modules, each lasting 5-6 days. About 200 participants attended these courses.

CSMCRI

CSMCRI organized ten training programmes on scientific methods of salt manufacture, with the aim to impart training to marginal salt producers of Gujarat. Each programme was for a duration of two days. 200 marginal salt producers (agarias) participated in each training programme. The marginal salt producers are now able to understand the importance of quality salt production and they are in a position to produce good quality salt by adopting scientific methods.

An extensive training course was organized for the executive officials of salt department, Government of India. The course duration was for a period of ten days including visit to major salt works and chlor alkali industries. The salt officials were trained in different areas of salt manufacture starting from its chemistry. The salt department and UNICEF sponsored the programme jointly.

CSMCRI provided facilities for summer training and dissertation to students of various universities in partial fulfillment of the requirement of master's programmes in chemistry and biological sciences.

IICT

- IICT operates project and technician training programmes for attracting qualified youth for its sponsored research activities. The 4-level technician training

programme is specially designed for generating highly skilled technical manpower not only for IICT sponsored projects but also for other institutions. The Education and Training Department of IICT has also established counseling facilities for providing employment opportunities outside CSIR system after completion of training at IICT.

- IICT in collaboration with Centre for Development of Advanced Computing (C-DAC) conducted a 3-month full time 'Advanced Diploma Course in Bioinformatics (ADB)' consisting of thirteen modules and an industry relevant project. Thirty candidates were trained during October-December 2002. The course covers fundamentals of biology, bioinformatics, computer science and new programming concepts. The hardware at IICT has access to the supercomputer PARAM 10000. The course provides for one week visit to C-DAC, Pune for hands-on experience on super computers with applications in genomics and sequence analysis.
- IICT organized a 5-day Lead Auditors Course conducted by TQMI (Total Quality Management of India, Mumbai) through IRCA (International Registrar for Certifying Agency, Australia) to train the candidates in new auditing requirements as per ISO-9001-2000 system. 20 IICT participants from administration and scientific departments participated in the course.
- A special lecture session under CSIR's Programme of Youth Leadership in Science (CPYLS-2002) was organised at IICT to motivate the youth to take up science as their career. About 40 school children attended the programme.
- A CSIR Diamond Jubilee Science Seminar was conducted by the Education & Training department with the theme "Advances in science as school children see them". Eighty school students from various disciplines of biology, chemistry and physics participated in the seminar. Three best performers were awarded prizes.
- SEP BOX



Hon'ble Minister S&T inaugurating a facility SEP Box set up by IICT

- IICT organized the 1st Indo-German Conference. It was first of its kind in the country. The focal theme of the conference was "cross-disciplinary vision on catalysis". More than 25 International experts on catalysis from Germany, UK, USA, Hungary, Poland, France, South Africa and India attended.



His excellency Hon'ble Governor Shri S.S. Barnala inaugurating a conference organized in frontier area of catalysis at IICT

IIP

HRD development for Industry

As an important on-going activity of the Institute the training programmes are organized for the personnel from various sectors of industry. The faculty for the courses is mostly drawn from the scientists of the Institute. This year courses were organized in: Naphtha to Gas and Gasoline Technology (NTGG) for Gas Authority of India Ltd., GAIL; Petroleum Refining Technology for Indian Oil Corporation, Bharat Petroleum Corp. Ltd. and many other refineries and petrochemical organizations.

Courses organized for Automobile industry included: Application of Lubricity oils in automotive engineering industry for Hero Honda Motors Ltd.; Automotive emissions – control and measurement for Ministry of Road Transport and Highways.

Numerous laboratory practicals were conducted for Power Generation Industry and participants from NTPC benefited from the programme.

NCL

- **RIL training programme:** NCL has been conducting training programmes for the Reliance Industries Ltd (RIL) for the last three years. Two training programmes were conducted during the year, one at Hazira for the senior management entitled "Polyolefins: Technology for competitive advantages" and other at NCL for the junior management personnel entitled "Polyolefin science and engineering".
- **GE training programme:** NCL developed tailor-made courseware on the subject of Polymer Science and Engineering for training research scientists and engineers belonging to the General Electric- J.F. Welch Technology Centre (GE-JFWTC), Bangalore and also conducted five 3-day classroom sessions at the client's site. Around 156 scientists and engineers at the Welch Technology Centre benefited from the classroom sessions. The participants came from various groups within GE-JFWTC such as the Polymers and Synthetics Materials, Chemical Engineering and Modelling, Chemicals and Catalysis, Advanced Mechanical Engineering, Materials Research, Intellectual Property and Knowledge Centre, and included persons with wide variety in background (chemists, physicists, engineers), experience in the area of polymers (1 to 25 years) and designation (Research Associate to Senior Programme Managers).

1.3.3 RECOGNITION & AWARDS

Foreign Associate of US National Academy of Engineering (2002)	
D.Sc., Hon. Causa, University of Wisconsin, USA (2002)	
Dadabhai Naoroji Memorial Award (2002) by the Dadabhai Naoroji Memorial Prize Trust, Mumbai for contributions to advancing S&T in India	Dr. R.A. Mashelkar, FRS, DG, CSIR
A.V. Rama Rao Research Foundation Award (2003) by AVRA Laboratories Pvt. Ltd., Hyderabad	
ASSOCHAM New Millennium Innovation Award (2003) by Associated Chamber of Commerce for excellence in innovation	
IMC Juran Quality Medal (2002) by Indian Merchants Chamber for leadership and continuous involvement as a role model for improvement of quality in CSIR	

RMK Engineering Award for outstanding work in Science & Technology (2003) by Lakshmikanthammal Educational Trust, Tiruvallur, Chennai Hari Om Ashram Senior Scientist Award (2002) by Physical Research Laboratory, Ahmedabad Maharashtra Bhushan Award (2003) by Maharashtra Times, Mumbai for all round excellence Shraddhanand Award (2003) by Brahman Sabha, Mumbai for excellence in research	Dr. R.A. Mashelkar, FRS, DG, CSIR
Life-time Corrosion Awareness Award from NACE-International/Asia Pacific Region	Dr. D. Mukherjee, CECRI
CSIR Prize for Chemical Technology for Development of environment friendly cost effective process technology for detergent grade Zeolite A (Jointly with NALCO, Bhubaneshwar)	Shri M.R.Gandhi, Dr. P.M.Oza, Dr. R.S. Somani, Shri V.M. Sheth, CSMCRI, Shri C.R. Mishra and Shri M.M. Seth, NALCO
S S Bhatnagar Prize (2002) in Chemical Sciences	Dr. T. K. Chakraborty, IICT
1999 VASVIK Award in Chemical Sciences and Technology	Prof. S. Swaminathan, IICT
Silver Medal of the Chemical Research Society of India (CRSI)	Dr. J. S. Yadav, IICT
Thomas Kuhn Honour Pin and Nobel Laureate Yuan Tse Lee Honor	Dr. Umesh C. Kulshrestha, IICT
Sir Rajendra Nath Mookerjee Memorial Medal by the Institution of Engineers (I), Kolkata	Shri D. V. R. Murthy, IICT
S.S. Bhatnagar Prize in Chemical Sciences	Dr. Murali Sastry, NCL
Fellow of Indian National Science Academy	Dr. V. R. Choudhary, Dr. S. Pal, NCL
Materials Research Society of India	Dr. S. Sivaram, NCL
Distinguished Lecturership Award	
Outstanding Achievement Award for Scientific Research, CHEMTECH Foundation, Mumbai	Dr. P. Ratnasamy, Dr. S. Sivaram, NCL

1.4 ENGINEERING SCIENCES & TECHNOLOGY

1.4.1 SCIENCE, TECHNOLOGY & SERVICE

Analytical studies on fracture behaviour of metallic structural components considering corrosion

Metallic corrosion has been identified as one of the issues of major concern as it affects the overall strength, safety, integrity and performance of structures. In India, the loss due to corrosion is estimated to be around Rs.20,000 crores per year. It is therefore essential to contribute towards methodologies that can reduce such losses and predict the rate of corrosion on a scientific basis for reliable and economic designs of structures. At the state-of-the-art level, R&D is focused towards not only in understanding the nature and behaviour of structure under corrosive environment but also provides estimates of rate of corrosion for cost effective design of structures. Internationally, the practice has been based on thumb rules, past experiences and empirical corrosion rate prediction models. At SERC, after conducting number of studies, a linear damage function model has been developed to predict the rate of corrosion under atmospheric and seawater environments. The model developed considers a number of corrosive agents like temperature, humidity, percentage of SO_2, etc. and their variations. The proposed model is simple to use and is flexible. It can be extended for application to additional metals and corrosive environments. The proposed model has a scientific basis to evaluate the corrosion rate and is among the very few such models available internationally. When used along with fracture mechanics principles, this will facilitate in arriving at reliable estimate of the remaining life of the structure.

Attenuation relationships for Indian region

The attenuation relationships are considered to be applicable for earthquake range between magnitude range 5.0 to 7.0 with hypocentral distances ranging 10 to 300 km. The relationships give good prediction PGA values for above magnitude range, a larger data set is required for accurate prediction of PGA values for further use for earthquake resistant design and seismic hazard estimation.

CBRI is actively involved to study natural hazards such as earthquakes, cyclones, landslides and their mitigation. Seismic microzonation involves the combination of geological features, ground conditions and seismic activity for the division of a region into sub-regions. The earthquake database is one of the most important factors for

such studies. CBRI has established first and only Digital Strong Motion Accelerograph (DSMA) Network in seismically active and strategically important National Capital Region to record ground motion in real time. The site-specific studies provide basic inputs for the town planners and city managers.

Beneficiation of waste Phosphogypsum for value added Building materials

Out of several waste materials produced in India, phosphogypsum is an important by-product of phosphoric acid industry which is currently available to the extent of about 6.0 million tonnes per annum. It has a serious problem of disposal and health hazards. Presently, it is being used not more than 10.0 percent annually in India. in the manufacture of ammonium sulphate fertilizer, cement and soil reclamation. It contains impurities of P_2O_5, F, organic matter and alkalies which hamper the normal setting and strength development of cements and plasters produced from it. It is, therefore, essential to beneficiate phosphogypsum to get gypsum of acceptable properties for use in plaster and value added products.

Based on wet sieving of phosphogypsum, a pilot plant of capacity one tonne per shift (3 tonnes per day) has been designed and installed at CBRI for the beneficiation of phosphogypsum.

Investigations on cyclic tearing and crack growth in straight pipes

Earthquake load, which is cyclic in nature and of short duration, is the main design basis accident load for designing the Primary Heat Transport (PHT) piping components of Indian Nuclear Power Plants. Adequate protection of piping components from the effects of earthquake requires detailed knowledge of strength and deformation characteristics of the components and assemblies making up the piping system. SERC conducted investigations to understand the fracture behaviour of pipes under cyclic loading. Fracture tests were conducted on carbon steel (SA333 Grade 6) pipes of 219 mm OD and stainless steel (AISI Type 304LN) pipes of 168 mm OD with through-wall circumferential crack. The influence of various parameters, such as cyclic load ratio, range, amplitude and initial crack size on crack growth and number of cycles for failure was investigated. The studies showed significant reduction in the fracture resistance under cyclic loading conditions. The results would be useful in formulating appropriate guidelines for pipe design under earthquake type loads.

Habitable reclamation of abandoned flyash ponds

CBRI was entrusted the responsibility of exploring technical feasibility of habitable reclamation of ash ponds. Keeping in view the exigency of the problem, study was undertaken to develop and demonstrate the techniques of local stabilization of abandoned ash pond for ground improvements to sustain loads of at least four storey buildings. Under the current programme, abandoned ash pond at National Fertilisers

Ltd., Panipat and Badarpur Thermal Power Station (BTPS), Badarpur were selected for the exploration and construction purposes. Exhaustive laboratory and field studies were carried out to determine the physico-chemical, mineralogical and engineering properties. In addition evaluation of ambient air quality and under ground water quality in the vicinity of both the sites was also carried out. Demonstration dwelling units were constructed at NFL, Panipat ash pond site on the improved / virgin deposit of ash. Dwelling units were instrumented for monitoring long term behaviour with respect to settlement, crack development on the super structure and the pore pressure development and its dissipation during seasonal variations. At BTPS ash pond site four full scale foundations were constructed and loaded upto $16t/m^2$ which is equivalent to 4 storey building load.

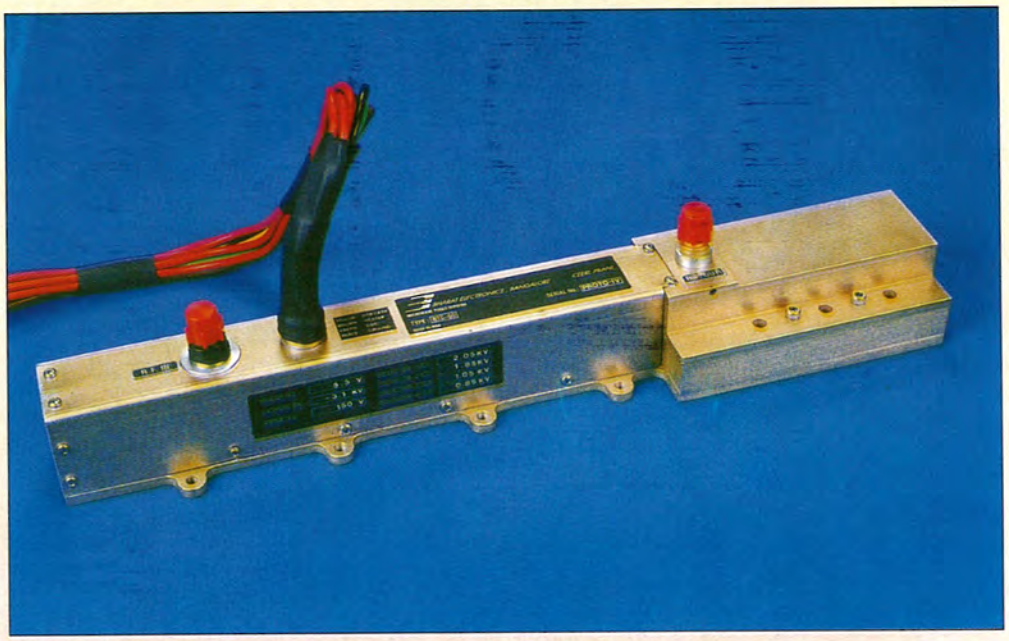
Image codec simulation

Study and simulation work on Digital Image Codec for both the Encoder and Decoder paths consisting of signals scaling, quantization, zig-zag scanning, huffmann and entropy coding and 1-D to 2-D sequencing in its Forward (Encoder) and Reverse (Decoder) paths were carried out at CEERI. Approximately 600 lines of Visual C++ Version 6.0 and C Codes were developed in Windows and RedHat Linux O.S. to simulate the JPEG Codec behaviours for input pixel block patterns, minimum five times data compression were achieved within the desired S/N ratio which is ~+/-5%. Some of the Codec modules were simulated after developing 320 lines of VHDL. This work can be propagated for the modeling of vision chip and design for the components of vision chip starting from the sensor to signal processing which incorporates various algorithms and control modules.

Studies on design aspects for couplers, multistage depressed collectors, magnets and backward wave oscillation for high efficiency space TWT

TWT is one of the most complex and expensive components of any communication system either being used in space or ground. There has been a growing demand for high power, high efficiency C-band and Ku-band space TWTs to meet the new emerging requirements of the satellite communication systems. CEERI designed different components of the space TWTs using in-house developed software packages. The input and output couplers are also important parts of TWTs for efficiently coupling the microwave power in and out from the helical SWS of a TWT. Input and output coaxial couplers have been designed for Ku-band 140 Watts space TWT. Impedance transformation approach was used for design of the input/output couplers with return loss better than -20dB (VSWR<1.20:1) over the desired frequency band from 10.9 to 11.7GHz. The design was refined using 3-D electromagnetic field simulator ANSOFT HFSS that can simulate the coupler along with the helix slow wave structure (SWS). Multistage depressed collector is one of the major components of a space TWT that enhances the overall efficiency of the tube and reduces the amount of heat generated.

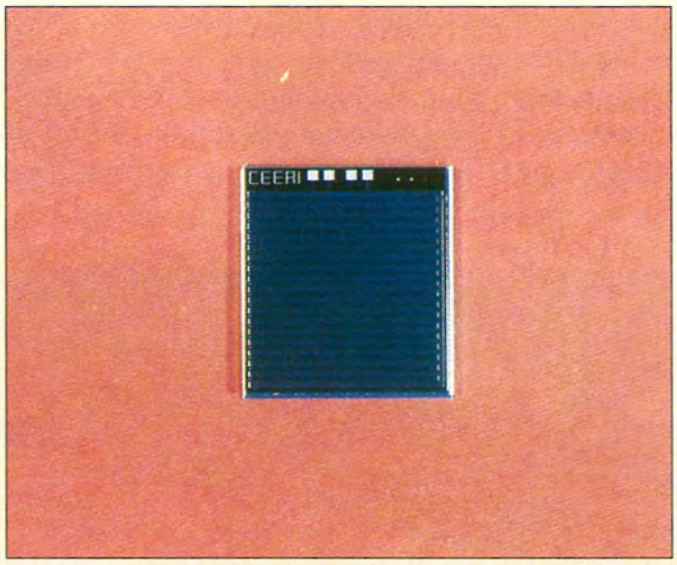
A 3-D simulator including the secondary electron emission model was developed for the simulation of multistage depressed collectors. This package included an automatic optimization technique that uses the genetic algorithm during the studies on design aspects. Critical packages namely, SUN-CKT (for magnetic field simulation in the GUN region) and SUN-BWO (for backward wave analysis) were also developed.



CEERI-developed package for Space Traveling Wave Tube (TWT)

Silicon load cell

Load cells are force sensors, which are used for weighing bridges, lorries, cars and trailers. Piezoresistive property of polycrystalline silicon thin film is used at CEERI to realize load cell capable of measuring loads in the range of 100s of kilogram. Using standard lithography and reactive ion etching (RIE) based etching of (100) orientation silicon a meander type of silicon piezoresistor is realized on SiO_2 covered silicon surface. Proper control of the grain size, residual stress and doping in the polysilicon, high sensitive strain gauge performance is achieved. Silicon load cell chip of 10 mm × 11 mm was designed. It is basically a force sensor, where force is measured by compressing meander shaped poly silicon strain gauge. Another strain gauge, which does not come into contact with load, is used for reference and temperature compensation, generated due to bending and stretching stresses in the chip. The specifications of the chip are: input load range - 0 - 200 Kg.; resistor value (Meander) -100 K W 15%; chip size -10 mm × 11 mm; and chip thickness - 0.50 mm.



Silicon Load Cell (force sensor) useful for weighing bridges etc.
– a CEERI development

On-line freeness tester for pulp and paper industry

CEERI has developed an on-line freeness system for the pulp & paper industry. The technique is based on intermittent timed level measurement. It consists mainly of an optical detector, transparent measuring column, a fine mesh screen, etc., and is assembled and mounted directly on a bye-pass line. The development is built around a RISC based micro-controller which controls the cycle of operations as well as computes freeness value after due linearisation added with suitable correction for consistency and temperature. The on-line freeness tester has been tested at M/s. Seshasayee Paper & Boards Ltd. The system had performed very well and the results matched well with standard set. The development of such an instrument will be of great use to the pulp & paper industry especially during the refining stages of the paper making process.

Development of investment cast aluminium components from wax impregnated polystyrene RP patterns

In this competitive age, engineering and consumer product companies are continuously seeking ways to compress the lead-time from concept to market. Despite the rising interest in computer simulations of 3-dimensional objects and virtual reality, physical models and prototypes remain fundamental to superior product development. CMERI initiated this project recently and successfully concluded it in an effort to establish the process technology for conversion of selective laser sintering (SLS) based polystyrene patterns to functional metallic parts. This technology converts wax-impregnated polystyrene patterns to Al- based metallic part through investment casting

process. This will help to suitably utilize RP process for development of metallic component and benefits the clients by reducing the chances of rejection to make convertible polystyrene RP-patterns to metallic part. In CMERI, wax patterns of different automobile components like crank case, covers, cylinder heads, etc. and other engineering components from CAD model and RP&M process followed by silicone rubber mould are used in investment casting. Expendable polystyrene and wax impregnated polystyrene patterns, however, need considerable research in order to establish the process parameters. CMERI has carried out the manufacturing run of high quality functional metallic parts by Rapid Prototype Soft Tooling (RPST) and quick cast process.

Neuro-fuzzy controller

A neuro-fuzzy control system is relevant and effective in an unpredictive nature of system. CMERI has derived an approach for the neuro-fuzzy control methodology for any system of uncertain and unpredictive nature through the development of a control mechanism for a centrally airconditioned floor area comprising several rooms with different degrees of occupancy and different articulated requirements for the comfort level.

Management Information System (MIS) for highways

CRRI has developed an intelligent road map and the database which is useful for designing, planning and maintenance of rural roads. The database is useful for socioeconomic and transport development of a given region and could be easily updated. CRRI has also developed a GIS based MIS for a section of National Highway-2 between Varanasi and Aurangabad.

Environmental aspects in corridor management of a major highway

In recent decades the demand for both urban and regional travel has increased manifolds due to higher economic growth in the country. This has manifested in the form of much higher traffic and consequent environmental implications along the major highways. One of the important highway corridors is the section of National Highway-2 between Delhi and Agra. Due to the weak land use control in India, the complexion of the developments along the highway is fast changing and it is likely to cause serious problems in terms of environmental pollution. Thus, all corridor management projects should account for environmental parameters also as part of the performance criteria.

NH-2 corridor of 201 km length where measurements of primary air pollutants and meteorological data have been made by CRRI in six locations representing the varying traffic and land use conditions along the corridor. These six sections are then divided into eighteen subsections for the purpose of modeling the pollutants

dispersions based on CALINE 4 model. This spread of primary pollutants, when modeled longitudinally and laterally in the form of profile showed its present correlation with the land use development status. However, both the traffic along the corridor and the land use are expected to grow exponentially due to the NCR (National Capital Region) development strategy as well as other provisions. For example, the National Highways Authority of India (NHAI) has given this corridor to a franchisee for all types of management (in term of maintenance /management of road pavement, traffic control including development of ITS, and other land use developments) with authorization for collection of toll. By adoption of new technology in vehicles, it has been found that the level of pollution (CO) is decreasing over a period of time along the corridor, provided the land use pattern remains same. The result clearly shows that corridor management contracts cannot be left only to cover the road and traffic management, but also must include the environmental parameters. It also suggests how the development controls can help in arresting the environmental degradation.

Use of marble slurry dust (MSD) in roads and mass concrete work

Marble slurry dust (MSD) is generated as a waste product during the cutting and polishing of marble. The hazardous dumping practices of this waste material has posed a severe environmental threat in Rajasthan. CRRI has carried out extensive R&D for the bulk utilization of MSD in roads, embankments and mass concrete work and a technology for the purpose has been developed. A road stretch based on the technology was under construction in Rajasthan using MSD. The same was done through a joint project of CRRI and Udaipur Chamber of Commerce & Industry, with the financial support of DSIR.

Development and implementation of Pradhan Mantri Gram Sadak Yojana (PMGSY programme)

CRRI is the Principle Technical Agency for GOI launched Nation wide programme called Pradhan Mantri Gram Sadak Yojana (PMGSY). The programme aims at providing connectivity through good all-weather road to all rural habitations with population more than 500 by the year 2007. A wholistic approach for rural road development including planning, design, construction and quality control, project preparation, execution, monitoring and as well as human resources development was adopted to execute the programme. Rural road plan at district level was developed, based on prioritized links of a core network to provide most cost effective connectivity to education, health and market facilities. Detailed projects were prepared for the prioritized links taken in a year under the programme. The road structure including pavement and cross-drainage structures were designed based on the local conditions. A manual covering all the technical details has also been prepared for the use of state implementing agencies. The entire programme has changed the concept of rural roads into an engineering structure. The effort has not only optimized the utilization of available resources but also provided transparency in implementing the programme.

Long-term performance monitoring of Lok Nayak Setu (New Yamuna Bridge) in New Delhi

Scientific monitoring of the health of major bridges helps in the creation of a reliable database which will be useful in the efficient management of the bridges. The Lok Nayak Setu, across river Yamuna at I.T.O., New Delhi is the first four-lane single cell box girder bridge built in the country. The long-term monitoring of this bridge presented a unique opportunity to instrument it and observe its performance since inception. It is clear from the site data collected of the bridge through instrumentation that there are progressive changes in performance parameters due to shrinkage, creep etc. for a period of four to five years after its construction. The stabilized values of performance parameters provide the base-line data for future performance monitoring of the bridge. These base values may change within the limits of diurnal and seasonal variations. The changes in structural performance parameters beyond the boundaries of normal changes due to environmental effect is required to be analyzed critically in the course of bridge management. The performance monitoring on long-term basis will provide information in terms of structural parameters regarding the effects of any distress, in the bridge during its service life. The data collected during monitoring would help in identifying the causes of such a distress and facilitate adoption of timely and appropriate remedial measures to avoid aggravation of distress in bridges thus extending the life of structures . It will also reveal the unknown long-term behavior of bridges which will result into useful guidelines for the design of new bridges.

Road safety audit of engineering design for construction packages on NH-2

On the sponsorship of NHAI, Govt. of India, CRRI carried out the road safety audit of the detailed engineering designs of the 15 construction packages of 897 km of NH-2 from Agra to Dhanbad. Detailed engineering drawings (existing and new proposals) of the given 15 stretches as well as traffic volume and accident data for the last five years were examined. Safety audit checklists, and the best international practices suited to Indian conditions were applied on all the stretches to cover aspects like alignment cross-sections, sight distances, shoulders, footpaths, pedestrian crossings, road marking signs, road lighting, junction layout, lay byes, access adjacent development, road side furniture, etc. Appropriate recommendations were provided for each parameter. Also one-day awareness-cum-training programme on "Road Safety Audit" was organised for training the practicing engineers and concerned personnel. The draft final report has been submitted to NHAI.

Vehicular pollution study in Dhaka

NEERI provided expertise on fuel quality issues for Asian Development Bank funded project entitled "Urban Transport and Environment Improvement Study" in Dhaka, Bangladesh. The study resulted in first ever action plan suggested to Government of Bangladesh for Vehicular Pollution Control.

Wind tunnel investigations on a 220 m tall building

A dynamic pressure measurement study was conducted by SERC on a model of a 56-storeyed tall building, which has different plan shapes at four different levels. The height of model was about 95 cm based on a geometric scale of 1:250. As much as 240 pressure taps were used and average pressures were recorded based on pneumatically pressure averaging technique. The acrylic model was fabricated in-house and it was tested for various angles of wind attack. The model was tested in simulated open terrain conditions. The values of mean drag and rms lift coefficients were evaluated experimentally. Thus, for a structure, where no direct aerodynamic loading information is available in code of practice, such wind tunnel experiments are necessary and useful.

Wind turbine support towers

Green power production structures, specially the wind turbine support towers are designed for static, dynamic and operational fatigue loads (service loads). SERC experimentally evaluated the Fractional Fatigue Damage (FFD) of a tower at given site during various operating conditions adopting a novel methodology. A table of hourly fatigue damage rate evaluated from measurements could be used to assess the possible residual life of the support tower.

Adequacy & efficacy and up-gradation of the common effluent treatment plant at Ankleshwar, Gujarat

Large number of small-scale chemical industries are located at industrial estate of Ankleshwar, on Mumbai-Ahmedabad National Highway No.8 around 90 km from Baroda in the state of Gujarat. These units do not have their own treatment facilities due to lack of space, expertise, inadequate capital, and operation & maintenance problems. The estate houses large number of medium and small scale industrial units manufacturing chemicals, pharmaceutical products, textiles, pigments, dye & dye intermediates and pesticides. M/s Enviro Technology Limited (ETL) is authorised by the small-scale industrial units for environmental management arising from the activities of the industries in the estate. Hence, M/s ETL proposed treatment of combined process effluent from various small-scale industries through implementation of a Common Effluent Treatment Plant (CETP) at a centralized place. M/s ETL approached NEERI to carry out a detailed assessment of the adequacy and efficacy of the CETP. NEERI designed the cost-effective CETP to treat the coloured combined effluent. Also various treatment options were suggested to achieve the quality of treated effluent for recycle/reuse in the industries as process water. The quality of treated effluent complied with the standards prescribed by Gujarat Pollution Control Board (GPCB) for discharge of effluent into inland surface water.

Upgradation of the effluent treatment plant for PAP

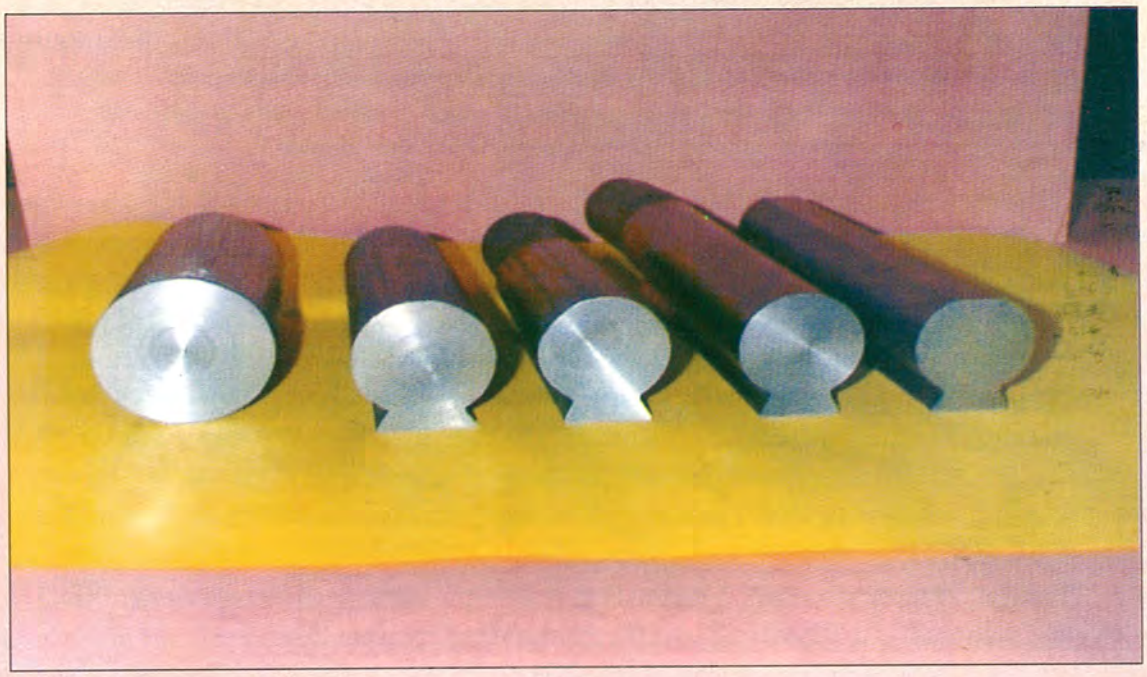
The industrial complex of M/s Sterlite Industries (India) Ltd at Thoothukkudi (Tuticorin) has a phosphoric acid plant (PAP), which produces 350 tonnes per day of

100% phosphorus penta oxide (P_2O_5) and 7.5 tonnes per day of hydroflurosilisic acid (H_2SiF_6). In the manufacturing process of P_2O_5 and H_2SiF_6, highly acidic wastewater is generated and requires prudent management, which is environmentally, ecologically and economically sustainable. An effluent treatment plant has been provided for PAP effluents. M/s Sterlite approached NEERI, to conduct treatability studies, and optimize the operating parameters to enable upgradation of the existing treatment facility.

NEERI designed the cost-effective ETP for the treatment of phosphoric acid wastewater and provided an appropriate wastewater management option for treatment of effluent generated from PAP. The unit processes/unit operations were recommended for effective treatment of phosphoric wastewater included: plant wash collection sump; filter wash collection cum equalization tank; flash mixer (stage I); clariflocculator (stage I); flash mixer (stage II); clariflocculator (stage II); treated effluent collection tank; sludge collection tank; and sludge drying beds or sludge centrifugation. The knowledge based on this project can be utilized for the treatment of wastewater of similar nature, mitigate environmental pollution leading to sustainable development.

Process for cold drawing of the key bar profiles

RRL,Bhopal has developed a process for cold drawing of the key bar profiles. The process parameters have been standardized to fabricate defect free dove tail stud and stator key bar having improved performance. Conventionally these are fabricated by



Cold-drawing of key bar defect free dove tail stud with improved mechanical properties developed by RRL-Bhopal

milling/machining of the cylindrical rods to the required shape and size. The product so fabricated generally suffered from inadequate mechanical properties. The developed process involves the final shaping of the components by cold drawing in different steps associated with intermediate heat treatment. This led to improvement in mechanical properties and surface finish of the components. Stress analysis, using FEM technique at different regions of the components, has been carried out. It shows that the fabricated product is strong enough to withstand different levels of stress.

Veneers from banana leaf

A method of preparation of veneers from banana leaf sheath and a process for fabrication of composite sheet materials using the veneers has been scaled up by RRL,Tvm. The major advantages of the process are high production rate, lower energy consumption and tailorability of the composite to suit a wide range of applications in building industry. The process is designed in such a way that it can be easily adopted by the existing plywood manufacturing industries. Commercial level trials are being carried out in collaboration with Indian Ply Wood Industries Research And Training Institute, Bangalore.

1.4.2 HUMAN RESOURCE DEVELOPMENT

CEERI

- Provided training to final year BE/B.Tech,MCA/ME/M.Tech/M.Sc./ B.Sc.(Hons) students as the part of their degree. At CEERI, Pilani to 82 students for a period of 6 months; CEERI, Chennai Centre to 49 students for 2-6 months; and CEERI Delhi Centre to 60 students for a period of 2-6 months.

CRRI

- Training Programme on Materials, Design & Quality Control of Flexible Pavements for the Engineers of UP PWD. It was attended by 15 engineers of various level.
- Training Programme on Laboratory & Field Testing in Quality Control for Road Works for the Engineers of Andaman PWD at Port Blair which was attended by 60 engineers.
- Training Programme on Roads and Bridges for ICICI Bank Officers at Mumbai. The programme was attended by 15 marketing officers.
- Training Programme on Quality Control & Materials Testing for the Engineers of IRCON International Ltd.; 18 engineers participated.
- Training Programme on Concrete Roads Technology for the Engineers of IRCON International Ltd.; attended by 10 engineers of various level.
- Training Programme on Laboratory & Field Testing Procedures for Road Works for the Engineers of Assam PWD, Guwahati. About 10 engineers participated in the programme.

CSIO

Human Resource Development is an ongoing activity of the Institute in the areas of: instrument technology; mechatronics & industrial automation; and die & mould making. A variety of short-term courses have recently been started for benefit of industry in these areas. In addition CSIO continued imparting trainings to: engineering graduates or equivalent and post-graduate students from various academics throughout India; under privilege persons approved by Jan Shikshan Sanstan, a unit of Human Resource Development, Government of India; and degree/diploma holders under apprenticeship training act. Students from neighbouring countries like Nepal have also taken the benefit of CSIO training. CSIO also conducted a training programme of hospital technicians on repair & maintenance of medical equipment



Hon'ble Minister S&T and Vice President, CSIR, Prof. Murli Manohar Joshi laying the foundation stone of ISTC building at CSIO

NEERI

- Training in compliance monitoring, laboratory networking and quality control: an overseas training programme for Central Environmental Authority, Sri Lanka was organized.
- Short-term course for Government Officers: overseas training programme on Environmental Monitoring-Vehicular Emission for Department of Motor Traffic Colombo, Govt. of Sri Lanka was organized to help officers acquire recent knowledge on modern tools in environmental management.
- Training programmes on Environmental Issues: three short-term programmes were held during the year to benefit trainees from the Ministry of Food Processing. In all 30 participants attended the programmes.
- Training on Sampling and Analysis Methods for Volatile Organics in Ambient Air for Central Pollution Control Board, Delhi was organized. Twenty participants attended the programme and acquired knowledge about regulatory issues and problems faced by implementing agencies.

1.4.3 RECOGNITION & AWARDS

CSIR Technology Prize For Engineering Technology 2002 for the Development of unique Head-Up Display	Shri V.M.L. Narasimham, Dr. M.S.N. Srinivas, Dr. K.R. Sarma, Dr. S. Mohan, Dr. R.P. Bajpai, Shri P.K. Jain and Shri B.D. Sharma, CSIO
CDC National Award for Excellence in Consultancy Service – awarded for design and construction of common effluent treatment plants for small scale industrial clusters at Pali and Balotra in Rajasthan	
UN Habitat Award 2002 by the Ministry of Urban Development and Poverty Alleviation for mplementation of common effluent treatment plants for various small-scale industrial clusters in India	NEERI, Nagpur
Dubai International Award for implementation of common effluent treatment plants for various small-scale industrial clusters in India	
Best Metallurgical and Materials Engineers Award-2002 of Institution of Engineers, Kolkata	Prof. S.P. Mehrotra, Director, NML
Indian Institute of Mineral Engineers-Mineral Beneficiation Award 2002 for the outstanding contribution in the field of Mineral Processing	
Young Scientist Award 2002 of Materials Research Society of India, Kolkata Chapter	Dr. Jui Chakraborty, NML
CSIR Young Scientist Award in Engg. Sciences -2002	Dr. K.K. Sahu, NML
The Altekar Award for the Best Technology	Dr. G. Bhaskar Raju, Dr. S. Prabhakar, Dr. Subha Rao and Shri T.V. Krishna Das, NML
Pandit Lajja Shankar Jha Award, Deptt. of Science and Technology, Govt. of M.P. in the field of Engineering and Technology	Dr. N. Chand, RRL-Bhopal

1.5 FOOD SCIENCE & TECHNOLOGY

1.5.1 SCIENCE, TECHNOLOGY & SERVICE

Identification of new allergens

CFTRI has identified the allergens in pomegranate (*Punica granatum*), and cultivated mushroom (*Agaricus bisporus*), as mannitol, the sugar alcohol of D-mannose. It is the first report of IgE-mediated allergy to mannitol which is described as a new low molecular weight allergen in foods. The study has provided new insight into the mechanism of allergenicity of low molecular weight sugar alcohols. This contribution has also resulted in the development of mannitol-specific antibodies which has applicability in the development of immunoassays for mannitol.

Novel method for measurement of texture of cooked grains

Grains are consumed generally after processing and cooking and it is always a difficult task to properly assess the cooking quality of grains especially in the routine laboratory analysis. The methods available currently for measurement of cooking quality are either subjective or based on sophisticated instrumental analysis. CFTRI has developed a simple device and a method for direct measurement of cookability of grains based on the measurement of 'spread area' of cooked grains. It is a new concept for measurement of textural softness of cooked grains particularly that of cooked dhals and rice. This method also eliminates the subjectivity in testing the textural softness, which is a problem in other methods. Being a simple device, it can be adopted for assessing the cookability of grains for routine laboratory evaluation. The development has been patented. Efforts are underway for the development of a full-fledged equipment for measurement of textural softness of cooked grain. The equipment will be useful for the quality testing laboratories and agricultural scientists involved in breeding newer varieties.

Dehulled finger millet

Finger millet (*Eleusine coracana*) or *ragi* is an important nutri-cereal. Its utilization however is confined to flour based foods, that too to the traditional consumers. This is because of the dark unappealing color and characteristic odour of the millet foods, mainly caused by the seed coat content in the meal. The millet cannot be cooked in grain form, as it has tough and fibrous seed coat which inhibits swelling and softening of the endosperm. The millet is at disadvantage for its decortication due to its smaller size and the floury texture of its endosperm attached rigidly with the seed coat. These disadvantages have been overcome, by the process of decortication of the millet

developed at CFTRI, wherein the texture of the endosperm of the millet is hardened by hydrothermal treatment and the grains are decorticated in a cereal milling machinery. The decorticated grains, with appealing light cream color resemble native grains in shape and size, cook to a soft edible texture within 5-7 min as discrete grains and contain nutrients such as protein, carbohydrates, lipids, dietary fibre, calcium and polyphenols. It can be consumed as a substitute to rice and bulgur wheat in conventional products or can be used to prepare millet foods such as *roti* and *mudde*. It is amenable to secondary processing to prepare expanded millet, flakes, semolina and bakery products. The decorticated millet would not only thus diversify its utilization but also could provide health benefits to the non-traditional millet consumers.

Bioactive compounds from Garcinia species

The importance of bioactive compounds is very well established. Studies at CFTRI on the fruit rind extracts of certain indigenous species of *Garcinia pedunculata* and *Garcinia cowa* established their antioxidant, antimicrobial and antimutagenic activities. These bioactive principles have a potential for application as food biopreservatives. The spray dried powder of hydroxy citric acid obtained from the rinds of *G. pedunculata* had a purity of 60-65% (w/w) which can find commercial application. The structural and functional characterization of the bioactive components was in progress; it will provide newer insight into the mechanism of activity.

Continuous bio-plate casting machine

CFTRI has developed a continuous bio-plate casting machine. It is an attempt towards mechanizing the preparation of bio-plates and cups. The unit is based on a unique concept of circular rotating die sets, with adjustable arrangement to



Continuous bio-plate casting m/c for bio-plates and cups developed by CFTRI

accommodate different thickness of leaves. The application of load/pressure in the machine are done by a geared motor through a cam. The machine has a capacity of producing 750 nos./h and has connected electric load of 9.0 kW. The engineering material in contact with the bio-plate is of food grade. The bio-plates can be an alternative for the plastic and paper products. Work is also in progress for obtaining sterilized plates and cups in large volumes. The machine has a societal application for mass production of plates and cups for serving of food in places like industrial canteens, hostels, hotels, and other mass feeding centers.

Technology for phycocyanin

CFTRI has developed a technology for production of phycocyanin from *Spirulina*. *Spirulina* is cultivated in clean water system using CFTRI protocol. *Spirulina* biomass is processed for obtaining a phycocyanin rich aqueous fraction which is later subjected to aqueous two phase extraction method to separate the contaminant such as chlorophyll. Stabilization of phycocyanin is achieved using permitted preservative. The crystalline phycocyanin is separated from the extracts through drying and cell debris is separated as another fraction which is a bioproduct of utility for animal feed. Novelty of the process lies in separation of the pigment from other cell constituents in three step process to obtain over 90% phycocyanin. This methodology is simpler and easily adoptable compared to that available elsewhere in the world. The product is superior and highly stable compared to international samples. Since all bioproducts are utilized and the cultivation medium is recycled, this is an eco-friendly technology, free from pollutants. The technology has been licensed to M/s. Indoleena Biotech Company, Madurai for commercial exploitation. CFTRI's efforts have thus led to establishment of first plant for the production of phycocyanin in India.

Hybrid heating system for food processing

A hybrid system with provision for both convective and infrared (IR) heating of food materials has been developed at CFTRI for various food processing operations. The system can be used for different heating modes such as convective, infrared and, combined infrared and convective. It could be conveniently used for drying of vegetables (such as Carrot, Potato, Cabbage), and dry blanching of vegetables. This has a unique design; consists of a continuous SS perforated wire mesh conveyor on either side of which the infrared heat sources are provided for uniform heating. The combination of hot air and infrared heating reduces the overall processing time and thereby increases the organoleptic quality of the product. As there is a greater demand for better quality products in the market, the development could be a good alternative to the conventional dehydration process.

Machine vision system for on-line sorting and grading of fruits like apples

CEERI has developed an on-line fruit sorting system for sorting and grading of fruits, apples in particular. Various studies on the problem of sorting and grading of

apples using machine vision technology were conducted. New algorithms were developed that applied on the fruit images collected dynamically on-line to sort them based on color, size and shape. The system developed consists of conveyor assembly, diffused uniform illumination system, CCD camera and image processing software. It can perform complex color, size and shape based classification, comparable with human vision but with far greater speed, repeatability and reliability. This development will help the farming community to increase value addition to their produce and it will help separate the bad agricultural produce from the good.

Convection driers

Natural convection driers have been designed and developed by RRL, Thiruvananthapuram. These have been licensed to fabricators for commercial manufacturing. The driers are being used by farmers, artisans, cottage scale industrial units and household sector for drying of variety of materials. The laboratory has participated in demonstration and training programmes organized in collaboration with various panchayats and NGOs. Trials have been carried out for drying of apricots in Jammu for the benefit of defence personnel.

S&T Services

CFTRI rendered diverse S&T services which were of value to the economy, environment, society etc. These included:

- **Technical reports:** Techno-economic feasibility reports were prepared on fruits and vegetable preservation and export in SAARC countries, utilization of fruit and vegetables in Chotanagpur and poultry dressing plant. Detailed project reports were prepared on centralized facility for the manufacture of milled ragi flour/husk free milled cereal flour of capacity 5 tones/day, dehydration plant for fruits and vegetables and processing of jack fruit.
- **Process demonstration:** Twenty one processes were demonstrated to various entrepreneurs. Notable among these were: ready to use idli batter in retail packs, dehydration of bitter gourd, malted ragi flour, tamarind juice concentrate, ginger powder, bulk preservation of mango pulp, minimally processed vegetables, and fixation of green colour in cardamom.
- **Awareness programmes:** Several EDP and technology awareness programmes were organized in different parts of the country on aspects such as, investment opportunities in the food processing sector, food processing, rural technologies, leaf cup making, technologies and facilities that CFTRI can offer among others.
- **Analytical testing:** A number of samples of food commodities and packaging materials received from private and public sector food industry, port health authorities and legal samples from judiciary were tested and analyzed for their adherence to set food standards such as PFA, FPO and codex alimentations. Sensitive methods were developed for detection and determination of contaminants and pesticide residue in foods.

1.5.2 HUMAN RESOURCE DEVELOPMENT

- **M.Sc. food technology:** CFTRI continued to run the course. Scientists at CFTRI imparted training to the students in specialized areas of food science and technology. The effort resulted in equipping the students with the state of the art in food science and technology. They had an opportunity to undergo a thorough hands-on training. The course also benefited the food industry in the country in meeting their requirement of trained professionals. Twenty-one students were admitted in the course during the year.
- **Certificate course in milling technology:** The course in milling technology, of ten months duration is only one of its kind, not only in India but in whole Asia for the formal training in the area. During the year twenty participants underwent the course. The students who passed out were immediately absorbed in the roller flour mills. The mills are thus greatly benefited by the training.
- **Ph.D. programme:** CFTRI runs a well recognized Ph.D. programme. Fifteen candidates were registered for Ph.D. degree in food science and allied basic subjects in the year. Eligibility for the programme is post graduate degree in science with the clearance of CSIR-UGC NET examination. The participants of the programme get equipped with sufficient theoretical and practical knowledge to make a successful career related to R&D.
- **Student training:** The students from different colleges and universities are trained under the programme for a period of four weeks covering various frontier areas of food science and technology. During the year 95 graduates and post graduate students from various engineering colleges and universities undertook the training.
- **CPYLS:** CFTRI organized a programme under CPYLS (CSIR Programme for Youth on Leadership in Science) wherein 37 top scorers in X standard examina-



Students interacting with scientists under CSIR programme on Youth for Leadership in Science

tion from all over Karnataka and their parents participated. During the programme the students and parents were familiarized with the contribution of CSIR, CFTRI and Indian scientists, for the progress of science and technology in the country.

1.5.3 RECOGNITION & AWARDS

Fellow, National Academy of Agricultural Science, New Delhi	Dr. G.A. Ravishankar, CFTRI
Fellow, Indian Academy of Sciences, Allahabad Fellow, Indian National Academy of Engineering, New Delhi Councillor - IUFoST, (International Union of Food Science and Technology) Academy Council, Canada	Dr. V. Prakash, CFTRI
Sir C V Raman Young Scientist Award in Life Sciences instituted by Government of Karnataka for the year 2001	Dr. K. S. Jagannatha Rao, CFTRI

1.6 INFORMATION SCIENCE & TECHNOLOGY

1.6.1 SCIENCE, TECHNOLOGY & SERVICE

Traditional Knowledge Digital Library (TKDL)

TKDL is a collaborative project between NISCAIR and Department of Indian Systems of Medicine and Homeopathy (ISM&H). TKDL was created with the objective of preventing the grant of patents on non-patentable traditional knowledge. Traditional knowledge documented in regional languages is neither easily accessible nor easily understood by the patent examiners. Traditional knowledge needs to be made accessible to patent examiners by overcoming the language barrier in a format that is easily understood by the patent examiners. Therefore, the project on TKDL was initiated to create more easily accessible non-patent literature databases that deal with traditional knowledge. TKDL software with its associated classification system, i.e., Traditional Knowledge Research Classification (TKRC) converts Sanskrit *Slokas* into English, French, German, Spanish and Japanese. The software does not do transliteration rather it does smart translation, where data abstracted once are converted into several languages by using Unicode and Metadata methodology. Software also converts traditional terminology into modern terminology, for example *Kumari* to *Aloe vera*, *Mussorika* to smallpox, etc. TKDL includes a search interface providing full text search and retrieval of traditional knowledge information on International Patent Classification (IPC) and keywords in multiple languages. Traditional Knowledge Classification shall be integral to TKDL database along with background on Ayurveda concepts, definition and scientific basis of Indian Systems of Medicine, details of practitioners, hospitals and dispensaries.

From the Ayurvedic texts so far 35,000 *Slokas* have been identified for inclusion in the database. About 32,800 formulations have been entered and decodified. Transcription of the rest of the 2,200 formulations is being carried out. About 13,200 *Slokas* have been scanned for establishing the prior art. Besides, 11,750 formulations have been verified and validated by eminent Ayurveda experts. Four thousand formulations have been frozen for publishing the first CD to be sent to patent examiners. A concordance table has been prepared to correlate existing subgroups of TKRC with corresponding group of IPC. A software programme has also been developed for incorporation of appropriate IPC codes into the database. The translation of TKRC in Hindi, Spanish, German, French and Japanese has been completed.

TKDL database shall act as a bridge between ancient Sanskrit *Slokas* and a patent examiner at a global level, since the database will provide information on modern as well as local names in a language and format understandable to patent examiners. It is expected that the gap on lack of prior art knowledge shall be minimized. The database shall have sufficient details on definitions, principles, and concepts to minimize the possibility of minor/insignificant modifications.

Indo-Russian collaboration in S&T: An analysis through co-authored publications, 1995-99

NISTADS conducted a study to analyse the Indo-Russian collaboration in S&T through the co-authored publications during the period of 1995-99. The study revealed that there were two streams of collaboration; the first was bilateral in which only Indian and Russian institutions/scientists were involved and in the second, scientists/ institutions from other countries like USA, UK, Japan, etc. also participated, besides Indian and Russian. It is astonishing to find that out of 355 jointly authored papers in S&T, a majority of 294 papers had multilateral collaboration, and only 61 were under bilateral collaboration. The study included an analysis of co-authored papers by main fields and sub-fields and the impact of such collaboration in different fields, and identification of major participating institutions involved in collaborative research, and also provided a few suggestions for improving further collaboration between the two countries. It has been found that under the bilateral category (involving at least one Indian and one Russian institution), there were 61 co-authored papers, which accounted for only 18% of the total output during 1995-1999. The remaining 294 were multilateral papers and involved the participation of India, Russia and 40 other countries. In order to make collaboration between India and Russia more effective, there is a need to understand the shortcomings in the mechanism of participatory research by Indian institutions. This mechanism needs to be modified in the light of the changing priorities of the two countries in S&T. For promoting collaborative research, both Russian and Indian institutions may offer more fellowships, travel grants, etc. to researchers. There is also a need to extend the scope of cooperation to frontier areas of S&T, particularly to those areas where Russia has a strong base.

Collaboration in material science research in India

NISTADS undertook a study of collaborative aspects of material science research in India based on papers published by Indian scientists in collaboration with foreign researchers. The study based on SCI journals, covered a period of five years (1995-1999). The results indicate that materials science in India is broad based and covers most of the important sub-areas, and is based on inherent strengths. Most of the work involved bilateral rather than multilateral collaboration. The top collaborating countries were the US, Germany, France, UK and Japan. Collaborative linkages with developing countries accounted for only about 10% of the total papers Ten top Indian institutions contributed nearly 50% of the collaborated papers. The major areas of collaboration were theoretical studies, metals and alloys, electronic materials and superconducting materials.

EU-India cross cultural innovation network project

NISTADS carried out an EU-India cultural innovation network project. The main objective was to set up a management framework for effective academic-

entrepreneurial networking involving universities and entrepreneurs in the EU and India and to build upon and promote existing models and paradigms of innovation for sustainable transfer of cross cultural knowledge and know-how. The project revolved around the models of enterprise innovations in cross cultural context in three settings: model of entrepreneurial innovations—a cross-cultural model of research: action research in the dairy sector; model of entrepreneurial innovations – small and medium enterprises; and model of entrepreneurial innovations – traditional technologies (Dhokra artifacts from Bankura). The main reports which emerged from the effort under the project, depicted a unique model of innovation in each setting in the Indian context. These were also compared in Cross-cultural context with the EU-India project partners from UK, Germany, Denmark, Italy, Gujarat and Ludhiana.

Techno-economic study on artisans in unorganised sector

Techno-economic study on artisans in unorganised sector was carried out by NISTADS under sponsorship of ICAR. The study included collection of data regarding the clusters of various artisans in the country; organization of demonstration-cum-extension programmes in these clusters; upgradation of the technological skill of the rural artisans; development of curriculum in ITI's as per the needs of the artisans of the area; quality improvement in the products of these artisans by providing the necessary infrastructural facilities; development of an information network on these artisans' products, exploitation of market potential of these products so that the socio-economic condition of the artisans may improve. The report has been adopted by the scientific panel on agricultural engineering, ICAR. It was suggested that R&D groups should consider these artisans as manufacturers of simple equipment and they may be used in the fabrication of research prototypes for multi-location trials. It was suggested by the Panel that PC (FIM) should bring these clusters to the knowledge of the concerned R&D Centres located in Northern India so that they could use these for the fabrication of their prototypes.

National Science Digital Library (NSDL)

CSIR has envisaged setting up of the National Science Digital Library (NSDL). It will be a national information facility designed to provide internet access of digital resources to universities and college education system throughout the country, in particular the student community in remote areas facilitating similar level of access to information as is available in metro cities. NSDL is being developed on the concept where digital repository is created not by acquiring the contents, but with the content providers who would pay for storing their intellectual property and access to users.

Research Journals

NISCAIR's contribution to Indian Science is through publication of as many as nineteen journals covering all the major disciplines of science. The *Indian Journal of*

Traditional Knowledge was launched during 2002-03. These journals are of international repute and provide communication links among members of the scientific community engaged in research in India and abroad. The papers published in the journals are indexed and abstracted in most of the international indexing and abstracting journals and thus provide international exposure to Indian R&D workers. The contents and abstracts of all the periodicals are regularly updated on the NISCAIR's website www.niscair.res.in. A programme was launched to widen the visibility and reach of NISCAIR journals and enhance the subscription base. Efforts have been made to reach out to the new potential subscribers at the national and international level. The impact of journal outreach programme is evident from the increased total subscription to a record Rs. 1 crore (54.8% increase).

CSIR electronic journals consortium

The CSIR E-Journals Consortium aims at providing electronic access to nearly 4,500 worldwide S&T periodicals. CSIR has entered into an agreement with *M/s. Elsevier Science*, one of the largest publishers of S&T e-journals for having access to its 1,700 S&T journals among all the laboratories/units/centres of CSIR. NISCAIR (erstwhile INSDOC) has been designated the implementing agency for CSIR E-Journals Consortia.

Science popularisation

Popularization of science among the masses is a major programme of NISCAIR. For the purpose of spreading awareness about scientific developments and creating a scientific temper among youth, the Institute publishes three well-circulated popular science journals, *Science Reporter* (English monthly), *Vigyan Pragati* (Hindi monthly), and *Science ki Duniya* (Urdu quarterly) apart from a number of popular science books.

Science Reporter a monthly science magazine enjoys a wide readership throughout the country. *Science Reporter* continued with its objective of providing to its readers topical coverage of issues in various fields such as information technology, wildlife, environment, space, nuclear technology, health, and biotechnology as well as light reading material such as humour, amazing scientific facts, profiles of scientists, science projects, inventions and discoveries and much more. Efforts were made to give a contemporary look to the magazine by inviting special articles from experts.

Vigyan Pragati is a monthly popular science magazine in Hindi that reaches far and wide in the country. It endeavours to introduce readers with important current events/issues in an easy to understand manner. The major issues covered during the year were: medicinal plants, diamonds, alpha space station; plant hormones/human hormones (April 2002); syndrome X, edible vaccines, research institutions of India, vermiculture, seabuckthorn (May 2002); biodiversity, air pollution, pollution & human role, noise pollution, pollution from organic chemicals (June 2002, special issue on

Environment & Biodiversity); geoscientific monuments, the world of spiders, antarctica, internet telephony, minerals (July 2002)*;* A.P.J. Abdul Kalam, Honorable President of India, wireless application protocol (August 2002)*;* vultures, *Withania somnifera* & *Ocimun sanctum* (September 2002)*;* world food day (October 2002, special issue)*;* children's day (November 2002, special issue)*;* metro rail project, bats, Stephen Hawkings (December 2002)*;* traditional knowledge (January 2003, *special issue);* special issue on national science day (February 2003)*;* and the latest on Columbia Space Shuttle Tragedy (March 2003).

Science ki Duniya, the quarterly popular science magazine in Urdu, reaches far and wide across the country. One of the most widely read Urdu magazines in the country, it has now entered into its 30th year. During 2002-2003 *Science ki Duniya* continued to disseminate information on current scientific topics in easy and attractive manner. The cover stories brought out during this year were: *Biodiversity – ek jaeza* (April-June 2002), *A.P.J. Abdul Kalam – laboratory se rashtrapati bhawan tak ka safar* (July-September 2002), *Indian railways ke ek sau pachas sal ka ek jaeza* and *Delhi metro rail* (October-December 2002). The October-December issue was also a special issue on children containing a number of articles for children, like *Duniya ka azeem darya Amazon, nap taul ke maiyaron ki ahmiyat, parindon se hum nae kya seekha* (science fiction), *machchar bhi kuch kam nahin,* and *main protein hoon.* On the occasion of international year of mountain *Himalaya pahar aur mahuliya* and other major articles covering the Diamond Jubilee of CSIR have been published in the January-March 2003 issue.

CSIR News, the fortnightly newsletter, serves as a useful link among the various CSIR establishments and communicates activities/accomplishments of the Council to other R&D organizations, universities, S&T agencies/departments, industry and other users, mass media, etc. It also disseminates information on CSIR to other countries through Indian missions abroad and foreign missions in India. Twenty-four issues brought out during the year covered news pertaining to R&D accomplishments, technology transfers, marketing, commercialization/utilization, sponsorships, collaborations, IPR, etc. A special issue was brought out on Traditional Knowledge Digital Library. The 30th October issue was a special issue on CSIR Diamond Jubilee, and 28th February 2003 issue was special issue on Dr. R. A. Mashelkar, Director General, CSIR.

CSIR Samachar launched in 1984, is now in its 20th year. It is a monthly news bulletin in Hindi, which covers the R&D activities of all the laboratories of CSIR and consequently serves as a useful link. It also disseminates information on various activities of CSIR. November-December issue of CSIR Samachar exclusively covered the CSIR Diamond Jubilee function held at Vigyan Bhawan on 26th September 2002. It also included the awards instituted by CSIR, especially Shanti Swarup Bhatnagar award; Technology award; Young Scientist award etc.

S&T Books: NISCAIR brings out S&T books, popular as well as of advanced level, for different target groups. Such books brought out during 2002-03 include: *A Text Book of Biotechnology,* for CBSE, who have introduced Biotechnology course in schools for the first time: Revised and updated version of the much appreciated and highly sold *Golden Treasury of Science & Technology;* the book covering the 89th session of the Indian Science Congress held at Lucknow, *Healthcare, Education & IT – The Road Ahead;* and Hindi version of the Golden Jubilee Series book *Curable Cancer, 'Cancer per roktham'.*

A major development was the launching of a new series of low-cost, self-explanatory books on Information Technology – the *IT Series,* to help generate computer literacy in the country. The following titles have been brought out: *The C Adventure: A Beginners Guide to C Programming, C ++* for Beginners, Build Your Web Home : An Introduction to HTML Web Page Design, Microsoft Word for Beginners *(also in Hindi), Zoom In: A Beginners Guide to MS PowerPoint* (also in Hindi), *Web dot Com: A Tour Guide to the Web,* and *Visual Basic for the Beginners.* These books have become very popular in a short span of time. Hindi, Bengali, Marathi, Tamil and Punjabi versions of these IT books are being also brought out.

NISTADS Dhokra Museum

NISTADS Dhokra Museum was inaugurated, which presents a collection of brass and bronze artefacts made in the Dhokra belt over an extended period of time. NISTADS Dhokra Museum will not only demonstrate the phases of evolution of the lost-wax technique but also highlight an unbroken tradition starting from the Mohenjodaro days when a craftsman cast the bronze figurine of a dancing girl. The museum, which will serve as an educational resource for children and others, now has a repository of artefacts created over a period of time.



Dr. R.A. Mashelkar, FRS, DG-CSIR receiving a Saraswati artefact by a Dhokra shilpi during inauguration of NISTADS Dhokra Museum

1.6.2 HUMAN RESOURCE DEVELOPMENT

Associateship in Information Science

The course was revised and redesigned from time to time to suit the changing information needs within the country as well as other developing countries. Special attention is given to information technology, information analysis and information systems applications in some of the fast developing fields like environment, biotechnology and information networks. An important feature of this two-year course is the holding of periodic seminars, which provide an opportunity to the students for articulation, collective thinking and debating. The students are encouraged to participate in seminars/workshops/short-term courses as well as to visit, observe and study the working of various institutions, libraries, documentation and information centres. NISCAIR continued with the various activities and for the batch 2002-2004, 25 candidates (24 general + 1 reserved) were offered admission for the course. Admission has been offered to foreign candidates, from Bangladesh, Nepal and Sri Lanka under the SAARC Documentation Centre (SDC) Programme.

Short term training courses by NISCAIR

The emergence of information technology has brought in tremendous change in information handling and management techniques. In order to prepare information professionals from various organisations to cope up with the changing technological environment in their day-to-day activities, NISCAIR organised four courses in 'Computer Applications in Library and Information Activities' and trained 40 participants; two courses on 'Internet' having 7 participants; one course on WINISIS having 5 participants, and two courses on 'Information Technology for Information Management' having 17 participants. In all, 12 short-term training courses were conducted and 109 persons were trained.

Attachment training programmes

During the year, NISCAIR organised three Attachment Training Programmes and 11 persons were trained. These included two training programmes for the SAARC Documentation Centre sponsored candidates and for Vietnamese nationals sponsored by the DST/ITEC, MEA, Govt. of India.

IGNOU study centre

NISCAIR has been identified as the Programme Study Centre for the following IGNOU sponsored programmes namely: Certificate in Computing (CIC); Master/ Bachelor in Computer Applications (MCA/BCA); and Master/Bachelor in Library and Information Science (MLISc/BLISc). NISCAIR has the responsibility of

counselling, practical training, organising seminars, guiding student projects, conducting practical examinations and evaluation of assignments for these programmes. A total of 5344 students were trained during the period.

1.6.3 RECOGNITION & AWARDS

Himwant Kavi Chandra Kunwar Bartwal Samman Awarded by Kedarkhand Sanskritik Sansthan, Mussorie	Deeksha Bist, NISCAIR

1.7 LEATHER SCIENCE & TECHNOLOGY

1.7.1 SCIENCE, TECHNOLOGY & SERVICE

Studies on the potential uses of plant poly-phenols as raw material for industrial chemicals

Considering the value addition by converting vegetable tannins and other plant poly-phenolics into dyes/pigments, studies have been carried out at CLRI. The preliminary studies reveal that reagents like vanillin-HCl, paradimethylamino benzaldehyde develop coloured species with vegetable tanning constituents and other associated phenol carboxylic acids. Characterization of the colourants formed by spectral data is under progress. Studies have also been carried out for the process development of iron-hydrolysable type of vegetable tannin complexes as tanning cum dyeing agent for the production of eco-friendly black leathers.

Evaluation of a new source of natural oil for possible use as a fat liquor

Jatropha oil is an indigenously available forest product from Madhya Pradesh and Andhra Pradesh. It is toxic and used, in a limited way, in native medicines and fungicides. It has a relatively high Iodine value (95-105) with Oleic and Linolic acids as major components (about 78%). CLRI has developed a novel method for complexing the oil with a polymer composition. It has proved to be successful. Pickled pelts treated with the product show tanning effect giving white and soft leather.

Enzymes in leather processing

Under CLRI-NCL collaborative programme on "Alkaline protease" supported by DBT, a fungal lipase from *Conidiobolus coronatus* has been found to be very good for dehairing and soaking of goat skins. Initially, an enzyme assisted process has been standardized using alkaline protease for dehairing of goat skins and cow/buffalo hides. The enzyme assisted process has been demonstrated in tanneries in and around Dindigul. Recent experiments show that enzyme only process could be standardized using alkaline protease without sodium sulphide for dehairing of sheep skins and cow/buffalo hides.

Utilization of chrome shavings for product development

Chromium containing wastes in various forms in leather processing is under review. The high protein content of chrome shavings has been utilized for reduction of chromium (VI) in the preparation of chrome tanning agent at CLRI. This approach has been exploited in the development of two products one with chrome shavings

alone as reducing agent and other with equal proportion of chrome shavings and molasses. The developed products exhibit more masking due to the formation of intermediate organic oligo-peptides. Hence, the developed products find use as chrome tanning agents for leather processing, thus providing means for better utilization of chrome shaving wastes.

Technology package for synthetic tanning agents

New generation syntans namely formaldehyde-free chrome syntan and polymeric syntan have been developed by CLRI and patented for eco-benign chrome tanning in leather processing. The technology package has been licensed to M/s Balmer Lawrie & Co. These syntans are free from formaldehyde and also help in the reduction of pollution loads such as chromium and Total Dissolved Solids (TDS).

Alternative source for water in leather processing

CLRI has carried out a study for using seawater and common chemicals for pre-treatment of leather. The method developed has basically addressed the hardness of seawater. The leathers processed using treated seawater were comparable to the leather processed using conventional water. Studies at pilot tannery level were underway.

Fashion design and development of leather products through ethnic skills

In the North Eastern region ethnic products based on bamboo and textiles are widely in use. CLRI undertook a systematic study on these products and collected samples of these products. The knowledge so generated through this organized effort has been utilized for developing innovative leather products with a view to enhance the market base and value addition to the product. Dissemination through training programmes is being carried out for a range of these products.

Cost effective therapeutic material

CLRI has developed a material based on starch/oil cake using water/vegetable oil as binder. It could be an alternative for existing methods of taking foot impressions of patients needing therapeutic and orthotic shoes. This new material provides additional advantages, such as forming the impression of foot in standing position, producing accurate negative impression of patient's insole and reusability. The clinical trials using the same were in progress.

Resolving the total dissolved solids problem

The tanning sector in India has been able to comply with Pollution Control Norms except for Total Dissolved Solids (TDS). Viable solutions for TDS have formed an

area of priority. Pickle free chrome tanning based on use of combination of masking salts and polymeric syntan free from formaldehyde has been standardized at CLRI and field tested. Salt free short term curing methods have been developed and tested in goat upper leathers.

Ecofriendly processing

Hexavalent chromium formation poses serious problems in leather production. Post tanning chemicals/auxiliaries have been screened at CLRI for their tendency to convert Cr(III) to Cr(IV) in chrome tanned leathers. Suitable treatment methodologies have been developed using reducing agents to avoid formation of Cr(VI). The process technologies have been standardized for production of cow upper and sheep nappa garment leathers.

High rate biomethanation plant for chrome shavings

A high rate biomethanation plant has been set up by M/s Tata International Ltd. for managing the chrome shavings generated from their leather finishing unit at Dewas, Madhya Pradesh. The capacity of the plant is 2 MT/day. The process technology was developed by M/s Tata International Ltd. The uniqueness of the process is the technology, which offers solution for management of chrome containing wastes from the tanneries. CLRI worked out use of recovered chromium in the process of manufacturing leather. Also the gelatin solution was biologically treated under anaerobic condition and the biogas was used for thermal energy recovery. The treated effluent from the biomethanation plant was tested and disposed in the effluent treatment plant. This plant is the first of its kind in the world implemented and demonstrated with a totally indigenous technology and equipment.

Biomaterial testing devices

CLRI has developed an instrument to study the two dimensional stress deformation (creep) effect in leathers. The two dimensional sample could be held in the sample holder and provision is given for simultaneous application of the load to the four pans attached to the sample holders, by releasing a lever. The strain gauge connected to the sample holders records the deformation in four directions. The results obtained from the tests will be correlated, to understand the surface characteristics transformation as a function of the creep behaviour of leathers. The focus is on upper leathers only, as the results would have direct bearing on shoe uppers.

Analytical methods for eco testing

Xylidines are important precursors for the production of dyes, drugs and various other products used in industries. Due to the high carcinogenic nature of some xylidine isomers, it becomes very essential and relevant to develop suitable analytical

procedures to separate isomers as well as enhance detection at very low concentrations. Efforts have led to standardization of micellar electrokinetic chromatography at CLRI against varying parameters such as pH, ionic strength and micelle modifiers and the optimum conditions of these parameters have been ascertained for the best separation and the sensitivity of standard mixtures. The methodology has been applied in environmental studies as well.

1.7.2 HUMAN RESOURCE DEVELOPMENT

CLRI continued academic and vocational training for the leather industry. A unique effort in the area has been to empower leather cooperatives by mentoring, tutoring and training artisans from Gujarat for technology upgradation and management. The artisans have expressed immense satisfaction with the new training methodology.

1.7.3 RECOGNITION & AWARDS

Anna University Distinguished Alumnus Award	Dr. T. Ramasami, CLRI
Chemical Research Society of India Silver Medal for extensive contributions to Chemistry	
TANSA award for Chemical Sciences	Dr. P.T. Perumal, CLRI
CRSI Bronze Medal for contributions to Surface Science	Dr. Aruna Dhathathreyan, CLRI
CRSI Young Scientist Award for contributions to Computational Chemistry & Molecular Modelling	Dr. V. Subramaniam, CLRI

1.8 MATERIAL SCIENCE & TECHNOLOGY

1.8.1 SCIENCE, TECHNOLOGY & SERVICE

Development of polarization maintaining optical fibre

In the area of avionics, rotation sensing using interperometric fibre optic gyro is now emerging as a potential alternative to existing devices used in aircrafts and tactical missile guidance due to better sensitivity and excellent bias stability. One of the key component in Fibre Optic Gyro (FOG) is the high birefringent polarization maintaining (PM) optical fibre. The basic design and functionality of this fibre are widely different from standard optical fibres used in telecommunication. Only a few manufacturers in the world produce this type of fibre and supply to a very limited extent at an exorbitant price because of its strategic importance. CGCRI has successfully developed PM fibre with an extinction ratio as high as 30 dB at 1550 nm following the MCVD (Modified Chemical Vapour Deposition) process of preform fabrication. A geometrical cross section of the fibre is shown in the figure where the dark elliptical region is the stress inducing boron doped outer cladding and bright circular spot is the germaniumoxide doped core of the fibre. The achievement has opened the possibility of producing the fibre in long length for indigenous optical gyro development. An ambitious programme has already been taken by the defense establishments like RCI/DRDO and DTSR, who sponsored the fibre development programme in CGCRI, to develop FOG with high accuracy.

Development of equivalency chart between UHV & GCV of Indian non-coking coals

CFRI in order to develop the equivalency chart used coals from the major coalfields. It is observed from the scatter plot of different coalfields that the variation within a coalfield is significantly less than the variation between the different coalfields. This is primarily because the UHV concept is based on the role of diluents and it does not consider the organic matrix and petrographic mix of the different coals which ultimately decide the inherent heat value and its burning properties. Due to such high regional variations it is suggested that no single relationship can be adopted for evaluating the GCV value rather relationships specific to individual region may be used for categorizing the coals of that region. The study provided a reliable and scientific basis for making the equivalency charts between UHV and GCV, which can be used for grading the coals in terms of the experimentally determined GCV. Similar studies could be initiated for the thermal coals of Eastern Coalfields Limited and for the coals from BCCL which are going to the power sector because the coals of these regions are relatively more mature than the coals of earlier study. Switching to GCV from UHV for grading would require the equivalency chart for these coals as the chart derived for other non-coking coals should not be applied to them.

Investigation of transport across grain boundary in colossal magnetoresistance (CMR) materials

Epitaxial thin films, polycrystalline films/bulk samples of colossal magnetoresistance (CMR) materials show different magnetoresistance behaviour. In order to understand the role of grain boundaries in these materials, transport across a single artificially prepared grain boundary in epitaxial CMR films has been investigated at NPL. The single artificial grain boundary is realized by depositing epitaxial film on a $SrTiO_3$ bicrystal substrate. Analysis of dynamic conductance of the grain boundary reveals that three carrier transport mechanisms operate across the grain boundary. These mechanisms exist in parallel, and at a given temperature one mechanism may dominate. At higher temperatures (T>175 K) the transport across the grain boundary involves spin-flip scattering, which established leads to decrease of the bicrystal grain boundary contribution in magnetoresistance. At lower temperatures (4.2-45K), tunneling through a disordered oxide at the grain boundary dominates, whereas in the temperature range from 100 to 175K, carrier transport is dominated by inelastic tunneling via pairs of manganese atoms.

Long decay luminescent powder

Long decay luminescent powder also known as long afterglow phosphor is capable of emitting light in the visible range not only during excitation but also for a long period of time after excitation is cut-off. This phenomenon is known as 'phosphorescence'. Uniqueness of phosphor is that these are excited by daylight, tube light and tungsten lamp whereas normally phosphors require high-energy radiation such as cathode rays, ultra violet rays, X-rays and gamma rays. Conventional long decay phosphor like ZnS:Cu also shows long phosphorescence but decay time is not long enough for certain applications such as warning signs and escape routes, etc. Addition of radioisotopes can produce the required performance level but now its use has been restricted due to safety and environmental considerations. Strontium aluminate phosphor developed by NPL is a non-radioactive material and exhibits a very bright and long lasting phosphorescence whose decay time exceeds well beyond twenty hours. Some of the phosphors developed have decay time more than fifty hours. It has been primarily developed for DRDO but it can very well be adopted for a number of civilian applications, such as, photoluminescence escape routes and rescue guidance system; warning signs; important marking such as of machinery; producing special effects in bars, discotheques etc.; flexible and rigid plastics for switches and consumer goods; toys; sports equipment etc.

Reduction of uncertainties in emission coefficient of CO_2 emission from coal combustion

CFRI has carried out studies on Indian coals with the objective of improving upon the reliability of Carbon Emission Factor (CEF) for different categories of coals and also to provide a more reliable basis of the conversion factor (NCV/GCV). Direct

measurements of emissions were carried out at different power, cement and steel plants and estimates made for sector specific emission coefficients. The refined NCV and CEF of coals to be used for preparation of the National GHG inventory will provide a better estimate of emissions from the key sectors. Estimation of CO_2 emission with the assumption of a single emission factor of thermal coals and average oxidation factor do not reflect the variance associated with fuel quality from different sources and the combustion technologies/vintage of individual power plants. The emission coefficients of the key sectors obtained from direct measurements will reduce the uncertainties associated with deriving the coefficients for fuel quality.

Nano material catalysts

Under the NMITLI programme, a project on "Nano material catalysts and associated process technology for pre-reforming of hydrocarbons" was taken up at CFRI as a network programme with IICT, Hyderabad and Sude-Chemie (India), Cochin. The project is envisaged in two phases : viz. design and development of nano particulate based catalysts and scale up of the catalyst preparation and process standardization. Stabilization of nano particles is the greatest challenge and CFRI has been engaged in preparing nickel nano based catalysts using different precursors employing sol-gel method. A 100-ml reactor for pre-reforming of naphtha has been designed by CFRI and installed during this year. The reactor has a HDS module to desulphurize the feedstock before it enters the pre-reformer, which can operate upto 600° C. Economic production of hydrogen through nano particle based catalysts would significantly influence the economy of fertilizer industry.

Industrial briquetting plant from coke-breeze

CFRI successfully commissioned a briquetted fuel (for industrial use) producing plant within the premises of Gujarat Heavy Chemicals Limited (GHCL), Sutrapada, Varabal, Gujarat. GHCL will be able to reduce import of coke by 15 percent. GHCL was accumulating approximately 20 tonnes of rejects daily from imported coke. The company had contacted CFRI to provide technology for optimum utilization of coke fines accumulated as waste. The Institute after conducting a survey suggested GHCL to establish a plant of 20 tonnes per day capacity. To reduce the production cost, the CFRI scientists successfully utilized the gas and surplus steam of the captive power plant of GHCL.

Coal-washing JIG

Based on the design of CFRI a coal-washing JIG of 30 tph capacity is being manufactured by a private party for commercial washing of both coking and non-coking coals suitable for small-scale entrepreneurs. The washability characteristics and subsequent beneficiation and carbonization studies in the pilot plant at CFRI

showed that both Dhansar and Kalyani washed coals and blended cleans with Mohuda washed coals produce good quality coke and are suitable for metallurgical purpose.

Durability study of fly ash bricks

CFRI has setup a facility for determining the comparative durability of fly ash / clay bricks/blocks in different aggressive environmental conditions. These include alkaline, acidic, saline, chloride, CO_2, SO_2, NO_2, UV radiation, temperature and moisture treatment, wetting and drying, normal aging over a period of time. The durability has been tested for different properties such as surface appearance, bulk density, compressive strength, moisture content, loss on ignition, water absorption, efflorescence, wear and tear, fire rating, etc. The study was sponsored by Fly Ash Mission (TIFAC) DST, New Delhi. There was no significant change in most of the properties of bricks when autoclaved and subjected to different aggressive conditions, from that of unexposed bricks. These bricks were quite comparable with clay bricks. This unique facility created for the purpose is used for testing various fly ash based building materials manufactured by various agencies in the country.

Spacer-aided-initiation technique for blasting-off-the-solid

CMRI has developed a spacer-aided-initiation technique for blasting-off-the-solid. The technique envisages use of decking in explosive cartridges with air column in between for distribution of explosive energy over a greater length of the shot hole to improve pull, powder factor, detonator factor and fragmentation. It will help to increase the pull for optimum utilization of men and machine. Decking of cartridges is being used in opencast mines all over the world. But, multiple initiation in a single hole is not permissible in underground coal mines because of DGMS stipulation. Based on the studies in the laboratory as well as in coal seams, it has been observed that air gap sensitivity of permitted explosives i.e. capacity of transmitting the shock wave over an air gap from primed or donor to the receptor cartridges increases significantly with confinement. An explosive having only 2 cm-air gap sensitivity in unconfined condition may give an air gap sensitivity of over 50 cm in coal bed confinement. Thus a series of decked cartridges with intentional air gaps can be detonated with a single cartridge initiation. This property of increase in air gap sensitivity with confinement has been used by CMRI in spacer-aided-initiation technique for the first time in India. Trials carried out with this technique in blasting-off-the-solid method have shown promising result through improvement of about 50 percent pull with better powder factor and fragmentation.

Improvement of stowing rate

Depillaring operation in conjunction with sand stowing is being carried out in two collieries. But the rate of stowing has been observed by CMRI to be very low due to

incorrect hydraulic profiles, faulty mixing trough, absence of stool bends, too many leakages, etc. On the basis of inspection of stowing range and necessary investigations, modification of existing mixing trough and stool bend design, proper screening arrangements, reduction of bends, etc, have been suggested by CMRI. As a result more than 50 percent improvement in stowing rate has been achieved by the implementation of the above mentioned modifications.

Development of hydro-mechanical steel cog

Wooden cogs and some box-type steel cogs which are used to support goaf edges, slices and junctions of Indian underground coal mines are having the limitations as they can not be extended for more heights and can not provide required setting load. Moreover, withdrawal system of these cogs is completely manual. CMRI has developed a novel design of steel cog, commercially named as hydro-mechanical steel cog, which can provide a setting load from 5 to 10 t. It can be extended up to a height of 4m and has the facility of withdrawal system with mechanical advantage. The load bearing capacity of this cog is 40t which is highest amongst its class. The design of this device has been patented. The know-how developed has also been licensed for commercial exploitation.

Spray forming of aerospace grade Mg-Alloy ZK31 (Mg-Al-Zn)

The spray deposition of Mg-alloy is very challenging primarily because of their extreme reactive nature and strong affinity for oxygen to form MgO, which is detrimental for its mechanical and other properties. Mg-alloy, AZ31 (Mg-Al-Zn) has been successfully spray deposited at NPL by disintegrating liquid melt by a stream of Argon gas and depositing the atomized gas through atomization in an inert atmosphere. It has been possible to spray deposit Mg-alloys devoid of any MgO phase, as suggested by the X-ray diffraction results. The microstructure of the spray formed deposits indicated equiaxed grains with no indication of any dendritic features normally observed with conventional cast alloys, which is due to the unique rapid solidification mode associated with spray forming.

Design and simulation of phosphosilicate glass antireflection coating for solar cells

Phospho Silicate Glass (PSG) is grown *in situ* on the heavily doped n^+ front emitter during diffusion of phosphorous in p-Si at temperature range 800-900°C using $POCl_3$ liquid dopant source. NPL conducted study provided an insight to the growth rate of the PSG and incorporation of phosphorous into silicon dioxide. This results in the change in refractive index of the PSG and makes it suitable for application as antireflection coating for silicon solar cells fabricated by P-diffusion in p-Si by the above process. It will allow one to use the PSG which is grown *in situ* over the n^+-

emitter region during the formation of p-n junction structure based silicon solar cell using p-Si wafers to use as a low cost antireflection coating on these solar cells.

Performance evaluation of Tri - Flo separator treating Indian coals

RRL, Bhopal has worked out an efficient coal cleaning technique known as Tri - Flo separator. The salient features include: two-stage separation in one pass; high sharpness of separation due to multi-stage cleaning; and lesser wear as solids have little contact with the body of the separator. A test rig of Tri-Flo separator was designed, fabricated and installed at RRL, Bhopal. Experiments were conducted on Tri-Flo separator using coal samples from Nandan area of MP and Moonidih area of Jharkhand at identical operating conditions. Based on these results, the performance of the Tri-Flo separator has been optimised. The results have indicated that the Tri-Flo separator can achieve organic efficiency as high as 97%. This effort was sponsored by Department of Coal through CMPDIL, Ranchi.

Energy Management Cell

Energy Management Cell has been established at CFRI Unit, Nagpur specifically, to provide total solution in energy audit and conservation which has benefited the industries in reducing their energy and financial bill. The cell conducts awareness programmes. About 15 major detailed energy audits have been conducted so far. The clients are likely to be benefited by the recommendations made in these reports.

S&T by CMRI

CMRI continued to extend testing, evaluation and consultancy services to the mining companies and mining equipment manufacturers in India and abroad dealing with explosives and accessories, mine ventilation and safety equipment, roof supports, personal protective equipment, flameproof and intrinsically safe equipment, electrical cables, mining and allied industrial components, wire ropes, cage and suspension gear components, aerial rope ways, etc, for their safe use in mines and other hazardous areas. Mine gases, metals, minerals, coal, etc, have also been analyzed by CMRI as the S&T services to various mining and allied industries.

1.8.2 HUMAN RESOURCE DEVELOPMENT

CFRI

- Study tour of M. Sc. (Geo) students of Jadavpur University was organized by CFRI to help students acquire the latest and updated S&T knowledge.
- Forty-two students benefited from the CPYLS programme held during the year for meritorious students of class X.

- Three training programmes on Training on Coal Quality and Analytical Methods for Coal Analysis were conducted. Participants from NTPC and assistant chemists attended the trainings.

1.8.3 RECOGNITION & AWARDS

NRDC Technology Award 2002 for "Low Cost Environment-Friendly and Energy Efficient Device for Production of Soft Coke"	Dr. S. K. Hazra and Shri P. Sengupta, CFRI

1.9 PHYSICAL AND EARTH SCIENCES & TECHNOLOGY

1.9.1 SCIENCE, TECHNOLOGY & SERVICE

Advance forecasting of cyclone track using a global circulation model

Relatively rare but a regular component of our climate system, tropical cyclones pose a serious and growing threat to many coastal areas world over; there is increasing demand for better accuracy as well as longer range for tropical cyclone forecasts. There are also issues, such as the effect of an intense system like a tropical cyclone in the embedding large-scale environment, that cannot be properly addressed using Limited Area Models (LAM)—the traditional tool for dynamical forecasting of cyclones. Simulation experiments carried out at C-MMACS showed that a relatively new class of Global Circulation Models (GCM), combining the advantages of LAMs and global models, can provide both longer range and better accuracy for such critical parameters like track and intensity. For seven cyclones representing different locations, seasons, years and strength, simulated tracks and land-fall locations show, with initial condition more than 5 days ahead and only monthly climatology of sea surface temperature (SST), less errors than those from current operational forecast 48 hours in advance. Other interesting features of the simulations include selective intensification from multiple incipient systems. The results opened up a new approach to forecasting as well investigating dynamics of tropical cyclones.

Experiments at C-MMACS were designed, taking into account that tropical cyclone formation has a strong seasonality that varies from one basin to another. For the Bay of Bengal the occurrence of tropical cyclones has a secondary maximum in May and a primary maximum in the October-November period. Two strong points of the simulations were considerably longer lead and relatively low error in track and landfall forecast. The errors in 7-day simulations were often smaller than 5-day simulations. The consistent performance of the model for different conditions with only climatological SST made it an attractive tool for tropical cyclone forecasting. In an actual application one could generate multiple forecasts, each for an ocean basin, with a grid that has been critically evaluated for the basin. Future studies both for more rigorous validation as well as for improving forecast skill are necessary and are under progress. To address the former point, increase in the size of the hindcasts and inclusion of other important parameters like rainfall and intensity in the evaluation process has been planned. For the latter, improvement through higher resolution, better choice of schemes etc. is possible and is under investigation.

Establishment of continuous recording GPS systems in north eastern region

GPS Geodesy is used all over the world to monitor seismotectonic activities. IGS (International GPS Service for Geodynamics) is a coordinating agency which maintains

a GPS tracking network of 300 permanent stations all over the world. The data of these stations and their precise positions and velocities along with precise orbits of satellites is made available to the GPS user community through global archives of IGS. Many countries have established their own national GPS networks for earthquake hazard, based on the IGS network. Department of Science and Technology (DST) of Government of India are in the process of establishing such a National network with participation from various research and academic institutions. As a first step towards it, C-MMACS had established five permanent GPS stations at Bangalore, Kodaikanal, Ladakh, Hanle and Almora in collaboration with Indian Institute of Astrophysics (IIA) and G.B. Pant Institute of Himalayan Geology (GBPHIED). Six permanent GPS sites were established by C-MMACS in the north-east India during 2002, which form part of the national network of GPS stations envisaged by DST for monitoring the geotectonic activities in the Indian subcontinent. These stations were set up in collaboration with local Universities in the north-east. These sites were chosen so as to answer specific questions related to Indo-Burma Convergence, and the tectonic relationship of the Shillong Plateau with the Himalayas. The GPS derived velocities of these sites form a key input for the earthquake hazard quantification of the north-east. The GPS data collected will give precise coordinates and velocities of these sites which can be used as reference coordinates for the regional campaign mode GPS surveys in the north-eastern region. Also the Zenith troposphere delay derived by analyzing the GPS data at these sites can be used for the calculation of perceptible water vapor in the atmosphere. On a plate tectonic scale these sites provide valuable information on the Indo-Burma convergence and also the convergence and strain accumulation in the eastern Himalayas.

Freshwater flux climatology over the Indian Ocean

In recent years, there has been increased interest in the study of air-sea fluxes in general and freshwater flux in particular over the tropical oceans, as it plays a major role in the oceanic transport/circulation. Very little is known about it for the data sparse regions like the Indian Ocean due to the non-availability of the basic parameters needed for the computation of freshwater flux. Over the Indian Ocean, the precipitation estimates are totally lacking or unknown due to the lack of *in-situ* measurements. Climatology and the annual cycle of the freshwater flux over the Indian Ocean have been examined by NIO using the newly available Hamburg Ocean Atmosphere Parameters and Fluxes from Satellite data (HOAPS). The climatological estimate of precipitation from HOAPS is able to depict the mean annual patterns over the tropical Indian Ocean much better than the microwave estimate, even though the sampling was not as good as for a geostationary satellite. The annual cycle of freshwater flux shows that the Bay of Bengal is a moisture convergence region most of the year as compared to the Arabian Sea, which is a moisture flux divergence region. Further the build-up of moisture in the southern Indian Ocean is also clearly seen from March to June, indicating its major role in the summer monsoon activity over the Indian subcontinent.

Offshore limit of coastal ocean variability in the eastern Arabian Sea

Continental shelf is generally considered as the region where very large variations in coastal water characteristics occur due to a variety of physical processes active in the area. Therefore, the shelf break is generally seen as the offshore limit of variability of the coastal water characteristics. In the eastern Arabian Sea, since the shelf width ranges from 50 km in the southern part to about 140 km off Mumbai region, the shelf width scales have generally been considered for defining the coastal variability limit. However, recent hydrographic observations in the eastern Arabian Sea provided evidence to show that the variability limit could extend beyond the shelf edge into the deep ocean. Based on hydrographic observations and satellite altimeter (TOPEX/ Poseidon) information, vertical sections of temperature from two contrasting seasons – south-west (SW) and north-east (NE) monsoons – when projected together by NIO are found to intersect offshore at 350-400 km from the coast along a transect in the eastern Arabian Sea during 1996. Formation of such intersections along transects from south to north in the entire eastern Arabian Sea is noticed in the hydrographic data of 1987-88 also. Existence of these intersections has further been authenticated by the altimeter-derived sea level anomalies.

Reconstruction of late quaternary monsoon oscillations

The sedimentary records from continental margins represent an ideal archive to study various sedimentary processes and for deciphering the past fluctuations in the climate system and possible forcing mechanisms. The nature and composition of clay minerals thus accumulated is expected to provide valuable information on the type and intensity of weathering on land. Although several factors influence the ultimate distribution of clay minerals in the ocean, a careful and independent evaluation of these processes carried out at NIO indicated consistent climatic signals on clay minerals. The clay mineral records of the cores document a generally weak summer monsoon condition and resultant reduced hydrolysis activity during the last glaciation, which was interrupted by discrete events of humidification at ~28000 and 22000 yr BP. Precipitation and terrigenous input increased considerably between 15700 and 14800 yr BP, indicating a regional climatic augmentation during the early deglaciation.

The phosphorite story: "Present is key to the past"?

Studies carried out by NIO on the quaternary phosphorites of the continental margin off Chennai indicate that the bottom dwelling microbial mats which thrived on the shallow shelf during the low sea level conditions are responsible for phosphatization. The bacteria associated with the decaying microbial mats utilized phosphorous supplied by continental sources and rapidly precipitated phosphate. The availability of a high percentage of phosphorous in seawater seems to be an important controlling factor for the formation of phosphate stromatolites. The composition of

these phosphorites differs from the modern phosphorites in upwelling regions, but are similar to the ancient Cambrian (~500 Ma) apatite stromatolites. This constitutes evidence that they could have formed under similar conditions. More importantly, this similarity also provides a valuable insight into the environment of formation of ancient phosphatic deposits. While it has been the opinion of majority that the modern phosphorites are of inorganic origin, NIO study reveals that the *microorganisms are the key players in both modern and ancient phosphatic deposits.*

Estimation of sea surface salinity in the Bay of Bengal

Sea surface salinity (SSS) has not been monitored from space so far while satellite measurements of the sea surface and the lower atmosphere have become an integral part of the global observing systems. A SSS product measured from satellite would enhance the availability of salinity measurements in par with the larger number of sea surface temperature (SST) observations. NIO has developed a new technique for retrieval of sea surface salinity (SSS) from space-borne satellite measurements of Outgoing Longwave Radiation (OLR) through the 'Effective Oceanic Layer (EOL)'. It is envisaged that the SSS estimated in this way may be useful in improving the existing climatologies at least for those parts of the world ocean where intense convection is the regular feature, such as the tropical Indian and Pacific Oceans. In this method EOL parameter, representing the thin upper oceanic stratified layer takes into account both temperature and salinity for linking the convection in the atmosphere. EOL is estimated in the top 30 m, as the depth of the shallow stability maximum varied between 20 m and 40 m in the Bay of Bengal.

Mercury and lead tolerance in hypersaline sulfate-reducing bacteria

Microorganisms contribute to the biogeochemical transformations of metals and organic matter. The anaerobic sulfate-reducing bacteria (SRB) play a significant role in coastal ecosystems where more than 50% of biodegradation takes place through sulfate-reducing activity (SRA). Saltpans are sites where different ions, including metals, become concentrated. Studies on metal microbe interactions are generally restricted to aerobic bacteria, anaerobic consortia and sometimes to mesophilic SRB. Studies at NIO of a few hypersaline isolates of SRB with Hg and Pb at elevated concentrations of the metal salts showed that sulfate-reducing bacteria (SRB) HSR1, HSR4 and HSR14 isolated from the salt pans of Goa grew best at 90-100% salinity on substrates like formate, acetate, lactate, butyrate, ethanol and benzoate. They were gram negative, non-sporulating, non-motile rods lacking in desulfoviridin and cytochromes. The HSR1 and 14 were tolerant of both the test metals up to a certain concentration. At the end of 14 days, growth was on par with the control in the presence of Hg although the concentration of Pb was double that of Hg, HSR4 could grow and respire better. The hypersaline SRB have adapted to grow under extreme environmental conditions, although their habitat for isolation may not necessarily

reflect their ability to tolerate and proliferate under adverse conditions. HSR4 was more adapted than the other two. Some of these forms could prove useful to mitigate high levels of toxic metals. Some highly toxic forms of elements and compounds can be biotransformed to innocuous forms through reductive metabolism by anaerobes.

NIO led marine archaeological explorations

- ***Mahabalipuram:*** Explorations at Mahabalipuram (near temple region) – famous for its fabulous art and architecture of Pallava dynasty, on the east coast of India, brought to light a large number of man made stone structures at water depths of 5 - 8 m. The important structures found include walls, steps and platforms. Based on the coastal archaeological data, the date of construction of these structures could be assessed to be in between 1500 and 1200 years BP.
- ***Goa Waters:*** Explorations of shipwreck at Sunchi Reef in Goa waters, found Chinese ceramic, Martaban pottery, round bases of wine bottles and neatly trimmed stone bricks. A brass metal tube (artefact) 56 cm long which could be part of a telescope, viewfinder or blunderbuss or gun was also retrieved. The Martaban pottery collected from Sunchi Reef are similar to those found in Mombasa wreck. The Thermoluminescence age of Martaban pottery, collected earlier, is deciphered to be 360$\pm$ 40 years. These findings indicated that the wreck pertains to the Portuguese period.

Gas-charged sediments and gas hydrates in the western continental margin of India

The western continental margin of India is biologically highly productive. Organic matter deposited in such environments is diagenetically transformed by bacteria and/or heat and break down to methane and other organic compounds. Thus, the main source of methane hydrate formation is from organic matter and it is 6-7% of organic matter on the continental slope and 2% in the deep Arabian Sea sediments. Nearly 30,000 line kilometer echosounding, high-resolution shallow seismic data were collected by NIO along track lines spaced at 20 km interval across the western continental margin of India and analyzed. Occurrence of methane-bearing gas-charged sediments and pockmarks in the shelf and gas hydrate horizons along the slope and rise was deciphered. Significant contributions of gas from the slope sediments to the upper strata and the overlying waters are indicated by buried/exposed pockmarks and the prominent plumes are represented by strong echoes in the sediments. These pockmarks occur as conical and dish-shaped incisions often truncating the strata above the sub-bottom reflector. Distinct gas plumes rise from a few meters to about 70 m above the seafloor. The existence of an acoustic turbid zone beneath the pockmarks and a continuous supply of gas from below towards the pockmarks indicate the sediments as gas-charged. The presence of bottom simulating reflectors (BSRs) in slope-rise areas off Goa suggest the presence of gas hydrates in water depths >500-

2200 m. Over the Laccadive ridge complex, BSR lies at about 460 milliseconds below the seabed where the water depth is found to be nearly 2000 m.

Indian marine bivalves: potential source of antiviral drugs

Marine bivalves are abundant in coastal and estuarine waters of India. Here bivalve fishery is constituted mainly by clams, mussels and oysters. Molluscan fishery is not well-organised along the coast. They are exploited in large quantities by traditional methods and sold live in the market for human consumption. NIO carried out investigations with Russian scientists showed that Indian green mussels (*P. viridis*) are not only a rich source of protein for human consumption, but also a potential source of antiviral drug. The extract from the mussel showed high antiviral activity when tested with various viral strains such as influenza, hepatitis, RSV and herpes.

Understanding gondwana land

Palaeomagnetic studies were undertaken by NGRI on Govindgarh sandstones, Upper Rewa Group of Vindhyan formations and Trans-Aravalli Marwar Supergroup Jodhpur sandstones from central India. The data generated reveal that they are contemporary. This indicates that India forms a tectonic trio with Madagascar and Seychelles in the Rodina Supercontinent at around 750 Ma ago.

Groundwater sanctuary

Studies have been carried out by NGRI in low rainfall, groundwater overdraft hard rock granite terrain of Gurukanipalli Watershed, Chittoor district, A.P. These efforts have resulted in evolving groundwater sanctuary in the waste land part of catchment area for meeting the water requirement of problem villages. The village water supply has been commissioned under gravity and siphoning without depending on energy.

Geochemical baseline map

Geochemical baseline maps have been prepared for the first time in Cauvery basin for environmental management as a part of Global Baseline Program. These maps will be helpful in finding out the future contamination due to anthropogenic sources.

Geotechnical investigations by NGRI

NGRI systematically undertook diverse geotechnical investigations during the period:

- Applied for the first time the multichannel analysis of surface waves (MASW) method for geotechnical investigations and microzonation studies in the country;

- Conducted surveys to determine depth of the bedrock, P and S wave velocities information and dynamic elastic properties for the underground rail corridor to be constructed by Delhi Metro Rail Corporation;
- Undertook study for laying of two pipelines, by Gas Transportation & Infrastructure Company Limited from Jamnagar to Bhopal; and Goa to Hyderabad for transportation of hydrocarbons;
- Conducted surveys for Damodar Valley Corporation (DVC) for the construction of Unit-IV power generating unit (210 M/W) site at Mejia, West Bengal.

Surface modification and phase stabilization in nanophase materials

Extensive X-ray photoelectron spectroscopic studies have been undertaken to understand the role of surface modification in the nanophase stabilization of several electronic materials. Study conducted at NPL reveal that the Cu_2O nanoparticles are stabilized by the formation of a CuO cap surface layer of thickness of 1.6 nm. Electronic structure studies show effect of electron confinement and formation of defect states that pin the Fermi level. Electronic excitations by Dense Swift heavy ion irradiation of these CuO stabilized Cu_2O nanophase is demonstrated to be useful to tailor the structural and optical properties of nanocrystalline Cu_2O phase, without destroying the nanocrystallinity. The monoclinic CuO phase transforms to the cubic Cu_2O phase. It has been also shown that the presence of a $CdTeO_3$ layer modifies the crystal structure of the CdTe nanoparticle core by introducing a large number of stacking faults. The $CdTeO_3$ cap in case of the cubic CdTe is amorphous and is crystalline for hexagonal CdTe. Thus, a structural transformation in the nanoparticle core mediated solely by surface effects has been observed for the first time in any nanoparticle system. Due to large surface area of Gd nanoparticles, the interaction of gaseous species with rare earth metals is expected to be enhanced resulting in large changes in hydrogen sensing characteristics of nanoparticle films capped with a polycrystalline Pd over-layer. A detailed study at the Pd-Gd interface clearly demonstrated the suitability of using nanophase Gd for hydrogen sensors and storage.

Coherent procedure for calibration of force transducer

The force transducers (measuring/proving instruments) all over the world are being calibrated periodically to establish national traceability either through NMI of the country or through accredited laboratories. In the era of growing awareness of quality assessments, MRA demands that the calibration data and its analysis should be acceptable to the member countries of MRA. This is possible only if the procedures adopted to calibrate and analyze the data are similar in all respects. The situation however, is not that conducive, as different countries follow different standards for the calibration of force proving instruments used for verification of the testing machines. For example, USA follows ASTM standard, Europe follows EN and in Asia

standard procedure based on ISO are followed. The major differences in these calibration procedures lie in the number of force cycles taken at same position or at different positions, loading regime/sequence, method of calculating the interpolation error, etc. Studies have revealed differences in calibration data under identical conditions following the different calibration procedures. The need was thus felt to evolve a coherent written calibration procedure, which may incorporate the salient features of most of the prevalent written calibration standards.

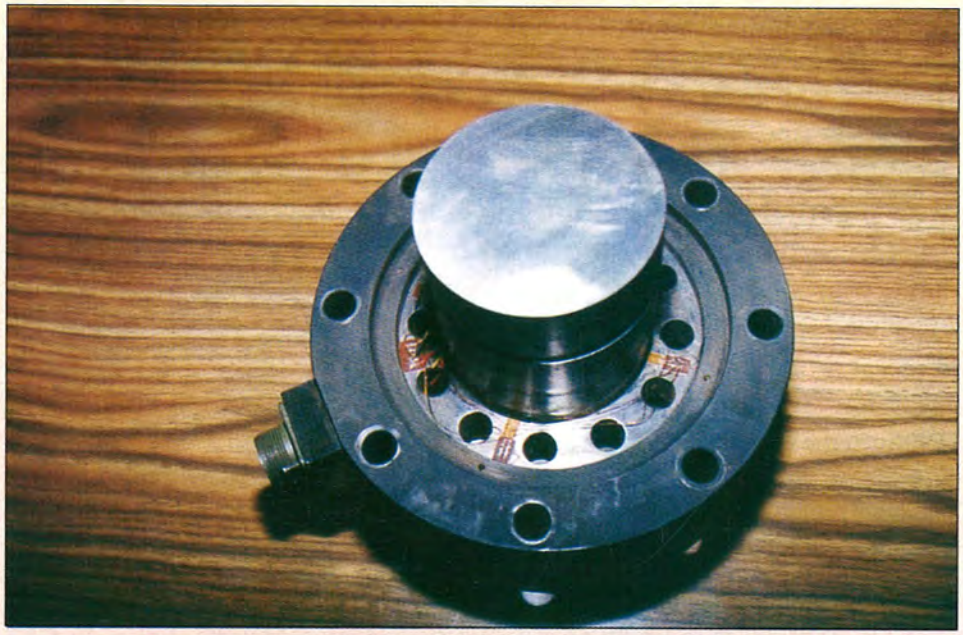
A detailed investigation was carried out at NPL to calibrate a well-characterized force transfer standard of 5 kN full scales on the newly developed 5 kN dead weight force machine following the different written calibration standard procedures viz. ISO 376-99/EN 10002-3-1994, IS 4169-1988 and ASTM E74-2000. The data has been analyzed, and a coherent calibration procedure has been proposed. In the said procedure six force cycles are taken, three of these at one position enabling evaluation of type A uncertainty, which has not been taken into consideration in the standard procedures. Further, the minimum deviation of the calibration data from the interpolation curve obtained with the procedure as compared to that obtained following other standard procedures proves the superiority of the proposed procedure. The proposed procedure, if accepted for calibration of force transducers, uniformity in force measurement would be brought about at international level leading to mutual acceptability of calibration procedures and hence the calibration report followed by different countries. Further, it would help in bringing about uniformity and ease of trading in force standard machines manufactured by different countries, which hitherto are based on the calibration procedures adopted by respective country.



New 5 kN dead weight force m/c developed by NPL – useful for calibration of force transducers of International quality

Precision force transducers

NPL has designed and developed novel precision strain gauge force transducers based on an axe-symmetrical diaphragm pierced by a number of holes. It is for lowering down the measurement uncertainty in force measurement and improving the reproducibility of the transfer force standard. The spring element has been designed to act as multiple bending beams arranged symmetrically around the axis for transverse force stability. A finite-element software has been used to optimize the design of the force transducers in the ranges 100kN, 200kN and 500kN.



Designed & developed by NPL, new Precision Force Transducer reduces uncertainty in force measurement

Upgradation of standards and calibration facilities

NPL has been maintaining the national standards of various electrical and electronic parameters and disseminating them throughout the country by providing apex level calibration and testing. Several standards and calibration facilities have been upgraded viz. AC & LF power (single phase), primary standard of AC & LF voltage (1-3 V), reference standard of AC & LF voltage, AC high current ratio (50Hz), LCR measurements at high frequencies (75 kHz – 30 MHz), and DC resistance. To fulfill the obligation under global Mutual Recognition Arrangement (MRA), NPL has participated in several Key and Supplementary Comparisons of Standards under BIPM and APMP to establish international equivalence of its standards. So far 38 intercomparisons have been included in Appendix B of BIPM database. 456 entries for Calibration & Measurement Capabilities (CMC) in the area of Electricity & Magnetism have been accepted for inclusion in Appendix C of BIPM database.

1.9.2 HUMAN RESOURCE DEVELOPMENT

NGRI

Training programmes on water harvesting and artificial recharge methods - their applications in drinking water supply programmes were organised for the officers from the states of Rajasthan, Himachal Pradesh, Punjab; Haryana and Andhra Pradesh.

NIO

- A capsule course in oceanography was conducted for Naval Officers.
- Two personnel from Ghana were trained in meteorological and oceanographic instrumentation. This was followed by supply of NIO designed tide gauges and weather stations to Ghana.
- Provided 3 months internship to 4 students from National Higher Engineering School of Limoges (ENSIL), France, on aspects of marine corrosion and biofouling.

1.9.3 RECOGNITION & AWARDS

Fellow, Geological Society of India, Bangalore	Malay Mukul, CMMACS
National Mineral Award	Dr. S.N. Prasad, NGRI
CSIR Young Scientist Award 2002	Dr. V. Chakravarthy, NGRI
Special award of DOD for the contribution to scientific studies being carried out by NGRI in Antarctica.	L. Prem Kishore and I.P. Raju, NGRI
FICCI Award	Dr. V.P. Dimri, NGRI
CSIR Young Scientist Award for the year 2002 in Earth, Atmosphere, Ocean & Planetary Sciences	Dr. Shankar Doraiswamy, NIO
Fellow of the Indian Academy of Sciences, Bangalore	Dr. Purna Chandra Rao, NIO
National Mineral Award by the Ministry of MinesSubrahmanyam, NIO	Dr. Vandrapu Coal &
S.S. Merh Award – 2002 by the Council of Geological Society of India	Dr. Pothuri Divakar Naidu, NIO

Antarctica Award—by Department of Ocean Development to the participants of First Indian Expedition and the First Wintering Expedition	Drs. S.Z.Qasim, (Leader of the Expedition), H.N. Siddiquie, Dy. leader (posthumous award), R.Sen Gupta, Ehrlich Desa, A.H. Parulekar (posthumous award), S.G. Prabhu Matondkar, Shri M.C.Pathak and D.V.Ramaraju, NIO
Scientist of the Year Award-2001 by National Environmental Science Academy, New Delhi	Dr. Zakir A. Ansari, NIO
ISHEER Award (Indian Society of Health Environment Education and Research Award for excellent contributions in popularization of Ocean Science through Hindi	NIO

1.10 SCIENCE & TECHNOLOGY FOR THE SOCIETY

Bio-villages: geranium as catalyst of green hope

CIMAP signed MoU with Technology Information, Forecasting and Assessment Council (TIFAC), New Delhi, last year for commercial cultivation of geranium in Uttaranchal, through community participation, in an end-to-end mission. Under this scheme, entitled "Technology dissemination, commercialization and utilization of Geranium (*Pelargonium graveolens*) cultivation through processing and value addition of end products in Uttaranchal at bio-village level", CIMAP has demonstrated the cultivation of geranium in Kumaon region of Uttaranchal in 46 farmers' field during the crop year 2001-02. Installation of distillation units and harvesting of the crop for distillation was also done. Three distillation units were designed, fabricated, installed and commissioned, one each at the geranium bio-village sites, i.e., Someshwar, Dangoli and Gagrigol in Uttaranchal to facilitate the distillation of the crop produced in the respective bio-villages. Quality planting material was generated on a large scale at CIMAP research facilities and transported to beneficiary farmers at Uttaranchal. The germplasm will be multiplied *on site* in the selected bio-villages for expansion of cultivation.

Forty-six farmers of Almora and Bageshwar were inducted into the project in its first phase. They produced quality geranium oil from their fields. About 19 tonnes of geranium biomass produced was distilled to produce about 20 kg oil, with 0.1% recovery. Oil samples were evaluated at CIMAP. The marketing of the produce was arranged as per commitment. To mark the occasion, Shri Bachi Singh Rawat, Hon'ble MoS, Govt. of India, handed over a part of the oil to industrialist Ramakant Harlalka, on 4th August, 2002 in a function held at field station, Purara. Efforts were on to establish bio-village clusters in Uttaranchal leading to the social transformation through mediculture-based entrepreneurship in the state. This move, to attain self-sufficiency, bears importance in view of Indian imports of about 140 tonnes of geranium oil, which will be substituted by home grown geranium oil in the northern hills.

In the second and third phase of the project, 229 farmers were identified from eight villages in Almora, Nainital, Bageshwar and Chamoli districts. One tenth of the total planting material has been supplied to the farmers as resource plants which will be multiplied *on site*. Fourteen farmers received training to multiply the planting material. These farmers have also gained sufficient knowledge on plant protection measures. Six villages have been identified for the installation of low cost distillation units to process geranium herb in the project area. One village, Gwaldam, has been earmarked for the near organic cultivation of geranium. In total, 42 vermicompost pits have been constructed in farmers' field in this village. Scientists provided all possible help to the beneficiary farmers covered under the project and collected soil and yield data.

S&T for employment generation for women

In order to promote employment generation among women Self Help Groups (SHGs), CECRI has adopted 'Perungondan Viduthy Village Panchayat' at Pudukkottai District, Tamil Nadu. A cashewnut industry is being set up. District Rural Development Agency (DRDA), Pudukkottai will be providing funding for this effort.

Ceramic membrane based technology for removal of arsenic and iron from contaminated ground water

CGCRI has developed a ceramic membrane based technology for simultaneous removal of arsenic and iron from highly contaminated ground water. The process developed removes arsenic down to <10 ppb - the level specified by WHO and iron content below 0.1 ppm (WHO specification is 0.3 ppm). A pilot plant was installed at Akrampur, Barasat, West Bengal in collaboration with Public Health Engineering Directorate (PHED), Govt. of West Bengal where ground water containing arsenic 0.9-1.3 ppm and iron 5-12 ppm is being treated successfully to produce safe drinking water conforming to the WHO specifications. About 500 litres of safe drinking water is being produced daily and distributed to the local inhabitants. Being satisfied with the performance of the above pilot plant unit, PHED, Govt. of West Bengal has approached for installation of more units with higher capacity (2500 LPD) in different parts of arsenic prone areas of Barasat Municipality. Installation of the units was in progress.



Pilot plant using ceramic membrane technology developed by CGCRI for removal of arsenic from contaminated ground water

Lead-free Jaipur blue pottery

CGCRI Naroda Centre has developed body composition, engobe and matching glaze totally free from lead and other toxic ingredients present in the raw materials used for making traditional Jaipur blue pottery. This has been achieved without sacrificing original aesthetic appeal but drastically reducing the rejection of the wares. It has opened up greater export potential by way of elimination of lead in the product and achieving greater cost-effectiveness. The technology has been transferred to Rural Non-Farm Development Agency (RUDA), Jaipur for disseminating the same to the blue pottery artisans of Jaipur and several other regions of Rajasthan. The Govt. of Rajasthan has since released the technology to them and CGCRI Naroda Centre has provided active technical support for successful implementation of the technology in those areas. The artisans have since started routine production of crockery and several other diversified products with better market potential.



Environment friendly Lead-free blue pottery of Jaipur based on CGCRI technology

Improving quality and yield of salt recovered from Sea/inland brines by the marginal salt producers in Gujarat

About 50% salt produced in the country is in the unorganized sector. The marginal salt producers across the country are unaware about the correct methodology of salt manufacture and hence the quality of salt produced by them is not up to the desired level. The price derived by them for their produce is thus much lower. CSMCRI along with other Government and non-Governmental Agencies like Rural Technology Institute Gujarat (RTIG), and Self Employed Women's Association (SEWA) analyzed the problems being faced by marginal salt producers across Gujarat State. Periodical training programmes are being arranged at various places of Gujarat to make the Agarias aware of the importance of producing quality salt. CSMCRI imparted training to the marginal salt producers in South Gujarat and established a model salt works at Dharasana Village in Valsad District with the financial support from RTIG. Taking this as a model farm, the marginal Agarias were able to produce good quality industrial grade salt from sea brines, which was sold to user industries at a much higher price.

The revenue earned by the agarias was almost double as reported by the Cooperative Society at Dharasana.

Desalination by Reverse Osmosis

- **Prototype RO plants for long-term field study:** Under the DST sponsored project, CSMCRI installed two RO plants of 2000 liters/hour capacity, one each at Kalyanpur village of Bhavnagar district, Gujarat and Kasari village of Jhunjunu district, Rajasthan. The plant has six spiral elements each of 100 mm dia × 1 m size made from our TFC membranes. The pilot plant in Gujarat is operating with 10,000 ppm brackish water to give about 600 ppm water with 94% salt rejection. The pilot plant installed in Rajasthan is treating brackish water of about 2200 ppm TDS to give a potable drinking water of about 250 ppm TDS with 90% selectivity.

- **Development of Solar Powered R.O. unit**: Two solar powered R.O. units of 8 l/hr and 15 l/h capacity were designed and fabricated on behalf of Rajiv Gandhi National Drinking Water Mission (RGNDWM). One unit was installed at Science Park, Jaipur for publicizing and promoting the concept while the second unit was installed for conducting field trials in Bahadurvas village of Jhunjunu district, Rajasthan. Both the units are operating with the help of two solar photovoltaic (PV) panels.



Solar powered R.O. unit developed under Rajiv Gandhi National Drinking Water Mission

- **Animal powered R.O. for brackish water desalination for village community:** CSMCRI has developed a unique water desalination system, which uses animal energy to energize the high-pressure pump to effect brackish water desalting by R.O. process. The desalination system, which runs on animal power, consists of speed increaser, high-pressure pump and membrane modules. The above system can produce 300-500 liters/hr product water from feed water whose TDS is in the range of 3000-5000 ppm.



Animal powered R.O. plant for village developed by CSMCRI

Pesticide removal unit for producing potable water free from organic pollutants

NEERI has developed a unit for producing potable water free from organic pollutants viz., ¡-HCH, p,p'-DDT and p,p'-DDD and p,p' - DDE, total coliforms, faecal coliforms, turbidity and total organic carbon (TOC). The unit is tap attachable and has the capacity to store treated water, consumes no electricity and is easy to operate and cost-effective. It comprises of two cylindrical shaped interconnected chambers. The filter materials incorporated in the unit are indigenous GAC as an adsorbent for OCIPs and TOC, and sand-iodine mixture as a disinfectant medium for coliforms. Efforts are in progress to extend the application of the system for the treatment of other priority pollutants in water and modifications in its design aspects.

Fluoride mapping

NGRI carried out systematic mapping of fluoride in Rajgarh tehsil of Rajasthan. The study revealed pockets of higher concentrations. For these pockets remedial measures were suggested to help improve the quality of ground water. The studies also delineated the buried Kandli river course in the region.

Polymer modified concrete

CECRI has developed a water soluble polymer to improve the miscibility and workability of resin based concrete. The polymer was used as an admixture and evaluated in various mechanical and corrosion tests. The polymer modified concrete is found to be superior in property when compared to ordinary portland cement concrete. Water soluble system has been developed to minimize the pollution due to evaporation of solvent as in the case of resin based mortar.

Eco-friendly process to combat fouling - an alternative to antifouling paints

An eco-friendly process to combat fouling has been developed at CECRI. Unlike the conventional fouling prevention methods, in this system no chemical or hazardous substance is used to combat fouling. This system does not warrant dry-docking, as fouling is prevented completely. Hence the exchequer of dry-docking and the business loss due to the inactivity of the vessels, are prevented. The fouling proof nature of the system not only conserves fuel but also enhances the efficiency of the marine installations. The fouling proof and eco-friendly nature of the system, completely eliminates the release of toxic ions from operating vessels and emission of pollutants during dry-docking compared to the existing antifouling systems.

Development of sensors

CECRI has developed an analytical methodology for the quantitative estimation of sub-milli-molar levels of the anti-microbial agent triclosan. The methodology has been integrated into a prototype sensor for use in personal care products. For ELFE sensors for underwater applications, electrode pairs with extremely low self-noise levels (nanovolt) have been developed. The electrode pairs also show near-identical characteristics (differential voltage signal £ mV). The fabrication of electrodes is optimized with regard to the choice of electrolytic bath constituents, metal purity and addition agents. Electrode characteristics have been optimized for different sizes and shapes. ELFE sensors are strategically important from their naval applications and hence the indigenous development of the electrodes for the above sensor assumes high importance.

Dynamics of the interfacial protection using redox property of Electronically Conducting Polymer (ECP)

CECRI has provided a new insight into the understanding of the corrosion protective action of the redox features of ECP. It would help in modulating the ability of redox functionality of the polymer. The protocol evolved in this finding facilitates simple and easy screening of potential candidates of ECPs for corrosion protection role of the desired substrate. The Al/Al_2O_3/polyaniline interface in corrosive medium

has been examined through AC impedance spectroscopic analysis whose experimental data has been simulated using equivalent circuit model. Diagnostic approaches on nature and type of protective role especially for polyaniline at corroding Al interface have been evolved. This type of synergization of experimentally observed values and simulated values have provided a new platform for predicting the protective action of ECP in general, polyaniline in particular for the first time.

Corrosion resistant portland pozzalona cement

CECRI has standardized a process which involves addition of suitable organic and inorganic inhibitors in powder form while blending fly ash with portland cement during the manufacture of portland pozzalona cement at the blending stage. Development and evaluation studies have indicated that the addition of suitable inhibitors, the durability factor against corrosion of steel rebars has been increased by several times due to excellent corrosion resistant property of this product even in severe environment. The synergistic effect of the inhibitors offer better passivation to the steel reinforcement embedded in such concrete inspite of the lower alkalinity of the portland pozzalona cement. This process serves the dual purpose of disposal of waste product viz. fly ash and utilization of the same for durable construction even in severe corrosive environments. The product has been commercialized.

Cadmium plating on maraging steel parts of SARAS and LCA

The cadmium plating on wing flap tracks made up of maraging steel is being carried out using the technology developed at CECRI for plating on maraging steel using a hydrogen embrittlement free cadmium plating solution. The wing flap tracks of SARAS aircraft are made of maraging steel and nitrided for increasing its surface hardness. These components are cadmium plated for enhancing corrosion resistance. During cadmium plating the tracks are masked and remaining areas are plated and then chromated. Also cadmium plating on Light Combat Aircraft (LCA) uplock components, made of maraging steel, was successfully done by CECRI. The uplock system for the LCA designed by Aeronautical Development Agency (ADA) Bangalore consists of a variety of components of varying sizes made of maraging steel. These components are cadmium plated and chromated prior to assembly of the uplock. Suitable jigging and masking procedures were identified for the various types of components and about 1000 components processed. This technology has been transferred to Aeronautical Development Agency, Bangalore.

Clean technology park for electroplating units

CECRI and Science & Technology Entrepreneurship Development scheme (STEDS) jointly initiated steps to establish a clean technology park for electroplating units at Karisalkulam village near Madurai. A common effluent treatment

plant to serve all the industries is to be set up in this park. In order to implement quality management system, training will be imparted to persons from plating industries. Action on land acquisition and other formalities like EIA, NOC etc., is in progress.

Cultivation of aromatic plants and production of essential oil

RRL, Jorhat has implemented a DBT sponsored project entitled cultivation of aromatic plants and production of essential oils for earning the livelihood by the ST population of Arunachal Pradesh. About 135 families have benefited. The beneficiaries have covered about 300 acres of unutilized lands with initial free supply of 7.00 lakh citronella slips by RRL Branch Laboratory, Itanagar and its subsequent multiplication. Through this project, the people of Arunachal Pradesh have found a way of generating income out of so far unutilized degraded, jhum and waste lands. Seven citronella distillation units of 600 kg/batch were installed in six different villages for production of oil through seven registered Co-operative Societies. The societies purchased the citronella grass from the beneficiaries and produced about 14000 lit. of citronella oil for marketing and earned profit. Necessary market assistance has also been provided by the branch laboratory.

Marine sanitation device for "Kettuvallom"

A unique selling point for Kerala's tourism industry is its backwaters. An overnight ride and stay on a "Kettuvallom" houseboat is a highlight of a holiday in Kerala. The Kettuvallom was traditionally used for cargo transport using Kerala's extensive waterways. It is made from local materials; jackwood seasoned with fish oil and jointed using coir fibre. The kettuvallom and traditional boat building skills had become almost extinct with the dominance of road transport. Now the kettuvallom has been resurrected, outfitted with modern amenities including bed, bath, kitchen and solar power and has proven to be a unique tourist attraction. The disposal of sewage from Kettuvallom, however remains an unsolved problem. Discharging waste into the same water used for swimming and fishing is obviously unattractive. It has the potential to damage the image of this unique tourist attraction, besides being a real public health issue. The Department of Tourism, Government of Kerala, contracted RRL,Trivandrum to design a "Marine Sanitation Device" (MSD) suitable for Kettuvalloms. RRL designed and developed a modular MSD. It was fabricated using rotomolded LLDPE technology. A prototype unit has been installed on board a Kettuvallom and was undergoing extensive testing. It could achieve complete treatment of houseboat sewage and sullage using a combination of biological processes. It is compact for underdeck fitting and its power consumption is limited.

2

CENTRAL MANAGEMENT ACTIVITIES

CSIR is a premier R&D organization. It has a dynamic network of 38 laboratories and 47 field/extension centres spread throughout the country. CSIR's expertise and experience is embodied in about 5,000 active scientists supported by over 10,000 scientific and technical personnel working with an impressive, state-of-the-art infrastructure. The R&D activities and affairs of the organization are managed by the Director General with the assistance of a multifunctional and multidivisional CSIR HQs., under the guidance and directions of the Governing Body (GB), and the Advisory Board (AB). The policy directions are outlined by the CSIR Society, which has Hon'ble Prime Minister as the President. The Central Management Activities during the year are described here in brief.

2.1 GOVERNING BODY (GB)

The Governing Body of CSIR met four times during the year i.e. on 1st May 2002, 3rd September 2002, 19th December 2002 and 17th February 2003. The GB in its meetings deliberated on several crucial subjects and gave direction on these issues:

- On 1st May 2002 in its 153rd meeting, the Governing Body approved: the setting up of a Recruitment and Assessment Board (RAB) in view of the modifications in Recruitment and Assessment Promotion Rules for Group IV Scientists in CSIR; revision and reinitiation of Bhatnagar Fellowship Awards; amendment of 'CSIR Service Rules, 1994' for recruitment of technical and support staff ; and recruitment of Civilian Pilot.
- On 3rd September 2002, in its 154th meeting, the GB approved: the programme for CSIR Diamond Jubilee Celebration; revision of annual financial ceiling for reimbursement/payment of subscription fee for becoming members of professional Societies/Bodies; and ratified the decision of Chairman GB for implementation of procedure and guidelines regarding disposal of unserviceable/obsolete and surplus stores and procedure for writing off the losses including the delegation of powers to the MCs of Laboratories/Institutes. It constituted a subcommittee to consider all investment proposals of CSIR during the TFYP; amended CSIR Administrative Services (Recruitment and Promotion) Rules –

1982; enhanced fellowship and contingency grant for JRF/ SRF/ RA. Approval was also given to: the enhancement of honorarium to experts invited by Human Resource Development Group (HRDG) for selection committee meetings of JRF/ SRF/RA/SRA etc.; renaming of Centre for Biochemical Technology (CBT) to Institute of Genomics & Integrative Biology (IGIB); establishment of Earthquake Engineering Laboratory at SERC and restructuring/reorganization of CSIR Finance and Accounts Cadre.

- In its 155th meeting, on 19th December, 2002, the key issues discussed and approvals were given to: amendment to CSIR Scientist Recruitment and Assessment Promotion Rules (CSRAP); delegation of power to Directors of Labora tories/Institutes to sanction TA to retired officers engaged as Emeritus Scientist/Distinguished Scientist/Adviser/Consultants etc.; and modification in the terms and conditions for appointment to the CSIR IPR chairs.
- On 17th February, 2003, in its 156th meeting, the Governing Body deliberated and approved: project proposals taken up by the New Millennium Indian Technology Leadership Initiative (NMITLI); Tenth Five Year Plan proposals under the ongoing scheme "National Laboratories"; CSIR Diamond Jubilee Research Intern Awards; Mobility of staff between CSIR and other organizations of autonomous nature; and Global Research Alliance.

2.2 ADVISORY BOARD (AB)

The Advisory Board is a high level think tank of CSIR which advises and provides S&T inputs to CSIR Governing Body and Society on major S&T issues. The AB was reconstituted with effect from 1st August 2002 for a period of three years (membership at Annexure V).

2.3 DEPARTMENT RELATED PARLIAMENTARY COMMITTEE

The Department Related Parliamentary Committee on Science and Technology, Environment and Forests examines and recommends the demands for grants of the DSIR including CSIR. It also takes up for deliberation from time to time specific topics/subjects of national S&T interest. The Committee considered the Demand of grants for the year 2003-2004. A background note was prepared highlighting activities, programmes and financial summary. Based on the note Committee made the following observations/suggestions:

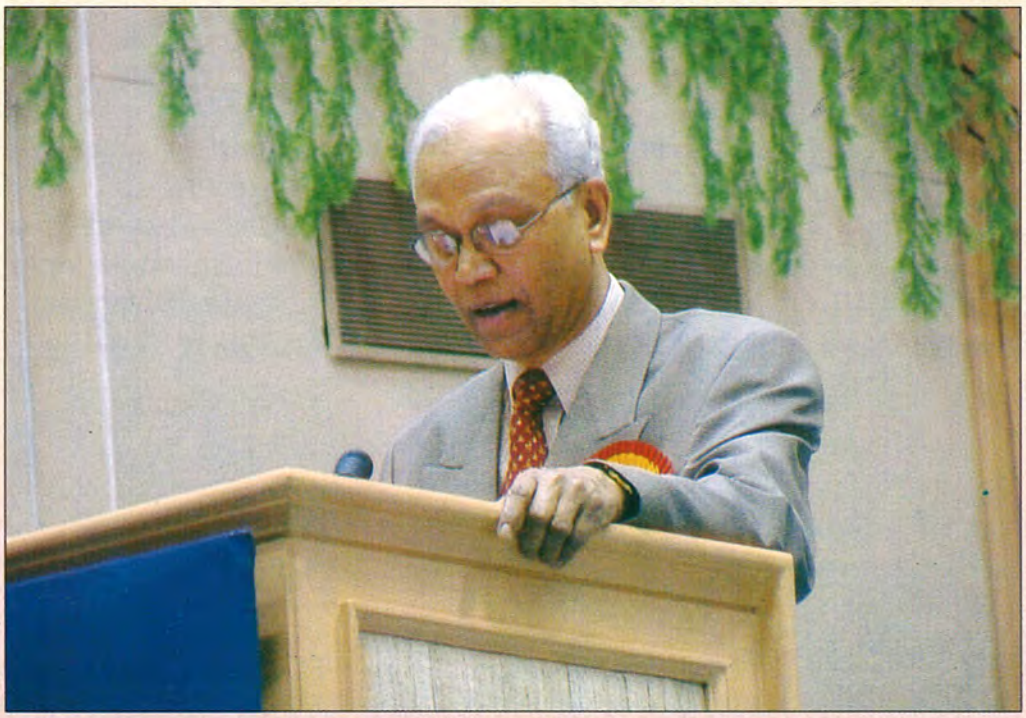
- the pricing and the terms at which the technology is transferred to industry needs to be looked into afresh with a view not only to retain competitive edge for the industry but it should also generate royalty for the Government;
- the manufacturing/marketing rights could be given to more than one company keeping the interest of the user in view;
- in order to encourage talented persons to take up research, they should be encouraged through remunerative schemes and should be provided state-of-the art laboratory facilities, so as to prevent them going abroad. The committee was also of the view that the efforts should be made to utilize the services of scientists as long as they can meaningfully contribute in the interest of the society and the country;
- the efforts put in for increasing the pace of filing patents were appreciated but suggestion was made for simultaneous efforts on the utilization of these patents by licensing before they get outdated;
- high speed internet access facility be established to enable scientists to have faster access to scientific databases available on the internet; and
- industry should be supplied with newer technologies developed for pollution control.

Visit to Laboratories: The committee visited the laboratories namely, IMTECH, SERC, CGCRI to assess their performance. The Director of the laboratory made presentation for the committee members describing R&D activities carried out and achievements over the period. Emphasis was laid by the members on developing technologies which could benefit the common man; and creating enabling environment for the scientists to think creatively and carry out path breaking research and be free from bureaucratic hurdles.

2.4 CSIR FOUNDATION DAY: DIAMOND JUBILEE CELEBRATIONS

CSIR celebrated 26th September 2002, its Foundation Day with fervor and gusto which marked 60 years of its glorious existence, beginning in 1942. Dr. R.A. Mashelkar, Director General, CSIR, initiating the proceedings, extended a hearty and warm welcome to Hon'ble Prime Minister Shri Atal Bihari Vajpayee; Hon'ble Minister for Human Resource Development, Science and Technology and Ocean Development, Prof. Murli Manohar Joshi; Hon'ble Minister of State for Science and Technology, Shri Bachi Singh Rawat; Chairman of the CSIR Diamond Jubilee Celebration Committee Dr. E. Desa; members of CSIR family and other distinguished delegates. Dr. Mashelkar in his welcome address said: *"Twenty-sixth September 2002 is a*

momentous occasion for all of us. It is the 60th birthday of CSIR. CSIR came into existence due to the great vision and imagination of Dr. Shanti Swarup Bhatnagar. Many distinguished scientists contributed to its growth. (Prof. M.G.K. Menon, Dr. S. Varadarajan, Dr. Abid Hussain, and many more present on the occasion were greeted). *All these 60 years we served the nation with sincerity and dedication and touched the lives of people of India in many ways. We strived to find innovative solutions to the problems of India. You will see a unique exhibition today, which Prof. Murli Manohar Joshi will inaugurate. The exhibits reveal 60 important achievements of CSIR during these 60 years. Some of these may look very ordinary today. But these depict our momentous journey down the lane. I am proud to be a member of the CSIR family for the past 25 years. In today's newspapers, an advertisement has been published, showing a finger with an indelible ink mark. The indelible ink was a CSIR product. Like the ink leaving an indelible mark on the voters' hands, CSIR has left an indelible mark on the nation. That finger in the advertisement touches the heart of India. India matters to us and we want to matter to India – more and more".*

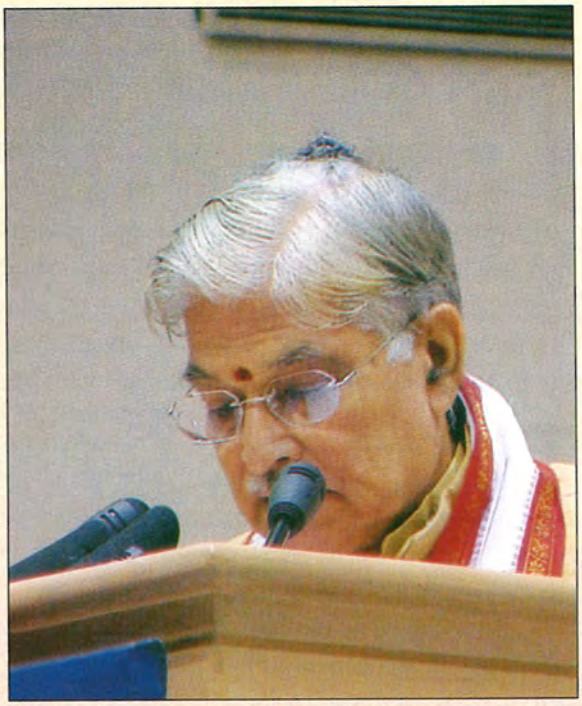


DGCSIR Dr. R.A. Mashelkar initiating the proceedings of Diamond Jubilee Celebration

A film on CSIR's Journey into Diamond Jubilee was screened. Dr. Mashelkar then read out citations of the CSIR Young Scientist and CSIR Technology Award winners for the year 2002. The awards were presented by Hon'ble Prime Minister. The winners of Shanti Swarup Bhatnagar Prizes for 2002 were also announced. CSIR

launched on World Intellectual Property Day (26 April 2002), a unique scheme, 'CSIR Diamond Jubilee Invention Award for inventions by School Children'. The names of winners for the scheme were announced at the function. Dr. Mashelkar requested Prof. Joshi, formally, to address the gathering.

Prof. Joshi was very grateful to the Hon'ble Prime Minister for his presence. He said:



Hon'ble Minister for S&T Prof. Murli Manohar Joshi addressing the gathering

"Respected Pradhan Mantriji, Shri Bachi Singh Rawatji, Dr. Mashelkar, Dr. Desa, Excellencies, Distinguished Scientists, Members of the CSIR Team, friends from media.

Today is a momentous day in the annals of CSIR as we celebrate its Diamond Jubilee. It has been a long and eventful journey for CSIR, which today prides itself as being the world's largest chain of public funded industrial R&D institutions. As CSIR's Vice President, I take pride in the multitude of achievements of this great organization.

We are grateful to our Hon'ble Prime Minister for his presence this morning. We greatly appreciate the fact that inspite of the traumatic and unfortunate events the nation has gone through in the last couple of days, you are present with us. This shows your deep commitment to science. In your inaugural address in the Indian Science Congress 2000, you had given us a Mantra – 'Develop Indian Science for India's Accelerated and All-Round Development'. This is precisely what CSIR has been trying to achieve. It is doing cutting edge science in frontier areas. It is using it to develop technologies in a wide

ranging areas that touch different aspects of Indian life so that the overall accelerated development of the nation can be achieved.

I want to pay my humble tributes to those who conceived the idea of setting up CSIR in pre-independent India and those who led it to the size, reach and status that it has achieved today. I want to especially pay a tribute to CSIR's founder Director Dr Shanti Swarup Bhatnagar. He was a remarkable builder of institutions. In a span of just seven years after independence, he built as many as dozen major national laboratories. It was his conviction that tools of science must be brought to bear on the problems of development in a post-independent India that was largely responsible for the CSIR that we see today.

But today's CSIR faces several challenges. We live in an era of constant change. Knowledge is doubling every ten years, and in some areas, even faster. The world is becoming increasingly seamless in terms of flows of human capital, information, R&D, trade, investment and services. Globalization has added new challenges to the developing nations. The comparative advantage in the globally integrated knowledge-based world economy today is shifting to those with brain power to absorb, assimilate and adopt the spectacular developments in science and technology and harness them for national growth.

In this context, we have to ask as to whether CSIR has the capacity to deliver the goods in these challenging times. Our past should give us the confidence. CSIR has linked closely with Indian industry, assuming the role of its partner in technology. Whether it was a Swaraj tractor, or an anti-malarial E-mal drug, CSIR has been there with Indian industry. In some cases it has led the industry – for example, which created the Leather 2010 vision for leather industry and worked with it. In some cases, it is working to create a new industry, where it did not exist before, an example being the journey from Hansa to, Saras aircraft, which will set up the dawn of the civilian aircraft industry. CSIR always responded to the needs of the time. Green revolution required fertilizers as well as pesticides, and CSIR laid the foundation of Indian agrochemicals industry; at a point in time 70% of agrochemicals in the market were based on CSIR technologies. But we cannot live on our past laurels. We must continuously introspect, since the times today are very demanding. We need to move upwards and faster on the technology trajectory.

India of today has the image of producing and supporting low-technology products. We need to launch intensive efforts to change this image by developing innovative technologies and increasing our share of high-tech products. Aggressive international bench marking and development of innovative technologies and products which will beat the very best in the world. To spur this movement of globally competent technology development, CSIR will set up an award of Rs. 10 lakh to be given annually to that technology that is developed in India by Indian innovators, which meets the highest benchmarks of competitiveness and excellence. It will be called Diamond Jubilee Technology Award.

CSIR must become a world class S&T institution of the twenty-first century, which

will create a niche in emerging areas as well as those in which India has a special niche or urgent demands. It should be an organization that should be able to run and compete with the best. But CSIR cannot run, if it has too much flab. We should, therefore, continuously relook at what we are doing, the way we do things, our resources, our capital assets and our ability to deliver results. This is why I had asked CSIR to set up Performance Appraisal Boards to review the performance of each of the laboratory during the last 3 years by doing the toughest scrutiny by using the most eminent experts from outside CSIR. This exercise has been just completed and we are looking at the implications of the findings that have emerged from such reviews. We are determined to make CSIR a more nimble and more focused organization. We have already responded to the demands on us by taking variety of decisions.

For example, CSIR carried out a review of its outreach centers, established in a different milieu, era and often for purposes which had lost their relevance today. At the end CSIR has closed down fifty of these centers. Change is the essence of life. As a living organization, CSIR has to grow in new emerging areas, shed the unproductive ones and right size those that are to continue.

While we should be trimming and shedding the irrelevant, we should be continuously looking up to the expanding frontiers of science and new opportunities. The unraveling of the human genome two years ago, altered the very paradigm of medicine and health care. CSIR had initiated a re-orientation of its Centre for Biotechnology (CBT) to develop skills and capabilities to apply the knowledge of genomics for diagnostics, screens and genomic medicine. Even prior to June 2000, CBT had forged the first-ever knowledge alliance in genomics with an Indian firm. Over these five years, CBT had transformed itself as the leading R&D Centre in genomics in the country and has been recognized the world over as a center of excellence. Realizing the emerging opportunity, CSIR has changed the mandate of the centre as reflected by the new name: Institute of Genomics & Integrative Biology. It will expand its infrastructural base at a new site, for which the Hon'ble Prime Minister will shortly lay the foundation stone. In keeping with times, this will be done in cyber space as you will soon see.

I have been urging CSIR to assume the role of a path setter nurturing and building human resources in science. CSIR today takes care of scientists in the age group of 16 to 65. The CSIR Program on Youth for Leadership in Science (CPYLS), announced by me three years ago, has received widespread acclaim and participation by school children. The innovative Shyama Prasad Mukherjee Fellowships for the most creative of 25 research fellows has pioneered a new paradigm in our search for innovative and creative talent amongst the young.

CSIR has done rather well in creating IPR awareness in the country. I wanted this awareness to reach our school children. Therefore, CSIR had announced on the World Intellectual Property Day, 26 April 2002, the CSIR Diamond Jubilee Invention Award for inventions by School Children. The competition was open to school students, below eighteen years of age, carried 60 prizes, the first being Rs. 50,000/- nearly 600 entries

were received from far off areas like Chengannur (Kerala), Rajkot (Gujarat), Gomoh (Jharkhand) and Jeypore (Orissa). After rigorous scrutiny 14 prizes have been announced. The first prize of Rs. 50,000/- has been awarded to Madhav Pathak of Jabalpur for the invention of 'A Front face Braille Writer' which facilitates writing and especially reading from left to right. The other prize have been announced today. One can imagine, if we create an IPR strong India through such initiatives, what an impact it can have on India becoming globally competitive.

I feel CSIR can do even more by increasing its interaction with our system of higher education. Therefore, I have set up a high powered Committee under the Chairmanship of Dr. S.K. Joshi to work out a grand plan to integrate CSIR organically with IITs and Universities. I want CSIR also to become a major supporter of those who are achievers in science across a wide range of institutions by instituting awards. CSIR, along with other science departments. will soon work out a major scheme of this. It is only by continuously recognizing and applauding the best that we can hope to spur them on to higher levels of achievement.

I have, time and again, expressed my concerns about the decline of scientific output in India. We need to take several measures to correct this situation. CSIR's CPYLS scheme has an interesting element of our young awardees spending upto 14 weeks in doing a research project with an eminent scientist in a CSIR laboratory as they work towards their B.Sc. It is important to train young students in the tools and techniques of research before they undertake a Ph.D. programme. With this in mind, I have a pleasure in announcing the launch of CSIR Diamond Jubilee Research Interns Awards. This internship will enable post M.Sc. and B. Tech. scholars to participate and learn the art of research by doing. It will be tenable for a period of two years at CSIR laboratories and carry an internship allowance of Rs. 7500 p.m. CSIR will not go to the government to secure extra funding. The expenses will be met from the laboratory reserves of CSIR, which they create today from their external earning from industry and other clients. This will be a unique way of CSIR's demonstration of its commitment to the building of manpower resource in science by spending from its own resources. This scheme will be an excellent preparatory ground for many of the interns to qualify and secure research fellowships.

CSIR must be known as an organization that provides innovative solutions to Indian problems. It should use technology as a tool to create jobs. I am, for instance, happy to see CSIR developing varieties of Menthol Mint namely Himalaya, Kosi and Sambhav. This has created 4 crore mandays of jobs last year. At the same time, it has helped India replace China to the second place as an exporter of Menthol Mint oil. I am a firm believer that competition with other nations can be won only through the instrument of technology.



On the dais during inaugural function of Diamond Jubelee Celebrations:
Hon'ble Prime Minister Shri Atal Bihari Vajpayee, Hon'ble Minister of S&T Prof. Murli Manohar Joshi, Hon'ble MoS (S&T) Shri Bachi Singh Rawat, DGCSIR Dr. R.A. Mashelkar and Dr E. Desa, Director, NIO

CSIR must learn to partner with the past to create the products of the future. I am, therefore, happy to see its programmes on networking of 19 CSIR laboratories to create new bioactives and therapeutics by using our traditional knowledge. India had contributed so much to the advancement of Science and march of civilization from the early days of her history but unfortunately the stream was lost due to several reasons. We have now to rediscover the flow. I was particularly happy to see CSIR partnering with Govigyan Anusandhan Kendra to discover the use of 'cow urine distillate' as a bio-enhancer with some wonderful findings, reducing the amount of toxic drugs required to achieve the same therapeutic effect. A U.S. patent has been granted for this work. Such work brings so many values that are dear to my heart. It brings in respect for our past achievements in science and technology. It shows an open mind to partner with those, who are outside the domain of formal science. It shows our ability to find niches where we can be ahead of the rest of the world. Lesser consumption of drugs means a benefit to the society with reduced costs and reduced toxicity. Equally importantly, less use of an anticancer drug like taxol means destroying less yew trees, thereby conserving the forests and our ecology. I, therefore, urge CSIR to go in search of such problems that will bring bigger benefits to the nation.

I am looking forward to inaugurate the excellent exhibition, which will show us the 60 things that CSIR has done during the last 60 years, of which they are particularly proud. I find that a lot of CSIR contributions are not known outside. Indeed, the way science benefits the common man is not known as much as it should. I, therefore, have directed CSIR to take this exhibition around India during the Diamond Jubilee year and to interact with the people. While doing so, it should not be just a one way process of CSIR, letting the people know what it has done. They must also use this opportunity to interact with people in different parts of the country and understand their problems, which are in search of solutions and enrich the research agenda that CSIR will set for itself in the coming decades. It is only by listening to the people, listening to the poor that we can understand what they really want. I am sure CSIR's Diamond Jubilee exhibition and its movement in India will create a new connection between the science and the society.

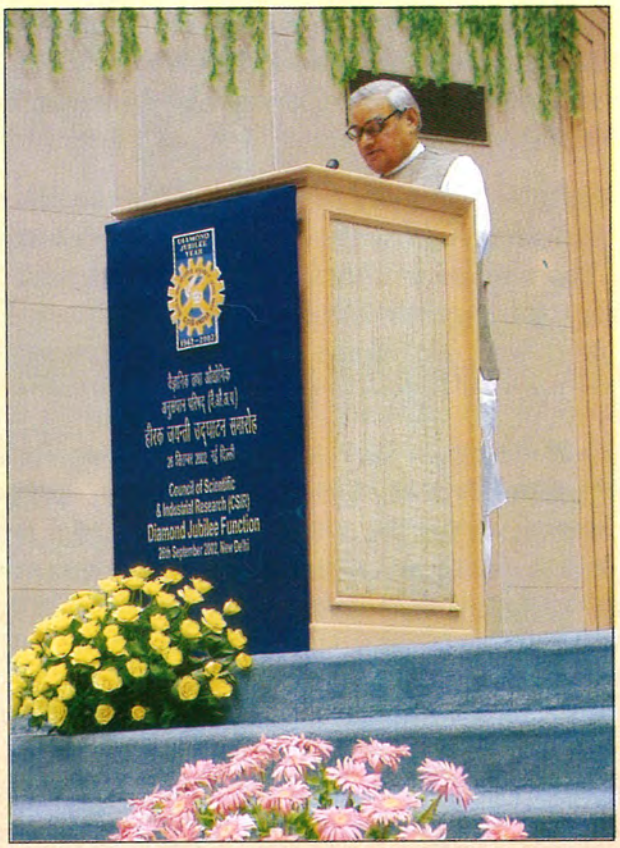
CSIR was built to serve India. I was truly proud when I presided over the Directors' Conference of CSIR on 11th May 1998 at Bangalore, the magical day on which India showed its technology prowess. That day has been designated as 'Technology Day' at my request by our Hon'ble Prime Minister. Apart from the three events that took place on that day, there was a fourth one. It was that of signing of 'Bangalore Declaration' in the spirit of 'Team CSIR'. This was signed by 40 Directors of CSIR, and myself also. The declaration said 'India matters to us, it is our endeavour that, we shall matter to India, more'. My final message to CSIR is that they must live up to this declaration in the coming part of the 21st Century. I wish CSIR and its entire family a glorious journey into the future and work as 'Team India' which brings glory to Indian Scientific endeavours".

The Hon'ble Minister (S&T), then requested the Hon'ble Prime Minister to address on the occasion of CSIR's Diamond Jubilee. The Hon'ble Prime Minister expressed his happiness in celebrating the Council's Diamond Jubilee. He said:

"This is the third time during this year that I am attending a CSIR function. Each time I do so, I feel proud of being associated with CSIR as its President. But on this occasion, my happiness is enhanced by the fact that we have gathered here to celebrate the Council's Diamond Jubilee.

They say life begins at sixty. For CSIR, it began six decades ago. It was a life of much accomplishment and glory. Today, the Council embarks on a new journey. And, I have no doubt that it will be a journey of grander achievement and greater glory than before.

On an occasion like this, it is natural for us to pay tributes to all those who built and nurtured the Council over the decades. I recall the words of Dr Shanti Swarup Bhatnagar, your founder and one of the outstanding personalities in Indian Science. "We can see today the dim lights of a new dawn in the distant horizon of India's progress. These faint radiations are not vanishing streaks of our glorious past; rather, they are the sure signs of a new birth full of promise and glory for the future. This dawn represents the birth of the industrial movement in India".



Hon'ble Prime Minister Shri Atal Bihari Vajpayee addressing during the Diamond jubilee celebrations

The dim lights and faint radiations that Dr. Bhatnagar saw way back in 1938 are no more dim or faint. India has dazzled in many areas of development. We are a self confident and steadily progressing nation, with a growing stature in the international arena.

A good part of India's global reputation is rooted in our strong scientific and industrial base, which we have built with a firm commitment to self-reliance. Successive governments since Independence have shown immense faith in the power of science and technology to propel our national development and strengthen our national security.

Proof of this lies in the many fine R&D institutions we have created in agriculture, industry, healthcare and, of course, defence. Another proud evidence of this is the fact that CSIR is now the largest chain of publicly funded industrial R&D system in the world.

As you are well aware, our Government has substantially stepped up support to the country's Science and Technology establishment in the past four and a half years. I assure you that his support will continue.

In this context, I applaud the birth of the 'Institute of Genomics & Integrative Biology' that Prof. Joshi alluded to. This shows CSIR's response to the emerging challenges and the opportunities that arise in a science that unravels the alphabets of life and has written the first draft of the human genome sequence.

Friends, occasions like the Diamond Jubilee are a time both to look back and to look forward – for both celebration and soul-searching. Your achievements so far are no doubt impressive. I came to know about one of the interesting achievements in the advertisement in today's newspapers – the Indelible Ink that every Indian voter proudly sports after casting the ballot. This shows that CSIR has served the cause of not only India's development, but also of India's democracy. Congratulations!

I am sure that you will not rest on your past laurels. Your past achievements encourage you to do better in the future. They also invite you to review what you have not been able to achieve and why. Needless to say, you are best suited to do this self-evaluation and also to take necessary corrective measures. Wherever the Government's assistance is needed for this purpose, it will certainly be forthcoming.

Any organization is built on the strength of its leadership. During the 1998 Bhatnagar Prizes Ceremony, I had commended the role played by Dr Mashelkar in giving a new vision to CSIR. We felicitate him today for completing 25 years of distinguished service to CSIR Prof. Murli Manohar Joshi, as Vice-President of CSIR, has provided an excellent leadership not only to CSIR, but to the entire scientific community. I congratulate both of them heartily.

Distinguished scientists, the mandate of CSIR requires you to pursue scientific research and its industrial application in tandem. This is best achieved through an active partnership between Indian science and Indian industry. I am happy to see that, over the years, your partnership with industry has both widened and deepened. Nevertheless, there is an urgent need to further enlarge public-private partnership in priority areas of research and development. This is no doubt because of the many unfulfilled tasks in our national development. But is also necessitated by the several new challenges that liberalization and globalization are continually throwing up before Indian industry. We have a large and diversified industrial base. All its constituents – whether they are in big, medium or small sectors – are facing the challenges of competition, local as well as global. The fast-changing business environment is also throwing up new opportunities for them, both nationally and globally. Our industry and services have by now realized one thing. And that is: to survive and to win in this Battle of Competition, they have to use Knowledge – figuratively speaking – both as a Shield and Sword. They are looking to our scientists and technologists for innovative and cost-effective solution to the problems in energy saving, material saving, constant quality enhancement, customer care, and introduction of new products and services on a regular basis. They also need practical solutions to the problems in environmental protection, which we in India have not paid sufficient attention to. And we are paying a huge price for this neglect.

I have just returned from a visit to Maldives. I was struck by the meticulous care with which they have preserved their extremely fragile environment – and yet succeeded in promoting a vibrant tourism industry. No doubt, they are assisted in this by technologies that help in water desalination, waste disposal and transport management.

I am giving this example just to illustrate that it is indeed possible to balance development and environmental protection. The problems in India are, no doubt, more complex and varied. But we can tackle them – indeed, we have to tackle them with scientific and technological knowledge, gained through focused R&D.

There is another challenge before India's S&T establishment. I have spoken about it before, but it is necessary to restate it on today's occasion. It is the challenge of transforming our large S&T base into a dynamic force capable of occupying leadership positions in global R&D. In this context, I commend the 'New Millennium Indian Technology Leadership Initiative' launched by CSIR two years ago, aimed at capturing global leadership in certain select technologies. I am told that CSIR has catalyzed 14 large networked projects involving as many as 110 R&D academic institutions and 45 industry partners. I congratulate industries in our private sector for participating enthusiastically in this largest Indian knowledge network. The projects, I understand, are truly path breaking and set new technology directions.

Even as this initiative seeks to position Indian R&D on a par with the best in developed countries, I also urge you to simultaneously strengthen your attention to the needs of developing countries. These countries admire our self-reliant progress in science and technology. They also know that India has the potential to provide more appropriate technology solutions to the problems of the developing world – solutions that are often vastly cheaper than those offered by others.

When we see the problems of the poor in India and in other developing countries – whether it is drugs to control diseases of the poor, such as Malaria, or nutrition for the poor, or providing gainful employment for the poor in their local habitats – it is clear that no research will be done in the western world to tackle these problems. CSIR and institutions such as ICAR, ICMR and others have done a lot to fill this gap. They can do a lot more.

I am reminded here of what the head of an important African country told me earlier this month, when I was in New York for the United Nations General Assembly session. He said how much Africa admired India's successes in agriculture, which have helped us not only in achieving food security for our large population but also in becoming an exporter of foodgrains. He then sought greater cooperation with India in improving his country's agriculture sector.

While in Maldives, we offered them cooperation in hydrography, digital mapping, telemedicine and IT connectivity to improve postal services in their far-flung islands. I am giving these examples just to illustrate the range of S&T solutions that India can offer to all our friends in the developing world both in traditional and modern areas.

Finally, let me reiterate one more challenge before our S&T establishment. It is the challenge of bridging the awareness gap between the people and your establishment. Take the case of CSIR itself. It has contributed a lot to the nation building process and, specifically, to improving the life of the common man. But are these contributions sufficiently known to our people? I don't think so.

Today, when a farmer uses a Sonalika tractor, or when two lakh women take Saheli as a once-in-a week non-steroidal family planning pill; or when a doctor prescribes E-Mal for a patient suffering from cerebral malaria; or when a villager uses a Mark-II hand pump, how many of them know that these are all CSIR products?

I would like CSIR and all other S&T institutions to reach out to the common man and tell them how we in India are progressing with our own efforts, while cooperating with the rest of the world. They should also be assisted to develop their own rich traditional knowledge-base to meet their needs as far as possible. Of course, this is a task in which you have to work closely with the media and the media will have to work closely with you.

Before I conclude, my kudos to all the scientists, technologists, and employees of CSIR once again. You have proved that yours is a dynamic and living organization, one which continuously responds to change, one which in recent years has taken a quantum jump in ambition. What CSIR should now do is to transform its ambition into achievement during its journey from Diamond Jubilee to Platinum Jubilee."

Dr. Mashelkar presented CSIR Diamond Jubilee Mementoes to Shri Vajpayee, Prof. Joshi and Shri Rawat.

The function concluded with a vote of thanks by Dr. E. Desa, Chairman, CSIR Diamond Jubilee Celebration Committee and Director, National Institute of Oceanography, Goa. The Prime Minister then departed as he had some other important engagement.



Dr. E. Desa giving the vote of thanks

2.5 SHANTI SWARUP BHATNAGAR PRIZES PRESENTATION CEREMONY

Shanti Swarup Bhatnagar Prizes for the year 2001 were presented by the Hon'ble Prime Minister Shri Atal Bihari Vajpayee, the President of CSIR at a glittering function held in the NPL Auditorium, New Delhi on 3rd September, 2002. The function was presided over by Prof. Murli Manohar Joshi, Hon'ble Minister for Human Resource Development, S&T and Ocean Development and Vice president of CSIR. Shri Bachi Singh Rawat, Hon'ble Minister of State for Science and Technology also graced the function. The function was attended by a galaxy of eminent scientists and technologists.

Dr. R.A. Mashelkar, Director General, CSIR, at the outset extended a warm and hearty welcome to Hon'ble Prime Minister, Hon'ble Minister, S&T and MoS, S&T. He also welcomed the scientists and technologists and guests attending the function. He began his address by paying homage to Shri Krishan Kant, the then Vice President of India, who passed away on 27 July 2002. Dr. Mashelkar said Shri Krishan Kantji was a thinker, a visionary, a leader, a patriot and a great son of India. He began his career in CSIR. As the member of the CSIR, we give our respectful homage to him said Dr. Mashelkar. In fact, the present function, scheduled for that day, was postponed as a mark of respect to the departed leader.

Welcoming Prime Minister Shri Vajpayee, Dr. Mashelkar pointed out that it was the fourth consecutive year when Shri Vajpayee ji was presenting the Shanti Swarup Bhatnagar Prizes and wished that there would be many more years when he will be doing so. Dr. Mashelkar thanked Shri Vajpayee for his commitment to science. *"Your moto of Jai Jawan, Jai Kisan, Jai Vigyan says it. You had promised during the Science Congress in January that the investment in science and technology would be increased and you have actually done so - CSIR got 35% increase in grant! You have shown highest respect to science by having Dr. A.P.J. Abdul Kalam as President of India."* Dr. Mashelkar assured the Hon'ble Prime Minister that the scientists will put in best efforts to make India a super power in science and technology. Welcoming Prof. Joshi, he said, *"Prof. Joshi rekindled the pride in us with his interest in modern technology as well as traditional knowledge. He taught us to break the boundaries and mingle the two. He persuaded us to look inside us as well, in addition to looking outside"*. Dr. Mashelkar also thanked Shri Bachi Singh Rawat for providing an able leadership.

Congratulating the Bhatnagar Prize-winners, Dr Mashelkar said that these awards were instituted in 1957 and till today 363 scientists/technologists have received these awards. Over the years, the prize money has been increased to the present Rs 2 lakh – however, it is not the prize money but the prestige attached to this coveted award which is much more important. Over 90% of the Bhatnagar Prize-winners have continued to stay in India and work here, he added. Dr Mashelkar then read out the citations of the Prize-winners.

Prime Minister Shri Atal Bihari Vajpayee presented the Bhatnagar Prizes for the year 2001. The awards presented were: Prize for Biological Sciences - Dr. Amitabha Chattopadhyay and Dr. Umesh Varshney; Prize for Chemical Sciences - Dr. Tavarekera Kalliah Chandrashekar and Dr. Uday Maitra; Prize for Earth Atmosphere, Ocean and Planetary Sciences - Dr. Prashant Goswami and Dr. Kolluru Sree Krishna; Prize for Mathematical Sciences – Dr. Gadadhar Misra and Dr. Tyakal Nanjundiah Venkataramana; Prize for Physical Sciences – Dr. Rahul Padit and Prize for Medical Sciences – Dr. Birendra Nath Mallick. Dr. Mashelkar then invited Prof. Joshi to address.



Hon'ble Minister S&T Prof. Murli Manohar Joshi & Hon'ble MoS (S&T) Shri Bachi Singh Rawat with DGCSIR, Dr. R.A. Mashelkar and Technology Award winners of 2001

Prof. Murli Manohar Joshi, Minister of Science & Technology and Human Resource Development in his address paid homage to the great leader Shri Krishan Kantji, who passed away on 27th July. In his address he thanked Hon'ble Prime Minister for gracing the occasion to present the highest award in science that a young scientist can aspire for in our country and expressed the respect and honour accorded to Dr. Abdul Kalam by electing him as President of the Republic. He has unflinching faith in the Indian genius and a great vision for India. We salute the new President said Prof. Joshi.

He was of the view that "S.S. Bhatnagar prizes have maintained their prestige over the years. The Bhatnagar Laureates are the best of our national assets. He

congratulated all the awardees for this unique distinction to join the exclusive club of Bhatnagar Laureates and was of the opinion that this will spur them to achieve even greater heights in research endeavours."

Prof. Joshi expressed his concern about the outputs and performance of our formal systems of research. He said *"the unusual power and the excellence of an Indian mind is something that we are all proud of. However, the results that we see are not commensurate with his great endowment. I find that there is a decline in Indian Science, as measured by the quantum of basic research papers published by Indian scientists. I was alarmed to see from a recent study that in terms of the total numbers if research papers cited in Science Citation Index, India has slipped from the 8th position in 1980 to 15th position in the year 2000. In 1980, India accounted for 15,983 papers, which came down to 12,127 in the year 2000. When we were slipping down, other developing countries were going up. For example, from 1980 to 2000, China has moved from 924 papers to 22,061 papers and South Korea from 175 papers to 12,013 papers. China has moved upto the number 9 position now. Even in areas of our strength, like mathematics, Chinese share of the world output of research papers is 10%, whereas ours is 2%.*

I am deeply concerned about this fall, because during 1980-2000, our universities have almost doubled in numbers and our R&D expenditure has gone up by almost 16 times when adjusted for the real value of rupee. We need to analyse the real reasons for this decline, identify areas for immediate intervention and take speedy corrective actions.

It is not only the quantity but it is the quality that matters, and that is what I have been emphasizing everywhere, including for our CSIR system. I am happy to see that the CSIR system has responded, and although their number of research publications during 1995-2001 went up by only 7%, their quality of publications, as judged by the average impact factor went up from 0.89 to 1.7, that is almost by 90%! Similarly, although I have lamented about the Chinese share of research papers in mathematics being higher than us, I must proudly mention to you the world class breakthrough in the 'primality' algorithm by Manindra Agarwal, Neeraj Kayal and Nitin Saxena of IIT last month, which has created waves around the world. I would like to see more such peaks from Indian science, but are we getting them? I am afraid not. Let me explain.

I was reading the speech of Britain's Prime Minister on his views on future of science in Britain the other day. He said that Britain produced 44 Noble Laureates in the last 50 years, but he was lamenting the fact that during the last 20 years, only 8 Nobel Laureates have been produced! I was looking at our situation and wondered as to why in 20th Century we have produced only one Nobel Laureate for work done in India. Let us take the next recognition, namely, Fellowship of Royal Society (FRS). Let us also take the areas in which we are most heavily investing today, namely chemistry and biology. I find that last FRSs in both Chemistry and Biology were more than 20 years ago. What does it indicate? Perhaps it shows that whereas we excel in what we do, our peaks of excellence are not tall enough in comparison to what the rest of the world achieves. We need, therefore, to raise the level of our innovation and creativity several folds to make a dent on the international scene.

The Government has launched several schemes to bring out the best among the young scientists pointed out Prof. Joshi. I again find that the results there are disappointing. Take, for example, Swarna Jayanti Fellowships, which with very attractive and remunerative packages coupled with total freedom, perhaps offer the very best that our scientists and engineers can aspire for. I am disappointed to see that we are barely able to offer the fellowships now since the highest level at which these fellowships are given, there are apparently no takers. Let me take another example. CSIR gives Junior Research Fellowships for those desirous of doing a Ph.D. I myself was the beneficiary of one such fellowship. About 30,000 students appear every year for these exams and we select 1,000 out of them for this fellowship. Two years ago, we started Shyama Prasad Mukherjee Fellowship for the top 25 amongst them. The only condition we put was that these fellowships will not go to those who secured the highest marks in written exams but to those who passed some rigorous evaluation tests based on their originality and creativity. I am sorry to say that last year we could give this fellowship to only 4 students and this year, with the results just announced, we have only 6. For two years, we could not have 25 students, who could meet these rigorous criteria of originality and creativity. What does it indicate? Is our educational system, which produces these Masters' degree holders, failing to create the best innovative and creative minds? We need a serious look at these. This Government will keep on taking initiatives to give reward system, but lack of quality at the highest level is indeed a matter of great concern to me personally, as it must have been to all of you.

I am a firm believer that the renewed spirit of creativity must percolate down to our school children. I have, therefore, directed CSIR to launch a CSIR Diamond Jubilee Award for the innovation done by school children for developing concepts or an idea. There will be nationwide competition. We will await the response to this national initiative, before launching further initiatives, which will start touching those areas, where we need to make a difference".

He then turned to another concern of his and said "*I am a little disturbed by our practice of science within a prescribed framework of formal laboratories. We seem to reject traditional knowledge as extraneous. We have created walls between the traditional knowledge and the so-called modern science. I often wonder how have these walls been created? During the colonial period western science was perceived, projected and accepted as an essential feature of a modern outlook. An unfortunate and retrograde corollary of this was that modern scientific knowledge was seen as an adversary of traditional wisdom and knowledge. The two were seen as being mutually exclusive. Traditional knowledge was perceived as being unscientific and voodoo; as if traditional knowledge was darkness in itself waiting to be dispelled by the light of 'true modern' science. Thomas Henry Huxley said in 1881, "It is easy to sneer at our ancestors – but it is much more profitable to try to discover why they, who were really not one with less sensible persons than our own excellent selves, should have been led to entertain views which strike us as absurd". This has been a regrettable syndrome amongst our educated elite because it had the effect of belittling the intellect and wisdom of a vast section of our population and the rich*

heritage of diverse indigenous knowledge systems that we have built up from time immemorial".

Prof. Joshi felt that there was a great opportunity in creating new drugs. It is only by fusing the ancient wisdom and modern science that India could create world class products, because new products cannot compete with products, which have only tradition and empirical observation as the knowledgebase. The knowledge to be integrated into the traditional products has to emerge from modern science, especially modern biology and chemistry added Prof. Joshi. Such fusion will lead to better definition of existing products, improved understanding of the mechanism of their action, modified compositions at molecular level and better understanding of interactions amongst various molecules, he said.

Prof. Joshi explained that in order to further bolster the innovation activity in the non-formal sector, a National Innovation Foundation (NIF) in the Department of Science and Technology has been set up. The NIF has been entrusted with the responsibility to scout, support, spawn and scale up the grass root innovations. It is already helping to generate employment and in the use of natural resources sustainably through linking of innovation, enterprise and investment by building symbiotic linkages with modern science and technology and market institutions. The extent of innovative creative activity among the grassroot innovators is phenomenal. This can be gauged from the fact that a national level competition set up by NIF last year drew around 1000 entries, whereas this year it has attracted over 13,000 entries, many times more than even the patents filed annually by Indians! It confirms that the native creativity and genius of Indians is second to none, he elaborated. Prof. Joshi was of the opinion that many of these innovations will help in improving efficiencies and productivity levels, generating income, overcoming poverty and providing employment to a large number of people in the rural sector. He urged the young scientists and engineers to forge linkages between excellence in formal science and informal innovation in India.

Summing up his encouraging speech Prof. Joshi said "Friends, you as highly acclaimed scientists, have a lot of responsibilities to the society and community and I am sure as enlightened citizens, you would do the nation proud. I would commit that the Government on its part will do everything to support your efforts and of the scientific community to bring glory to the nation. I once again congratulate the awardees and also appeal to you to keep on striving for being the first and be the best in the world".

Prof. Joshi requested then Hon'ble Prime Minister to deliver the address.

The Prime Minister in his address said "*As has already been mentioned this function ought to have taken place on 27 July. However, it had to be postponed due to the sudden demise of Vice President Shri Krishan Kant. He had a personal association with the CSIR, having started his working career with this organization. Therefore, at the outset, I join all of you once again paying my homage to Krishan Kantji".*

He continued "Friends, this is the fourth Bhatnagar Awards function that I have the privilege to address. But there is something special about it. I think we have now begun to pay greater recognition to our scientists. Just recently, India recognized a distinguished scientist by welcoming him as the 12th President of our Republic. I can assure you that the others won't grudge scientists' this honour. Because, the more science flourishes, the more India will benefit. The more Indian scientists are recognized, the brighter will India's image shine. I cannot help but recall what I said four years ago in this hall on this very same occasion. Congratulating Dr. Abdul Kalam on his being recognized with the nation's highest civilian honour, I had noted – in lighter vein – that he was honoured with a Bharat Ratna, whereas I had been awarded only a Padma Vibhushan. But I had hastened to add that this was because the Indian tradition held in the highest esteem scholars and persons of learning, and accorded the gyani a higher pedestal than even the raja. Therefore, it gives me special pleasure in joining all of you in welcoming a great gyani, a humble vigyani, and the inspiring patriot in the Rashtrapati Bhavan". Hon'ble Prime Minister congratulated all the talented young scientists who had won the prestigious Bhatnagar award. He said *"You have excelled in doing world-class research. What is more, you have been honoured for work done in India. I am told that most of the Bhatnagar awardees have continued to remain and work in India. This is indeed creditable. I would like to see more Indian scientists, working in India do pioneering research, develop their institutions as centers of global excellence and win international acclaim. I would also like the CSIR to take up a study on the impact of the work of the Bhatnagar awardees on global science and technology."*

He explained that "*Conservation and better utilization of water, energy and land resources are not merely our national concerns. They have become global concerns, accompanied by a growing sense of urgency for collective action. This is evident from the debate at the ongoing Earth Summit in Johannesburg. More than ever before in human history, the need for sustainable development, properly balanced with environmental protection, has engaged the attention of governments, NGOs, scientists, entrepreneurs and common people all over the world. All are also united in the recognition that we can effectively face this challenge only through a proper combination of global, regional, national and local action. We, in India fervently hope that the Johannesburg summit carries the agenda of sustainable development towards strong consensual action. At the core of this consensus lie the attitude and action of developed nations of the world. They have to agree to make amends to their many unfulfilled obligations. As far as India is concerned, our tasks in achieving the objective of sustainable development are very clear. We have to improve the living standards of all our citizens, especially those who have so far been deprived of the fruits of development. But even as we proceed to achieve this goal, we have to be extremely mindful of protection of our precious ecology and environment. What is also very clear is that we have to succeed in these tasks essentially with our own national effort. Nobody from outside is going to come and solve our problems for us. We may learn from others' experiences, we may even receive cooperation from others, but the main effort will have to be our own. Hence, if I have to round off my remarks today with one single message to CSIR and, in general, to India's Science and*

Technology establishment, it is this: Strengthen the contribution of Indian Science and technology in India's self-reliant march towards sustainable development."

Before concluding he said *"Let me briefly join my voice to the concerns expressed by Prof. Joshi about the decline in both the quantity and quality of scientific research in India. The scientific community, and those engaged in the administration of our S&T establishment, are the best judge of why this is happening. The corrective to this situation also has to come principally from you. The Government has done all it can, through substantially enhanced and innovative funding, to help you arrest and reverse this trend. And we will continue to do more. I would like our scientific community to take up this challenge with determination, and carry out all the attendant tasks with utmost dedication. I would like the heads of all of our S&T establishments – CSIR, ICAR, ICMR, DRDO, IISc., universities, and all others – to provide stronger and more focused leadership to this effort. I am sure that Prof. Joshi, who has articulated this problem with such passion, will soon device an action plan to promote excellence in Indian science".*

Dr. Krishan Lal, Director, National Physical Laboratory, New Delhi, proposed a vote of thanks.

3

HEADQUARTER ACTIVITIES

3.1 R&D PLANNING AND BUSINESS DEVELOPMENT DIVISION (RPBD)

Tenth Five Year Plan (2002-07) & Annual Plan 2003-04

The Division facilitated in formulation of Tenth Five Year Plan (TFYP) and Annual Plan 2003-04, effecting network approach in project formulation. Detailed analysis on strength, weakness, opportunities and threats carried out earlier for the specific sectors were taken into consideration while carving out the specific projects. In TFYP, the R&D activities of National Laboratories are being pursued through fifty-five networked projects. Planning Commission had introduced a system of 'in principle approval' for TFYP projects. It was insisted that in-principle approval be first taken for all the fifty-five projects before final processing. Division facilitated the same, and the projects were thus processed for the purpose. For the period under consideration, in-principle approval to nine proposals was provided. Six of these proposals were considered by the Sub-Committee of the Governing Body of CSIR on investment proposals and were recommended for approval. Governing Body based on the recommendations made by the Sub-committee accorded approval to these proposals. Rest of the proposals were under consideration in the Planning Commission.

Programme on discovery, development & commercialisation of new bioactives and traditional preparations

Initiated in 2000, the CSIR coordinated programme completed its first phase in March 2003. It grew from strength to strength during the period as its genesis was based on novel thinking and strategy based on network which was rare and unknown then, not only in CSIR system but in other publicly funded National R&D agencies as well. As it grew, it involved systematically, 20 CSIR labs, 12 universities and 3 systems of medicine i.e. Ayurveda, Siddha and Unani, which form now, a formidable delivering network. The programme gained in terms of resource collection, their processing, extraction, bioevaluation and pursuing then the lead(s) obtained in a defined mode of drug discovery leading to IND(s).

On nearing completion of the first phase, the progress under the programme was reviewed by a 'High Power Committee' under the Chairmanship of DGSIR. The membership for the committee was drawn from CSIR's Governing Body, Advisory Board and Society in addition to the well-known peers in the field. The Committee appreciated the programme endeavor in totality. It recognized that in a short span of three years, 52 leads were obtained for diverse diseases namely cancer, ulcer, tuberculosis, immunomodulation, parkinsonism and other neurological disorders etc. due to well orchestrated concerted effort. These leads, characteristically have national and international relevance. The committee also appreciated, the creation of diverse 'state of the art' facilities, namely for bioevaluation (in vitro and in vivo), for breeding and maintenance of transgenic animals for various diseases, and associated facilities for resource collection, processing and extraction as well. The members endorsed extensive approach for screening of the extracts and intensive approach for INDs as a right strategy employed for the project endeavour. CSIR efforts for joining hands with the industry for the identified leads for some diseases were applauded. Infact the network set up in the country by the programme has been termed exemplary and extraordinary. The concept has now become role model for other CSIR Tenth Five Year Plan Programmes.

For the period under report 4000 plant extracts and 1500 microbial extracts were processed and sent to identified laboratories for bioevaluation. Additionally, 161 traditional preparations (100 Ayurveda, 36 Siddha and 25 Unani) were received and were at various stages of screening for 19 diseases. Efforts are on to convert these leads into the commercially exploitable therapeutics.

New Idea Fund (NIF)

The proposals for support under the NIF scheme were invited from the scientists in CSIR system. Twenty-one proposals were received. They were processed for peer review by the Expert Committee. The Project Investigators (PIs) of selected few top project proposals were invited for making presentation of their proposals to the Committee. The criteria for selection was very stringent thus only one proposal from IICT entitled "the holy grail of organic chemistry: directing influence in aromatic substitution - a proposal to demolish this by site selective catalysis" could qualify the standards laid for selection under the NIF. The committee also reviewed the earlier awarded projects. Detailed discussion was held with each PI of earlier awarded projects, regarding the research carried out and the objectives achieved of the given project. The committee thereafter gave its observations/suggestions on each of the project.

Unit for Research & Development of Information Products

CSIR's Unit for Research & Development of Information Products (URDIP) continued its endeavour to put in place value added IT products covering diverse

S&T domains for the benefit of professionals, academicians and industry. It consolidated its resources during the year and successfully developed following:

- **Patestate** is a full text database of Indian and Foreign patents that have been granted to CSIR. Four volumes in this series covering the period 1981 to 1985 (Vol.I), 1986 to 1990 (Vol.II), 1991 to 1995 (Vol.III) were brought out earlier. A fourth volume covering the period 1996 to 2000 (Vol. IV) has been brought out during the year. In addition, a fifth volume containing the abstracts of all the patents granted to CSIR from 1940 to 2002 was also brought out. All the above five volumes are available in the form of CD-ROMs. A separate website for CSIR patents has been created (www.patestate.com). Abstracts of all the patents granted to CSIR from 1981 till date have been put on this site. This site is being developed as an online marketplace for CSIR Intellectual Property.
- **Health Heritage** is an archival, interactive, multimedia CD incorporating both traditional knowledge from Sanskrit Classics referred to by practitioners of Indian systems of medicine and the modern information made available through systematic research during the past forty years on medicinal plants used in Ayurveda. The modern chemistry literature from 1960 to 2000 was completely scanned for the purpose. The CD summarizes the chemical studies of plants and biological evaluation of total extracts and fractions thereof. It also lists all the pharmacological, biological and clinical work done on pure constituents obtained from plants and gives the complete structures of new substances isolated. Abstracts of patents currently granted by US and Indian Patent Offices on traditional medicinal plants have also been included. The two volumes covering 100 widely used plants have been brought out. The third volume covering additional 50 plants is under preparation.
- **Ayuta Index** is a digital version of Ayurvediah Triskandha-Kosha based on the basic four texts of Ayurveda i.e. Charakasamhita, Sushrutasamhita, Ashtangasangraha and Ashtangahridya. The first volume in this series representing the Lakshana - Kosha that contains each and every reference related to symptoms of various diseases as well as health conditions from above texts has been brought out in the form of a CD-ROM.
- **CSIR Technology Advisory Point (TAP)** is a web based technical service, prototype for which has been put on the web and is being tested. It will bring the knowledge of CSIR's 6000 scientists to desktop of customers. This service will be particularly useful for small and medium scale enterprises.

In collaboration with C-DAC a one year Diploma in Database and Web Technologies was launched to upgrade the skills of URDIP and NCL staff. Training Programmes were also organized on "Online Searching of Science and Technology Databases" and "Patent Information for Drug Research".

CSIR Technology Awards 2002

The nominations for the CSIR Technology Awards were invited as per the guidelines. Twenty-two nominations under various categories were received which were processed in the Division for the perusal and consideration of the Technology Awards Selection Committee. The selections were done by the Committee as per the criteria in place. The Prize in Business Development and Technology Marketing was given to NAL for making significant contributions to enhancing of business. Only five Technology Awards could be awarded for the year. These were: for Biological Sciences and Technology to IICB for Asmon - a herbal composition for treating Asthma; for Chemical Technology to CSMCRI - for developing a detergent grade Zeolite-A; for Engineering Technology to CSIO - for designing the Headup Display (HUD) for Light Combat Aircraft; and shield for Process Technology to IMTECH, Chandigarh - for process of production of natural streptokinase.

Security and sensitivity clearance

The Division continued to carryout its responsibility for clearance of project proposals of laboratories involving foreigners/foreign collaborations in any form from security/sensitivity angle. During the period under report, about eighty proposals were processed.

Interministerial linkages

The Division represented CSIR on various committees of the Government, namely Ministries of Chemical and Petrochemicals, Petroleum and Natural Gas, Environment and Forests, Health and Family Welfare etc. and Department of Science and Technology, Biotechnology, Indian System of Medicine and Department of Scientific and Industrial Research etc.

R&D Management Conference (RDMC)

Since 1999 CSIR (RPBD) has been organizing the R&D Management Conferences. These conferences have been organized as a self-supporting event with no financial inputs, subsidy, advertising or sponsorship from any source. Each one of these Conferences was organized professionally meeting international standards. In a short time they have come to be recognized as a prestigious event for R&D managers, practitioners and academics. The R&D Management Conference 2002 was organized with the theme "The Challenge of Managing Indigenous R&D in a Global Setting" in Delhi from December 6-7, 2002. The event was organized in a project mode as was done for earlier Conferences.

There were eight sessions namely, managing indigenous R&D in a global setting (8 papers); impact of indigenous R&D in specialized sectors (6 papers); HR development

for international competition(7 papers); managing industrial and corporate R&D(6 papers); indigenous R&D and knowledge management(10 papers); performing R&D for international customers(6 papers); and performing competitive R&D in the changing global regime(7 papers). The Conference organized and conducted professionally was widely acknowledged by about 150 participants in terms of technical contents and organizational effort. The participant spectrum comprised representatives of academia, industry - private as well public, government S&T departments, research institutions and faculty and students from IIMs and other reputed management schools in the country. It was decided that the Conference 2003 should be organized with the theme "Managing Knowledge Markets in a Global Economy: The Indian Context".

3.2 RECRUITMENT & ASSESSMENT BOARD (RAB)

RAB took up a preliminary exercise of conducting interviews of Scientists whose promotion date fell within the period January 1 to March 3, 2001. The scientists covered were of group IV from 'B' to 'E-II' level, who had cleared the required threshold linked to their residency periods. The interviews were conducted at seven locations; NAL, Bangalore; CGCRI, Kolkata; NGRI, Hyderabad; NCL,Pune; CIMAP, Lucknow; IICT,Hyderabad; and CRRI, Delhi (twice at two different occasions).

The Committees formed were for the following five subject clusters made amongst the ten identified 'Core Subject Areas' of CSIR, namely: Cluster I - biosciences & biotechnology and food science & technology; II - chemical sciences & engineering and energy; III - civil & structural engineering, engineering science & technology and material science & technology; IV - earth & environmental sciences and physics & electronics; V - management of science & technology. The success rate was about 72% in these first phase of assessments.

3.3 INTELLECTUAL PROPERTY MANAGEMENT DIVISION (IPMD)

The Division continued efforts for securing IP as per the strategy in place. As a result CSIR achieved target of highest PCT filings amongst developing countries. During the year, CSIR was granted a whopping 146 patents in USA, a feat unmatched by any other Indian firm or organization. It filed 728 foreign and 421 Indian patents.

Capacity building in the area of IP management: One week IP training programme was organized with FICCI. The objective of the programme was to provide

specialized training to managers working with Indian corporates. The program covered various aspects and issues related to IP viz., Strategic and Management aspects of IP, IP issues in emerging technologies, issues in IP taxation, present status of IP administration in India and managing IP litigation.

Conference-cum-Workshop on leveraging intellectual property for organizational strategy: The first ever "Conference -cum-Workshop" on the theme "Leveraging Intellectual Property for Organizational Strategy" was organized. The conference focused on various ways to identify, express and outsource IP to leverage it as a mechanism for organizational strategy. The workshop exposed the participants to emerging international developments in the field of patenting of bioinformatics inventions, trademark protection, valuation and taxation of IP, international issues relating to licensing of IP and Competition Law in IP agreements. The conference-cum-workshop was of value to R&D and technology managers, patent attorneys, representatives of Patent offices, academicians in Law School and universities and Govt. Policy makers.

3.4 INTERNATIONAL S&T AFFAIRS DIRECTORATE (ISTAD)

ISTAD continued its mandate of identifying, facilitating and promoting international co-operation between two countries in the areas of science & technology.. The major activities of ISTADs during the year included the following:

WebISTAD launched (www.csirwebistad.org)

During the period under report ISTAD launched its portal 'WebISTAD" providing a number of useful services and features to international scientists from among the CSIR Scientific Community and elsewhere. One of the most innovative feature of the WebISTAD is the e-clearance facility for processing and approval of various deputation proposals. In this e-clearance module, a scientist at any laboratory/ location can submit online his/ her proposal in the given format. The proposal is reviewed by key administrators including officials of ISTAD/CSIR and instantaneously approved by click of a button, without bulky paper transaction. ISTAD has cleared around 50 cases through e-clearance till date.

Bilateral cooperations

ISTAD continued to reinforce partnerships between CSIR and its overseas S&T partners with focus on developing synergies and leveraging CSIR's capabilities in core areas of Science & Technology. The major highlights of this year's activities were as follows:

Czech Republic: A two-member delegation from Academy of Sciences of the Czech Republic consisting of Prof. Jiri Niederle and Dr. Dan Dvorak visited CSIR labs to review and renew the working programme for next three years 2003-2005. Twelve project proposals have been identified for co-operation in different areas.

France: Senior scientists of Centre de Coopiration Internationale en Recherche Aagronomique (CIRAD) and Institut National de la Recherche Agronomique (INRA) working in the areas of agriculture, water, environment and health, visited CSIR to explore possibilities of S&T cooperation. Six proposals for technical assistance were approved by the Indo-French Centre for the Promotion of Advanced Research.

Germany: Under CSIR- FzJ Cooperative Science Programme, of the 17 joint projects in progress, three projects of CEERI were successfully completed.

- **CSIR-DAAD Exchange Programme:** Scientists from CSIR and Germany visited their counterpart institutions, respective countries. Nominations of 10 CSIR and 9 German scientists have been approved for exchange visits during 2003.
- **DST-DAAD Project based Personnel Exchange Programme:** Out of 4 ongoing projects (one each at ITRC, NPL, RRL,Tvm. and NCL), projects at ITRC and NPL were successfully completed. A new project to be pursued by CFTRI was approved for implementation during the year.

Guyana

CSIR-IAST S&T co-operation: Institute of Applied Science and Technology (IAST), Guyana and CSIR, India, have developed a Technical Cooperation Programme under the Bilateral Agreement between the Government of Guyana and the Government of India. An MoU was signed to facilitate the transfer and implementation of commercial technologies from CSIR to Guyana. A number of CSIR technologies for commercialization have been identified. An invitation was extended to CSIR to send a delegation to Guyana to hold the first joint committee meeting under the MoU.

Hungary

Indo-Hungarian JSTC Session: The Fifth session of the Indo-Hungarian JSTC was held at New Delhi and projects of NCL and RRL, Thiruvananthapuram were approved in POC, namely, new type of monolith supported V_2O_5/TiO_2 catalysts for environmental catalysis; and substrate specific enzyme complexes by solid state fermentation.

Italy

CSIR and Italian Council for Research (CNR) signed a new Working Programme for years 2003 - 2005. Eight projects were identified for cooperation.

Myanmar

India-Myanmar Joint Oceanographic Studies in the Andaman Sea: Ten Scientific & Technical personnel from NIO were deputed to Myanmar to carry out India – Myanmar joint Oceanographic Studies in the Andaman Sea beyond the EEZ of India.

Scientific Instruments repair carried out by CSIO experts at Myanmar: A three member CSIO team of technical experts visited Myanmar to carry out repairs of instruments at the institutes, namely, Myanmar Scientific and Technological Research Department, Yangon; Yangon Technological University, Yangon; Department of Medical Research, Yangon; and Department of Atomic Energy, Yangon. A total of 141 instruments and equipments were referred to the team. Of these, 84 instruments were successfully repaired. 31 instruments were found to be uneconomical for repairs. The team had carried replacement spares and electronic components to carry out repairs. The objective of the entire exercise was to help S&T organizations in Myanmar in their pursuits and to make Myanmar self sufficient in repair of scientific instruments.

Nepal

Indo-Nepalese JCS&T: The first meeting of the Indo-Nepalese JCS&T was held in Kathmandu. The Programme of Cooperation (PoC) in the fields of Science & Technology between the two Governments was signed during the meeting. Four joint projects in the fields of Medicinal plants, Metrology & Standards & Leather were approved by the Committee with CSIR labs as the Indian counterparts.

Indo-Nepal S&T Day: The first Indo-Nepal S&T Day was organized in Kathmandu under Indo-Nepal PoC in Science & Technology. Five experts from CSIR labs viz. CIMAP, NBRI, CDRI, RRL Jammu & IHBT, Palampur working in the relevant fields participated in the event.

Russia

CSIR-ILTP (Integrated Long Term Programme of Cooperation between India and Russia) Projects: Thirty one projects are ongoing in the areas of Engineering & Electronics Materials; Laser Science & Technology; Catalysis; Water Technology; Engineering Sciences; Earth Sciences; Chemical Sciences, Life Sciences, Ecology & Environmental Protection. Of these 5 projects were approved by DST for implementation under ILTP during the period of report.

Slovak

New working programme signed: CSIR and Slovak Academy of Sciences signed new Working Programme during the visit of Slovak delegation to Delhi. The new

areas included: development of nano materials of magnetic fluid and its polymer composites, degradation and stabilization of polymers and; novel methods for circulation of molecular properties using coupled cluster theory.

Switzerland

A twelve-member delegation from Switzerland led by their Minister for Science and Technology called on DG, CSIR. He highlighted the activities in S&T in India and CSIR. Presentations from CSIR on Swiss funded schools of Milling Technology and Instrumentation were made.

Taiwan

A 10-member delegation from Taiwan led by Dr. Clement Chang Chairman Board of Trustees, Tamkang University, Taiwan called on DG, CSIR. The delegation was interested in collaboration in areas like genetic engineering and aerospace. The visit was arranged by the Director, India International Centre.

Uganda

A 4-member team of Ugandan Agricultural Research Scientists visited CIMAP, Lucknow to explore possibilities of cooperation in the field of essential oils research.

Vietnam

Indo-Vietnam JCS&T: The Fifth Meeting of Joint Indo-Vietnam JCS&T was held in Hanoi, Vietnam. Five CSIR projects were recommended under the PoC by the Committee for implementation.

Fellowships

CSIR-DAAD Fellowship: Seven CSIR scientists benefited by DAAD fellowships.

Raman Research Fellows: 7 CSIR scientists were awarded with Raman Research fellowship.

UNU: The UNU-CFTRI agreement was extended for another 5 years from 1st January, 2002. UNU will provide CFTRI an institutional grant of US$ 417 per fellowship man month for a maximum of 100 man months and CFTRI to provide training to candidates from the developing countries in Asia and Africa up to 100 fellowships man-months per year.

TWAS: CSIR and the Third World Academy of Sciences (TWAS), Italy have jointly instituted Postgraduate and Postdoctoral fellowships for scientists of proven ability

from developing countries who wish to pursue advanced research in newly emerging areas in science and technology in the CSIR Laboratories/ Institutes in India. The principle aim of the programme is to promote scientific capacity and excellence for sustainable development in the South. During the year, 10 scientists from Sudan, Nigeria, Ethiopia and Kenya have joined CBRI, CFTRI,CDRI,NBRI, NGRI, CSMCRI, RRL, Jm. and NISTADS under Postgraduate fellowship and 10 scientists from Egypt, Senegal, Nigeria, Bangladesh, Cameroon, DPR Korea and Brazil have joined CCMB, IICT, NEERI, NISCOM, ITRC, CIMAP, CGCRI, IICB under Postdoctoral fellowship.

HRD effort

- **ISTAD-ISTAG meeting:** ISTAD organized an ISTAD-ISTAG meeting. About 48 participants from various CSIR labs participated in the meet. A number of policy issues and CSIR guidelines were discussed and recommended to Web enable many of the ISTAD's functions through the portal WebISTAD.
- **Meeting of the Global Research Alliance (GRA):** Representatives from nine leading Science and Technology Institutions from around the world met in New Delhi and agreed to establish a "Global Research Alliance" (GRA) with the objective of applying a global knowledge pool for global good through global funding. The Alliance will facilitate international R&D cooperation to address the problems facing the world, especially in the areas of water, health, energy, transportation and the digital divide. Participating institutions were: CSIR India; the Danish Technological Institute (DTI); the Fraunhofer Gesellschaft in Germany, SIRIM Berhad in Malaysia, TNO in The Netherlands, VTT in Finland, CSIRO in Australia, Battelle Memorial Institute in the USA and the CSIR in South Africa. Between them, these organizations have a formidable array of over 50, 000 scientists and technologists. The GRA group had an opportunity to meet with the President of India, Dr. A.P.J. Abdul Kalam. Over the two-day period, participants reached agreement on the Constitution and membership of the Alliance, as well as the terms for pooling the resources and expertise in the undertaking of joint projects. Organizations and institutions from outside the Alliance will be co-opted on a project basis. The "Nerve Centre" of the Alliance will be based at the CSIR in South Africa.

  At the signing of the membership agreement "Delhi Declaration" - Dr R.A. Mashelkar, Director General of CSIR India and host to the discussions remarked on the unique capability of this Alliance to combine not only skills but contexts from both developed and developing worlds.
- 718 CSIR scientists were deputed by ISTAD for different programmes during the year. Of these 383 were deputed for participation in international conferences/seminars, 64 for training, 9 for Business Development, one under the UNEP, 147 under bilateral exchange programmes, 105 under fellowships, leave/ PDF/ EOL etc. and 9 as experts. Partial travel assistance was granted to about

576 non-CSIR scientists for participation in international conferences/symposia/ seminars of relevance to CSIR.

3.5 UNIT FOR SCIENCE DISSEMINATION (USD)

USD continued to play an important role for public image building of CSIR as a whole. The Unit was the hub for the large number of activities aimed at creating Brand CSIR during the CSIR Diamond Jubilee Year. Effective media relations helped in furthering result-oriented relationship with the key press persons covering science in their respective dailies. *A 10-page feature was compiled on CSIR* for publishing in the in-flight magazine of Indian Airlines, *Swagat*, as a part of the publicity campaign during CSIR Diamond Jubilee. A *special calendar was produced* to commemorate the CSIR Diamond Jubilee year. The unit successfully coordinated the preparation of a *Corporate Film on CSIR* for the purpose of broadcast during the main CSIR Diamond Jubilee function in Vigyan Bhavan that was telecasted live nation-wide by Doordarshan National Channel. A large number of copies of this film were made for wider dissemination. A short film on CSIR technologies for turning point programme on TV was also catalysed by the Unit.

CSIR participated in the various national/international exhibitions and other related events with two main objectives: creating awareness about CSIR and its achievements, and supporting its business development efforts.

The unit also coordinated preparation of exhibits comprising '60 things that CSIR is proud of', which is a comprehensive well designed set of exhibits for the purpose of display in the exhibition organized in commemoration of Diamond Jubilee function at Vigyan Bhavan. The panels were made available to all CSIR labs and important stakeholders of CSIR in digital format on CD. During the year, the Diamond Jubilee Exhibition was organized in Hyderabad, Pune, Chennai, Goa and Delhi. It was planned to take this exhibition around the whole nation during the Diamond Jubilee Year.

3.6 HUMAN RESOURCE DEVELOPMENT GROUP (HRDG)

The HRDG has been contributing significantly to the development of highly qualified S&T manpower in the age group of 16 to 65 at the national level. It has the mandate to find new mechanisms and provisions for funding towards science so as to arrest continued trend of decline in basic science. It also promotes, guides and co-ordinates scientific & industrial research through scientific projects on a national level. The activities include: Award of Shanti Swarup Bhatnagar Prizes (SSB); Young

Scientist Awards (YSA); Selection of Junior Research Fellows (JRF) through National Eligibility Test (NET); Selection of Senior Research Fellows (SRF), SRF Extended and Research Associates (RA); Selection of Senior Research Associates (SRA); Extra Mural Research (EMR) schemes funding at universities/ R&D organizations; Visiting Associateship; Travel / Conference / Symposium grants; Conducting training programs for senior scientists; CSIR Program on Youth Leadership in Science (CPYLS); Selection of Shyama Prasad Mukherjee Fellows (SPMF). In its quest for promotion of science HRD group has formulated and started a new scheme for GATE qualified Engineering Graduates (JRF-GATE) during the year 2002-2003.

Shanti Swarup Bhatnagar Prize and Young Scientist Award 2002

In the year 2002, twelve (12) scientists were selected for SSB Prize making a total of 375 awards till date (2002). The awards were announced on 26th September 2002. Only four scientists were selected for the 2002 Young Scientist Awards. The Prime Minister, Honorable Shri Atal Bihari Vajpayee, presented the Awards on 26th September, 2002 at the Diamond Jubilee celebration function of CSIR, held at Vigyan Bhawan (details in Chapter 2).

Junior Research Fellowship (JRF)

CSIR conducts JRF-NET examination twice a year for the selection of JRF's. During the year 2002-2003, 1,04,960 applications were received out of which 81,498 appeared for the examination. A total of 2699 candidates were finally selected.

Shyama Prasad Mukherji Fellowship (SPMF)

The SPM Fellowship scheme was started in the year 2001-2002 for selected JRF-NET scholars, who qualify a written test especially designed for the purpose, followed by an interview. In the year 2002-2003, 338 students appeared for the written exam out of which 26 were shortlisted for interview. Six candidates could finally get the fellowship. Out of these three were from Life Sciences, two from Physics and one from Chemistry.

Senior Research Fellowship (SRF), SRF extended and Research Associateship (RA)

Applications are invited twice a year on all India basis for SRF's, SRF (Ext) and RA's. Selections are based on the interviews by Expert Selection Committees. During 2002-2003 a total of 4083 applications were received from which 1201 candidates were selected. The total number of candidates selected for SRF were 917, those for SRF (Ext) were 100 and for RA were 184.

Junior Research Fellowship for Gate Qualified Engineering Graduated (JRF-GATE)

CSIR introduced a new research fellowship in 2002 for the GATE qualified candidates with B.E./ B.Tech./ B.Arch./ B.Pharm. degree to pursue research leading to Ph.D. This is known as the GATE qualified Junior Research Fellowship (JRF-GATE). JRF's selected under this scheme get excellent opportunity to work with the CSIR scientists with state-of-art R&D facility and obtain Ph.D. degree. The fellowships under this scheme are tenable only at CSIR laboratories. At any point of time each laboratory can have 10 JRF-GATE fellows. In the year 2002-2003 around 70 candidates were offered JRF-GATE Fellowships in different laboratories of CSIR.

Senior Research Associateship (SRA)

The Senior Research Associateship (SRA) is primarily meant to provide temporary placement to highly qualified Indian scientists, engineers, technologists, and medical personnel returning from foreign countries and also those who are not in regular employment in the country. The data of the last 3 years of the scheme is presented below:

Year	No. of SRA selected	No. of SRA joined	Total no. supported
2000-2001	107	82	320
2001-2002	134	94	210
2002-2003	134	93	202

Extra mural research schemes and special support programs

CSIR provides financial assistance to promote research in the field of Science and Technology including Agriculture, Engineering and Medicine. These are given in the form of research grants to Professors, Scientists, Experts in regular employment in Universities/Academic Institutes/ IITs etc. The number of research schemes proposed and recommended during the year, along with the last year is given below:

Year	Total no. of proposals	Recommended for support	Renewals
2001-2002	500	220	870
2002-2003	555	223	511

Under the Emeritus Scientists scheme financial assistance was provided to 32 outstanding superannuated scientists out of the total of 134 proposals received and 110 renewals were made during the year. In the sponsored scheme category 21 schemes were sanctioned out of the 60 proposals received and 37 schemes were renewed. In addition, the sub-committee meetings renewed 10 schemes and made no fresh recommendations.

Travel /Conference grants

Travel grant is provided by CSIR to young researchers for presenting paper at the International Conferences held abroad. The travel grant committee considered a total of 609 applications out of which 363 cases were recommended. The same committee considered 478 proposals from scientific societies/ institutes etc for organizing national/ international conference/ symposium/ workshops, etc. and recommended 420 cases for funding.

Intramural training programs

A training program on 'Management of R&D' is organized annually to enhance managerial skills of the scientists. 17 Scientists representing 14 laboratories attended this training Program organized at the Administrative Staff College of India, Hyderabad.

CSIR Program on Youth Leadership in Science (CPYLS)

The CPYLS scheme is a unique 'hand holding' program started for school children at secondary level. The scheme was started to attract the meritorious young school children towards science. In the year 2002-2003 around 1000 students participated in the CPYLS program organized by various laboratories throughout the country. About 20 nominations were received for Student Associateships by those students who had opted to take science as a career, amongst these 13 students joined as CSIR Student Associates.

106 Bright students from different boards of 7 North Eastern states were selected and invited to participate in a programme organized during 30-31 October, 2002.

4

DATELINE CSIR

April 2002

2nd – 3rd	IICB celebrated J.C. Ray Birth Centenary. National symposium on tropical diseases was organized by West Bengal Academy of Science & Technology in collaboration with IICB and National Institute of Cholera & Enteric Diseases. Shri Surya Kanta Misra, Hon'ble Minister of Health & Family Welfare, Govt. of West Bengal inaugurated the Symposium. Dr. N. K. Ganguly, DG, ICMR was the chief guest. He delivered the keynote address.
3rd	IICB celebrated its foundation day. Dr. N. K. Ganguly, DG, ICMR delivered J.C. Ray Memorial Oration Lecture. Prof. Sujit Basu, Vice Chancellor, Visva-Bharati was the chief guest.
8th – 9th	RRL, Bhubaneswar organized National Seminar entitled "Raw Material Preparation for Metallurgical Industries: Problems and Solutions".
10th	CSMCRI celebrated its foundation day. Dr. Brij Bhusan Lohray, President, Zydus Research Centre, Ahmedabad delivered the foundation day lecture entitled "Asymmetric Synthesis and its Application in Industry".
12th	NAL handed over the 4m x 8m autoclave to HAL.
15th	Second International Women's Day Lecture was delivered by Dr. Manju Sharma, Secretary, Department of Biotechnology, entitled "Role of Women Scientists and Technologists in National Development – Excitement, Challenges and Opportunities".
16th	NAL celebrated Dr. B.R. Ambedkar's Birthday. The lecture entitled "Reservation and the Role of Dr. Ambedkar in the Constitution of India" was delivered by Hon'ble Mr. Justice M. Ramakrishna, former CJ, J&K and Guwahati.

16th	SERC-TNCST-DST jointly organized a programme for the promotion of Science & Technology in the state of Tamil Nadu. Fifty students in 2 batches participated in the programme.
19th	CSIR workshop on purchase & vigilance was held at IICB.
23rd	Hindi workshop was organized at CFRI.
29th – 30th	CEERI, Chennai Centre participated in the ELITEX-2002-Exhibition-cum-Seminar organized by the Department of Information Technology, New Delhi.
30th	IHBT organized a workshop on the "Development of Essential Oils in HimachalPradesh". Hon'ble Minister of Revenue and Biotechnology for the State of Himachal Pradesh, Shri Rajan Sushant inaugurated the workshop.

May 2002

1st	One day NAL-DLR International Seminar on Air Traffic Management was organized at NAL, Bangalore.
11th	CSIR's constituent laboratories celebrated National Technology Day. CECRI: Prof. K. Dharmalingam, Madurai Kamaraj University was the Chief Guest. CFRI: Dr. S. K. Choudhury, Chief Scientific Officer (IPR & IR), IIT, Kharagpur delivered National Technology Day lecture entitled "Technology Management: Some Important Aspects". CFTRI: Dr. B.L. Amla Former Director CFTRI delivered a lecture and presented mementoes to entrepreneurs. CIMAP: Open day was declared for the general public including students. Demonstrations on the distillation of aromatic oils were arranged for the benefit of the visitors. CIMAP also opened its experimental farm, crop museum and "Swasthya Vatika" (health garden) for the public. An interactive meet was organized with the lead farmers to obtain feedback of medicinal and aromatic plants based technology adoption and further expansion. CMRI: Dr. G.V. Rajamanikam, Professor and Head of the Department of Earth Science, Tamil University, Thanjavur delivered a lecture entitled "Role of Small Sector in Beach Placer Mining – Scope & Constraints".

IHBT: Dr. H.R. Bhojwani, Emeritus Scientist and former Head, RPBD, CSIR delivered lecture entitled "Changing face of CSIR"; Padma Bhushan Prof. V.L. Chopra presided over the function.

IICB: Organized a seminar entitled "Academia-Industry Liaisons: Emerging Areas for Biomedical Research for Technology Benefit". Shri D.P. Nag, Secretary, Bengal National Chamber of Commerce & Industry was the Chief Guest.

IMT: Open day was observed for the general public and students to acquaint themselves about the ongoing activities of the institute. Lectures by three award winning scientists were organized. Dr. C.L. Kaul, Director, NIPER presided over the function.

NPL: Dr. S.Z. Qasim, former Secretary DOD delivered the Technology Day Lecture.

RRL, Jammu: Launched Maa Shakti Project under Ministry of Human Resource Development Scheme of support to Training and Employment Programme for women in collaboration with J&K Ex Services League. Around 10,000 rural women will be trained in cultivation & utilization of aromatic crops over a period of three years under the project.

SERC: Prof. M.S. Ananth, Director, Indian Institute of Technology Madras delivered the lecture entitled "The New Technology as an Economic Opportunity".

17th – 18th: CIMAP organized the National Interactive Meet (NIM-2002) entitled "Scope and Opportunities in Research and Business of Medicinal and Aromatic Plants". The aim of the meet, which was first of its kind, was to bring together four major links of the value chain of medicinal and aromatic plants trade in the country, i.e., farmers, industry, funding organizations and research scientists, on one platform for gainful interactions. About 300 representatives from all over India attended the meet. Distinguished personalities namely Dr. (Mrs.) Manju Sharma, Secretary, DBT, Dr. Y.S. Rajan, Director, TIFAC and Shri G.D. Kelkar, MD, Kelkar Group, addressed the gathering. Eminent resource persons delivered lead lectures. Contributions in diverse related fields were presented by invited speakers. About 100 theme posters were displayed by the scientists and industrialists.

18th: Second NPL Industry meet on Calibration Services was organized.

20th – 25th	RRL, Jammu organized a training workshop for master trainers on Aromatic Herbal Farming under Maa Shakti Project, in which 20 Master Trainers were imparted training through lectures and field demonstrations.
20th – 7th June	IHBT and Wild Life Institute, Dehradun organized a three week course entitled "Bioresource for School Children" to generate awareness among children on nature. Twenty children from different schools of Uttaranchal and Himachal participated in the programme.
27th	MoU signed between CFRI and M/s. BLG Minerals Pvt. Limited, Kolkata for joint development of Coal Washing Jig under the brand name "CFRI-BLG Flexi-Jig".
28th	CFTRI organized a Colloquium on Human Resource Development for Food Industry "A National & International Perspective of Networking with Academia & Institutions". Prof. Joseph H. Hulse, President, Siemens-Hulse International Development Associates Inc., Ottawa, Canada, addressed the participants.
29th	One Day Symposium was organized by NAL on "Aerospace Technologies in NAL: Reflections and Perspectives".
30th	Prof. P.K. Dhumal, Chief Minister of Himachal Pradesh inaugurated two distillation units designed and installed by IHBT at Fatehpur, Kangra.

June 2002

1st	Prof. P. K. Dhumal, Chief Minister of Himachal Pradesh inaugurated a 5 Q capacity distillation unit designed and installed by IHBT at Salooni, Chamba.
5th	World Environment Day was celebrated at ITRC and NEERI with the theme "Give Earth a Chance".
7th	IHBT celebrated its foundation day. Dr. Anil Kush, Vice-President, Reliance Life Science, Mumbai delivered lecture on "Genes from Greens". Dr. Tej Pratap, Vice-Chancellor CSK HPKV Palampur was the chief guest of the function.

10th	SERC celebrated foundation day. Shri M. Iyengar, Executive Director (Engg., Retd.), Engineers India Ltd. delivered the foundation day lecture entitled "Some Trends in Technological Developments in Indian Industrial Sector".
12th	The Parliamentary Standing Committee on Science and Technology, Environment & Forests visited IMT. Hon'ble Committee members were appraised of diverse achievements and were shown the facilities in place.
16th	A technical delegation from the Beijing Institute of Machinery, China visited SERC. The Asian and Pacific Centre for Transfer of Technology (APCTT), New Delhi coordinated the visit.
20th	Controlled Atmosphere Storage system was inaugurated at CFTRI by Prof. Chaman Lal Gupta, Hon'ble Union Minister of State for Food Processing Industries.
26th – 27th	NCL Research Foundation organized two-days Conference on "Catalysis: Concepts to Practice" at NCL, Pune in the honour of Dr. Paul Ratnasamy, Director NCL on his 60th Birth anniversary.

July 2002

1st – 31st	A training programme for newly recruited scientists of NIO in the area of mathematical modelling and its applications was organized at CMMACS.
15th – 16th	CIMAP organized a two days workshop on "Application of Internet/ Intranet in Retrieval of Scientific Information and Database Search Techniques" under the sponsorship of DBT. Twenty-five participants attended the workshop.
24th	NAL celebrated its 16th foundation day. Mr. K. S. Sudheendra, Adviser and Wg. Cdr. (Retd.) C. D. Upadhyay, Chief Test Pilot, of HAL's Rotary Wing Research and Design Centre delivered foundation day lecture entitled "Technology & Status of the Indian DHRUV and Potential for R&D in Rotor Craft Technology from the DHRUV Platform".
25th	CECRI celebrated its foundation day. Shri N.N. Jha, His excellency the Lt. Governor, Andaman Nicobar Islands was the Chief Guest. Foundation Day lecture entitled "Nano Technology – Microsensors & Their Application" was delivered by Dr. S. Ahmad, Director, CEERI, Pilani.

25th-26th	Seminar on different areas of Deposit Rating of Engine Components organized at IIP under aegis of National Rotors forum. 12 engineers from Oil Companies and OEM's participated.
29th	Prof. Goverdhan Mehta, Director, Indian Institute of Science, Bangalore delivered 12th Sidhu Science Lecture entitled "Natural Product Synthesis: Is it relevant any more?" at IICT.
29th	Dr. Ravindra Gettu, Director, Structural Technology Laboratory, Universitat Politecnica de Catalunya, Barcelona, Spain, visited SERC and delivered a lecture entitled "Advances in the Study of New Chemical Admixtures".
31st	A delegation from Malaysia led by the Malaysian Education Minister Sri Y.B. Tan, Sri Musa Bin Mohamad visited CCMB to explore the possibility of scientific collaboration.

August 2002

19th	Prof. G. Padmanaban, IISc., Bangalore delivered the 5th Prof. B.K. Bachhawat Memorial Lecture entitled "New Facets of Malaria Parasite Biology". The function was presided over by Dr. C.M. Gupta, Director, CDRI. Prof. Kasturi Datta, Dean & Professor, School of Environmental Sciences, JNU was the Chief Guest.
19th – 23rd	ITRC organized a five day workshop under the sponsorship of WHO to build capabilities in the area of environmental epidemiology. Twenty participants from various Medical Colleges, Industry and State Pollution Control Boards participated in the workshop.
21st	Prof. Brahm Prakash Memorial Lecture was delivered by Dr. R.A. Mashelkar, DG,CSIR entitled "Fun and Joy of Science: Learning from Anomalies and Discontinuities".
26th	Dr. R. Chidambaram, Scientific Advisor, Govt. of India and DAE-Bhabha Professor delivered 11th S. S. Bhatnagar Memorial Lecture entitled "Technology Imperatives of Development" at IICT.
28th	NAL entered into an agreement with Reinforced Plastic Industries (RPI) for manufacture of HANSA shells marking the start of HANSA productionisation efforts.

September 2002

2nd – 4th	NEERI organized Indo-Italian Workshop on Emerging Technologies for Industrial Wastewater and Environment.
2nd – 16th	Hindi Pakhwara was inaugurated by Hindi poetess Dr.(Mrs.) Premlata Dwivedi. Programmes like Kavi Gosthi and various competitions in Hindi were organized. Shri Nara Narayan Rao Akhare, Development Officer, LIC delivered a lecture on "Importance of Hindi in Various Fields" at CFRI Unit, Nagpur. Concluding lecture was delivered by Shri V. K. Shukla, Director, Akash Vani, Ranchi.
3rd	CFRI arranged Kisan Gosthi to popularize bulk use of fly ash in agriculture and wasteland management at Pipri Village, Obra TPP area.
4th – 13th	Hindi pakhwara was celebrated in SERC. Several competitions viz. Hindi writing, dictation, hindi songs were held. Shri M.P. Dube, Dy. Director (S), Hindi Teaching Scheme, Chennai was the Chief Guest.
6th – 7th	Two day Interactive Meet on Clarysage in Ladhakh was conducted by RRL, Jammu. Shri Thupstan Chewang, Chief Executive Councilor, Ladhakh Autonomous Hill Development Council, Leh inaugurated the meet.
11th	The Parliamentary Standing Committee on Science and Technology, Environment & Forests comprising of 45 members from Rajya Sabha and Lok Sabha under the leadership of Mr. C. Ramachandraiah, Member, Rajya Sabha and Chairman of the Committee visited SERC. A presentation about the R&D Activities and Technological Achievements of the laboratory was given.
12th	NISTADS organized a workshop on Valuation Indicators for Natural Resources Research in collaboration with Centre for Advancement of Sustainable Agriculture (CASA). The workshop was part of the requirements of a multidisciplinary study in NISTADS, on "Ecological Economics for Sustainable Agriculture: Valuation Indicators for Evaluation of Soil Sciences Research in India", sponsored by the National Agricultural Technology Project (NATP), of the ICAR-World Bank.
14th	Hindi Saptah was celebrated at IHBT. A hasya kavi sammelan was organized on the occasion.

20th – 22nd	CEERI celebrated its foundation day. Workshop on MEMS Packaging Technology and Applications (MEMSPACK-2002) was organized.
26th	CSIR Foundation Day: Diamond Jubilee Celebration.
	CCMB: Observed open day. More than 5000 people including school and college students visited the campus. Director, CCMB honoured the retired staff and distributed prizes to the children of staff who participated in the Essay Writing Competition.
	CDRI: H.E. Shri Vishnu Kant Shastri, Governor, U.P. was the Chief Guest; Dr. G. Padmanaban delivered the lecture entitled "Molecular Medicine for the Future".
	CFRI: H.E. Justice M. Rama Jois, the Governor of Jharkhand was the Chief Guest. He delivered the foundation day lecture encompassing the role of CFRI in energy sector. Shri D.K. Das, GM (QC), WCL, delivered a lecture at CFRI Nagpur Unit. Prizes were distributed to children – wards of CFRI staff members for scientific essay competition.
	CMRI: Foundation Day was celebrated with great enthusiasm. Justice M. Rama Jois, Governor of Jharkhand delivered the CSIR Diamond Jubilee Foundation Day Lecture on this occasion.
	Renaming of CBT: Anticipating the arrival of human genome sequence, CBT, positioned itself to meet the challenges in expanding horizons of Biotechnology, Genomics, Genome Informatics and Bioactive Molecules. Since CBT was uniquely poised in the CSIR family, need was felt to change the name of Center to reflect its areas of exploration. Therefore, CBT was renamed as Institute of Genomics & Integrative Biology (IGIB) with formal announcement by Shri Atal Bihari Vajpayee, Hon'ble Prime Minister of India. The Foundation stone of "IGIB Diamond Jubilee Campus" was laid by Hon'ble Prime Minister of India on the same day.
	IHBT: Padma Bhushan Prof. Pushpa M. Bhargava delivered lecture entitled "Scope and Implications of Biotechnology Today". Prof. P.K. Khosla Senior Scientific Advisor (Biotechnology) Himachal Pradesh Government, presided over the function.
	IICB: Prof. Asish K. Banerjee, VC, Calcutta University inaugurated the function. Prof. Susanta Duttagupta, Director, S.N.Bose National Centre for basic sciences graced the occasion as the Chief Guest.

IICT, CCMB & NGRI: Three laboratories of Hyderabad jointly organized CSIR Diamond Jubilee Celebrations. His Excellency Padma Vibhushan Dr. C. Rangarajan, the Governor of A.P. was the Chief Guest.

IIP: Mr. Ram Naik, Hon'ble Union Minister of Petroleum and Natural Gas, Government of India and Mr. M.A. Pathan, former Chairman, Indian Oil Corporation Ltd. graced the function as Chief Guest in IIP marking the beginning of year long Diamond Jubilee Celebration.

IMT: Open day was observed. A number of visitors, students, teachers visited the institute. They were apprised of the ongoing work in the institute. Two special lectures were organized.

ITRC, NBRI, CIMAP, CDRI: The Lucknow based laboratories joined to celebrate the diamond Jubilee. H.E. Shri Vishnu Kant Shastri, the Governor of Uttar Pradesh inaugurated the function. Hon'ble Mayor of the City, Dr. S. C. Rai presided over the function. Dr. P.K. Seth, Director, ITRC, gave a historical background and significant achievements of Lucknow based laboratories. Dr. C.M. Gupta, Director, CDRI presented detailed highlights and future vision of CSIR laboratories. The Governor exhorted scientists to develop indigenous technologies and economical drugs for the common man. Hon'ble Mayer of the City Dr. S. C. Rai in his presidential address lauded the public awareness programmes of Lucknow based laboratories and appreciated the achievements. Dr. Pushpangadan, Director, NBRI proposed the vote of thanks. The Governor later inaugurated 'CSIR Diamond Jubilee Exhibition'. Prof. G. Padmanabhan, former Director, IISc., Bangalore, delivered the first Diamond Jubilee Lecture, entitled 'Molecular Medicine for Future'.

NAL: Foundation day lectures were delivered by Mr. Shyam Chetty on "Design and Development of Control Laws for Modern Aircraft" and Prof. H.S. Mukunda on "Combustion Science & Technology in India".

NML: Shri B. Muthuraman, MD, Tata Steel delivered a lecture entitled "Successful Steel Company of the Future".

RRL, Bhopal: H.E., the Governor of M. P., Dr. Bhai Mahavir was the Chief Guest and Dr. T. Karunakaran, Vice Chancellor, Mahatma Gandhi Chitrakoot Gramodaya Vishvavidyalaya presided over the function. Shri S. N. Roy, ED, BHEL, Bhopal was the Special Guest. The theme of celebration was Rural Technology Development.

RRL, Jammu: Dr. A. V. Rama Rao, CMD, AVRA Laboratories Pvt. Ltd., Hyderabad delivered the CSIR Foundation Day Lecture entitled "Science & Technology for Development - Our Experiences and Certain Imperatives for the future". Dr. Bansi Lal, President & Head Research, Nicholas Piramal India Ltd, Mumbai presided over the function. A three day National Seminar on Intellectual Property Management of Herbs and Horticulture was organized during 26-28 September. The seminar was attended by 74 delegates from all over India.

30th — One day meet/workshop on Water Resources Management was organized at RRL, Bhopal. Dr. N. Ramakrishnan, Director, RRL, presided over the function. Dr. H.P. Garg, DG, MPCOST was the Chief Guest. Shri M.S. Billore, Former Secretary, Water Resources, Govt. of M.P. delivered the keynote address entitled "Water Resources Development & Management in the State of M.P.".

October 2002

1st — CFRI entered into strategic alliance with M/s Aar Ess Exim, Delhi for execution of projects related to metallurgical/industrial grade coke, injectable coal for steel melt shop, briquetted fuel for domestic use, coal devolatilization and related areas in India and abroad.

4th — One day Roving Seminar on "IPR in Biotechnology" was held at CIMAP under the sponsorship of Department of Biotechnology, in collaboration with World Intellectual Property Organization (WIPO), Geneva. Eminent speakers of the seminar were Mr. Nuno Pires De Carvalho, Head, GRB&AT, WIPO, Geneva and Dr. Victoria Henson, Apollonio, Manager CGIAR, Netherlands, Shri R.K. Gupta, Head – IPMD, CSIR, Dr. K.V. Swaminathan, Chairman, WITT and Dr. Malathi Laxmikumaran of TERI. The seminar was attended by scientists, researchers and students. The discussion was on various aspects of the IPR in today's perspective. Dr. B.N. Dhawan, Former Director, CDRI, delivered the inaugural address and highlighted the need and extent of IPR protection in biological sciences. Dr. Gulshan Wadhwa, Scientist, DBT, proposed the vote of thanks.

19th — NBRI and Centre for Science and Technology of Non-Aligned and Other Developing Countries jointly organized a one-day Symposium on medicinal plants with the theme "Strategies for Development of the Herbal Drugs in the Third World Countries" at CSIR Science Centre, New Delhi. About 35 experts on various subjects from third world countries and from India participated in the symposium. The

	Symposium was inaugurated by Dr. M.S.Valiathan, President, Indian National Science Academy (INSA) and was presided by Dr. R.A. Mashelkar, DG,CSIR.
22nd	Hon'ble Mr. B. S. Ngubane, Minister for Arts & Culture and Science & Technology, Ms. Sibusiso Manzini, Deputy Director in Ministry of Science & Technology and Mr. Maite Nkoana-Mashabane, Hon'ble High Commissioner, South Africa visited NISCAIR. They showed keen interest in TKDL.
22nd – 23rd	Two days Conference on Light Metals and Composites for Strategic and Societal applications LMCSSN 2002 was held at RRL, Tvm.
24th – 25th	NML in collaboration with the Institution of Engineers (India) and Materials Research Society of India organized a two days National Seminar on 'Resurgence of Metallic Materials -The Current Scenario'.
25th	Dr. Stephane Chapuliot, Research Engineer, Laboratory for Structural Integrity and Standards (CEA), Saclay, France, visited SERC. A lecture entitled "Ductile Tearing Analysis using the Gfr Parameters" was delivered by him.
28th	NBRI celebrated its Annual Day. Padma Bhushan Dr. P.K. Iyengar, Former Chairman, Atomic Energy Commission presided the function and delivered the 22nd Silver Jubilee Lecture entitled "Creativity and Commerce - Role of Research in Science and Society".
31st – 6th November	CSIR laboratories observed Vigilance Awareness Week.

November 2002

1st	A Bulgarian delegation led by Dr. Igor S. Demyanov visited CCMB. Prof. Vladimir A. Ovacharov, Prof. Venclin Gorkov Rector, Tech University Sofia, Mr. B. Koster, Charge D Affairs, Bulgarian Embassy, New Delhi, Dr. A.K. Kalra, Adviser, DST were the members of Delegation. They had detailed discussion about various R&D Activities.
4th	ITRC celebrated its 37th foundation day. Dr. P.K. Seth, Director, ITRC welcomed the guests. Prof. Asis Datta delivered the foundation day lecture entitled "Green Revolution" and explained the application of advances in plant breeding particularly tissue culture and genetic engineering.

7th	IICT foundation day lecture entitled "The New Role of Technologists in Creating Knowledge Societies at Village Level" was delivered by Dr. M.H. Mehta, Vice-Chancellor, Gujarat Agricultural University, Gujarat.
8th – 22nd	A German Scientist, Prof. G. Kunze with expertise in biosensor, from Institute of Plant Genetics and Crop Plant Research, Gatersleben, Germany visited IGIB under CSIR-DAAD scientists Exchange Programme.
14th – 15th	A two-day Trainer's Training Programme on CSIR e-journal Consortium was held at SERC. The programme was arranged by M/s Elsevier Science for the southern region of CSIR Labs. Seventeen participants from various CSIR laboratories were trained in the programme.
18th – 15th December	Mr. D. Koschmieder, ZAM, Germany, visited SERC under Indo-German Collaborative Programme. A lecture entitled "RAPS & XRAPS: Products of SERC - FZJ Collaboration in FE Post-processing" was delivered by Mr. Koschmieder.
21st	17th National Carbohydrate Conference was jointly organized by CFTRI and Association of Carbohydrate Chemists and Technologists (India). The focal theme of the conference was 'New vistas in carbohydrate research and application'. Prof. Goverdhan Mehta, Director, IISc, Bangalore, inaugurated the conference and delivered the keynote address entitled 'Towards New Carbohydrates'. About 150 delegates participated in the Conference, which had five technical sessions. Invited papers were presented on a wide range of topics related to carbohydrates i.e., structure and synthesis, chemistry and biochemistry, biotechnology, processing, nutrition and health. Current R&D work carried out in various scientific organizations and academic institutes was depicted in the poster sessions.
24th – 25th	SSBMT sports meet held at RRL,Bhopal. Hon'ble minister of Sports, Govt. of MP, Shri Tejilal Saryam inaugurated the meet.
24th – 29th	CCMB celebrated its foundation day. An international symposium on "The Current Excitement in Biology" was organized as a part of CCMB's Silver Jubilee Celebrations. His Excellency Hon'ble President of India – Dr. A.P.J. Abdul Kalam, Hon'ble Minister of State for Science & Technology – Shri Bachi Singh Rawat, Director General, CSIR – Dr. R.A. Mashelkar, Noble laureates and many distinguished visitors were present. Many distinguished scientists

	including Noble Laureates from abroad and from India delivered lectures on latest subjects in biology.
26th	NML celebrated foundation day. The function was presided over by Dr. Placid Rodrigues, Chairman, Recruitment and Assessment Centre, DRDO, New Delhi. Annual Report 2001-2002 was released on this occasion.
28th – 29th	SERC conducted the CSIR Programme on Youth for Leadership in Science (CPYLS). About 20 students attended the programme. Various programmes viz., technical audio-visual presentation comprising brief documentaries especially the CSIR Diamond Jubilee Celebrations held on 26th September 2002 at New Delhi, Specific Laboratories Tour; Talent Essay competition on Science Topic, and ; Quiz programmes; and Special Lectures were given by Dr. T.V.S.R. Appa Rao, CSIR Emeritus Scientist & Former Director, SERC and Prof. R. Parthasarathy (Retd.) S&T Advisor, Science Bureau, The Hindu. The programme concluded with a feed back session. Prizes and certificates were also given away to the participants.

December 2002

1st	RRL, Jammu celebrated foundation day. Prof. B. B. Chattoo, Vice Chancellor, Mata Vaishno Devi University, Jammu delivered foundation day lecture entitled "Trends in Biotechnology". Dr. P. Pushpangadan, Director NBRI presided over the function.
1st – 5th	NISTADS organized a five day conference on 'Health Care and Food: Challenges of Intellectual Property Rights, Biosafety and Bioethics'. Around 150 participants attended the conference.
2nd	An MoU between Korean Electrotechnology Research Institute (KERI) and CECRI for R&D cooperation in the field of electro-chemical science and technology was entered into.
3rd	French delegation led by Jean Simon, DG of CAHR visited CCMB.
4th	Prof. V. Ramakrishnan, Distinguished Professor, South Dakota School of Mines and Technology, Rapid City, USA visited SERC and delivered a lecture entitled "Bacterial Enhancement of Concrete and Use of Basalt Composite Rebars for Concrete Reinforcement". The programme was jointly organized by SERC, Chennai and International Centre for Fibre Reinforced Concrete Composites (ICFRC).

4th – 6th	3rd NAM Workshop on Role of VLSI for MEMS with S&T Centre, New Delhi and AIT Bangkok was organized by CEERI.
12th	CSIR Diamond Jubilee Lecture entitled "Crystals for high technology" was delivered at CECRI by Prof. P. Ramasamy, Director, Crystal Growth Centre, Anna University, Chennai.
12th – 15th	RRL, Jorhat organized an exhibition (on behalf of CSIR) at Guwahati on the occasion of "North East Vision 2010".
13th – 14th	Two days national symposium on Science & Technology for Societal Protection - Need for a Paradigm Shift (Road Sector Perspectives) in commemoration of CSIR Diamond Jubilee Celebrations was organized at CRRI. The symposium was inaugurated by Dr. K.L. Thapar, Director, Asian Institute of Transport Development and was presided over by Shri D.P. Gupta, Chairman, Research Council, CRRI. Prof. Dinesh Mohan, IIT, Delhi and Dr. R.K. Bhandari, Director, CDMM, Chennai delivered the key note address entitled "Fast Changing Trends in Road Sector - The Societal Dimensions". The technical session included threat perception in ecology and environment; Intelligent Transport System and Society; Road Infrastructure Management for Safer Societies; S&T contribution to HRD for Road Sector; Round Table Discussions - Vision of S&T for Societal protection - A Road Sector Perspective and finally Concluding session which was chaired by Prof. M.G.K. Menon.
14th – 15th	Chrysanthemum & Coleus Show 2002 was organized by NBRI. About 146 exhibitors participated in the show by sending 1077 entries. In all 389 prizes besides 22 Running Challenge Cups/Shields and Trophies were awarded at the prize distribution function. Padmashri Dr. S.C. Rai, Hon'ble Mayor of Lucknow presided over the prize distribution function. Smt. Madhu Rai presented the prizes to the successful competitors.
18th – 19th	Two days National Seminar on Smelting Reduction for Iron Making was organized at RRL, Bhubaneswar.
30th	CFTRI celebrated its foundation day. Dr. J. Ramachandran, President, Ganga-Gen Biotechnologies Pvt. Ltd., Bangalore delivered a lecture entitled "Novel Natural Therapies against Antibiotics Resistant Bacterial infection". CFTRI actively participated in holding the X National Children's Science Congress, organized by the Karnataka Rajya Vijnana Parishat, Bangalore, in association with the NCSTC Network, New

	Delhi. The congress was held at the Regional Institute of Education, Mysore. About 950 participants comprising children delegates and their teacher/guides witnessed demonstration of a numberof machines designed at CFTRI.

January 2003

1st	One day symposium entitled "Creating a Wealth Pyramid: A Partnership of Science, Technology, Innovation and Entrepreneurship" was organized by NCL Research Foundation at NCL, Pune to commemorate sixtieth birthday of Dr. R. A. Mashelkar, FRS, DG,CSIR. A galaxy of distinguished speakers from business, industry, research, academia and government congregated at NCL on the occasion.
7th	Certified Reference Materials (CRMs) of NPL was released by Prof. V. S. Ramamurthy, Secretary, DST.
11th	CEERI initiated Golden Jubilee Celebration lectures series – first lecture was delivered by Dr. S.K. Joshi, Former DG,CSIR and Chairman, RAB.
17th	Dr. S.J. Chopra, Executive Director, Centre for High Technology, Ministry of Petroleum and Natural Gas delivered 7th Dr. P.S. Murti Memorial Lecture entitled "Refinery for the Future" at IICT.
18th	Mr. Jack Dowell and Mr. John McGowan, Diesel Engine CoE, GE Transportation Systems, USA visited SERC.
18th – 19th	NBRI organized Rose & Gladiolus Show. About 59 exhibitors participated in the show by sending 602 entries. Dr. Man Mohan Sinha, Director, Horticulture and Food Processing, U.P. presided over the function and presented prizes to the winners.
21st	Presentation of ISO 9001: 2000 Certification for Quality Management System Standard for R&D, Consultancy, Testing & Analytical services for utilization of Minerals and other Natural Resources to RRL, Bhubaneswar by Prof. S. K. Joshi, Former DG, CSIR & Chairman, RAB, CSIR.
21st – 23rd	NML organized a seminar entitled "Continuing Education Course on Metallurgy" for Engineers. The objective was to impart an understanding of metallic materials, their properties and characteristics, the methods employed to transform them into useful components and structures and the techniques used to ensure their

	efficacy to the practising professionals. More than seventy participants from different organizations participated.
22nd	One day International Workshop entitled "Recent Advances in Nanotechnology of Magnetic Fluids (RANMF 2003)" was organized at NPL. Inaugural address was given by Prof. K. Venkatasubramanian, Member, Planning Commission and keynote address by Dr. S. W. Charles, University of Wales, Bangor, U.K.
24th	IMT celebrated its 19th foundation day. Foundation day lecture was delivered by Prof. Gautam R. Desiraju, School of Chemistry, University of Hyderabad, Hyderabad entitled "Chemistry Beyond the Molecule - Supramolecular Chemistry and Biology". The lecture was presided over by Prof. K. N. Pathak, Vice-Chancellor, Punjab University, Chandigarh.
26th	HANSA aircraft of NAL participated in Republic Day Parade.
27th – 31st	Indian Society for Mass Spectrometry (ISMAS) in association with NIO, Goa organized ISMAS Silver Jubilee Symposium on Mass Spectrometry.
28th	Visit of Prof. Murli Manohar Joshi, Hon'ble Minister for Science & Technology & Vice President, CSIR to CSIO – Inauguration of Seismological Observatory and Biomolecular Electronics & Nano Technology Lab – Foundation Stone Laying for ISTC Building – Technology Transfer of Head Up Display to Bharat Electronics Ltd.
28th	Iranian delegation led by Hon'ble President of Islamic Republic of Iran, His Excellency Sri Seyed Mohammad Khatami visited CCMB to explore the possibility of collaboration in scientific programmes. They had detailed deliberations on R&D activities and various infrastructure facilities available at CCMB.
28th – 29th	NGRI organized a two day seminar entitled "Ocean and Antarctic sciences in India Current Programs and Emerging Frontiers". It culminated in planning for new strategies and methodologies for a better understanding of ocean system and enhancing the ocean resources.
30th – 31st	NML and Indian Institute of Metals, Jamshedpur jointly organized a National Seminar entitled "Micro-alloyed Steel for Automotive

Industries (MSAI-2003)". The representatives from the organizations namely Tata Steel, Rourkela Steel Plant, Bhillai Steel Plant, Bokaro Steel Plant, RDCIS (SAIL), IISc, Bangalore, IIT Kharagpur, IIT Kanpur, IIT Roorkee IT-BHU, Varanasi and BE College Howrah participated and contributed in the deliberations.

February 2003

3rd	Dr. R.A. Mashelkar, FRS, DG,CSIR was honoured with Dadabhai Naoroji Memorial Award 2002 by Dr. A.P.J. Abdul Kalam, Hon'ble President of India for advancing the interests in the field of science and technology in a function organized at NPL.
	4th International Conference entitled "Advances in Metrology: Equivalence of Standards and Global Recognition (AdMet 2003)" was held at NPL. Prof. M.G.K. Menon, FRS inaugurated the conference.
4th	First prototype of SARAS (VT-XSD) rolled out in honour of Dr. Satish Dhawan, ex-RC Chairman of NAL responsible for initiation of Civil Aviation Activities in NAL.
5th	HANSA-3 of NAL participated in the flight display in Aero-India 2003.
5th –9th	Head Up Display System displayed at the International Air Show held at Bangalore
7th – 11th	A workshop entitled "Comet Assay: Applications in Toxicology and Molecular Epidemiology" was organized at ITRC. Eminent scientists from six different countries (India, USA, Japan, Germany, Austria and Slovakia) gave lectures and hands on demonstrations on various aspects of the Comet Assay to over 30 participants from Research Institutions, Universities and Pharmaceutical Industries.
10th	R&D Institute-Industry Meet was organized at CEERI Chennai Centre on Appropriate Automation Needs for Real Time Inspection and Quality Control.
12th	One day National Symposium on Luminescence and its Applications (NSLA 2003) was held at NPL. Dr. Harsh K. Gupta, Secretary DOD gave the inaugural address and keynote address was given by Prof. K. Inabe, Kanazawa University, Japan.
14th	CDRI initiated CSIR Diamond Jubilee Lecture Series: First lecture delivered by Prof. Stewart Cole, Director (Strategic Technology),

	Institut Pasteur, Paris on Impact of modern biology on strategies for tuberculosis control.
17th	CDRI organized 28th Mallenby Memorial Oration. Prof. N.K. Ganguly, DG, ICMR delivered a lecture entitled "Challenges in Rheumatic Fever/Rheumatic Heart Diseases – an Overview". CDRI celebrated its annual day function, Prof. G.P. Talwar was the Chief Guest.
19th – 20th	Two day National Seminar entitled "Desalination & Membrane Technology: Present & Future" was held at CSMCRI. Prof. M.M. Sharma, Ex-Director, UDCT, Mumbai was the Chief Guest. Dr. M.H. Mehta, Vice Chancellor, Gujarat Agricultural University and Dr. Ramgopal, President, INDA were the Guests of Honour. About 100 participants from various agencies/organizations attended the Seminar.
20th – 22nd	Yeast 2003 – An International Meeting on Yeast Biology was organized at IMT. About 120 participants from India and abroad actively participated in the meet. The inaugural lecture was delivered by Dr. S.K. Brahmachari, Director, IGIB entitled "Comparative Genomics - An Approach to Seamless Biology". There were speakers from USA, Singapore, Spain, Denmark, Germany, Belgium, UK, Sweden and France. A poster session was organized on each day of the meeting in which a total of 38 participants displayed their research findings.
24th – 25th	NIO organized a two day International Workshop on Biogeochemical Processes in the Northern Indian Ocean.
28th	CSIR constituent laboratories celebrated 'National Science Day'. ITRC: Theme was "50 years of DNA, 25 years of IVF - The Blueprint of Life". Dr. S.K. Katiyar, Prof. & Head, Department of Chest Diseases and Tuberculosis, GSVM Medical College, Kanpur delivered a lecture entitled, "Pulmonary disease: Indian Perspective". Dr. Nitya Anand, former Director CDRI, presided over the function. NAL: A lecture was delivered by Prof. S. Ranganathan on "Discovery to Design of Materials". NBRI: The day was celebrated as 'Open Day'. Large number of students besides a number of farmers and general public visited the laboratory. A lecture entitled "Food Secure India : Long Journey of Progress Through Science" was delivered by Prof. Anupam Verma, National Professor, IARI, New Delhi.

	RRL, Bhopal: Dr. N. Ramakrishnan released the quality policy of the laboratory and Dr. O.P. Modi delivered a lecture entitled "Advanced Composite Materials".
	SERC: A lecture was delivered by Prof. B.K. Raghu Prasad, Professor, IISc, Bangalore entitled "Capacity Spectrum for Structures Asymmetric in Plan".
March 2003	
4th	CDRI organized 7th Dr. C.R. Krishna Murti Memorial Oration. Prof. S.K. Brahmachari delivered a lecture entitled "Unusual DNA structure to genome analysis".
30th	NAL handed over HANSA VT-HNW to Trivandrum Flying Club.

ANNEXURE-I

INTELLECTUAL PROPERTY FROM CSIR DURING 2002-2003

Laboratory	Patents				Copyrights	Trademarks
	India		Abroad			India
	Filed	Granted	Filed	Granted	Filed	Filed
CBRI	2	2	-	-	-	-
CCMB	4	0	1	3	-	-
CDRI	11	19	28	3	-	-
CECRI	11	8	15	1	-	-
CEERI	0	2	-	-	-	-
CFRI	8	1	10	2	3	2
CFTRI	122	5	105	7	-	-
CGCRI	21	3	6	1	-	-
CIMAP	12	2	65	36	-	-
CLRI	8	4	8*	6	1	-
CMERI	5	0	1	0	-	-
CMRI	3	3	0	1	-	-
CRRI	0	1	-	-	-	-
CSIO	1	2	15	0	-	-
CSIR(SCH)	18	0	11	2	-	-
CSMCRI	7	1	38	1	-	-
IGIB	11	2	36	6	10	-
IHBT	5	1	24	12	-	-
IICB	5	4	22	5	-	-
IICT	46	10	139	32	1	-
IIP	8	9	6	1	-	-
IMT	6	1	5	1	2	-
ITRC	2	0	-	-	-	-
NAL	10	2	3	2	1	-
NBRI	1	1	19	3	-	-
NCL	27	48	41	46	1	-
NEERI	2	7	2	0	4	-
NGRI	1	0	5	0	7	-
NIO	9	1	36	4	-	-
NML	7	3	14	0	2	-
NPL	5	2	12	5	-	-
RRL(Bhu)	11	5	2	1	-	-
RRL(Bho)	2	1	-	-	-	-
RRL(Jm)	12	5	45	0	-	-
RRL(Jt)	8	8	0	1	-	-
RRL(Tvm)	8	3	9	7	-	-
SERC(M)	2	0	-	-	1	-
HRDG/CSIR	-	-	-	-	2	-
TOTAL	421	166	728	189	35	2

* There have been 8 new inventions, 4 of which filed only in US remaining 4 have been filed both in US & through PCT.

ANNEXURE I-A

FOREIGN PATENTS GRANTED – 2002-2003

CCMB

DNA markers for assessing seed purity.	Sonti, R.V. and Jamir, Y.	BD 1003650
Use of DNA encoding a promoter or promoters alongwith CIS regulatory elements and a novel process for producing polypeptides.	Gowrishankar, J., Bhandari, P. and Rajkumari, K.	JP 3375830
DNA markers for assessing seed purity and method of using DNA sequences for assessing seed purity.	Sonti, R.V. and Jamir, Y.	US 6528265

CDRI

Composition useful for the early diagnosis of visceral leishmaniasis and a process for preparing the same.	Jain, G.K., Tiwari, S., Gupta, S. and Katiyar, J.C.	US 6423529
Novel substituted 1,2,4-trioxanes as antimalarial agents and process of producing the substituted 1,2,4-trioxanes.	Chandan Singh and Puri, S.K.	PK 137301
Linker based solid support for peptide and small molecule organic synthesis.	Haq, W. and Katti, S.B.	US 6492460

CECRI

Process for the preparation of flexible and free standing conducting polyaniline film.	Kumar,K.K.S., Sivasubramanian,G., and Trivedi, D.C.	US 6402992

CFRI

Process for the production of a fly ash slurry.	Rao, S.K., Ghosh, S.K., Basu, S.K., Mall, B.K., Verma, S.K., Singh, G. and Mazumdar, S.	US 6419620

Process for the production of low ash fuel.	Sinha,P.N., Sengupta,P. and Bhattacharya, K.S.	US 6524354
CFTRI		
A continuous circular cutting machine useful for lemon and other similar fruits.	Murthy,K.V., Jayaprakashan, S.T.G. and Shivakumar, M.	SL 12699
An improved process for producing dry, fine spice mix/garam masala powders and the like.	Sridhar,B.S., Sankar,K.U., Ramesh,T., Nagesha,G.K. and Kumar, A.K.V.	SL 12700
A process for preparation of sugarcane juice powder.	Raghavan, B., Ramalakshmi, K., Borse, B.B.R., Ramesh, M.N. and Prakash, V.	SL 12701
A device useful for continual volumetric dispensing of Idli batter and like materials.	Nagaraju,V.D., Ramesh, T., Premkumar, D., Bharath and Rangaswamy, K.P.	SL 12711
An improved nutrient medium formulation for the rapid multiplication of banana variety "Nanjangudu Rasabale" by plant tissue culture method.	Bhagyalakshmi,N., Ravishankar,G.A. and Venkataraman, L.V.	SL 12712
Process for the preparation of a high protein hydrolysate.	Cheruppanpullil,R., Parigi,R.K and Vishweshwariah, P.	US 6420133
Adding flavidin to a composition as an anti-oxidant.	Rao, L.J.M., Jayaprakasha, G.K. and Sakariah, K.K.	US 6503552
CGCRI		
A process for high density hydration resistant lime sinters.	Banerjee,G., Das,S.K., Ghosh,A., Mukherjee,B., Biswas,J.R., Majumdar,S.D., Banawalikar,D.G. and Mukherjee,S.	DE 10012260
CIMAP		
Antibacterial composition comprising oenostacin from *Oenothera biennis*.	Shukla,Y.N., Santha Kumar,T.R., Srivastava,A., Khanuja,S.P.S., Gupta,V.K. and Kumar, S.	US 6365197
Process for the production of a compound (+) catechin penta acetate useful as a precursor for the production of (+) catechin.	Chattopadhyay,S.K., Banerjee,S., Agarwal,S., Sashidhara,K.V., Tripathi,V., Kukreja,A.K., Kumar,S., Kulshrestha,M., Sharma,R.P. and Mehta, V.K.	US 6365757

Herbal skin care formulation and a process for the preparation thereof.	Farooqi,A.H.A., Sharma,S. and Kumar,S.	US 6368639
Anthocyanin producing callus line in cultures of *Panax sikkimensis* and a method of producing *Panax sikkimensis* line capable of producing anthocyanin.	Mathur,A., Gangwar,A., Mathur,A.K., Sangwan,R.S. and Jain,D.C.	US 6368860
Process for the production of (-) 3,4-divanillyl tetrahydrofuran.	Chattopadhyay,S.K., Srivastava,S. and Tripathi.V.	US 6372922
Process for the preparation of maltol from plants belonging to the genus Abies.	Chattopadhyay,S.K., Srivastava,S., Sashidhara,K.V., Tripathi,V. and Kumar, S.	US 6384246
A novel anti fungal formulation active against a broad spectrum of dermatophytoses.	Shahi, S.K., Shukla, A.C., Dikshit, A., Bajaj, A.K., Singh, A.K. and Kumar, S.	JP 3304329
Stable esterase obtained from palmarosa.	Dubey,V.S., Luthra,R., Naqvi,A.A. and Kumar,S.	US 6387678
An improved process for the preparation of arteether from dihydroartemisinin.	Jain,D.C., Bhakuni,R.S., Saxena,S., Kumar,S. and Vishwakarma,R.A.	DE 10014669
Method for maximization of artemisinin production by the plant *Artemisia annua*.	Kumar,S., Gupta,S.K., Gupta,M.M., Verma,R.K., Chand, Jain,D.C., Shasany,A.K., Darokar,M.P. and Khanuja,S.P.S.	US 6393763
Ecological method of phyto-remediation of alkaline and chemically degraded soils using scented geranium (*Pelargonium* sp.).	Sangwan,R.S., Tyagi,B.R. and Sangwan,N.S.	US 6398841
Method of producing organogenetic tissue from a plant of the genus Mentha.	Khanuja,S.P.S., Shasany,A.K., Dhawan,S., Darokar,M.P., Santha Kumar,T.R., Saikia,D. and Kumar,S.	US 6420174
Anti-microbial composition and method for producing the same.	Khanuja,S.P.S., Srivastava,S., Santha Kumar,T.R.., Shasany,A.K., Jain,D.C., Darokar,M.P., Saikia,D. and Kumar, S.	US 6423741
Novel, high yielding stable *Mentha arvensis* plant named 'Damroo'.	Patra,N.K., Kumar,S., Khanuja,S.P.S., Shasney,A.K., Kalra,A., Singh,H.B., Singh,H.P., Singh,V.R., Tanveer,H., Mengi,N., Rajput,D.K., Negi,M.S., Tyagi,N.K.,	US PP12791

	Ram,P., Singh,V.P., Shukla,R.S., Kumar,B., Singh,J.P., Ram,R., Kumar,V. and Sharma,S.R.	
A formulation useful as a natural herbal insect repellent and a method for the preparation thereof.	Kumar, D., Shukla, Y.N., Tewari, S., Bansal, R.P., Bahl, J.R. and Kuamr, S.	PK 137289
Process for the preparation of 10-deacetylbaccatin III.	Chattopadhyay,S.K., Srivastava,S. and Mehta,V.K.	US 6437154
Synthetic precursors to 4-(p-methoxyphenyl)-2-amino-butane.	Chattopadhyay,S.K., Sashidhara,K.V., Tripathi,V., Tripathi,A.K., Prajapati,V. and Kumar,S.	US 6441205
Antibacterial composition comprising oenostacin from *Oenothera biennis*.	Shukla,Y.N., Santha Kumar, T.R., Srivastava,A., Khanuja,S.P.S., Gupta,V.K. and Sushil Kumar	US 6451356
Process of its application against lepidopteran insects using *Albizzia lebbeck* plant extract and *Bacillus thuriengiensis delta-endotoxin*.	Khanuja,S.P.S., Satapathy,S., Singh,S.C., Santha Kumar,T.R., Arya,J.S., Tripathy,A.K., Shasany,A.K., Darokar,M.P. and Kumar,S.	US 6455079
'Jal Palalvi', water logging tolerant *Cymbopogon winterianus*.	Patra,N.K., Kumar,S., Kalra,A., Singh,H.B., Singh,H.P., Mengi,N., Khanuja,S.P.S., Shasany,A.K., Darokar,M.P., Singh,V.R., Tanveer,H., Naqvi,A.A., Ram,P., Singh,V.P., Singh,K., Rajput,D.K., Kumar,B., Singh,J.P., Ram,R., Kumar,V. and Sharma,S.R.	US PP12997
An improved process for the production of 10-deacetyl taxol.	Chattopadhyay,S.K., Sharma,R.P. and Kumar,S.	EP 1028116
Lippia alba plant named 'Bhurakshak'.	Kumar,S., Bahl,J.R., Bansal,R.P., Garg,S.N., Naqvi,A.A., Khanuja,S.P.S., Shasany,A.K., Darokar,M.P., Singh,V. and Sinha,S.	US PP13110
Strain of *Trichoderma harzianum* useful as nematode inhibitor, fungicide and plant growth promoter and a process for the isolation thereof.	Kalra,A., Singh,H.B., Pandey,R., Patra,N.K., Katiyar,N., Gupta,M.L., Dhawan,O.P. and Sushil Kumar	US 6475772

High yielding stable plant of *Rosa damascena*, called 'Ranisahiba'.	Patra,N.K., Kumar,S., Khanuja,S.P.S., Shasney,A.K., Kalra,A., Singh,H.B., Singh,H.P., Tanveer,H., Singh,V.R., Mengi,N., Rajput,D.K., Negi,M.S., Tyagi,N.K., Ram,P., Singh,V.P., Singh,A., Kumar,B., Singh,J.P., Kumar,V. and Sharma,S.R.	US PP13203
Mint plant named 'Saksham'.	Khanuja,S.P.S., Kumar,S., Shasany,A.K., Dhawan,S., Darokar,M.P., Naqvi,A.A., Dhawan,O.P., Singh,A.K., Patra,N.K., Bahl,J.R. and Bansal,R.P.	US PP13279
Method for the faster multiplication of earthworms, and production of vermi compost from the distillation waste of industrial aromatic crops.	Kalra,A., Kumar,S., Katiyar,N., Bahl,J.R., Bansal,R.P., Chauhan,H.S., Prasad,A., Pandey,R., Dhawan,O.P., Krishna,A. and Srivastava,R.	US 6488733
High yielding and stable plant of *Cymbopogon flexuosus* called 'Chirharit'.	Patra,N.K., Kumar,S., Khanuja,S.P.S., Shasney,A.K., Kalra,A., Singh,H.B., Singh,H.P., Singh,V.R., Tanveer,H., Mengi,N., Rajput,D.K., Negi,M.S., Tyagi,N.K., Ram,P., Singh,V.P., Shukla,R.S., Kumar,B., Singh,J.P., Ram,R., Kumar,V. and Sharma, R.	US PP13336
Process for the preparation of novel growth media from distillation and other plant wastes for mass multiplication of bio-control fungi.	Singh,H.P., Kalra,A., Patra,N.K., Kumar,S., Pandey,R., Khanuja,S.P.S and Shasany,A.K.	US 6511821
Formulation comprising thymol useful in the treatment of drug resistant bacterial infections.	Khanuja,S.P.S., Srivastava,S., Shasney,A.K., Darokar,M.P., Santha Kumar,T.R., Agarwal,K.K., Ahmed,A., Patra,N.K., Sinha,P., Dhawan,S., Saikia,D. and Kumar,S.	US 6514541
Composition of herbal biscuits for lactating mothers acting as dietary supplement and process for preparation thereof.	Singh,A.K., Bindra,R.L., Singh,J. and Kumar,S.	US 6517861
Analgesic and refreshing herbal composition and a process for preparing the same.	Singh,A.K., Bindra,R.L., Gupta,R., Shukla,Y.N. and Kumar,S.	US 6531115

Method of producing a poppy plant.	Dhawan,O.P., Shahabuddin,S., Trivedi,M., Sattar,A., Alam,M., Samad,A., Zaim,M. and Samresh	US 6534696
CIMAP+GVAS		
Pharmaceutical composition containing cow urine distillate and an antibiotic.	Khanuja,S.P.S., Kumar,S., Shasany,A.K., Arya,J.S., Darokar,M.P., Singh,M., Sinha,P., Awasthi,S., Gupta,S.C., Gupta,V.K., Gupta,M.M., Verma,R.K., Agarwal,S., Mansinghka,S.B. and Dawle,S.H.	US 6410059
CLRI		
EPR imaging device using microwave bridge translator.	Chandrakumar,N., Babu,K.V. and Vijayaragavan,V.	US 6472874
Electronic paramagnetic resonance imaging device using high amplitude modulator.	Chandrakumar,N., Babu,K.V. and Vijayaragavan,V.	US 6504367
An improved logic device.	Chandrakumar, N.	EP 0869510
CMRI		
Device useful for measuring the flow rate of cryogenic liquids flowing through a tube.	Bhowmick,B.C., Dutta,A.K., Ray,S.K., Sahay,N., Bandyopadhyay,L.K., Verma,S.M., Ahmad,I. and Singh, T.N.	US 6435041
CSIR(S)		
Process for extraction of piperine from piper species.	Gaikar,V.G. and Raman,G.	US 6365601
CSIR(SCH)		
Process for the preparation of olivine lithium nickel phosphate composite.	Angaiah,S., Thiagarajan,V., Ramaiyer,G. and Ariyanan,M.	US 6485699

CSMCRI

Eco-friendly method of preparation of high purity Tetrabromobisphenol-A.	Ramachandraiah,G., Ghosh,P.K., Mehta,A.S., Pandya,R.P., Jethva,A.D., Vaghela,S.S. and Misra,S.N.	US 6365786

IGIB

Immobilized microbial consortium for the treatment of phenolic waste-water from petroleum refineries.	Kumar,R., Sharma,A. and Kumar,A.	US 6406882
A rapid method for estimation of Chemical Oxygen Demand (COD).	Kalia, V.C., Sonakya, V., Raizada, N. and Joshi, A.P.	BD 1003648
Rapid method for enzyme-linked immunosorbent assay.	Nahar,P., Bora,U. and Sharma,G.L.	US 6498016
Immobilized microbial consortium useful for rapid and reliable BOD estimation (Divisional).	Kumar,R., Sharma,A., Rastogi,S., Makhijani,S.D. and Manoharan,A.	US 6511822
A process for the preparation of immobilized microbial composition for use as seed inoculum in the BOD Test.	Kuamr, R., Kumar, A., Sharma, A. and Gangal, S.V.	GB 2339435
Immobilized microbial consortium useful for rapid and reliable BOD estimation.	Kumar,R., Sharma,A., Rastogi,S., Makhijani,S.D. and Manoharan,A.	US 6531293

IHBT

Use of tagetes minuta oil and its components as antiviral agents.	Singh,B., Joshi,V.P., Ram,R., Sharma,A. and Zaidi,A.A.	US 6444458
Method for inducing improved seed germination in podophyllum hexandrum royle.	Kharkwal,A.C., Om Prakash, Bhattacharya,A., Nagar,P.K. and Ahuja,P.S.	US 6449899
Species specific DNA sequences and their utilization in identification of viola species and authentication of "Banafsha" by polymerase chain reaction.	Singh,M., Sharma,C. and Lal,B.	US 6465637
Isozyme of autoclavable superoxide dismutase (SOD), a process for the identification and extraction of the SOD in cosmetic, food and pharmaceutical compositions.	Kumar,S., Sahoo,R. and Ahuja,P.S.	US 6485950

One step process for the preparation of substituted trans-cinnamaldehyde, a natural yellow dye from phenyl propane derivatives.	Sinha, A.K., Joshi, B.P. and Dogra, R.	BD 1003654 PK 137766
Dihydrotagetone alcohol and a method for preparation thereof from tagetes minuta oil.	Singh,B., Joshi,V.P. and Kaul,V.K.	US 6492567
Gladiolus plant named 'Anurag'.	Mukherjee,D., Dhayani,D. and Rana,J.C.	US PP13353
Gladiolus hybrid plant 'Brick Beauty'.	Mukherjee,D., Dhayani,D. and Rana,J.C.	US PP13417
Gladiolus hybrid plant named 'Palampur Queen'.	Mukherjee,D., Dhayani,D. and Rana,J.C.	US PP13418
Gladiolus hybrid plant named 'Cute Munni'.	Mukherjee,D., Dhayani,D. and Rana,J.C.	US PP13591
Process for the preparation of 1-propyl-2, 4,5-trimethoxybenzene from toxic beta-asarone of acorus calamus or from crude calamus oil containing beta-asarone.	Sinha,A.K.	US 6528041
IICB		
Process for preparation of alpha-amylase from *tinospora cordifolia* Miers useful for starch saccharification.	Sengupta,S., Naskar,A.K., Jana,M.L. and Naskar,P.	US 6379721
Herbal formulation of a combination of *Piper betle* and *Murraya koenigii* extracts for blocking 5 lipoxygenase activity.	Bandyopadhyay,S., Roy,K.C., Roy,M., Pal,B.C., Bhadra,R., Das,K. and Bhattacharaya,S.	US 6413553
An process for the preparation of a purified new epididymel forward motility protein useful as a fertility pronuter/ blacker.	Majumder,G.C. and Jaiswal,B.S.	JP 3400367
Use of betel leaf extract to induce IFN-gamma production from human peripheral blood T cells and as a TH1 type immunomo-dulator.	Bandyopadhyay,S., Pal,B., Bhattacharya,S., Ray,M. and Roy,K.C.	US 6531166

An improved process for the isolation of a new highly specific 9-O-acetylated sialoglycoconjugate binding lectin (ACHATININ-H) from achatina fulica snail, useful for the diagnosis of acute lumphoblastic leukemia (all) for the determination of minimal.	Mandal, C., Sinha, D. and Bhattacharya, D.K.	EP 0867721

IICT

Process for the production of nitroaromatic compounds from aromatic hydrocarbons using modified clay catalysts.	Choudary,B.M., Kantam,M.L., Sateesh,M., Rao,K.K. and Raghavan,K.V.	US 6376726
Herbal formulation useful as a therapeutic and cosmetic applications for the treatment of general skin disorders.	Diwan,P.V.R., Sitaramam,B.S., Ramakrishna,S. and Raghavan,K.V.	US 6379673
Herbal formulation useful for treatment of skin disorders.	Ramakrishna,S., Sitaramam,B.S., Diwan,P.V.R. and Raghavan,K.V.	US 6383495
Process for the preparation of 4'-isobutylacetophenone.	Choudary,B.M., Sateesh., Kantam,M.L., Ranganath,K.V.S. and Raghaven,K.V.	US 6384285
Preparation of new layered double hydroxides exchanged with osmate for asymmetric dihydroxylation of olefins to vicinal diols.	Choudary,B.M., Chowdari,N.S., Kantam,M.L., Raghavan,K.V. and Reddy,C.V.R.	US 6387033
Process for the microwave induced preparation of crystalline microporous titanium silicalite.	Kulkarni,S.J., Prasad,M.R., Kamalakar,G., Raghavan,K.V., Prasad,P.S.S. and Rao,K.N.	US 6387349
Enzymatic process for the preparation of an acetylated phospholipid.	Marellapudi,S.L.K., Vemulapalli,V., Penumarthy,V. and Rachapudi,B.N.P	US 6403344
Process for the isolation of oryzanols from rice bran oil soap stock.	Rao,K.V.S.A., Rao,B.V.S.K. and Thengumpillil,N.B.K.	US 6410762
Process for the preparation of stable yeast crystals for enhanced production of ethanol.	Ramakrishna,S.V., Prakasham,R.S. and Komaraiah,P.	US 6420146
Podophyllotoxin dimer as DNA topoisomerase II inhibitors, and a process for the preparation therefore.	Kamal,A., Eltepu,L., Mohammed,A. and Khanna,G.B.R.	US 6441198

Process for the preparation of amine oxides.	Choudary,B.M., Bharathi,B., Kantam,M.L., Reddy,C.R.V. and Raghavan,K.V.	US 6455735
Solid catalyst having a hydrotalicite structure with fluoride ions playing the role of compensation ions.	Figueras, F., Choudary, B.M., Kantam, M.L., Neeraja, V., and Rao, K.K.	FR 00/02987
Use of two plant phenols in the treatment of arteriosclerosis.	Rao,J.M., Tiwari,A.K., Srinivas,P.V., Yadav,J.S. and Raghavan,K.V.	US 6458831
Process for the production of esters from alcohols using acetic acid as acetylating and clays as catalysts.	Choudary,B.M., Bhaskar,V. Kantam,M.L., Rao,K.K. and Raghavan,K.K.	US 6472555
Process for the preparation of 2-chloro-5-methylpyridine-3-carbaldehyde.	Banda,G., Bhimapaka,C. and Rao,V.J.	US 6479664
A pesticidal dry powder formulation enriched in azadirachtin upto 88%, an emulsifiable concentrate enriched upto 30% of azadirachtin and a process for preparing such formulation and concentrate from neem seed/kernel.	Sankaram, A.V.B., Marthandamurthy, M., Manohar, A.D., Subramanyam,M., Gopal, V.S.S.R. and Srihari, V.	JP 3369413 EP 0834254
Vitamin B12 - biodegradable micro particulate conjugate carrier systems for peroral delivery of drugs, therapeutic peptides/proteins and vaccines.	Chalasani,K.B., Diwan,V.R., Raghavan,K.V., Russell-Jones,G.J., Jain,S.K. and Rao,K.K.	US 6482413
(-)-Secoisolariciresinol as an anti-oxidant obtained from a new natural source namely stereospermum personatum.	Rao,J.M., Tiwari,A.K., Kumar,U.S., Yadav,J.S. and Raghavan,K.V.	US 6489514
Novel process for production of amides from amines.	Choudary,B.M., Bhaskar,V., Kantam,M.L., Rao,K.K. and Raghavan,K.V.	EP 1090907
Process for the synthesis of an aryl pyridine base using a zeolite catalyst.	Kulkarni,S.J., Raghavan,K.V., Nagabandi,S. and Vippagunta,R.R.	US 6492524
Process for the synthesis of an annulated pyridine base.	Kulkarni,S.J., Raghavan,K.V., Vippagunta,R.R. and Nagabandi,S.	US 6495690

Process for the preparation of a collidine and 2,3,5,6-tetramethyl pyridine	Kulkarni,S.J., Raghavan,K.V., Nagabandi,S. and Vippagunta,R.R.	US 6495695
Process for the production of benzaldehyde by the catalytic liquid phase air oxidation of toluene.	Kantam,M.L., Choudary,B.M., Sreekanth,P., Rao,K.K., Naik,K.R., Kumar,T.P. and Khan,A.A.	US 6495726
Process for the preparation of a monoglyceride.	Thengumpillil,N.B.K., Penumarthy,V. and Ayyagari,A.L.	US 6500974
Envirocatuct for interaction of aromatic compounds.	Choudary,B.M., Kantam,M.L., Sateesh,M., Rao,K.K. and Raghavan,K.V.	EP 0949240
An improved process for the preparation of tetrabromobisphenol-A.	Kantam,M.L., Jeevaratnam,K., Choudary,B.M., Reddy,C.R.V., Raghavan,K.V., Sivaji,L.V. and Someshwar,T.	EP 1149817
Process for synthesis of a porphyrin compound using a molecular sieve catalyst under microwave irradiation.	Kulkarni,S.J., Raghavan,K.V., Kishan,V.R., and Srinivas,N.	US 6524446
Process for the synthesis of an aliphatic cyclic amine.	Kulkarni,S.J., Raghavan,K.V., Kishan,V.R. and Srinivas,N.	US 6528647
Process for *in situ* synthesis of supported heteropoly acids and salts thereof.	Prasad, P.S.S., Raghavan, K.V., Suryanarayana, I., Rao K.N., Lakshmi, C.S., Kumar, M.S. and Reddy, K.B.	US 6534435
Plant phenol as new hepatoprotective agents.	Rao,J.M., Tiwari,A.K., Srinivas,P.V., Yadav,J.S. and Raghavan,K.V.	US 6537593
IICT+CCMB		
Cationic amphiphiles containing n-hydroxyalkyl group for intracellular delivery of biologically active molecules.	Banerjee,R.K., Das,P.K., Srilakshmi,G.V., Rao,N.M. and Chaudhuri,A.	US 6503945
IIP		
An improved process for preparation of carboxylic acids by one step oxidation of hydrocarbons.	Kulsrestha,G.N., Saxena,M.P., Gupta,A.K., Goyal,H.B., Prasad,R., Prasada Rao,T.S.R. and Patel,P.D.	JP 3389363

IMT

Method for the simultaneous monitoring of individual mutants in mixed populations.	Sharma,V.M. and Ganesan,K.	US 6528257

NAL

A foil journal bearing having straight foils useful for providing support for high speed rotors and a process for the fabrication of the said bearing.	Ramamurthy S. R. Rao, Rangarajan Vijayaraghavan, Siddalingappa Siddananjappa, and Arun K. Vyasamurthy	EP 0728955
A foil bearing journal.	Ramamurthy S. R. Rao, Rangarajan Vijayaraghavan, Siddalingappa Siddananjappa, and Arun K. Vyasamurthy	JP 3390104

NBRI

Chrysanthemum plant named 'Mother Teresa'.	Datta,S.K.	PP 13678
Method for preparation of microprojectiles for efficient delivery of biologicals using a particle gun.	Tuli,R. and Sawant,S.V.	US 6406852
Method for regenerating viable and fertile citrus plants by tissue culture from explants.	Chaturvedi,H.C., Singh,S.K. and Sharma,A.K.	US 6485975
Biologically pure culture of bacteria which suppresses diseases caused by pathogens in chickpea crops and a culture of bacteria comprising a strain of pseudomonas fluorescens.	Nautiyal,C.S	US. 6495362
Safe, eco-friendly, health protective herbal colours and aroma useful for cosmaceutical applications.	Govindrajan R., Khatoon S., Mehrotra S., Pushpangadan P., and Rawat A.K.S.	GB 2374284 WO 02078652
Tissue culture process for producing a large number of viable cotton plants *in vitro*.	Tuli R., Gupta S.K., Singh P.K., and Srivastava A.	US 6242257

NCL

Culture medium composition useful for induction and proliferation of taxus calli.	Kulkarni,A.A. and Krishnamurthy,K.V.	US 6365407
Process for the preparation of n-substituted acrylamides.	Lele,B.S. and Kulkarni,M.G.	US 6369249
Process for the preparation of (4r,6s)-4-hydroxy-6-hydroxy-methyl-tetrahydropyran-2-one.	Kumar,P. and Fernandes,R.A.	US 6376683
Process for the transesterification of keto esters using solid acids as catalysts.	Chavan,S.P., Dantale,S.W., Keshavaraja,A., Ramaswamy,A.V. and Zubaidha,P.K.	US 6376701
Process for the preparation of molecularly imprinted polymers useful for separation of enzymes.	Vaidya,A.A., Lele,B.S., Kulkarni,M.G. and Mashelkar,R.A.	US 6379599
Process for the preparation of a mixture of 19-hydroxyelcosate-traenoic acid and 20-hydroxyeico-satetracnoic acid (10 HETE and 20 HETE).	Prabhune,A.A. and Ratledge,C.	US 6379937
Process for the preparation of a carboxylic acid.	Kelkar,A.A., Tonde,S.S. and Chaudhari,R.V.	US 6380426
Process for the preparation of beta hydroxy-delta lactone using novel intermediates.	Ghorpade,S.R., Kalkote,U.R., Chavan,S.P., Bhide,S.R. and Ravindranathan,T.	US 6388097
Process for the oxidation of cyclohexane to adipic acid.	Saji,P.V., Ratnasamy,C. and Gopinathan,S.	US 6392093
Single step hydrogenation of nitrobenzene to p-aminophenol.	Rode,G.V., Vaidya,M.J. and Chaudhari,R.V.	US 6403833
Process for the preparation of a polyesteramide.	Kelkar,A.A., Kulkarni,S.M. and Chaudhari,R.V.	US 6410681
Process for the preparation of beta hydroxy-delta lactone using novel intermediates.	Ghorpade,S.R., Kalkote,U.R., Chavan,S.P., Bhide,S.R. and Ravindranathan,T.	US 6417374
Process for the preparation of thermoprecipitating affinity polymers.	Vaidya,A.A., Lele,B.S., Kulkarni,M.G. and Mashelkar,R.A.	US 6420487

Process for the preparation of aromatic polyesters.	Kharul,U.K. and Kulkarni, S.S.	US 6420511
Process for the selective esterification of tertiary alcohol by an acid anhydride using a reusable solid catalyst.	Choudhary,V.R., Mantri,K. and Jana,S.K.	US 6420596
Process for the conversion of 1,4-butynediol to 1,4-butenediol.	Chaudhari,R.V., Rode,C.V., Jaganathan,R., Telkar,M.M. and Rane,V.H.	US 6420615
Membrane process for the production of hydrogen peroxide by non-hazardous direct oxidation of hydrogen by oxygen using a novel hydrophobic composite PD-membrane catalyst.	Choudhary,V.R., Sansare,S.D. and Gaikwad,A.G.	US 6432376
Compound bearing an urethane linkage, which is an addict of ricinoleic esters and an isocynate, useful as a plasticizer for polyvinyl chloride (PVC) and a process for preparing such compound.	Iyengar,S.S.R., Ganpat,R.K., Saxena,P.K. and Swaminathan,S.	US 6437032
Process for the acylation of aromatic compounds using a reusable solid catalyst comprising indium halide.	Choudhary,V.R., Jana,S.K. and Patil,N.S.	US 6437191
Process for the preparation of a carboxylic acid.	Seayad,A.M., Seayad,J. and Chaudhari,R.V.	US 6444844
A process for the preparation of adipic acid.	Ratnasamy, P. and Raja, R.	JP 3347568
Process for the preparation of 4(r)-hydroxy cyclopent-2-en1(s)-acetate.	Bastawade,K.B., Gokhale,D.V., Thottapillil,R., Ghorpade,S.R., Joshi,R.R. and Kalkote,U.R.	US 6448051
Alkalothermophilic bacillus that produces a protease inhibitor.	Dash,C., Phadtare,S.U., Ahmad,A., Deshpande,V.V. and Rao,M.B.	US 6448060
Hydrophobic composite pd-membrane catalyst useful for non-hazardous direct oxidation of hydrogen by oxygen to hydrogen peroxide and method of its preparation.	Choudhary,V.R., Sansare,S.D. and Gaikwad,A.G.	US 6448199
Process for the liquid phase acylation of aromatic compounds.	Choudhary,V.R. and Jana,S.K.	US 6459000

Water soluble palladium complexes and process for the preparation thereof.	Seayad,J., Seayad,A..M., Sarkar,B.R. and Chaudhari,R.V.	US 6469169
Process for the conversion of 1,4-butynediol to 1,4 -butanediol, or a mixture of 1,4-butenediol and 1,4-butanediol.	Chaudhari,R.V., Rode,C.V., Jaganathan,R., Telkar,M.M. and Rane,V.H.	US 6469221
An improved process for the synthesis of D (+) biotin.	Ravindranathan,T., Chavan,S.P. and Tejwani,R.B.	EP 0564723
Substituted 2-[-6-benzyl-5-oxo-3-phenyl-(3s,7s, 7ar)-perhydroimidazol-[1,5-c][1,3]thiazol-7yl] compounds.	Chavan,S.P., Chittiboyina,A.G., Kamat,S.K., Kalkote,U.R. and Ravindranathan,T.	US 6486328
Process for the preparation of novel vinylic hindered amine light stabilizers.	Desai,S.M. and Singh,R.P.	US 6489482
Tinuvin p-hindred amine light stabilizer and derivatives thereof.	Desai,S.A.,M. and Singh,R.P.	US 6492518
Process for the preparation of dihydroxydiphenylmethanes.	Singh,A.P. and Dagade,S.	US 6492566
Process for the preparation of 1-[cyano-(aryl)methyl] cyclohexanol.	Chavan,S.P., Kamat,S.K., Sivadasan,L., Balakrishnan,K., Khobragade,D.A., Thottapillil,R., Gurjar,M.K. and Kalkote,U.R.	US 6504044
Process for the preparation of 2-acrylamido-2-methyl-1-propanesulfonic acid.	Barve,P.P., Joshi,S.S., Shinde,R.W., Gupte,M.Y., Joshi,C.N., Ghike,S.M., Naik,R.V., Kulkarni,R.A. and Bote, A.N.	US 6504050
Low temperature process for the production of hydrogen.	Choudhary,V.R., Rajput,A.M. and Banerjee, S.	US 6509000
Strain of streptomyces for the preparation of an alkaline protease inhibitor.	Vernekar,J.V., Ghatge,M.S., Rao,M.B. and Deshpande,V.V.	US 6514748
Process for the preparation of acetic acid or methyl acetate.	Kelkar,A.A., Tonde,S.S., Divekar,S.S., and Chaudhari,R.V.	US 6521784
Process for the preparation of adipic acid.	Srinivas,D., Chavan,S.A. and Ratnasamy,P.	US 6521789
Process for preparation of substituted aromatic compound employing Friedel-Crafts reaction using a reusable basic anionic clay catalyst.	Choudhary,V.R. and Jana,S.K.	US 6525226

Noble metal containing hydrogenation catalyst for selective hydrogenation of 1,4-butynediol to 1,4-butenediol, and a process for the preparation thereof.	Chaudhari,V.R.,Chandrashekhar, V.R., Jaganathan,R., Telkar,M.M. and Rane,V.H.	US 6528689
Process for the preparation of acidic lipase.	Mahadik,N.D., Gokhale,D.V., Khire,J.M. and Puntambekar,U.S.	US 6534303
Process for the activation of a metallic palladium based catalyst useful for the direct oxidation of hydrogen to hydrogen peroxide.	Choudhary,V.R., Gaikwad,A.G. and Sansare,S.D.	US 6534440
An improved process for the preparation of aromatic polysters.	Idage,B.B., Mahajan,S.S. and Sivaram,S.	EP 0807655
Process for the preparation of a nanosized colloidal metal particle.	Priyabrata,M., Deendayal,M., Ahmad,A., Sastry,M. and Kumar,R.	US 6537344
NCL+CDRI		
Mifepristone analogue, process for the preparation thereof and use thereof.	Hazra,B.G., Pore,V.S., Joshi,P.L., Basu,S., Singh,J. and Dwivedi,A.	US 6512130
NCL+IFCPAR		
Polyimides, process for the preparation thereof and use thereof as alignment films for liquid crystal devices.	Mathew,J.S., Vernekar,S.P., Mercier,R. and Kerboua,R .	US 6500913
NIO		
White rot-lignin-modifying fungus flavodon flavus and a process for removing dye from dye containing water or soil using the fungus.	Raghukumar,C., Souza,T.M.D., Thorn,R.G. and Reddy,C.A.	US 6395534
Method for enhancing levels of polyunsaturated fatty acids in thraustochytrid fungi.	Kumar,S.R., Chandramohan,D.R. and Desa,E.	US 6410282
Biologically active aqueous fraction of an extract obtained from a mangrove plant Salvadora persica L.	Goswami,U. and Fernandes,N.	US 6428823
Composition for treating white spot syndrome virus (WSSV) infected tiger shrimp penaeus monodon and a process for preparation thereof.	Desai,U.M., Achuthankutty,C.T. and Sreepada,R.A.	US 6440466

NML

Sensing device for non-distructive evaluation of steel structure	Mitra A., Sagar S., Bhattacharya D.K.	JP /2002-556211

NPL

Formulation for iron chelation, a process for preparing the formulation and a method of treating thalassemia.	Kumar,S.A., Sudarshan,K., Harsh,P., Rattan,K.S. and Ghansham,D.	KR 335793
A process for the preparation of conducting polymeric membrane and a conducting polymeric membrane prepased therby useful as a filter for capturing viruses in potable liquids.	Singh,R., Chandra,S., Singh,H. Narula,A.K. and Broor,S.	PK 136850
Polymer coated long duration optical memory device and a method for the development thereof.	Biradar,A.M., Bawa,S.S., Haridas,E.P. and Chandra,S.	US 6407797
A simulation circuit layout design for low voltage, low power and high performance type ii current conveyor for analog signal processing applications.	Rajput,S.S. and Jamur,S.S.	TA 165972
Reusable heat pack, method of manufacture thereof, mixture for use in a reusable heatpack and process for the preparation thereof.	Sharma,C.P., Sharma,R.K., Kant,C. and Sarkar,A.K	US 6537309

RRL(BHU)

Process for the stabilization of soluble chromium contaminated solid by down draft sintering.	Nayak,B., Mohapatra,B.K., Nayak,B.B. and Ray,H.	US 6416251

RRL(JT)

Process for the preparation of refined hard sugarcane wax having improved qualities from press mud.	Phukan,A.C.	US 6486335

RRL(T)

Squaraine based dyes and process for preparation thereof.	Das,S., Kakkudiyil,G.T., Pillai,B.V., Unni,S. and Velate,S.	US 6417402

Melt processible liquid crystalline terpolyesters and process for the preparation thereof.	Vijayanathan,V., Prasad,V.S.N. and Pillai,C.K.S.	US 6419851
Melt processable liquid crystalline terpolyesters.	Vijayanathan,V., Prasad,V.S.N. and Pillai,C.K.S.	JP 3350659
A 'RFLR' device and a process thereof for continuous purification of wastewater with retained biological catalysts while enabling removal of solid products.	Haridas,A. and Majumdar,S.	NL 1017614
Apparatus for purification of waste water and a "RFLR" device for performing the same.	Haridas,A. and Majumdar,S.	US 6527948

RRL(T)+DST

Melt processible thermotropic liquid crystalline terpolyesters and process for the preparation thereof.	Prasad,V.S.N., Pillai,C.K.S. and Ravindranathan,M.	US 6409937 JP 3350660

DE-Germany
EP-Europe
FR-France
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NL-Netherlands
PK-Pakistan
SL-Sri Lanka
TA-Taiwan
US-United States of America

ANNEXURE-II

TOP PAPERS PUBLISHED BY CSIR (2002)

TITLE/ AUTHOR	JOURNAL AFFL	IF	LAB
RNA i Related Mechanisms affect both Transcriptional and Post-Transcriptional Transgene Silencing in Drosophila: Bhadra, M.P., Bhadra,U. and Birchler, J.A	MOLECULAR CELL, 2002, Vol 9, pp 1-20	16.611	CCMB
Expanding Colonies and Expanding Repeats: Saleem,Q., Muthane.U., Verma,I.C., Brahmachari,S.K. and Jain,S.	LANCET, 2002, Vol 359, Iss 9309, pp 895-896	13.251	IGIB
Lamin A/C Speckles Mediate Spatial Organization of Splicing Factor Compartments and RNA Polymerase II Transcription: Kumaran,R.I., Muralikrishna,B. and Parnaik,V.K.	JOURNAL OF CELL BIOLOGY, 2002, Vol 159, pp 783-793	12.915	CCMB
Electrostatic Assembly of Nanoparticles and Biomacromolecules: Sastry,M., Rao,M. and Ganesh,K.N.	ACCOUNTS OF CHEMICAL RESEARCH, 2002, Vol 35, Iss 10, pp 847-855	12.781	NCL
C-Terminal Domain Phosphatase-Like Family Members (Atcpls) Differentially Regulate Arabidopsis-Thaliana Abiotic Stress Signaling, Growth and Development: Koiwa,H., Barb,A.W., Xiong,L.M., Li,F., Mccully, M.G., Lee,B.H., Sokolchik,I., Zhu,J.H., Gong,Z.Z. Reddy,M. and Sharkhuu,A. Manabe.	PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA, 2002, Vol 99, Iss 16, pp 10893-10898	10.896	CSMCRI
Mitochondrial RNA Import in Leishmania-Tropica - Aptamers Homologous to Multiple Transfer-RNA Domains That Interact Cooperatively or Antagonistically at the Inner Membrane: Bhattacharyya,S.N., Chatterjee,S. and Adhya,S.	MOLECULAR AND CELLULAR BIOLOGY, 2002, Vol 22, Iss 12, pp 4372-4382	9.836	IICB
Sugar Nonspecific Endonucleases: Rangarajan,E.S. and Shankar,V.	FEMS MICROBIOLOGY REVIEWS, 2002, Vol 25, Iss 5, pp 583-613	9.000	NCL
Identification and Analysis of Dyad - A Gene Required for Meiotic Chromosome Organization and Female Meiotic Progression in Arabidopsis: Agashe,B., Prasad,C.K. and Siddiqi,I.	DEVELOPMENT, 2002, Vol 129, Iss 16, pp 3935-3943	8.624	CCMB
A Trifunctional Catalyst for the Synthesis of Chiral Diols: Choudary,B.M., Chowdari,N.S., Madhi,S. and Kantam,M.L.	ANGEWANDTE CHEMIE-INTERNATIONAL EDITION, 2002, Vol 40, Iss 24, pp 4619+	8.255	IICT
A Highly Specific Ca2+-Ion Sensor - Signaling by Exciton Interaction in a Rigid-Flexible-Rigid Bichromophoric H Foldamer: Ajayaghosh,A., Arunkumar,E. and Daub,J.	ANGEWANDTE CHEMIE-INTERNATIONAL EDITION, 2002, Vol 41, Iss 10, pp 1766+	8.255	RRLTVM

Identification of Novel Differentiation-Specific Genes Expressed During Heat-Induced Differentiation of Mouse Embryonal Carcinoma-Cells Pcc4: Tripathi,R. and Srinivas,U.K.	MOLECULAR BIOLOGY OF THE CELL, 2002, Vol 12, Iss S, pp 2051	7.700	CCMB
Picroliv Enhances Angiogenesis and Regulates the Expression of Vascular Endothelial Growth-Factor: Singh,A.K., Madhavan,S., Gaddipati,J.P., Sharma,S.C., Kulshreshtha,D.K. and Maheshwari,R.K.	MOLECULAR BIOLOGY OF THE CELL, 2002, Vol 12, Iss S, pp 787	7.700	CDRI
Role of the C-Terminal Extensions of Alpha-Crystallins - Swapping the C-Terminal Extension of Alpha-A-Crystallin to Alpha-B-Crystallin Results in Enhanced Chaperone Activity: Pasta,S.Y., Raman,B., Ramakrishna,T. and Rao,C.M.	JOURNAL OF BIOLOGICAL CHEMISTRY, 2002, Vol 277, Iss 48, pp 45821-45828	7.258	CCMB
Entry into Cells and Selective Degradation of . Transfer-RNA by a Cytotoxic Member of the RNase-A Family: Saxena,S.K., Sirdeshmukh,R., Ardelt,W., Mikulski,S.M., Shogen,K. and Youle,R.J	JOURNAL OF BIOLOGICAL CHEMISTRY, 2002, Vol 277, Iss 17, pp 15142-15146	7.258	CCMB
Crystal-Structure of Binary and Ternary Complexes of Serine Hydroxymethyltransferase from Bacillus-Stearothermophilus - Insights into the Catalytic Mechanism: Trivedi,V., Gupta,A., Jala,V.R., Saravanan,P., Rao,G.S.J., Rao,N.A., Savithri,H.S. and Subramanya,H.S.	JOURNAL OF BIOLOGICAL CHEMISTRY, 2002, Vol 277, Iss 19, pp 17161-17169	7.258	CDRI
Elucidation of the Molecular Mechanism: Soulliac,P.O., Vladimir,N.U., Millet,L. and Khurana,R.S. et. al.	JOURNAL OF BIOLOGICAL CHEMISTRY, 2002, Vol 277, pp 12666-79	7.258	CDRI
Effect of Association State and Conformational Stability: Souillac,P.O., Uversky,V.N., Millet,L. and Khurana,R. et. al.	JOURNAL OF BIOLOGICAL CHEMISTRY, 2002, Vol 277, pp 12657-65	7.258	CDRI
Mycobacterium-Tuberculosis Hemoglobin HBO Associates with Membranes and Stimulates Cellular Respiration of Recombinant *Escherichia-coli:* Pathania,R., Navani,N.K., Rajomohan,G.and Dikshit,K.L.	JOURNAL OF BIOLOGICAL CHEMISTRY, 2002, Vol 277, Iss 18, pp 15293-15302	7.258	IMTECH
Involvement of a 9-Residue Loop of Streptokinase in the Generation of Macromolecular Substrate-Specificity by the Activator Complex Through Interaction with Substrate Kringle Domains: Dhar,J., Pande,A.H., Sundram,V., Nanda,J.S., Mande,S.C. and Sahni,G.	JOURNAL OF BIOLOGICAL CHEMISTRY, 2002, Vol 277, Iss 15, pp 13257-13267	7.258	IMTECH
Distinct Role of Cd80 and Cd86 in the Regulation of the Activation of B-Cell and B-Cell Lymphoma: Suvas,S., Singh,V., Sahdev,S., Vohra,H. and Agrewala,J.N.	JOURNAL OF BIOLOGICAL CHEMISTRY, 2002, Vol 277, Iss 10, pp 7766-7775	7.258	IMTECH
Chromodomain Protein Swi6-Mediated Role of DNA-Polymerase A in Establishment of Silencing in Fission Yeast: Ahmed,S., Saini,S., Arora,S. and Singh,J.	JOURNAL OF BIOLOGICAL CHEMISTRY, 2002, Vol 276, Iss 51, pp 47814-47821	7.258	IMTECH

Slow-Tight Binding-Inhibition of Xylanase by an Aspartic Protease Inhibitor - Kinetic-Parameters and Conformational-Changes that Determine the Affinity and Selectivity of the Bifunctional Nature of the Inhibitors: Dash,C., Vathipadiekal,V., George,S.P. and Rao,M.	JOURNAL OF BIOLOGICAL CHEMISTRY, 2002, Vol 277, Iss 20, pp 17978-17986	7.258	NCL
Macrophage Effector Functions Controlled by Brutons Tyrosine Kinase are More Crucial than the Cytokine Balance of T-Cell Responses for Microfilarial Clearance: Mukhopadhyay,S., Mohanty,M., Mangla,A., George,A., Bal,V., Rath,S. and Ravindran,B.	JOURNAL OF IMMUNOLOGY, 2002, Vol 168, Iss 6, pp 2914-2921	7.065	CDRI
Evidence That Glycoprotein-96 (B2), a Stress Protein, Functions as a Th2-Specific Costimulatory Molecule: Banerjee,P.P., Vinay,D.S., Mathew,A., Raje,M., Parekh,V., Prasad,D.V.R., Kumar,A., Mitra,D. and Mishra,G.C.	JOURNAL OF IMMUNOLOGY, 2002, Vol 169, Iss 7, pp 3507-3518	7.065	IMTECH
Host-Tumor Interactions During the Regression of a Rat Histiocytoma, Ak-5: Khar,A. and Anjum,R	IMMUNOLOGICAL REVIEWS, 2002, Vol 184, Iss DEC, pp 244-257	7.000	CCMB
Effect of C-Terminal Deletion of p53 on Heat-Induced Cd95 Expression and Apoptosis in a Rat Histiocytoma: Sreedhar,A.S., Pardhasaradhi,B.V.V., Khar,A. and Srinivas,U.K.	ONCOGENE, 2002, Vol 21, Iss 25, pp 4042-4049	6.737	CCMB
The Cryoprotective Effects of Glycine Betaine on Bacteria: Chattopadhyay,M.K	TRENDS MICROBIOL, 2002, Vol 10, pp 311	6.523	CCMB
A High-Molecular-weight Outer-Membrane Protein of *Xanthomonas Oryzae* PV. Oryzae Exhibits Similarity to Non-Fimbrial Adhesins of Animal Pathogenic Bacteria and is Required for Optimum Virulence: Ray,S.K., Rajeshwari,R., Sharma,Y. and Sonti,R.V.	MOLECULAR MICROBIOLOGY, 2002, Vol 46, Iss 3, pp 637-647	6.398	CCMB
Nitric-Oxide Scavenging and Detoxification by the Mycobacterium-Tuberculosis Haemoglobin, Hbn in *Escherichia coli*: Pathania,R., Navani,N.K., Gardner,A.M., Gardner,P.R. and Dikshit,K.L.	MOLECULAR MICROBIOLOGY, 2002, Vol 45, Iss 5, pp 1303-1314	6.398	IMTECH
Polyamines Assisted Rapid and Clean Deprotection of Oligonucleotides from cis-diol Bearing Universal Supports: Kumar,P.	NUCLEIC ACIDS RESEARCH, 2002, Vol 30, pp 130	6.373	IGIB
An Insight into the Active-Site of a Type-I DNA Topoisomerase from the Kinetoplastid Protozoan *Leishmania donovani*: Das,A., Mandal,C., Dasgupta,A., Sengupta,T. and Majumder,H.K.	NUCLEIC ACIDS RESEARCH, 2002, Vol 30, Iss 3, pp 794-802	6.373	IICB
Tristetraprolin and LPS-Inducible Cxc Chemokine are rapidly induced in Presumptive Satellite Cells in response to Skeletal-Muscle Injury: Sachidanandan,C., Sambasivan,R. and Dhawan,J.	JOURNAL OF CELL SCIENCE, 2002, Vol 115, Iss 13, pp 2701-2712	6.213	CCMB

Artifacts in Electron Paramagnetic Resonance Spectra of C60 Fullerene ions. Inevitable C1200 impurity: Paul,P., Kim,K.C., Sun,D., Boyed,P.D.W. and Reed,C.A.	JOURNAL OF THE AMERICAN CHEMICAL SOCIETY, 2002, Vol 124, pp 4394	6.079	CSMCRI
Layered Double Hydroxide Supported Nanopalladium Catalyst for Heck-Type, Suzuki-Type, Sonogashira-Type, and Stille-Type Coupling Reactions of Chloroarenes: Choudary,B.M., Madhi,S., Chowdari,N.S., Kantam,M.L. and Sreedhar,B.	JOURNAL OF THE AMERICAN CHEMICAL SOCIETY, 2002, Vol 124, Iss 47, pp 14127-14136	6.079	IICT
Catalytic Asymmetric Dihydroxylation of Olefins with Reusable Oso42- on Ion-Exchangers - The Scope and Reactivity Using Various Cooxidants: Choudary,B.M., Chowdari,N.S., Jyothi,K. and Kantam,M.L.	JOURNAL OF THE AMERICAN CHEMICAL SOCIETY, 2002, Vol 124, Iss 19, pp 5341-5349	6.079	IICT
Enzyme-Mediated Extracellular Synthesis of CdS Nanoparticles by the Fungus, Fusarium-Oxysporum: Ahmad,A., Mukherjee,P., Mandal,D., Senapati,S., Khan,M.I.. Kumar,R. and Sastry,M.	JOURNAL OF THE AMERICAN CHEMICAL SOCIETY, 2002, Vol 124, Iss 41, pp 12108-12109	6.079	NCL
Anchored Pd Complex in Mcm-41 and Mcm-48 - Novel Heterogeneous Catalysts for Hydrocarboxylation of Aryl Olefins and Alcohols: Mukhopadhyay,K., Sarkar,B.R. and Chaudhari,R.V.	JOURNAL OF THE AMERICAN CHEMICAL SOCIETY, 2002, Vol 124, Iss 33, pp 9692-9693	6.079	NCL
Location of Protons in Anhydrous Keggin Heteropolyacids H3Pmo12O40 and H3Pw12O40 by H-1(P-31)/P-31(H-1) Redor NMR and DFT Quantum-Chemical Calculations: Ganapathy,S., Fournier,M., Paul,J.F., Delevoye,L., Guelton,M. and Amoureux,J.P.	JOURNAL OF THE AMERICAN CHEMICAL SOCIETY, 2002, Vol 124, Iss 26, pp 7821-7828	6.079	NCL
Triple-Quantum Magic-Angle-Spinning Al-27 NMR of Aluminum Hydroxides: Damodaran,K., Rajamohanan,P.R., Chakrabarty,D., Racherla,U.S., Manohar,V., Fernandez,C., Amoureux,J.P. and Ganapathy,S.	JOURNAL OF THE AMERICAN CHEMICAL SOCIETY, 2002, Vol 124, Iss 13, pp 3200-3201	6.079	NCL
Environmental and Auxin Regulation of Wood Formation Involves Members of the Aux/IAA Gene Family in Hybrid Aspen: Moyle,R., Schrader,J., Stenberg,A., Olsson,O., Saxena,S., Sandberg,G. and Bhalerao,R.P.	PLANT JOURNAL, 2002, Vol 31, Iss 6, pp 675-685	5.792	NBRI
Identification of Enzyme-Inhibitors Using Combinatorial Libraries: Batra,S., Srinivasan,T., Rastogi,S.K. and Kundu,B.	CURRENT MEDICINAL CHEMISTRY, 2002, Vol 9, Iss 3, pp 307-319	5.760	CDRI
Sugar Amino-Acids and Their Uses in Designing Bioactive Molecules: Chakraborty,T.K. Ghosh,S. and Jayaprakash,S.	CURRENT MEDICINAL CHEMISTRY, 2002, Vol 9, Iss 4, pp 421-435	5.760	IICT
Recent Developments on the Design, Synthesis and Structure and Structural Activity Relationship Studies of Pyrrolo (2,1-C)-(1-4) Benzodiazephines as DNA-interactive Antitumour Antibiotics: Kamal,A.	CURRENT MEDICINAL CHEMISTRY, 2002, Vol 2, Iss 2, pp 215-254	5.760	IICT

Association of Ifng Gene Polymorphism with Asthma in the Indian Population: Nagarkatti,R., Rao,C.B., Rishi,J.P., Chetiwal,R., Shandilya,V., Vijayan,V., Kumar,R., Pemde,H.K., Sharma,S.K. and Sharma,S. Si	JOURNAL OF ALLERGY AND CLINICAL IMMUNOLOGY, 2002, Vol 110, Iss 3, pp 410-412	5.506	IGIB
Single-Step Purification and Characterization of a 67 kDa Major Allergen from Imperata-Cylindrica Grass-Pollen Extract: Bijli,K,M, Singh,B.P., Sridhara,S. and Arora,N.	JOURNAL OF ALLERGY AND CLINICAL IMMUNOLOGY, 2002, Vol 109, Iss 1, pp 384	5.506	IGIB
Characterization of a Cross-Reactive, Major Allergen of *Epicoccum nigrum*: Bisht,V. Singh,B.P., Gaur,S.N., Arora,N. and Sridhara,S.	JOURNAL OF ALLERGY AND CLINICAL IMMUNOLOGY, 2002, Vol 109, Iss 1, pp 403	5.506	IGIB
Oral Allergy Syndrome to Sapodilla (*Achras zapota*): Hegde,V.L. and Venkatesh,Y.P.	JOURNAL OF ALLERGY AND CLINICAL IMMUNOLOGY, 2002, Vol 110, Iss 3, pp 533-534	5.506	CFTRI
Whole Genome Expression Profile of Yeast-RNA Polumerasw II Gene Submit, Rpb4 in Stress and Nonstress Conditions; Pillai, B., Verma, J., Abraham, A., Francis, P., Brahmachari, S.K., Sathale, P.P.	J. Biol Chem 278: 3339-46, 2003	6.696	IGIB
Stochastic Quantization of Order 2 Parafermi Fields: Balakrishnan,J.	EUROPEAN PHYSICAL JOURNAL C, 2002, Vol 23, Iss 2, pp 389-395	5.194	CMMACS

ANNEXURE-III

KNOWHOW LICENSED FOR THE FIRST TIME

KNOWHOW/ TECHNOLOGY (LAB)	LICENSEE
CHEMICAL & ALLIED PRODUCTS	
Conductive hydrogel (CECRI)	Achala Scientifics, Madurai
Synthetic tanning agent-formaldehyde free polymeric & chrome syntan (CLRI)	Balmer Lawrie & Co., Chennai
Enzyme technology based on animal/ plant source for lime,sulfide free unhairing (CLRI)	Textan Chemicals P. Ltd., Chennai
Emulsion suitable for shovel and deep hole blasting in surface (CMRI)	Keltech Energics Ltd., Karnataka
Catalyst for speciality polymeric materials based on zirconium tetrachloride (IICT)	Nuclear Fuel Complex, Hyderabad
Hydroxy ethyl cellulose (IICT)	Pidilite Industries Ltd., Mumbai
2-methyl-hydroxy-5-methyl-(2H) Furanone (Furaneol) (IICT)	Sameer Speciality Chemicals Ltd., Chennai
3-furaldehyde (IICT)	Standard Products Mfg. Co., Hyderabad
Methane sulphonic acid from effluent gas methyl mercaptan (IICT)	SMS Pharmaceuticals Ltd., Medak
Galvasalt (NML)	Ambica Industries, Kolkata
Office gum (additive) (RRL,Jt.)	S. Prasad Rao, Hyderabad
DRUGS & PHARMACEUTICALS	
Herbal pain balm formulation (CIMAP)	Hari Om Heritages, Chennai
Alpha fetoprotein-a diagostic marker (IICB)	Santha Biotech P. Ltd., Hyderabad
ASMON-herbal medicine for relief of asthma (IICB)	Herbochem Remedies India P.Ltd., Kolkata
Lacidipine-anti hypertensive drug (IICT)	Cadila Pharmaceuticals Ltd., Ahmedabad
Lambda cyhalothrin (tech)- synthetic pyrethroid (IICT)	Isagro (Asia) Agrochemicals P. Ltd., Mumbai
Doxazocin-anti hypertensive drug (IICT)	Cadila Pharmaceuticals Ltd., Ahmedabad.
Recombinant streptokinase (IMT)	Shasun Chemicals & Drugs, Chennai
FOOD & BEVERAGES	
Dehydrated bitter gourd (CFTRI)	Green Vision Industries, Karkala

Knowhow Licensed

Curry paste (CFTRI)	Heylands Exports P. Ltd., Chennai
Osmo air dehydrated pineapple (CFTRI)	NERAMAC, Guwahati
Malted rich ragi flour enzyme (CFTRI)	Girija N. Nair, New Delhi
Protein rich vermicelli (CFTRI)	Rajalakshmi Industries, Dindigul
Decortication of ragi (CFTRI)	Muihlenbau Services, Bangalore
Cola flavour concentrate (CFTRI)	Rajiv Beverages, Ambawadi
Enzymatic degumming and dewaxing of rice bran oil (IICT)	A.P. Organics Ltd., Dhuri
MACHINERY & EQUIPMENT	
Roof coaling device (CBRI)	S. Kumar, Roorkee
Device for pneumatic extrusion of dough (CFTRI)	S.M. Machinery Manufacturers, Mysore
Portable kits and instruments for edible oil and detection of pollutant (CSIO)	Abrol & Associates, Chandigarh
	Vaiseshika Electron Devices, Ambala Cantt.
Digital Aflatoxin Meter (CSIO)	Azjtronics Instrumentation, Chandigarh
Semi automatic pick & place machine (CSIO)	EMS Technologies Pvt. Ltd., Pune
Head Up display (CSIO)	Bharat Electronics Ltd., Bangalore
Automation and control of dipotassium salt formulation reactor (IICT)	SMS Pharmaceuticals Ltd., Medak
Improved industrial NG burner (IIP)	Encon Thermal Engineers, Faridabad
OTHERS	
Atmospheric packaging of minimally processed vegetables (CFTRI)	Gujarat Co-operative Milk Marketing Federation Ltd.,Anand
Extension of shelf life of egg (CFTRI)	Rudraraju Prameela, Hyderabad
Swing technology for food colours, spice flavours and extraction for fresh/dry spices (CFTRI)	Food and Natural Products P. Ltd., Hyderabad
Ceramic based hip joint prostheses and hydroxyapatite based integrated orbital implants (CGCRI)	IFGL Refractories Ltd., Kolkata
Glazed terra cottawares (CGCRI)	Furqan Potteries, UP
Phycocyanin from Spirulina (CSMCRI)	Strides Arcolab Ltd., Bangalore
Black board coating (RRL, Jt)	Creative Paper and Craft Indus., Golaghat
Low dust chalk pencil (RRL, Jt)	Sura C Vannanthurai, Chennai

ANNEXURE-IV

MEMBERS OF THE CSIR SOCIETY

(Including members of CSIR Governing Body)

1	Shri Atal Bihari Vajpayee Prime Minister, Govt. of India	President
2	Prof. M.M. Joshi Minister for Human Resource Development and Science & Technology Govt. of India Anusandhan Bhavan Rafi Marg, New Delhi - 110 001	Vice-President
3	Shri Jaswant Singh Minister of Finance Government of India North Block, New Delhi - 110 001	Member
4	Shri Arun Jaitley Minister of Industry Government of India Udyog Bhavan New Delhi - 110 001	Member
5	Prof. Goverdhan Mehta (Chairman, CSIR Advisory Board) Director Indian Institute of Science Bangalore - 560 012	Member
6	Shri B. Muthuraman Managing Director Tata Iron & Steel Co. Limited (TISCO) Bombay House, 24 Homi Mody Street Mumbai - 400 001	Member
7	Shri Mukesh Ambani Chairman & Managing Director Reliance Industries Limited Maker Chamber-V, 222 Nariman Point Mumbai - 400 021	Member
8	Dr. S.Z. Qasim Vice-Chairman Society for Indian Ocean Studies Secular House 1, Aruna Asaf Ali Marg New Delhi - 110 067	Member

9	Dr. Arun Nigvekar Chairman University Grants Commission Bahadur Shah Zafar Marg New Delhi 110 002	Member
10	Dr. D.N. Tewari Member Planning Commission Yojana Bhavan, Sansad Marg New Delhi - 110 001	Member
11	Shri Sirajuddin Qureshi Managing Director Hind Agro Industries Ltd. B-3, Friends Colony (West) Main Mathura Road New Delhi - 110 065	Member
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13	Shri Ashok Soota President Confederation of Indian Industry (CII) 23-26, Institutional Area Lodi Road New Delhi - 110 003	Member
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15	Shri Mahendra Nahata Chairman Himachal Futuristic Communications Limited 8, Commercial Complex, Masjid Moth Greater Kailash – II New Delhi - 110 048	Member
16	Shri K.V. Kamath Managing Director & CEO Industrial Credit & Investment Corporation of India Ltd. ICICI Tower Bandra, Kuria Complex Mumbai - 400 051	Member

17	Dr. (Mrs.) Swati A. Piramal Chief Scientific Officer Nicholas Piramal India Ltd. 100, Centre Point Dr. Baba Saheb Ambedkar Road Parel, P.O. Box No.6011 Mumbai - 400 012	Member
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20	Shri S.K. Tripathi Secretary Department of Education Ministry of Human Resources Development Shastri Bhavan Dr. Rajendra Prasad Road New Delhi - 110 001	Member
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22	Dr. R.A. Mashelkar, FRS Director-General Council of Scientific & Industrial Research Anusandhan Bhavan Rafi Marg New Delhi - 110 001	Ex-officio Secretary
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*As member of CSIR Governing Body

ANNEXURE-V

MEMBERS OF ADVISORY BOARD

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Director-General, CSIR

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President
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Research Institute
Mysore – 570 013

14 Dr. T. Ramasami
Director
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Adyar
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15 Dr. V.P. Dimri
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National Geophysical Research
Institute, Uppal Road
Hyderabad – 500 007

ANNEXURE-VI

C & AG REPORT

Technology transfer in Council of Scientific and Industrial Research: The Council of Scientific & Industrial Research, under the Department of Scientific and Industrial Research, was established as a society in 1942. One of the objectives of CSIR is to undertake R&D directed towards continuous improvement of indigenous technology and adaptation and development of imported technology. Out of the 984 technologies developed by 23 laboratories/institutes of CSIR, 607 technologies including 247 developed prior to 1996-97 had not been transferred. The laboratories were unable to furnish specific information on the actual expenditure on the development of the technologies. 77 technologies were not found fit for commercialization. In 87 cases, the technologies required further improvements/ developments. Of these, 65 cases were more than three years old. In the remaining 82 cases, the negotiations for transfer were underway. CSIR sustained a loss of Rs. 99.31 lakh due to its violation of the prescribed guidelines on technology transfer.

(Para 2.1 of Report No. 5 of 2003)
Scientific Departments

Avoidable loss of Rs. 64.93 lakh: CSIR owns two multi-storeyed buildings in New Delhi since 1987 called Maharani Bagh Scientific Apartments. It obtained the sanctioned load from Delhi Vidyut Board (DVB) at single point supply and itself managed the distribution from the sub-station. Though DVB charged non-domestic rates for the energy consumed, CSIR recovered electricity charges only on the basis of the prevalent domestic tariff from the occupants of the apartments. This resulted in avoidable loss of Rs. 64.93 lakh from May 1995 to March 2002.

(Para 4.1 of Report No. 5 of 2003)
Scientific Departments

Unfruitful expenditure: The Central Mining Research Institute (CMRI), Dhanbad undertook a project in June 1985 sponsored by the Department of Coal for development of a safety system for protection of underground mining equipment from break down by monitoring the mine's environmental parameters through six sensors. CMRI could develop only four sensors after spending Rs. 25.77 lakh. Subsequently, the Ministry of Coal sanctioned another project in September 1996 to CMRI to fabricate a Data Acquisition system comprising of six sensors and to install the system in a Colliery

for conducting field trials. CMRI was to ensure commercialization of the technology developed. It closed the project in March 2001 after incurring an expenditure of Rs. 4.63 lakh without achieving the complete objectives. Thus even after a lapse of more than twelve years and after incurring an expenditure of Rs. 30.40 lakh, CMRI could not develop the envisaged system comprising six sensors for protection of underground mining equipment.

(Para 4.2 of Report No. 5 of 2003)
Scientific Departments

Irregularity in transfer and commercialization of technology leading to non-receipt of technology fee: The Indian Institute of Petroleum (IIP) developed process technologies for production of two Butylated Phenol based antioxidants in a project sponsored by a private company. IIP entered into an agreement with a firm for commercialization of the technologies. Poor management of the transfer of technology agreement by IIP resulted in the Basic Engineering Package for a process technology being handed over to the firm without recovering the entire amount of license and design fees due from it. There is no prospect of recovery of the amounts due.

(Para 4 of Report No. 5 of 2003)
Scientific Departments

Designed and produced by National Institute of Science Communication and Information Resources,
Dr. K. S. Krishnan Marg, New Delhi - 110 012