ANNUAL REPORT
2000-2001

Council of Scientific & Industrial Research
New Delhi

ANNUAL REPORT
2000-2001

Physical Laboratory
LIBRARY
Date
New Delhi

Council of Scientific & Industrial Research
New Delhi

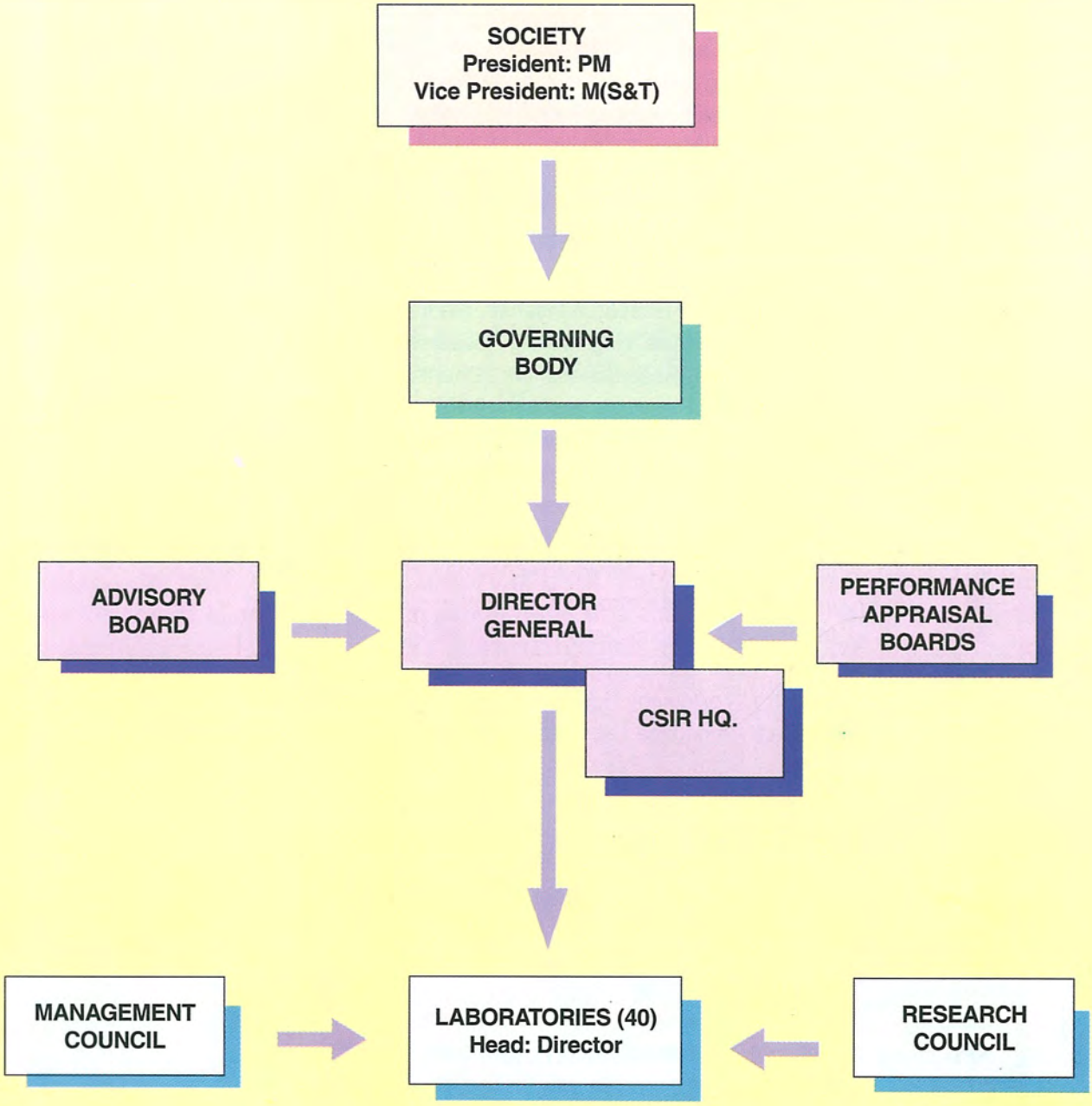
Edited, Designed and Produced by:
R&D Planning and Business Development Division
Council of Scientific & Industrial Research
New Delhi - 110 001

Printed at Photocomposing-cum-Printing Unit,
National Institute of Science Communication (NISCOM)
Dr. K.S.Krishnan Marg, New Delhi - 110 012

CONTENTS

		Page No.
Overview		1
1.0	**S&T Contributions**	9
1.1	Aerospace Science & Technology	9
1.2	Biological Sciences & Technology	15
1.3	Chemical Sciences & Technology	39
1.4	Earth Sciences & Technology	47
1.5	Engineering Sciences & Technology	55
1.6	Food Science & Technology	64
1.7	Information Science & Technology	70
1.8	Material Science & Technology	73
1.9	Societal Science & Technology	79
2.0	**Central Management Activities**	85
2.1	CSIR Society	85
2.2	Governing Body	86
2.3	Department Related Parliamentary Committee	87
2.4	Research Council (RC)	88
2.5	Directors Conference	88
2.6	CSIR Foundation Day	99
3.0	**Headquarter Activities**	105
3.1	R&D Planning & Business Development Division (RPBD)	105
3.2	International S&T Affairs Directorate (ISTAD)	110
3.3	Human Resource Development Group (HRDG)	113
3.4	Societal & Technological Missions Division (STMD)	115
3.5	Intellectual Property Management Division (IPMD)	118
3.6	Unit for Science Dissemination (USD)	118
4.0	**Dateline CSIR**	119
Annexures		
I	Intellectual Property from CSIR	129
IA	Foreign Patents Granted 2000-2001	131
II	Top Papers Published by CSIR (2000)	137
III	Knowhow Licensed for the first time	143
IV	Members of the CSIR Society (including members of the CSIR Governing Body)	145
V	Members of the Advisory Board	149

CSIR
ORGANISATIONAL STRUCTURE



PRESIDENT	: SHRI ATAL BIHARI VAJPAYEE
VICE-PRESIDENT	: PROF. MURLI MANOHAR JOSHI
DIRECTOR GENERAL	: DR. R. A. MASHELKAR

CSIR ESTABLISHMENTS

CBRI	Central Building Research Institute, Roorkee - 247 667
CBT	Centre For Biochemical Technology, Delhi - 110 007
CCMB	Centre for Cellular and Molecular Biology, Hyderabad - 500 007
CDRI	Central Drug Research Institute, Lucknow - 226 001
CECRI	Central Electrochemical Research Institute, Karaikudi - 623 006
CEERI	Central Electronics Engineering Research Institute, Pilani - 333 031
CFRI	Central Fuel Research Institute, Dhanbad - 828 108
CFTRI	Central Food Technological Research Institute, Mysore - 570 013
CGCRI	Central Glass and Ceramic Research Institute, Calcutta - 700 032
CIMAP	Central Institute of Medicinal & Aromatic Plants, Lucknow - 226 016
CLRI	Central Leather Research Institute, Madras - 600 020
CMERI	Central Mechanical Engineering Research Institute, Durgapur - 713 209
CMRI	Central Mining Research Institute, Dhanbad - 826 001
CRRI	Central Road Research Institute, New Delhi - 110 020
CSIO	Central Scientific Instruments Organisation, Chandigarh - 160 020
CSMCRI	Central Salt & Marine Chemicals Research Institute, Bhavnagar - 364 002
IHBT	Institute of Himalayan Bioresource Technology, Palampur - 176 061
IICB	Indian Institute of Chemical Biology, Calcutta - 700 032
IICT	Indian Institute of Chemical Technology, Hyderabad - 500 007
IIP	Indian Institute of Petroleum, Dehradun - 248 005
IMT	Institute of Microbial Technology, Chandigarh - 160 036
INSDOC	Indian National Scientific Documentation Centre, New Delhi - 110 067
ITRC	Industrial Toxicology Research Centre, Lucknow - 226 001
NAL	National Aerospace Laboratories, Bangalore - 560 017
NBRI	National Botanical Research Institute, Lucknow - 226 001
NCL	National Chemical Laboratory, Pune - 411 008
NEERI	National Environmental Engineering Resarch Institute, Nagpur - 440 020
NGRI	National Geophysical Research Institute, Hyderabad - 500 007
NIO	National Institute of Oceanography, Goa - 403 004
NISCOM	National Institute of Science Communication, New Delhi - 110 012
NISTADS	National Institute of Science Technology and Development Studies, New Delhi - 110012
NML	National Metallurgical Laboratory, Jamshedpur - 831 007
NPL	National Physical Laboratory, New Delhi - 110 012
RRL,BHO	Regional Research Laboratory, Bhopal - 462 026
RRL,BHU	Regional Research Laboratory, Bhubaneshwar - 751 013
RRL,JM	Regional Research Laboratory, Jammu Tawi -180 001
RRL,JT	Regional Research Laboratory, Jorhat - 785 006
RRL,TVM	Regional Research Laboratory,Thiruvananthapuram - 695 019
SERC,G	Structural Engineering Research Centre, Ghaziabad – 201 002
SERC,M	Structural Engineering Research Centre, Chennai- 600 113

OVERVIEW

The Annual Report 2000-2001 highlights the more significant of contributions made by CSIR to advancement of science & technology, to the growth of economy and in addressing societal concerns and issues. The Report gives details of the performance of CSIR as a whole. The S&T achievements and activities are categorized sectorally and the Chapter on Central Management captures the policy directions emanating from the overarching decision making bodies of CSIR i.e. Society, GB, AB etc. and the activities managed by the HQs.

Performance during the year

The major achievement during the year was in regard to intellectual property rights – for the first time in the history of CSIR, foreign patent filing outstripped the Indian patent filing. The foreign patent filing was 452 (199 in 1999-2000) and Indian patent filing was 410 (up from 377) besides 29 copyright for software and 16 trademarks were obtained indicating the emergence of CSIR in the domains of other forms of Industrial property as well. The output of papers and the average impact factor seem to have reached a saturation level, thus the average impact factor per paper increased to a mere 1.552 from 1.538. The external cash inflow was also highly constrained due to the very slow growth rate in the industrial sector, there was a marginal decline in ECF from Rs. 252 crore to Rs. 245 crore but despite the difficult times the industrial production based on CSIR knowhow grew by around 9% which was double the rate of growth of the industrial sector per se.

Operationalising of New Millennium Indian Technology Leadership Initiative (NMITLI)

NMITLI was launched from the year 2000-2001 with a budgetary allocation of Rs. 50 crore, which was revised to Rs. 25 crore later. NMITLI envisages to support innovation centered scientific and technological developments as a vehicle to attain for the country a global leadership position in selected niche areas, in a true Team India manner. A special meeting of the CSIR Advisory Board (AB) was held to discuss and give a direction to the NMITLI scheme. Thus wide-ranging national inputs from diverse constituencies were sought.

Over 1000 personal letters were addressed by DG, CSIR to leaders in academia, S&T, industry etc. seeking suggestions for these niche areas. Workshops were organised on the occasion of National Technology Day by all CSIR laboratories to foment national churning of ideas. Also special advertisement was issued in leading national dailies and around 8500 posters, seeking suggestions on potential niche areas, were sent to diverse educational and R&D establishments.

The process of national consultations thus involved fountainheads of wisdom from diverse walks of life to the young school students. An overwhelming response of 1000 bare ideas was received. Thereafter a very stringent and rigorous system of screening, expert evaluation and assessment, championing and brainstorming was set up involving eminent experts from Industry, Academia and Research Institutions. Over 4000 high quality man days were devoted to sift through the bare ideas and to bring them to 28 niche opportunity areas. In order to obtain an inverse risk-investment profile i.e. low investment – high-risk areas, two sets of technologies - firstly those where the initial R&D work had been successfully done and secondly those attempting to chart out a new technology path for the first time in the world were considered.

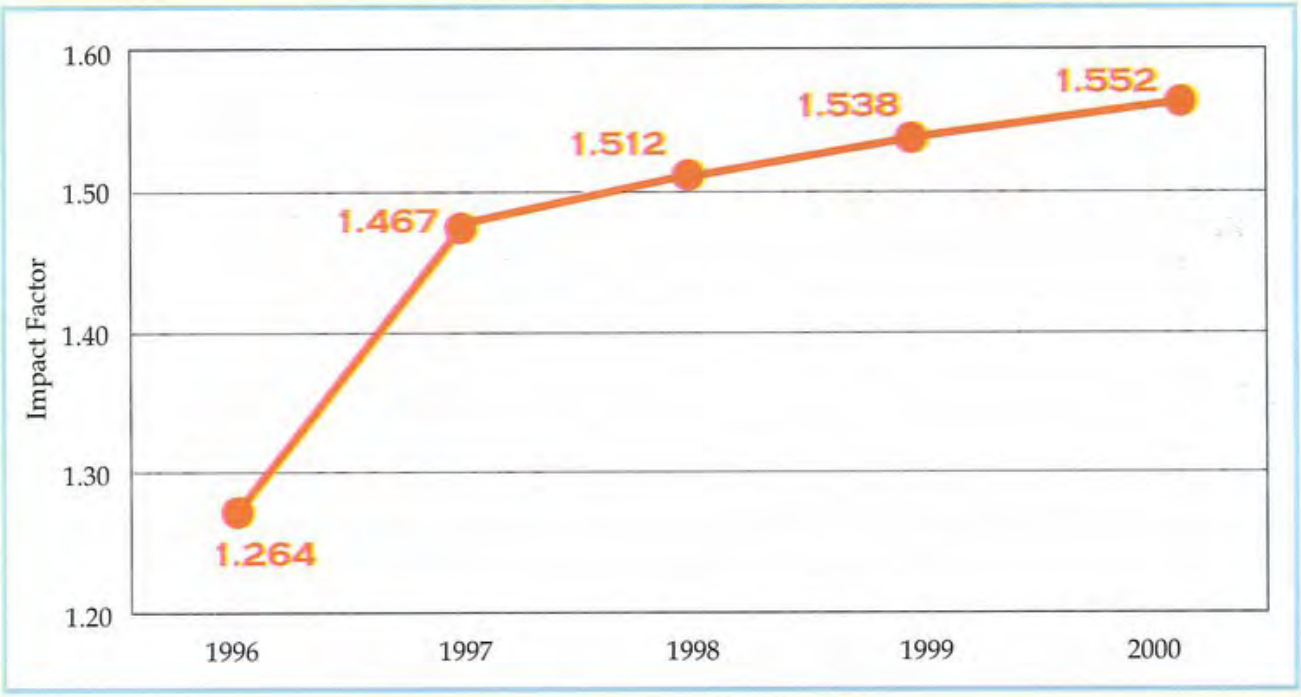
Thereafter another 2000 specialists man-days were devoted in converting nine of these areas to strategic technology projects. These detailed projects were then considered by a High Powered Committee - sub-committee of the CSIR Advisory Board - under the chairmanship of Prof. R. Narasimha and subsequently by the CSIR Governing Body.

The nine projects cover a wide spectrum of technology ranging from mesoscale weather modeling and forecasting, to defunctionalisation of carbohydrates as building blocks for chemical industry of the future, to nano-particle based drug delivery systems to selected diseases & drugs. The nine projects involve fifty five research institutions and twenty three industrial partners. Eight of the nine projects were taken up during the year and the nation reposes great hope and attaches great importance to the scheme and the farsighted projects.

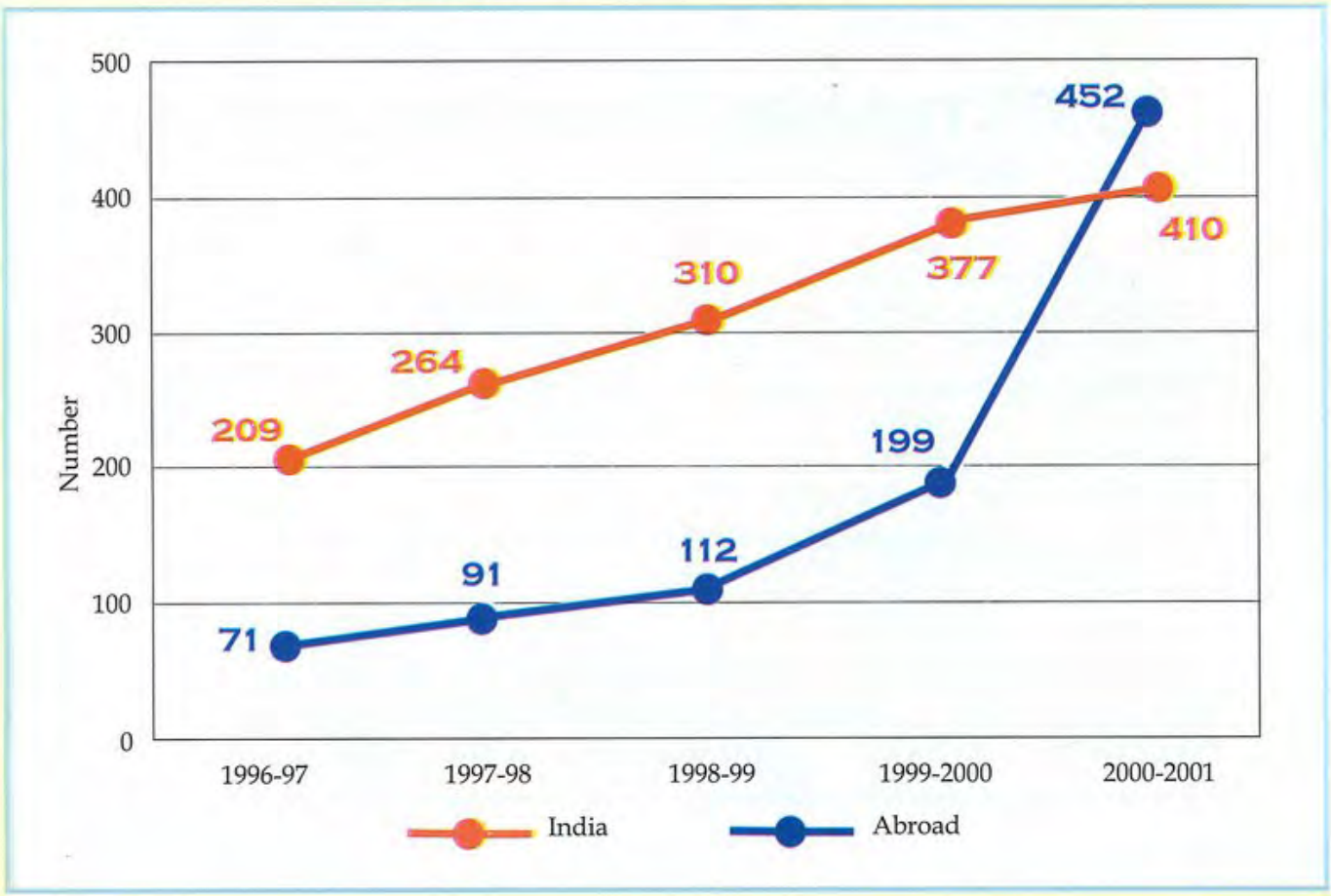
CSIR Plan 2000-2001 based on Zero Base Budgeting (ZBB)

With a view to optimise on the deployment of scarce resources, Government directed to incorporate ZBB as an integratal part of the budgeting process, from the financial year 2000-01. A CSIR Task Force under the Chairmanship of Dr. Harsh K. Gupta, Director, NGRI with the Financial Adviser, CSIR as the Convenor and other members from the CSIR system was constituted. The Task Force reviewed the ongoing & new Plan schemes of CSIR and recommended that, since the scheme 'National Laboratories' was the major component of the CSIR Plan, detailed exercise of formulation of the programmes/projects/activities in the national laboratories be done by applying ZBB.

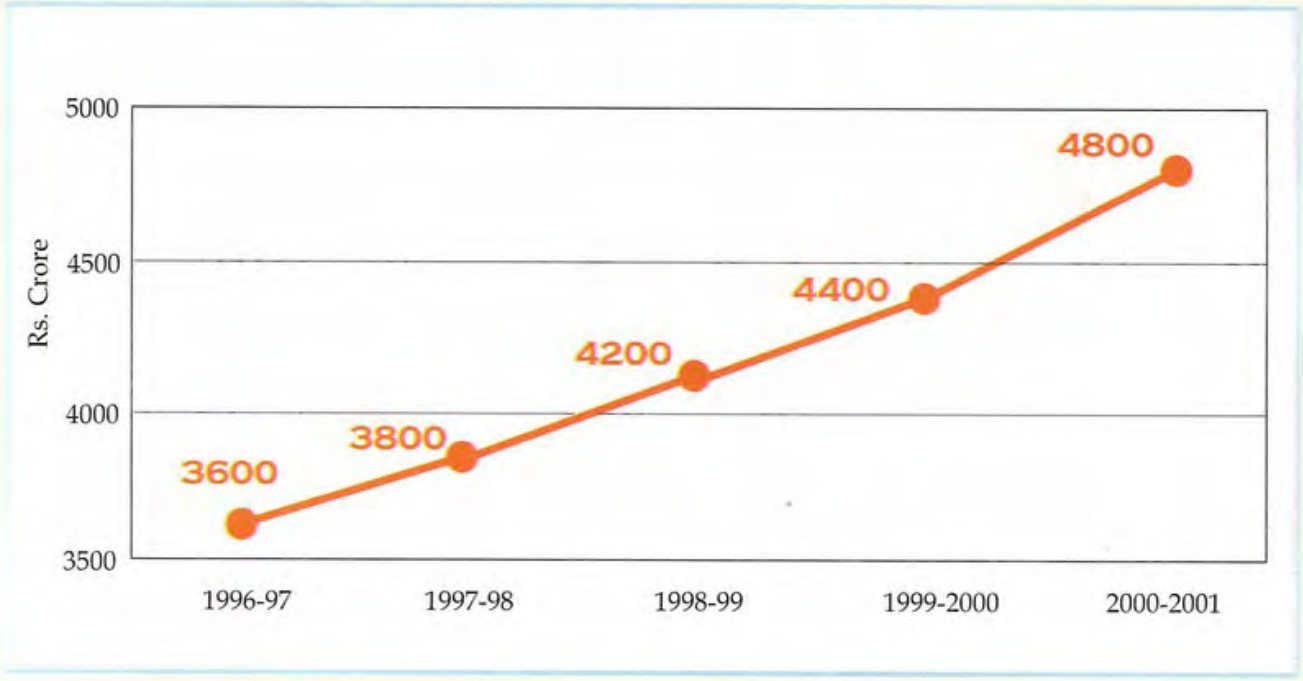
Papers Contributed
Average Impact Factor/Paper



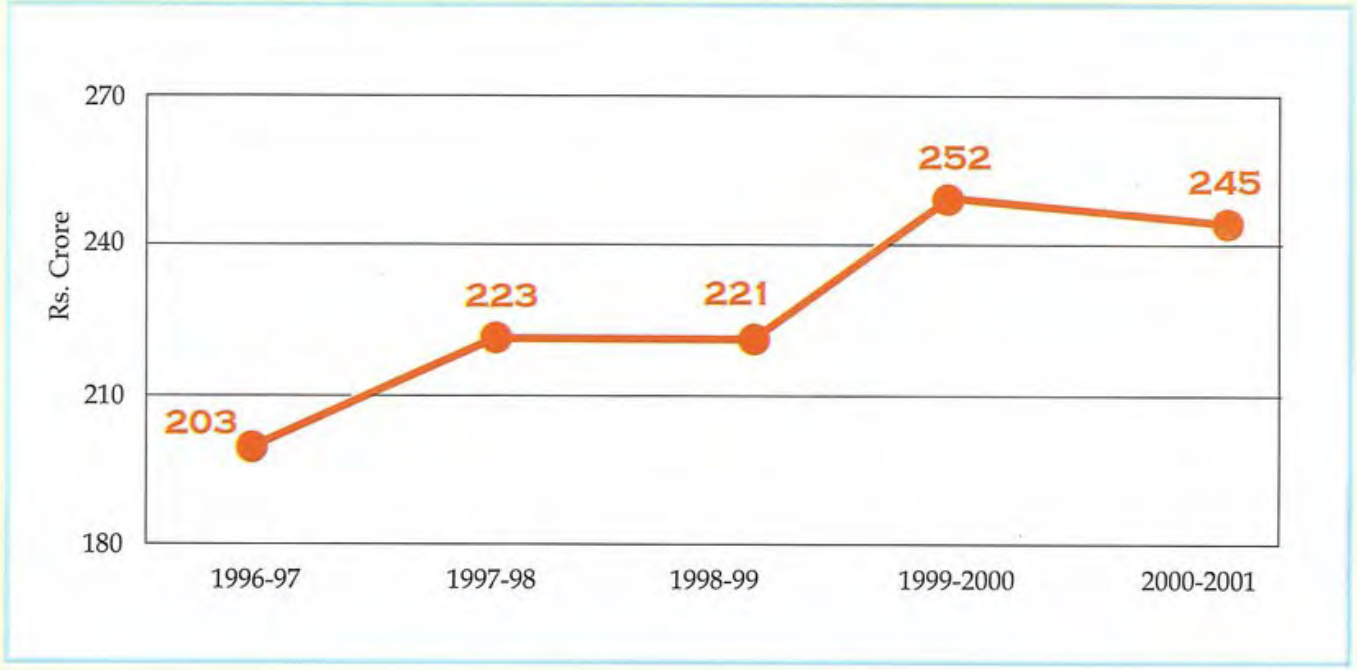
Patents Filing



Annual Industrial Production Based on CSIR Knowhow



External Cash Inflow



Considering the diverse nature of programmes/projects/activities being carried out at various national laboratories, broad guidelines for undertaking ZBB were devised, the specific methodology was left to the laboratories. The Guidelines were based on the designation of Decision Units (DUs; not Divisions) in the laboratory which in turn comprised of several Decision Packages. However, to educate the concerned personnel in the national laboratories on the methodology, nuances and intricacies of ZBB, regional Awareness Programmes were organized, at five locations.

High Level Committees (HLCs) were constituted in the national laboratories to implement the ZBB. The Annual Plan 2000-2001 of the national laboratories were thus prepared in consonance with a very detailed and involved ZBB exercise. These Plans of the national laboratories were reviewed then by CSIR Task Force and the CSIR Annual Plan was also accordingly based on ZBB. The CSIR Plan was presented to the Core Group on ZBB for the Scientific Departments under the Chairmanship of Dr. APJ Abdul Kalam, Principal Scientific Adviser to the Government of India. CSIR's Plan based on ZBB was appreciated.

New avenue for business development: Opportunia.com consortium

CSIR together with National Research and Development Corporation (NRDC), global consultants Ernst & Young (E&Y) India and the leading US stock exchange Nasdaq, have come together through Opportunia Enterprises in a major strategic alliance. The alliance seeks to promote technology based business in India, in the fast growth sectors of biotechnology, pharmaceuticals etc. by assisting entrepreneurs to tap the potential of CSIR's excellent infrastructure, technology and technical skills. Opportunia is a one-stop platform where entrepreneurs and emerging fast growth companies get end-to-end support and solutions for all points in the business life cycle – conceptualizing, seeding, growth, diversification, doing IPO's and mergers and acquisitions.

The strategic partners in the consortium bring with them a vast complementary experience and knowledge interalia of the brick and mortar sectors giving the entrepreneur an integrated business service for technology, IPR, legal, financial, management and marketing. The alliance has set-up the portal, 'www.opportunia.com', employing cutting edge technology tools to offer services such as information sharing, team discussions, customized mentoring as well as value added content in business, management technology, legal and other areas like idea validation, regulatory opinion etc. The consortium has already received enthusiastic response.

Knowledge alliance for genomics R&D

Nicholas Piramal India Ltd. (NPIL) and CBT forged a historic knowledge alliance, in November 2000, titled GenoMed. The alliance seeks to harvest the knowledge generated by human genome research alongwith the vast and diverse genetic wealth

of India in combination with knowledge of Indian traditional & current schools of medicine towards the development of genomic medicines.

GenoMed is business driven R&D with super focussed knowledge activities. The genome R&D is to be taken up mainly at CBT and the pharmaceutical and clinical ones at NPIL. The Genomic R&D is to concentrate on in-silico drug target identification and screen development, functional polymorphism, and microarray drug target screening. NPIL is to establish two special laboratories for the purpose, one at CBT and the other at NPIL. GenoMed has been initiated and the work on establishing the two laboratories is underway.

OUR RESOURCE BASE

1.	**Infrastructural**	Number
	* Laboratories/Institutes	40
	* Extension/ Field/ Regional/ Polytechnology Transfer Centres	80
2.	**Human**	
	Total Staff	21,228
	* Total S&T Staff	15,780
	• Scientists (Group IV)	5,052
	• Technical (Group III+V)	3,241
	• Technical (Group II+I)	7,487
	* Total Administrative & non-technical	5,448
3.	**Financial**	
		Rs. Crore
	* Government Budgetary Support	877.88
	• Government plan allocation	303.00
	• Government non-plan allocation	574.88
	* Extra budgetary resource generation	
	• From Contract R&D and Consultancy	229.29
	• Miscellaneous receipts (non-R&D)	42.83
	• Laboratory reserves	73.49

229
42
73
344

OUR PERFORMANCE IN 2000-2001

1. Science Output	Numbers	
* Papers Contributed		
• Number	1667	(1699)*
• Average Impact Factor	1.552	(1.538)
* Patents		
• Filed in India	410	(377)
• Filed abroad	452	(199)
• In force in India	657	(636)
• In force abroad	249	(169)
2. Technological Output	Numbers	
* New Knowhow Licensed	36	(36)
* Licensing agreements executed	140	(130)
3. National S&T Human Resource Development	Numbers	
* Research Fellows/Associates supported	5247	(3906)
* Emeritus Scientists in position	123	(117)
* Pool Scientists (SRAs) in position	320	(410)
* Research Schemes supported	750	(670)
4. Contribution to Economy	Rs. Crore	
* Industrial production based on CSIR Knowhow	4800	(4400)
* Saving in productivity accruing through CSIR R&D efforts	225	(225)
5. Resource Mobilisation	Rs. Crore	
* External Cash Inflow	245	(252)
* Contract value of projects on hand		
• Contract Research	350	(375)
• Consultancy	70	(75)

* Figures parenthesized correspond to the previous year 1999-2000

1

S&T CONTRIBUTIONS

1.1 AEROSPACE SCIENCE & TECHNOLOGY

1.1.1 SCIENCE, TECHNOLOGY & SERVICE

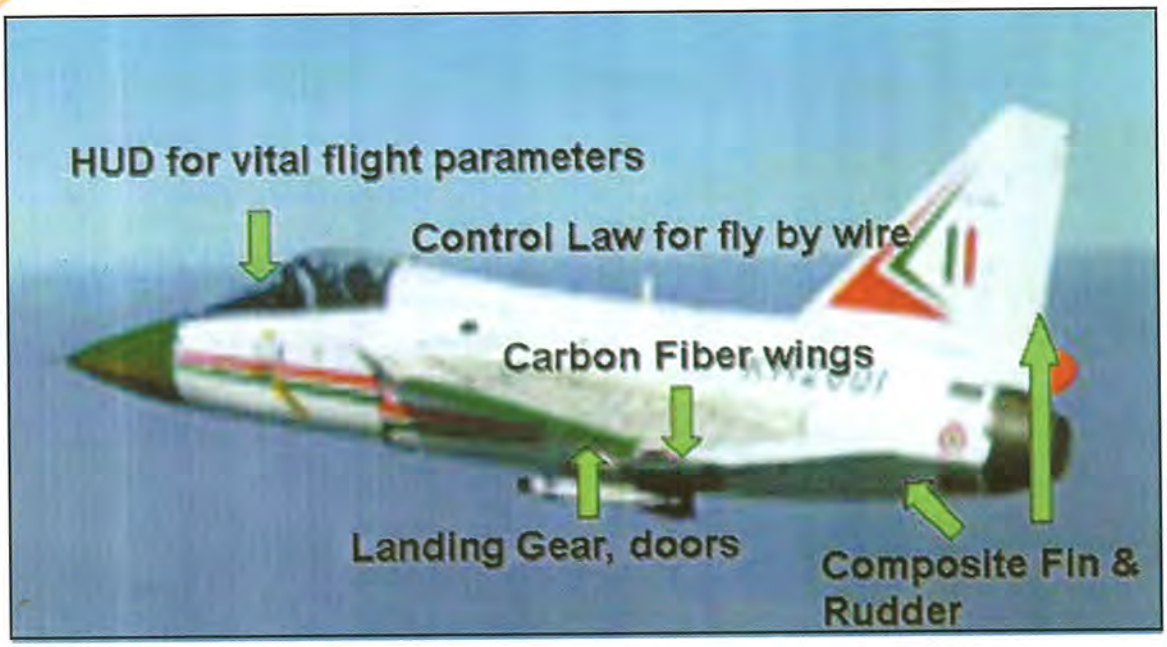
SARAS getting ready to fly

Work on the 14 seater multirole SARAS aircraft was in full swing to manufacture, assemble and equip major modules of the first prototype. Major SARAS related activities were underway at NAL, HAL, TAAL and 30 other work centers in and around Bangalore. Major structural assemblies of the aircraft were completed; in particular three numbers of horizontal tail, two numbers each of vertical tail and rear fuselage, one each of center and front fuselages and three emergency doors were completed. The rear, center and front fuselage modules of the first prototype were mounted on the fuselage-coupling jig at NAL. In addition, a large number of carbon fibre composites viz. elevator, aileron and rudder were assembled. Structural tests on the horizontal tail and elevator have been conducted with the participation of DGCA representatives. The trial equipping of the rear fuselage consisting mainly of the line replaceable unit (LRU) of the environmental control system, fire sensing systems and flight control system was also completed. Ground tests on the environmental and cabin pressure control systems and fuel systems were also completed. The first phase of the avionics system integration and testing on a ground test rig has been completed. The wing assembly has commenced at HAL (Nasik).

A systematic experimental study of deep stall characteristics of SARAS was carried out on a 1/6 scale model in the low speed wind tunnel at Indian Institute of Science. Ten ventral fins and three horizontal tails were tested as a part of this study. Based on the analysis of the wind tunnel results, suitable ventral fin geometry was chosen to overcome deep stall.

NAL's contributions to LCA

India's Light Combat Aircraft (LCA) had it's maiden flight on 4 January 2001. The aircraft has since completed its first block of 12 test flights. NAL and NAL-led teams



The light combat aircraft: CSIR's contributions

have played a major supporting role in the development of LCA. Most of the composite structures of LCA such as the fin, rudder, center fuselage, landing gear etc. have been developed at NAL. CFC wings for the LCA were also designed and developed by a national team led by NAL. Practically every LCA wind tunnel model has been fabricated at NAL (including the ¼ scale high speed air intake model built in 1990 against all odds, and numerous 1/7 scale composites models). These models have then been extensively tested at NAL's trisonic wind tunnel (many hundreds of wind tunnel tests have been undertaken spanning a whole decade). The LCA control law was completely designed and developed by a national team led by NAL. The success of the first block of test flights confirms that the safe, robust "inner loop" of the control law is performing well. NAL teams have also undertaken projects for the aero elastic testing of LCA models and carried out numerous CFD calculations to study LCA's configuration and the associated flow properties.

Hansa productionisation

The Ministry of Civil Aviation (MCA) supported the initial procurement of three Hansa aircrafts. Productionisation of HANSA-3 based on standard aircraft manufacture, to prescribed production procedures and to stringent quality assurance with elements covering approved inspection procedures, snag dispositions and inventory control documentation through controls were taken up. The HANSA VT-HNT was built and production test flights were completed successfully. This aircraft has been handed over to DGCA and which in turn has offered the aircraft to Andhra Pradesh Aviation Academy.

Ejector ramjet combustor employing a cavity cascade flame stabiliser

An ejector ramjet combustor development program was carried out under VSSC sponsorship. Rocket Based Combined Cycle (RBCC) propulsion is considered a promising candidate for application to reusable space launch vehicle. The secondary combustor need to be aerodynamically clean and also allow effective flame stabilization and combustion.

A novel method of achieving flame stabilization in an ejector ramjet has been proposed by NAL. It employs a cavity cascade as a flame stabilizer with some of the cavities also serving as integral fuel injector/flame holders. A cavity cascade flame holder has been successfully tested in the main $1/3^{rd}$ scale ejector ramjet combustor facility. The cavity cascade was found to stabilize flames when the ramjet was operated both in the ejector ramjet mode as well in the pure ramjet mode.

This method has been shown to successfully stabilise flames, both in subsonic and supersonic flows. Consequently, it could be used during the ejector rocket mode, pure ramjet mode, pure scramjet mode and even in the dual ram/scramjet mode. Additional trials have also been successfully conducted on a full scale 45 deg sectorial ramjet combustor incorporating a cavity cascade flame stabiliser.

Stress analysis of MiG-21

As a part of the full scale fatigue test requirement of the MiG-21 bis aircraft, finite element analysis of the wing of the aircraft was carried out by NAL using NISA-II software, with a view to predict the critical locations in terms of stress and strain induced under the design limit load. The analysis yielded maximum principal stress value which matches very well with that obtained from the stress album, in terms of both stress magnitude and location on the wing bottom skin. Also, it was found that the maximum strain value in the wing bottom skin along the lateral direction was within the permissible strain value for the material.

Aerostats

Aerostats used for surveillance, advertisements, weather predictions etc. comprise of a fabric balloon floating in air, maintaining equilibrium under aerodynamic load, buoyancy internal pressure and self-weight. It is held at the desired altitude by a connecting teether attached to a mooring system. They are generally made up of polyurethane-coated nylon fabric which is capable of resisting the load through membrane action. Since it is operated at high altitudes for long periods, the aerostat structure can undergo varied stress conditions, which have to be accounted in the design.

NAL has generated flat pattern templates for the fabrication of the doubly curved flexible aerostats of different sizes (250 m^3 and 1000m^3). The development of the

geometric modeling and the flat pattern templates was carried out using the special development features of CATIA software. The aerostats have been built using these templates.

Speech and hearing evaluation

In an interesting "spin-off application" of advanced composites, NAL's FRP Pilot Plant collaborated with the All India Institute of Speech and Hearing (AIISH), Mysore, to develop a composite mobile van for speech and hearing evaluation. While there are hospitals and clinics with low noise chambers, these are not available in the rural areas. The best that AIISH could do in these conditions was to use relatively silent classrooms or panchayat halls in rural areas. NAL designed a "mobile" speech and hearing clinic using a composite body for the van. This van, which has three chambers for examining patients, has a sound level of only about 25 dB inside (the noise "outside" can be as high as 90 dB) was fabricated at NAL. This low sound level was achieved by determining the optimal density and thickness of the composite foam core and skin. With better internal acoustic treatment, the sound level could even be reduced to 10-15 dB.

Molybdenum disilicide ($MoSi_2$) composites

Molybdenum disilicide ($MoSi_2$) and its composites have attractive properties and are considered for high temperature structural applications. $MoSi_2$ composites were synthesized by the hot pressing technique and characterized by X-ray and SEM. The introduction of second phase particles resulted in an increase in the hardness of the matrix and a decrease in the coefficient of friction and the specific wear rate. It was also found that introduction of $MoSi_2$ into the SiC matrix was beneficial in reducing the wear rate of SiC and the SiC based pins have low wear compared to pins based on $MoSi_2$ due to higher hardness.

Jet noise generator

A jet noise generator to generate high frequency noise between 2.5 kHz and 10 kHz in 1/3 octave bands was designed, fabricated, tested and delivered to Wyle Laboratories, USA on 28 Feb. 2001. The noise levels are controlled by the velocity of the gas jet and the frequency spectra by changing the dimensions parameters. This unit will be used to augment the acoustic test facility at NSPO, Taiwan, Republic of China.

Fatigue meter

NAL developed and type certified electro-mechanical Fatigue Meter (FM) were flight tested on the Jaguar at HAL. Five flights were conducted for studying the system and for obtaining the provisional type certificate. A comparative study of

the performance and accuracy of NAL's FM and Nagreti Zambra fatigue meter from one Jaguar aircraft was taken up at the LRDE centrifuge. Both the fatigue meters worked in a similar manner within the required accuracy. Also three smart fatigue meters developed as part on an ARDB project were getting ready for type certification. Fatigue meters with more accurate fatigue prediction are being designed to fix the time of occurrence of a peak or valley in the load spectrum.

Prototype ecam cutting machine

An Electro–Chemically Assisted Arc Machining (ECAAM) process was demonstrated at NAL by retrofitting a band saw. Using this laboratory machine, design parameters like the feed rate, speed of moving cathode, of electrolyte flow and the parameters for the power supply were generated. A prototype ECAAM was designed to use INTELK's 'FAGOR' CNC drive system. Detailed and assembly drawings were made of: (a) assembly layouts; (b) overall machine tool assembly; (c) band drive; (d) band guiding mechanism; and (e) CNC linear table/drive etc. Based on these drawings, an industry is fabricating the machine.

National trisonic aerodynamic facilities

A total of 707 blowdowns in the 1.2 m wind tunnel and 168 blowdowns in the 0.6m wind tunnel were carried out during the year. Some of these were on fighter aircraft models for force measurements and effect of add-on devices such as vortex plates, lateral stability at high angles of attack and effects of a pressure-based angle of attack sensor on the performance of air intakes; a jet trainer model to obtain its basic aerodynamic characteristics; a launch vehicle model with a provision to alter the alignment of boosters and fins to determine the rolling moment induced by such asymmetries; a missile model with different flare geometries for force measurements. A system using pressure sensitive paints for pressure distribution measurements on aerospace models was also successfully commissioned for the first time in the country in the 1.2m trisonic wind tunnel. Comparison of tests on a model coated with the Russian binary paint and the indigenously developed paint indicated excellent validation.

Information Centre for Aerospace Sclience and Technology (ICAST)

The center caters to the information requirements of the Indian aerospace community in particular and the engineering and technical personnel in general. ICAST also maintains the "AeroInfo", a WWW virtual library for aerospace science and technology, the first of its kind in the country and serves as a one-window information search facility for the entire aerospace community in the world, in general and in India in particular. ICAST's collections of books, journals and Technical reports from NASA, DLR, ONERA, NLR, ARL and UTIAS is unmatched.

1.1.2 HUMAN RESOURCE DEVELOPMENT

HRD programmes at NAL

During 2000-2001, 47 diploma holders, 112 graduates, 5 post-graduates and 7 ITI holders were trained under these programmes. Besides 119 of BE/MCA/M.Sc. students from Bangalore University and 436 students from other Universities did their project work at NAL. Two batches of 8 students from BITS, Pilani for B.Tech. also carried out their full time project work in different Divisions of NAL. Under the CPYLS 41 top students of State/CBSE/ICSE examinations along with their parents/teachers participated in the special two-day programme arranged at NAL.

1.1.3 RECOGNITION & AWARDS

CSIR Young Scientist Award in Physical Sciences	Dr. Harish Barshilia, NAL
Fellow, Indian National Academy of Engineering	Dr. M. Shivakumara Swamy, NAL
Sir C.V. Raman Award of Karnataka State Council of Science & Technology	Dr. R.M. Jha & Dr. Rakesh Mohan, NAL
Dr. Biren Roy Trust by the Aeronautical Society of India	Dr. S. Viswanath, NAL
Materials Research Society of India (MRSI) Medal	Dr. Sheela K. Ramasesha, NAL

1.2 BIOLOGICAL SCIENCES & TECHNOLOGY

1.2.1 SCIENCE, TECHNOLOGY & SERVICE

Association analysis of CAG repeats at the KCNN3 locus

The phenomenon of 'anticipation' is seen in some diseases caused by trinucleotide repeat expansions. CBT carried out 'association analysis' of CAG repeats at the KCNN3 locus in the Indian population with bipolar disorder and schizophrenia. CBT's analysis found no statistically significant evidence for the presence of an excess of longer alleles in the patient population, as compared to ethnically matched controls. However, an analysis of the difference of allele sizes revealed a significantly greater number of patients with schizophrenia having differences of allele sizes 0.5 when compared to normal controls. This finding is of functional significance as the KCNN3 protein is believed to act as a tetramer, and a large difference in allele sizes would result in an asymmetric molecule with a different number of glutamine residues in each monomer. A method for detection of human spinocerebellar atascia 2 gene variants has also been developed and a patent for it has been filed.

Molecular analysis of Friedreich's ataxia locus in the Indian population

Friedreich's ataxia (FRDA) is an autosomal recessive neurodegenerative disorder caused by the expansion of GAA repeats in the frataxin gene. All patients clinically diagnosed by CBT for Friedreich's ataxia were found to be homozygous for GAA repeat expansion. The GAA repeat in the normal population was in a bimodal distribution with 94% of alleles ranging from 7-16 repeats. The low frequency of large normal alleles (6%) could indicate that the prevalence of this disease in the Indian population was likely to be low.

Human genome diversity studies

Y chromosome and mitochondrial DNA (mtDNA) are transmitted uniparentally through father and mother, respectively and do not undergo any recombination. Hence, markers present on both are useful to trace the paternal and maternal lineages. CCMB was in the process of obtaining the genetic information on various castes and tribal populations to construct the evolutionary history. DNA samples of about 1000 individuals (male and female) from various castes and tribal populations, including primitive tribal populations of Andaman and Nicobar Island have been analysed. YAP analysis revealed the presence of Y-*Alu* insertion at the locus DYS271 in all the Onge

and Jarawa males. Among the main land populations, only 4 Kuruman possessed YAP+ chromosome, whereas the rest showed YAP negative. SNP based haplotype of Andamanese revealed that the Onges and Jarawas consist of the same haplotype (lineage), but the Great Andamanese and Nicobarese are falling in different haplotype. Analysis of Y-STRs revealed population specific haplotypes and some rare alleles. Amplification of intergenic region between COII and tRNA lysl showed deletion of 9bp in 6 individuals, who belong to Nicobarese (1), Rajput (2), Gond (1) and Bengalis (2). Unique event of 9 bp duplication at the same region was observed in one Rajput male. Analysis of hypervariable region I and II also revealed population specific haplotype.

Genomic structure analysis of Indian population

A study on genome diversity of Indian population has been undertaken by IICB in association with Saha Institute of Nuclear Physics and Indian Statistical Institute and mitochondrial DNA (mtDNA) profiles of 23 ethnic populations of India drawn from diverse cultural, linguistic and geographical backgrounds have been analyzed. It has been observed that there was extensive sharing of a small number of mtDNA haplotypes, reconstructed on the basis of restriction fragment length polymorphisms, among the populations. This indicated that Indian populations were founded by a small number of females, possibly arriving on one of the early waves of out-of-Africa migration of modern humans; ethnic differentiation occurred subsequently through demographic expansions and geographic dispersal. By examining the sharing of haplotypes between Indian and southeast Asian populations, the IICB study has provided evidence that southeast Asia was peopled by two waves of migration, one originated in India and the other in southern China.

Genotyping for angiotensin converting gene

CBT has developed a method for isolating Lutenizing Hormone (LH) from Bovine pituitary glands. Based on the principle of pseudoaffinity, the novel process replaces the use of a bio-molecule by an ordinary copper metal which has high protein binding capacity as a ligand. The process is cost effective and commercially viable.

Cloning and sequencing of rabies virus glycoprotein G-gene

Rabies genomic RNA of the street virus strain was extracted from purified virus. The integrity of RNA was checked by denaturing agarose gel electrophoresis. From the known nucleotide sequence of rabies virus genome forward and reverse primers specific for rabies virus glycoprotein G-gene were synthesized at CIMAP and were purified using oligonucleotide purification cartridges. The oligos used were 5'CTC TAG AGG AAA GAT GGT TCC TCA GGC TCT CCT G3' and 5'CGG ATC CAG TCC TCA CAG TCT GGT CTC 3'. They have specific restriction sites which were further used for cloning in appropriate vector. cDNA copy of RNA was synthesized by using reverse transcriptase enzyme and subjected to PCR amplification (RT-PCR). Intact

1.6kb fragment obtained was eluted from low melting agarose gel and used for directional cloning in Bluescript II SK+vector. The cloned fragment was sequenced in the automated DNA sequences (ABI Prism 377) and was confirmed to be the glycoprotein G-gene of the rabies virus. This gene showed 95% homology with the Marshall virus strain of rabies.

Genetic causes of male infertility

One out of six couples of Indian population are infertile due to various reasons. Although male infertility is found to be common all over the world, very little is known about the genetic etiology (micro and large deletion), particularly in Indian population. CCMB has undertaken a study on infertile males to establish the possible genetic causes of male infertility. During the period 90 infertile men were analysed for microdeletions on Y chromosome for the azoospermic factors AZFa, AZFb and AZFc. In the initial screening, microdeletions were found in a total of 12 individuals. Deletion at AZFc/DAZ region was found in all the 12 individuals. Of these, deletion was restricted to AZFc region in only three individuals whereas the remaining nine individuals showed deletions in AZFb also. None of them showed deletion at AZFa region. On STS walking on both proximal and distal regions of deletion in all 12 infertile males, they could precisely map the break point regions. Southern analysis using the probe 50f2, showed the deletion of C locus in all the 12 infertile males, who also showed deletion of AZFc region in STS analysis. Deletion of 50f2/E locus was found in nine individuals, who also showed deletion of AZFb region as revealed by STS walking. Southern analysis using 102(d) 2 showed the deletion of Yq heterochromatin in four individuals. The control study using 130 normal males showed no deletion in any of the azoospermic factors (AZFa, AZFb and AZFc). Southern analysis also did not show deletion of 102(d) 2, and 50f2. Sequence analysis at the deleted region revealed the presences of 191 kb tandem repeat of 125 bp and clusters of L1 (LINE) elements.

Molecular biology of *Leishmania donovani*

The DNA topoisomerases of Leishmania have been established at IICB as targets for various chemotherapeutic agents. The genes for type I and type II DNA topoisomerases have been cloned and sequenced. Both the enzymes are being used for screening molecules derived from various indigenous plants for their antileishmanial activities. It has been established that the flavonoids, luteolin and quercetin are potent antileishmanial agents that act by inducing topoisomerase II mediated kinetoplast DNA cleavage leading to apoptosis of cells. The gene encoding type II DNA topoisomerase from *Leishmania donovani* has been cloned, sequenced and expressed in bacteria. In view of the importance of both prokaryotic and eukaryotic DNA topoisomerase II as therapeutic targets, over expression and functional characterization of the gene should facilitate the screening and designing of drugs against this parasite.

Proteomic analysis of mycobacterial cell membrane

The bacterial plasma membrane is rich in protein content and considered as the site for several important enzymes, receptors and transporters. Immunogenecity of membrane proteins, specially the 'integral' ones, has been attributed to their hydrophobicity and lipid modification. These features make them attractive candidates for development as novel drug targets or subunit vaccines. The sequenced genome of *Mycobacterium tuberculosis* has predicted >700 'putative' membrane proteins though their location, expression patterns, and function remain mostly unexplored. CDRI has characterized the mycobacterial membrane proteins. In both BCG and *M. tuberculosis* H 37Rv the IMP pool was found to contain, besides many unidentified proteins, 3 of the known 'immunodominant' ones – the 38 and 19 kDa lipoproteins and 33/36kDa 'proline-rich' protein. The proteomic analysis of IMP of *M.tuberculosis H37Rv* has led to identification of some real integral membrane protein of the bacillus for the first time.

Regulation of gene expression in plants

NBRI undertook detailed computational analysis of plant gene database to identify conserved features in upstream regions of highly expressed plant genes. Appropriate software has been developed for such analysis and novel features in the architecture of plant genes were identified. A gene expression cassette, representing the conserved features was designed and synthesized chemically. The experimental reconstruction led to the development of very efficient plant gene expression vector. A number of patents have been filed on these developments.

Mycobacterial chaperone proteins

Efforts are on at IMT to carry out structural and functional studies on proteins derived from *Mycobacterium tuberculosis*, with the long term objective of utilizing them for drug design studies. For the structural work, the hsp 60 and hsp10 proteins have been worked out. These proteins are the homologues of well-characterized GroEL, GroES chaperonins from *E.coli*. Crystallizations of the protein in complex with divalent cations yielded several new crystal forms. Extensive sequence analysis has been carried out on protein folds similar to the GroES fold. The crucial isoniazid resistance related enzyme-alkylhydroperoxidase has now been characterized in biochemical details. The enzyme interestingly was decameric in nature unlike its homologues from gram negative bacteria.

Rapid estimation of polymer supported functional groups

A rapid method for the estimation of polymer supported functionalities under microwave irradiation has been developed by CBT. This uses a novel universal reagent,

S-(4,4'-dimethoxytrityl)-3-mercaptopropionic acid (DMPA) for the estimation of polymer supported hydroxyalkyl, aminoalkyl and mercaptoalkyl functionalities in the presence of triphenylphosphine-bromotrichloromethane (TPP-BTCM) as an oxidation-reduction coupling reagent. The loadings obtained on the supports following the proposed method were found to be comparable with those obtained with the standard, 4,4'-dimethoxytrityl chloride (DMTr-Cl) method. The usefulness of the method was demonstrated by monitoring the functionalization of polymer supports, suitable for solid phase peptide and oligonucleotide synthesis.

Biochemical basis of gastric hyperacidity and ulceration

The biochemical basis of gastric ulcer caused by stress, non-steroidal anti-inflammatory drugs and by *Helicobacter pylori* infection is not clearly understood. IICB has initiated a study to understand the molecular mechanism of gastric ulceration with emphasis on the plausible role of reactive oxygen species in the oxidative damage during ulceration. Also effort is on to identify some natural nontoxic antiulcer compounds which may find use to control gastric ulcer without any undesirable side effect. Melatonin, a pineal hormone having antioxidant activity has been detected in high concentration in the gastrointestinal tract, the significance of which is not yet known. It's possible antiulcer effect in experimental animal models has been worked out; interestingly melatonin can dose-dependently block stress indomethacin-induced gastric lessens showing around 90% inhibition at 60 mg/kg body weight. The melatonin is more effective than ranitidine but less effective than omeprazole. When compared to physiological antioxidant – antiulcer compounds it is superior to glutathione but is equipotent to α - tocopherol in exerting antiulcer effect.

Antimicrobial peptides

Synthetic antimicrobial peptides designed at CCMB have been shown to be active against clinical bacterial isolates, which are resistant to a large number of antibiotics. Analogs of indolicidin (an antimicrobial peptide present in bovine neutrophils which is also cytotoxic towards mammalian cells) with single tryptophan residues have been shown to be non-hemolytic while retaining its antimicrobial activity.

Prevention of drug resistance development in bacteria

Fluoroquinolones represent a major class of antibiotics used in the treatment of urinary tract infections, hospital acquired infections and drug resistant tuberculosis. However, pathogenic bacteria tend to develop resistance against this class of drugs due to mutations in the gene(s) for DNA gyrase enzyme, which limits the usefulness of this drug class. Studies at CIMAP have found plant derived semi-synthetic derivative of artemisinin, called α-arteether to be specifically inhibiting the growth of bacteria carrying mutations in the DNA gyrase enzyme A subunit. Consequently, a new drug

combination was developed, in which one component was α-arteether and the other nalidixic acid or any of the fluoroquinolones (comprising of ciprofloxacin, norfloxacin, levofloxacin, etc.). In this drug combination, quinolone resistant bacteria were inhibited by α-arteether and the arteether resistant cells were eliminated by quinolones themselves. Thus, the combination works through prevention of drug resistance emergence itself and hence enhances the effectivity of simpler quinolones against infections. A patent for use of this formulation has been filed internationally.

Use of a plant compound as fourth generation herbal antibiotic

Studies at CIMAP have established that *Escherichia coli* strains resistant against nalidixic acid, a broad-spectrum quinolone drug, due to mutations in the gyrA gene are sensitive to a compound obtained from a plant source. It is believed that this compound has the potential of an advanced generation antibiotic and can be used for the development of herbal antibiotic formulation with enhanced activity, particularly, against drug resistant bacteria. Its activity of inhibiting wild type and mutant DNA gyrase enzyme could be demonstrated *in vitro*. The compound showed substantial lethal action against multi-drug resistant and advanced generation drug resistant bacteria. An international patent has been filed on this finding.

Bioprospecting SOD from high altitude plants

IHBT has successfully isolated, for the first time, an autoclavable superoxide dismutase (SOD) catalyzing dismutation of speroxide radical from +80°C to sub-zero temperature from a plant of high altitude. The enzyme is autoclavable with no loss of activity rendering a germ free preparation and enabling smooth functioning in a temperature range of subzero to >50°C in resence of sodium chloride and detergents like SDS. It thus can be used for humans, animals and plants wherein the damage is mediated through the production of superoxide free radicals. In a living system generation of toxic oxygen or superoxide radical is inevitable. Under the situations of stresses and diseases, the generation of superoxide radical exceeds the scavenging capability thereby causing severe damage to the system. Therefore SOD is required to remove this toxic species of oxygen. Several medical operations require SOD. Plants require SOD to improve stress tolerance and better yields. Food industry requires to avoid spoilage in terms of alteration of taste, texture and increasing shelf life of the food products. In cosmetics SOD is required to be mixed with solutions, lotions, creams, oils, gels, and balms for extending the shelf life and maintaining the quality of the product.

Germplasm preservation through excised root culture

A breakthrough was made at NBRI in inducing differentiation of shoot buds and their development to proliferating shoots in segments taken from even 13 year old

excised root cultures of *Dalbergia latifolia*, the precious wood of commerce. Culture conditions, including nature (physical state) of the substratum, i.e., nutrient agar, liquid nutrient medium or borosilicate glass beads with added nutrient liquid medium were standardized for proliferation of root regenerated shoots. Along with increase in number of off shoots produced, the shoot tip necrosis was also contained on the borosilicate glass bead substratum with added liquid nutrient medium. The healthy shoots were being subjected to rooting to produce complete plantlets.

Cultivation technology for pyrethrum in north Indian plains

Chrysanthemum cinerariaefolium, commonly known as pyrethrum, is an economically important perennial crop grown to extract pyrethrins from its flowers. Pyrethrins have insecticidal properties and are localised mainly in the achenes (flower buds). The cultivation of pyrethrum is limited to the hilly areas of Kashmir and Tamil Nadu. CIMAP has developed agro-technology for cultivation of pyrethrum in other agroclimates of the country. The crop has been acclimatised for flowering under the subtropical climate of Central Uttar Pradesh. The profusely flowering selection Avadh suitable for plains has about 1.0% pyrethrins in its flowers which is at par with that obtained in the south Indian hills. Thus with the use of CIMAP agro-technologies,



Pyrethrum cultivation technology for north Indian plains

pyrethrum could now be successfully produced in the north Indian plains, which is so far being produced in the temperate region of the country.

Sambhav : A new menthol mint variety

CIMAP has developed a highly insect tolerant mint variety Sambhav of *Mentha arvensis*, using a novel biotechnological approach of *in vitro* manipulation. Sambhav has a unique and vigorous plant architecture, yielding higher amount of menthol per unit area. In 110 days, the canopy of Sambhav assumes a diameter of about 85 to 90 cm which is unmatched. This vigour leads to enhanced herbage yield of over 2 quintals per 100 sq. meter area with maintained high oil yield of parent variety Himalaya. The yield advantage is protected with the highly sought after genetic trait of very high insect tolerance. Under the natural infestation conditions of the insect *S. obliqua* and in the absence of insecticidal spray, Sambhav demonstrated conspicuous advantage of having merely 10% or less damage, compared to more than 50-60% in other mint varieties.



Menthol mint variety Sambhav

Frost resistant lemongrass variety

Lemongrass is long known to be prone to frost injuries often marked by the dark purple pigmentation of the leaves, especially when this crop is grown in foot hill areas (tarai). Selection breeding experiments in this direction identified a genotype with remarkable frost resistance and stay-green habit which is a variant from the open pollinated seed progeny of the existing high yielding variety Cauvery, earlier developed by CIMAP. It is a tetraploid (2n=4x=40). The plants have superiority over all the

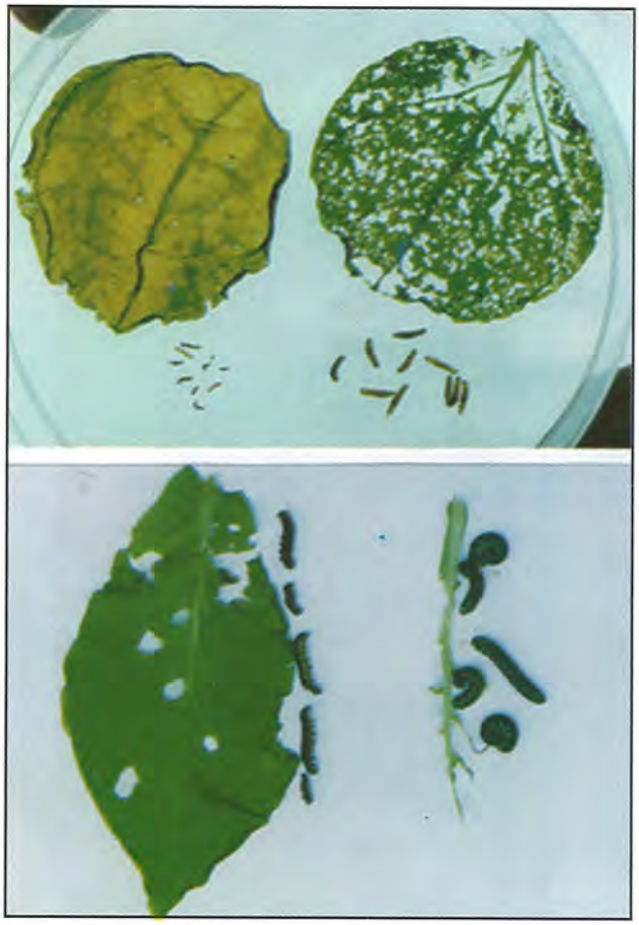


Frost resistant lemongrass variety developed by CIMAP

normal lemongrass varieties of diploid status (2n=2x=20) for growth habit and physiological fitness for withstanding the hostile environments of frosting during winter months and also high oil yield. The plants stay active in the field for more than five years and produce least stubble debris.

Transgenic tobacco

Transgenic plants of tobacco with the specially designed synthetic cry gene have been developed at NBRI. Evaluation of the novel cry protein design established its superiority over the earlier reported δ-endotoxins. Molecular analysis of the selected plants established accumulation of the protein at more than 0.5% of total leaf protein, substantiating functionally excellent designing of the gene. The strategically designed gene will be used for developing transgenic lines of medicinal plants, groundnut and castor under a collaborative programme. A gene of 1930 bp was also designed to encode 609 amino acid long Cry1Aa3 active toxin. The gene was modified for optimal expression in dicot plants using PC/Gene software.



Transgenic tobacco: Protection against *Spodoptera litura*

Gladiolus hybrids

IHBT has developed six superior gladiolus hybrids through conventional breeding as per the international standards of plant growth and flowering parameters. These hybrids have been selected and classified as per the specification systems of North American Gladiolus Council, U.S.A., and the Royal Horticultural Society, U.K and the colour description done as per the RHS colour chart.



Palampur princess Brick beauty

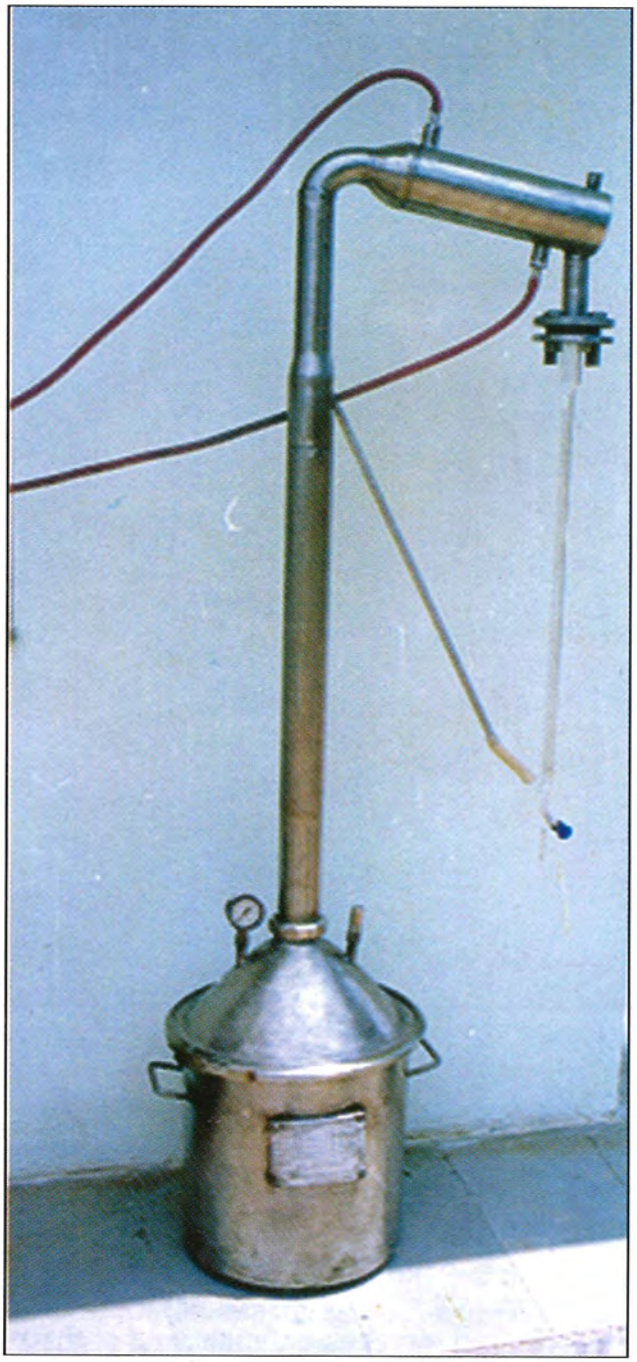
Gladiolus hybrids developed by IHBT

New Hippeastrum cultivar – Prakash

NBRI has developed an excellent hybrid of Hippeastrum christened Prakash through open pollinated seedling selections. The hybrid produces 1-2 spikes (51.0 cm tall) with 2-4 horizontal flowers during April. The flowers are large sized (18.0 cm across), flat faced, fully open, showy and are bicoloured, white and flushed with magenta red (53A/F-1) coloured streakes on inner side of the petals. The plant is evergreen and produces dark green foliage. The hybrid does not produce seeds but can be used freely as a male parent.

Mini distillation unit

A mini essential oil distillation apparatus useful to distill essential oils and hydrosols such as rose, ajowain, geranium, lavender etc. from fresh and dried plant material like leaves, flowers, roots and rhizomes has been developed at IHBT. The distillation



Mini distillation unit developed by IHBT

can be carried out by steam and as an option steam distillation can also be performed at atmospheric pressure. This unit can be heated on brick-clay furnace with small agro-waste, LPG cooking gas, electrically heated stove or kerosene/diesel burner etc., and requires minimum attention during handling. The unit is ideal for small and marginal farmers, aromotherapists and for demonstration purposes. Since the apparatus is made of stainless steel and glass, the essential oil distilled is of better quality than the oil distilled by glass Clevenger type apparatus used in the laboratory.

Distillation plants for aromatic oils

CIMAP has developed two specialised aromatic oil distillation plants for:

- Rose oil which is one of the most valuable perfumery compounds, used for the production of high quality premium perfumes. A low cost distillation plant based on a novel cohobation system for the extraction of the rose oil has been designed and developed which has higher distillation efficiency than the conventional units.
- Geranium oil which is one of the most valuable essential oils required by the Indian perfumery industry. Geranium herb, when distilled by the conventional



Improved distillation plants for aromatic oils

steam distillation system, yields low oil recovery of 0.1% as compared to 0.22% oil present in the herb. An improved, efficient low cost plant for geranium distillation which gives higher oil yield has been designed and developed. The improved plant design incorporates a packed stripping column, provision for generation of more steam through enhanced heating area and design improvements in furnace.

Modulation of winter dormancy in tea

An exclusive isozyme of superoxide dismutase (SOD), responsible for imparting low temperature tolerance in tea has been identified and purified at IHBT. Antibody was raised in rabbit against this enzyme with a view to clone the genes using antibody as a probe. cDNA was synthesized using MMLV reverse transiriptase in the presence of a bifunctional primer. After synthesizing the second strand, appropriate adaptor was ligated to generate a directional clone to be ligated into the vector. Cloned cDNA were packed in lamba phage. The isolated gene can modulate winter dormancy in plants like *Taxus*, kiwi, figs, strawberries, almonds, walnuts etc. for better utilization of land, manpower and machine.

New fingerprinting technique for natural product based drugs

A new fingerprinting technique based on HPLC-UV(Vis) Spectroscopy for natural product based drugs which can be barcoded has been patented by IICT in USA, European Union and other countries. The technique can be used for detection of adulteration, locational variation of active constituents of the plant materials, conjugation & activity levels and number of chemical constituents in order of their polarity. The technique is amenable to computerisation and integration with HPLC-UV spectroscopic hardware.

Herbal composition for asthma problems

IICB has developed a herbal composition for treating asthma. The composition to be taken orally in liquid or tablet form helps in improving quality of life of an asthmatic patient. It relieves from all chronic and old bronchial problems, blocks the key enzymatic step for the synthesis of leukotriene (asthma inducer) and shows no hepatotoxicity unlike currently used drugs. The composition has been licensed for commercial production.

Production of artemisinin derivatives

Dihydroartemisinin (DHA) and arteether are important derivatives obtained from artemisinin having useful antimalarial properties. Synthesis of DHA and arteether from artemisinin is a delicate process involving close control over the process conditions. The bench scale process for conversion of artemisinin to DHA has been successfully scaled up at CIMAP from 100 g/batch to 1500 g/batch on pilot plant.

The pilot plant has been specially designed to achieve and maintain the required reaction conditions of temperature, agitation, pH and vacuum at optimum levels to obtain high product purity.

Herbal/Plant extract concentrator

The existing practice of concentrating herbal/plant extract is through rota-evaporation, which is very time consuming and often affects structure of biomolecules due to higher temperature of operation thus inhibiting proper concentration of plant extracts. CSMCRI has developed a Polysulfone-Polyamide (PS-PA) thin film composite membrane based plant extract concentrator, which overcomes this limitation as it operates at ambient temperature, and the process of dewatering is much faster. The membrane removes only water from the extracts. An added advantage is that unlike a rotavapor this equipment avoids formation of froth thereby eliminating the need to remove the same and enhancing efficiency. The equipment would thus be very handy for studies involving large number of aqueous plant extracts.



CSMCRI developed plant extract concentrator

Novel herbal products

NBRI has developed a variety of novel herbal products, namely:

- **Herbal beer** – an innovative herbal drink with entirely different composition from that of currently available beer, however having diuretic and cooling effects of beer. In addition it is not only health protective/ promotive but also designed to have properties of antioxidants, immuno enhancers, hepatoprotection etc. The self generated alcohol in the composition with some ayurvedic ingredients provides instant energy and fights fatigue;
- **Herbal soft drink** – based on nutraceutical concept of indigenous system of medicine, purely natural and useful in inflammation, renal diseases and nephritic syndrome are designed to increase physical strength;
- **Nutraceuticals** – custom made nutritional supplements of certain specific herbal ingredients for pregnant women, nursing mothers and infants and school going children which take care of both the physical and intellectual growth and development at critical developmental stages of the child;
- **Herbal functional lipstick** – having a unique range of safe natural colours (15 shades) blended with specific combinations of essential oils to give different kinds of functional effects, such as, anti-depressant, brain stimulating, mood lifting, thought inducing etc.
- **Herbal holi colours** – non toxic mainly from flowers, fruit rinds, bark and leaves etc. of many commonly available plants both in the form of dry powders and in tablets form for wet application.

Beverages and brewing products from tea and natural flora

The making and brewing of wines from fruits and vegetables is an ancient art and as old as human civilization. However, the wine industries around the world are based on commercially grown fruits mostly grapes and apples and rarely on wild edible fruits which endow greater food attributes in terms of chemical constituents and other health values. IHBT has developed technology for preparing fine table dry and sweet wines of white and red variety from natural products like, tea and fruits both wild and cultivated. The nutritive herbal health product thus formed is self-preservative and with aging maturation, its valuation goes up.

Tea manufacturing in non-traditional areas in Himachal Pradesh

IHBT has imparted training on tea-manufacturing to the small growers in the non-traditional tea areas of Himachal Pradesh. The young tea trial plot owners in districts Kangra and Chamba having holding size of about one acre and who cannot afford to establish tea factories of their own, were given technology to process tea leaves manually. This technology will encourage other small farmers of the area for tea cultivation as they will be able to see themselves and get convinced with the manual

processing technique which assures marketable tea product for ready consumption in the local market. In rural areas, where wheat, paddy and other fruit crops are becoming non-remunerative, diversification to tea cultivation will increase their returns and hence pave way for economical upliftment.

Process for natural yellow dye

A novel process has been developed by IHBT to convert a banned toxic plant compound (oil) into a safe natural yellow dye. The developed product forms basis for a series of yellow coloured dyes some of which are presently not available commercially. These have wide application in flavouring and some of them are also known for their biological activities like anticancer properties etc. Thus a value added product is formed from otherwise a banned oil, affecting India and other Asian countries like Pakistan, Bangladesh, Nepal, Japan and China, where the plant grows in abundance but does not fetch economic returns owing to its toxicity.

Cytotoxicity evaluation of plastic biomedical devices

ITRC has evaluated cytotoxicity potential of the plastic biomedical devices (intravenous transfusions sets, dextrose normal saline bottles, ringer lactate bottles and Ryle's tubes) by investigating growth inhibition; percent survival, mitotic index and colony forming ability (DFA) in L929, an adherent type mouse fibroblast cell line. The leachates from all types of biomedical devices evaluated exhibited reduction in the growth and survival of the cell line. The leachates of some biomedical devices were more toxic as compared to other biomedical devices screened. The growth inhibition assay described hitherto has been found to be more sensitive and suitable for toxicity evaluation of biomedical devices.

Japanese encephalitis virus infection

Japanese encephalitis remains one of the major health hazards of epidemic proportions with significant mortality rate in India and South East Asia. Studies at ITRC have established protective role of cytokine mediated induction of inducible nitric oxide synthase (iNOS) during Japanese encephalitis virus (JEV) infection. This has been further evidenced by the observation that pretreatment of JEV infected mice with L-NMMA an inhibitor of NO, enhanced the mortality while administration on SNP, an NO donor, to JEV infected mice, significantly enhanced the MST with the reversal in JEV induced anemia. These observations indicated that iNOS may serve as a key mediator in host immune response to infection. These studies will help in understanding the mechanisms of natural immunity in controlling the initial stages of JEV infection. Efforts are underway to develop therapeutic agent in providing protection against JEV infection.

Induced structural change analysis in biosystems

Metal induced conformational changes in mitrogenic Achatinin H binding to carbohydrate ligands have been analysed at CLRI and their significance related in immunology. Chromium induced abnormalities in biomolecules and *in vitro* cell proliferation has been investigated and the role of chromium as a possible redox state of carcinogenicity has been emphasized. Metal induced molecular assemblies in collagen and bovine serum albumin and changes in the calcium transport pathways in cell expression have been demonstrated. The role of water and solvation in aggregation and organization of DNA has been evaluated using the application of density functional theory.

Clot specific streptokinase

A laboratory-scale process for the preparation of clot-specific streptokinase has been standardized at IMT. The process entails the culturing of *E. coli* carrying appropriate plasmid DNAs encoding for either recombinant natural-type streptokinase or its different engineered constructs, followed by cell-lysis refolding of polypeptides to their biologically active states, and their isolation at approx. 85-95% purity by chromatographic means. The clot-specific proteins display plasminogen activation property as well as two additional properties viz. time-delayed kinetics of plasminogen activation *in vitro* as demonstrated by chromogenic peptide and fibrin clot dissolution assays, together with an ability to bind with human fibrin under conditions wherein natural, i.e. unengineered streptokinase does not bind to fibrin. Several drug companies have shown interest in commercial exploitation of this process.

Colchicine and colchicoside production

RRL, Jm. has developed an improvised and economical process for the production of colchicine and colchicoside (colchicine glucosides). Colchicine and colchicoside find use in therapy, agriculture and industry. It is claimed, that the latter is 100 times less toxic than the former. In international market these alkaloids enjoy great demand but are very expensive due to prevailing process of their production. It requires only indigenously available raw materials

Improved process for the isolation of aescin

Aescin is an active ingredient of many pharmaceutical propriety products. It is widely used both topically and orally for the treatment of peripheral vascular diseases, mostly related to altered capillary permeability and resistance. The prevalent methods of its production have the disadvantage of being multistep processes, which increases the cost of production, and makes them non-ecofriendly. RRL, Jm. has developed an

improvised process for the extraction of aescin from plant material. The novelty of the process is that the extraction is done using single organic solvent; which is less time consuming and gives higher yields of aescin. The process is thus not only cost effective but eco-friendly as well.

Metal gluconates

RRL, Jm. has developed a single step fermentation process to directly convert starch hydrolysate into gluconates of Calcium, Sodium and Barium. The process has the advantage over the existing processes of being green and cost effective. The gluconate salts are used in neutraceuticals, human and veterinary pharmaceuticals, food and cosmetic industry. The process has been licensed and demonstrated to a company which is in the process of installing a plant of 1500 TPA capacity. The main users of the process would be biotech companies dealing in neutraceuticals, pharmaceuticals, food and cosmetics.

Liquid seaweed fertilizer (L.S.F.)

CSMCRI has developed a Liquid Seaweed Fertilizer, which is a bio-fertilizer prepared from brown seaweed Sargassum. It is eco-friendly and cost effective. While application of L.S.F. as foliar spray increased crop production from 10 to 30 percent, its application to soil as fertilizer in Jojoba plantation initially enhanced 46 percent growth of seedlings besides 56 percent increase in number of branches. L.S.F. contains trace elements and ingredients like alginates which improve the moisture retaining capacity of soil.

Unique collagens

The information on various kinds of mammalian and avian collagens is mostly available. However little is known about invertebrate and fish collagens that abound in nature. Collagen polymorphism in marine invertebrate tissues has been studied at CLRI with focus on structure-function relationship and molecular evolution. A unique type of collagen has been isolated from rare tissues of crustaceans and molluscs. The uniqueness of the collagen has been established by comparisons to other known forms. It lacks periodicity in fibrillar structure. The molecular characteristics of these unique type of collagens is being studied.

Knowledge network on medicinal plants

A Knowledge Network on Medicinal Plants and National Centre for Training and Technology Transfer has been established at RRL, Jm. as an extension of GOI-UNDP Umbrella Programme. A database on techno-commercial aspects of herbal drugs is under creation which would be launched on a database driven website. The website

www.herbalnet.org has already been hosted on a US based server. This database will be connected to other databases within and outside the country so that the center can serve as a National Clearing House of information on Herbal Drugs. Other activities of the Centre would be preparation of a Pharmacopial monographs, encouraging collaborative work on plant based drugs to fill in the existing gaps and developing human resource so that the herbal and medicinal plant wealth is harnessed in a fruitful manner.

National facility for virus diagnosis & quality control

IHBT setup has been recognized as national facility for viral diagnoses and quality control of tissue culture raised plants. This facility will help floriculture industry in general and to the exporter and importers of planting materials in particular for diagnoses of virus.

IMT national facilities

The national facilities created at IMT continued to generate interest in users around the country and elsewhere. The facility on Microbial Type Culture Collection & Gene Bank (MTCC) has been upgraded to act as India's only International Depository Authority. It would accept all those microbial cultures which are a subject matter of a patent application. Likewise, the Biochemical Engineering Research & Process Development Centre and Bioinformatics Centre on Protein Engineering continued to cater to the needs of industry, academic institutions and research organisations.

Identification of differentially expressed *Vibrio cholerae* genes

The importance of differentially expressed host genes following *V. cholerae* infection has been emphasized by IICB from several lines of evidences. Two different approaches have been taken to identify *in vivo* expressed genes following *V. cholerae* infection into host. Using RAP-PCR strategy, five differentially expressed transcripts were identified and subsequently cloned and sequenced. One clone containing the murE gene when transformed into cholerae 569B grew better than that of wild type *V. cholerae* 569B strain in ligated rabbit ileal loops. In an alternative approach DNA macrochip containing 92 recombinant cosmids covering 90% of *V. cholerae* 569B genome were hybridized with cDNAs synthesized from *in vivo* and *in vitro* grown *V. cholerae* total RNA. The results demonstrated that the global transcription profile approach might be a powerful method for identification of differentially expressed transcripts under *in vivo* conditions.

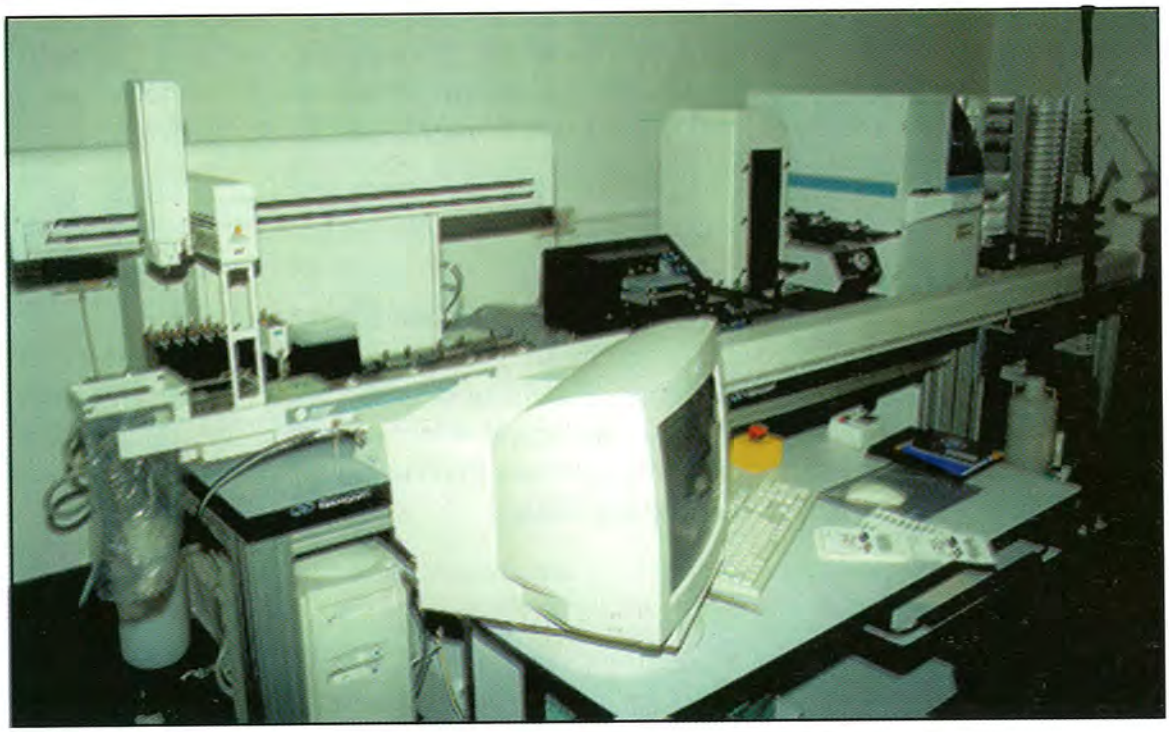
Automated DNA sequencing facility at RRL, Jm.

An automated DNA sequencer 310 prism form has been made operational at RRL, Jm. This would have wide range applications from molecular identification of microbes, plants and animals to medical sciences and forensics. The facility would be open for use by other R&D organizations in the state of J&K.

High throughput screening facility

A High Throughput Screening (HTS) system has been installed at CDRI with the objective to speed up the pace of drug discovery as it enables rapid *in vitro* screening of drug candidates so as to select the promising ones for further development. The speed and precision is attained through computer assisted robotics. Programmed assay procedures are allowed to run continuously and results are read using online microplate readers. Various HTS assays developed within the Institute have been selected for first phase of screening of synthetic / natural products, namely:

- Anti-tuberculosis activity - Inhibition of mycobacterial cell viability by monitoring the activity of a reporter gene (luciferase) or reduction of a fluorescent indicator dye (Alamar Blue);
- Anti-malarial activity - Inhibition of plasmodial cell viability by monitoring the activity of parasite lactate dehydrogenase as a reporter enzyme;
- Anti-leishmanial activity - Inhibition of *Leishmania promastigote* viability by monitoring reduction of an indicator dye (MTT/Alamar Blue);
- Anti-thrombin activity - Inhibition of thrombin activity by monitoring the rate of substrate consumption calorimetrically.



High throughput screening facility at CDRI

1.2.2 HUMAN RESOURCE DEVELOPMENT

Special training

- A special training programme of six months for the students from Birla Institute of Technology and Science (BITS), Pilani, in two batches was organized by CDRI in the area of modern biotechnology.
- The M.Sc. (Microbiology) students from Barkatullah University, Bhopal were provided training at CDRI for six months on specialized techniques and instrumentation in the field of microbiology.
- IMT conducted summer training programme for M.Sc. (Biotechnology) students from Universities of Pune, Panjab, Punjabi, Guru Nanak Dev, Birla Balika Vidyapeeth, Devi Ahilya, Calicut, I.I.T., Kharagpur, Jawaharlal Nehru, Nagarjuna, Delhi, etc. A total of 31 students underwent this training.
- CBT continued providing summer training in various aspects of biotechnology for a period ranging from 6 to 8 weeks. In 2000-2001, 35 students underwent training and had exposure to various scientific techniques, handling of sophisticated equipments and preparation of scientific project reports.

Workshop on respiratory allergy

A workshop on "respiratory allergy: diagnosis and management was organised by CBT in collaboration with VP Chest Institute. Twenty medical post graduates from different parts of the country were trained during the workshop in various aspects of allergy diagnosis, treatment and related aerobiology. The faculty was from various Institutes in the field.

Workshop on bioinformatics

CIMAP organized a workshop in introduction to bioinformatics in Medicinal and Aromatic Plants which was co-sponsored by DBT. A number of special lectures were arranged for the benefit of participants. Hands-on sessions were conducted for the trainees on internet, web resources on biological sciences and on and off-line database searching. Twenty participants from various R&D institutes situated in northern part of the country participated in the workshop.

Workshops on biodiversity

CIMAP conducted three workshops on biodiversity covering the essential theoretical and practical concepts on *ex-situ* conservation, inventorization and characterization of genetic resources. The participants were exposed to modern molecular techniques like, DNA fingerprinting, including RAPD and AFLP mapping and exposure to gene sequencing, while adopting holistic biosystematics approach of

diversity assessment. In all, 53 participants from various parts of country including the states of Maharashtra, Goa, Tamil Nadu, Karnataka, Gujarat, Punjab, Meghalaya, Madhya Pradesh, Jammu & Kashmir, Haryana, Bihar and Uttar Pradesh, participated in these workshops.

National seminar on the frontiers of R&D in medicinal plants

CIMAP conducted a national seminar on the frontiers of Research and Development in medicinal plants. The aim was to initiate debate on past-present-future scenario in mediculture and related industry. Over 300 research scientists, engineers, personnel from user industry, entrepreneurs and students attended the seminar. Sixty oral and 188 poster presentations were made in 10 technical sessions during the three day period of seminar. A number of suggestions/recommendations for sustainable R&D and business in the field of medicinal and aromatic plants and their related products were made during the seminar.

IPR-Literacy challenges for the Millennium

A three day workshop on IPR literacy was organised at IHBT. Seventeen participants attended the programme including scientists, Govt. officials and entrepreneurs. Participants gained hands-on experience on patent search, filing procedures and details of National and International agencies dealing with patent and patent laws.

Course on heavy metal poisoning

A three day training course on heavy metal poisoning with special reference to mercury was organized at ITRC. The course was sponsored by NTPC and attended by fifteen General Managers of NTPC and trainees including CMOs, Asst. CMOs and specialists in NTPC hospitals at Shaktinagar, Vidyant Nagar, Obra, Talcher & Dadri. The objective of the course was to create awareness and impart skill amongst doctors of NTPC on identification, diagnosis and management of sickness related to heavy metals exposure.

Workshop on application of IT in biosciences

A two day workshop on applications of information technology in biosciences was organized by RRL, Jm. It was 1st workshop of its kind in J&K where the application of information technology in biological sciences was emphasized during the two days activity. For the participants both theoretical and hands on sessions were arranged. Topics such as introduction to computers, operating systems, scientific documentation, sharing of resources, e.mail & internet welcoming, bibliographic, patent search and CD ROM based databases were demonstrated and taught.

1.2.3 RECOGNITION & AWARDS

G.P. Talwar Young Scientist Award by Indian Immunology Society	Dr. (Mrs.) Babita Madan, CBT
National Biosciences Award for Career Development by Department of Biotechnology Fellow, National Academy of Sciences	Dr. Madhu Dikshit, CDRI
Fellow, Indian Academy of Neuroscience	Dr. Ram Raghubir, CDRI
Fellow, National Academy of Sciences	Dr. Vinod Bhakuni, CDRI
CSIR Young Scientist Award in Biological Sciences	Dr. A.K. Shasany, CIMAP
Gold Medal by Phosphate and Potash Institute of Canada and Fertiliser Association of India	Dr. D.D. Patra, CIMAP
Young Scientist Award by the National Academy of Agricultural Sciences (NAAS)	Dr.(Mrs.) N.S. Sangwan, CIMAP
All India Biotechnology Association Award	Dr S.P.S. Khanuja, CIMAP
FIE Foundation Award	Dr. P.S. Ahuja, IHBT
National Bioscience Award for Career Development by DBT	Dr. K. P. Mohanakumar, IICB
Fellow, Indian National Science Academy	Dr. Ranajit K. Banerjee, IICB
National Bioscience Award	Dr. A.K. Bachhawat, IMT
Fellow, Indian Academy of Sciences, Bangalore	Dr. Girish Sahni, IMT
CSIR Young Scientists Award in Biological Sciences	Dr. P. Guptasarma, IMT
Fellow, National Academy of Sciences	Dr. P.K. Chakraborti, IMT
Novo Nordisk Life Science Research Award	Dr. R.K. Jain, IMT
J.W. Harshberger Medal by Society of Ethnobotanists	Dr P. Pushpangadan, NBRI

1.3 CHEMICAL SCIENCES & TECHNOLOGY

1.3.1 SCIENCE, TECHNOLOGY & SERVICE

Dichloro fluoro benzene

IICT has developed an ecofriendly process for 2,4 Dichloro fluoro benzene (2,4DCFB), an important intermediate for anti bacterials like Norfloxacin, Ciprofloxacin etc., using dichloro benzenes available as by-product from M/s HOCL's plant. The process is non-hazardous and replaces the expensive solvents by cheaper solvent such as dimethylformamide.

Esfenvalerate

A novel process for esfenvalerate, a broad spectrum synthetic pyrethroid having high specificity and low dosage, has been developed by IICT. The process obtains fenvaleric acid by kinetic resolution and the undesirable isomer is fully recycled. The resolved acid is converted into diastereomeric mixture from which Esfenvalerate is obtained by induced dynamic kinetic resolution.

Pyrazinamide

IICT jointly with SPIC R&D Centre, is developing technology for pyrazinamide, an anti TB drug. The first step of synthesis of methyl pyrazine (2 MP) in the multi-tubular catalytic reactor has been completed and work is in progress for conversion of methyl pyrazine in a single tube reactor to cyanopyrazine and finally to pyrazinamide. The catalysts for the two steps reaction have also been developed by the institute.

Perfluoro octanoic acid

CECRI has developed an electrochemical process for the production of perfluoro octanoic acid by the electrochemical perfluoronation of octanoyl chloride. The chemical process involves the electrolysis of octanoyl chloride, anhydrous hydrofluoric acid medium using nickel anodes and cathodes. Perfluoro octanoic acid and perfluoro cyclic ethers formed as dense fluid during electrolysis were separated from the AHF electrolyte and processed to separate the two products.

Phenanthrene

CFRI has developed a process for purification of crude phenanthrene and converting the refined product to 9:10 phenanthrenequinone through liquid phase

oxidation. The basic engineering for 100kg/day capacity plant has also been worked out in association with an engineering company.

Homobrassinolide

Brassinosteroids are a class of steroidal phytohormone with high growth promoting and antistress activity. Although several chemical routes are reported for the synthesis of Homobrassinolide (HBR), they were not suitable for large scale commercial production. NCL has developed a cost effective, ecofriendly process for the synthesis of (22S, 23S)- HBR under a project sponsored by a private firm. The technology has been manufactured and marketed.

Synthesis of block copolymers of Poly Ethylene Glycol (PEG)

Redox polymerization is a unique technique in which an oxidizing agent and reducing agent react resulting in the formation of an active free radical capable of initiating vinyl polymerization. For the first time it has been established at CLRI that the use of a polymeric reducing agent along with an oxidizing agent for vinyl polymerization results in the formation of a block copolymer. The reducing agents studied are PEG of several molecular weights (from 200 to 20000) with Ce^{4+} as an oxidizing agent. The salient feature of this particular redox system is its homogeneity in aqueous medium and its applicability at low temperatures, which avoids side reactions such as homopolymer formation. The block copolymerization kinetics has been studied with respect to different monomers like acrylonitrile, acrylamide, methyl methacrylate, etc. as well as by changing the oxidant (Ce^{4+}/Mn^{3+}etc.).

An improved process for removal of Ca^{++} ion impurity in brine

The production of industrial grade salt requires removal of Ca^{++} ion impurity from the brine. The conventional methods are not fully successful to remove ca^{++} ions. As an alternate root use of marine cyanobacterial strains was explored at CSMCRI. Their survival in the subsoil brine with variable density was checked. Simultaneously ca^{++} uptake was also estimated. Nearly 80% of the ca^{++} was removed from the brine under laboratory scale experiments. Lyngbya being the euryhaline species was taken for the field experiments at the experimental salt farm. A PCT/US-patent has been filed on the removal of calcium from brine by cyanobacteria.

Industrial grade salt from subsoil brine

Subsoil brine differs from sea brines with respect to the chemical composition and salt recovered from subsoil brines are not suitable for industrial consumption. Based on solubility data of the systems NaCl – $CaSO_4$ – $CaCl_2$ – H_2O and NaCl – $CaSO_4$ – H_2O, an eco-friendly route is worked out at CSMCRI for the recovery of industrial grade salt from subsoil brines integrating the process with recovery of marine chemicals like magnesium and potassium compounds, bromine etc. The

process would be beneficial to those salt manufacturers who produce salt from subsoil brine, an added benefit being that the process would in the ultimate be integrated to recovery of marine chemicals economically.

Spiral elements for large scale desalination plant

CSMCRI has developed 20 cm x 1 meter spiral elements based on Thin Film Composite (TFC) PS - PA membrane, which would accommodate 39 sq. meter membrane area and produce about 20,000 liters/day water output under standard test condition and remove 95% of salt. The 20 cm diameter spiral module is currently the world standard in RO plants. The indigenous development would enable to manufacture large-scale desalination plants at a lower capital cost and as a result the

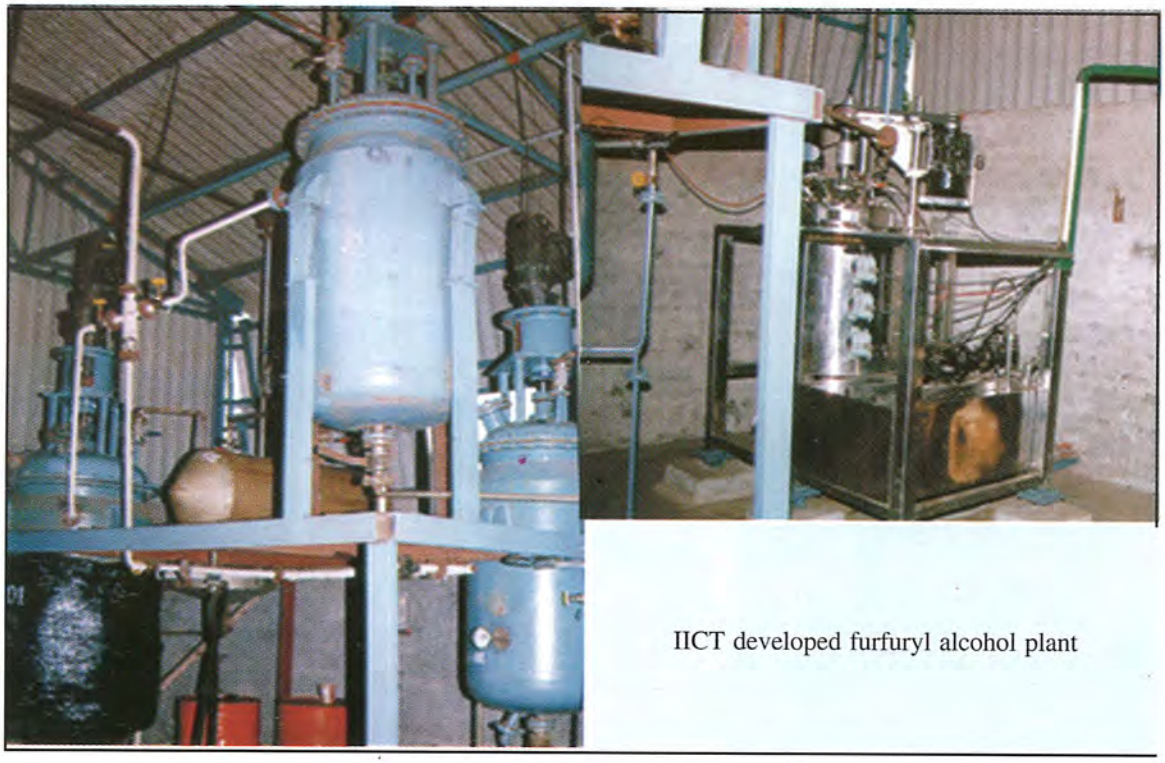


Large scale desalination plant: Spiral elements

cost of water will also be significantly reduced. Besides being useful in providing potable water it would also be useful in treating waste water in refineries, fertiliser and power plants ensuring water reuse concurrently, reducing to a large extent thus the effluent problem.

Furfuryl alcohol plant

A 75 tonnes/annum furfuryl alcohol plant based on the technology developed by IICT has been commissioned in Andhra Pradesh. The project was partially funded by Department of Scientific & Industrial Research (DSIR) under its PATSER scheme.



IICT developed furfuryl alcohol plant

Gas cracker plant

A 5kg/hr gas cracker pilot plant for cracking alkanes to alkenes is being set up at GAIL's Petrochemical Complex at Pata jointly by IICT, GAIL & IIT, Kanpur. The pilot plant will be compact, skid-mounted unit and will have a built-in flexibility to operate over a range of capacities around the design value.

Unified theory of tanning

CLRI has proposed a new unified molecular theory for tanning. The thermal stabilisation of collagen by variety of molecules has been traced to the long range

ordering introduced by the tanning species by correlations of variation in D-periodicity in Atomic Force Micrographs of tanned specimen with increase in shrinkage temperature. The stabilisation of collagen against collagenase on reaction with tanning substances has been assessed by correlating quantitatively the ratio of collagenase promoted hydrolysis of tanned collagen fibres with the inhibitor for bacterial collagenase. This theory is being extended to a variety of inorganic and organic substances.

Formaldehyde and chromium free leathers

Technologies currently employed for tanning skins/hides are highly eco-sensitive. It has been shown that Cr (III) is toxic to the human system at higher dosage levels. A chromium-iron based tanning salt has been developed by CLRI where partial replacement of chromium with iron has been achieved. The product exhibits 90% exhaustion of Cr as well as iron. A high-exhaust (>90%) chrome syntan without formaldehyde has also been developed for direct application on delimed pelts.

Special NMR probe

Application of NMR imaging technique to map the topological distribution of fluorocarbon derivatives in matrices has been worked out at CLRI. A special NMR



Special NMR probe developed by CLRI

probe has been designed for fluorine imaging and feasibility of fluorine imaging in leather matrix has been established. It is now possible using the tools and techniques developed to detect both hydrocarbon and fluorine signals in the same matrix. Two-dimensional and three-dimensional imaging systems for fluorine signals for both quantitative and topological assays are being developed for wider applications.

ECONCL process

NCL has developed a batch/ continuous process designated as ECONCL to treat the black liquor effluent from pulp & paper mills. The presence of lignin and other organics in the effluent contributes to the high level of COD (Chemical Oxygen Demand) and makes it difficult for the aqueous effluent to be disposed off. In the ECONCL process due to chemical and physical changes lignin and other organics from the aqueous stream gets precipitated. The precipitate settles at the bottom leaving the clarified water above, which is suitable for reuse in the plant or can be disposed in the surface water. The lignin fraction is removed and filtered to reduce its water content and can be used for various purposes. In a single step the process reduces colour, BOD, COD and total dissolved solids thereby reducing total pollution load and saving energy upto 50% in subsequent anti oxidation in the treatment plant. The process is covered by patents.

Ultrafiltration membrane for water purification

NCL has developed and patented an ultrafiltration membrane having pores small enough to exclude virus and bacteria to yet porous to water at 0.5 bars pressure. The membrane has 5-log reduction for virus and 7-log reduction for bacteria. The flat sheet membrane is wound in the form of a spiral module and fixed in a housing which can be used individually or coupled together to a prefilteration device, for filtering water. The life of the membrane has been found to be more than three years under normal conditions. Several UF devices, for use in diverse field conditions were made and supplied for trials. The technology for the membrane device has been licensed to a Pune based firm.

Arsenic monitor

NCL has developed an arsenic monitor kit for measuring arsenic in drinking water. The kit is highly sensitive as it can detect arsenic at concentration levels of 5 PPB. It does not use any electric source and thus can be used even at village level. Cost of the kit is less than Rs. 5000 and cost of a test is Rs. 20 only. NCL was fabricating 100 kits for use by the villagers of West Bengal. NCL has also developed field test kits for monitoring nitrates and fluorides in drinking water.

1.3.2 HUMAN RESOURCE DEVELOPMENT

HRD efforts by CLRI

CLRI continued to provide vocational and professional training programmes for the benefit of the leather industry. Seventy persons received diplomas and certificates. These training programmes are conducted at CLRI and the regional centers of CLRI at Ahmedabad, Calcutta, Jalandhar and Kanpur. Strengthening of under graduate and postgraduate degree courses in leather technology and footwear science and engineering continued. About 50 students graduated from Anna University through educational programmes.

IICT-BITS (Pilani) integrated MS in chemical technology

This off campus course offers Master's degree in chemical technology from BITS, Pilani for sponsored employees of IICT with a minimum of two year's work experience and possessing B.Sc. and Diploma in Engineering. The six semester programme covers subjects like engineering, mathematics, thermodynamics, transport phenomena, computer-aided analysis and design, catalysis and reaction engineering, etc.

Instrumental methods of analysis for forensic scientists

IICT and the National Institute of Criminology & Forensic Science (NICFS), New Delhi jointly conducted two-weeks Workshop-cum-Training on 'Instrumental Methods of Analysis for Forensic Scientists'. About twenty three scientists from State & Central forensic science laboratories participated in the programme.

Safety management courses

IICT organised a Risk based Safety Management course for Bharat Petrochemicals Ltd. (BPCL), POL Depot Managers. Twenty five participants from the company attended the course.

Training programmes on polyolefines

Four training programmes on polyolefins were conducted by NCL for Reliance Industries Ltd. Two programmes were meant for junior management cadre and two programmes for the middle management of the company.

1.3.3 RECOGNITION & AWARDS

Shanti Swarup Bhatnagar Medal by Indian National Science Academy for excellence in Science Shanti Swarup Bhatnagar Award by Indian Science Congress Association for excellence in Science JEPPIAR Educational Trust Award for excellence in Science and Technology	Dr. R.A.Mashelkar,DG, CSIR
Indian Institute of Mineral Engineers(IIME) Coal Beneficiation Award for outstanding professional contribution in Coal Preparation	Dr. Kalyan Sen, CFRI
CSIR Technology Award for design development of a novel eco-friendly, energy efficient and cost effective device (oven) for production of soft coke	Dr. S.K. Hazra & Sri Partha Sengupta, CFRI
Padmashri Fellow, Third World Academy of Sciences MRSI Medal	Dr T. Ramasami , CLRI
TANSA 2000 Award for Chemical Sciences	Dr R. Jayakumar, CLRI
Fellow, National Academy of Sciences	Dr T .K. Chakraborty, IICT
START Young Scientist Award(2000), USA	Dr U. C. Kulshrestha, IICT
CRSI Medal of the Chemical Research Society of India, Bangalore	Dr. Anil Kumar, NCL
FICCI Award for Excellence in Physical Sciences including Mathematics	Dr. B.D.Kulkarni, NCL
Padmashri	Dr. Paul Ratnasamy, NCL
Shanti Swarup Bhatnagar Prize in Chemical Sciences	Dr. S.Pal, NCL
IUPAC Prize for Young Chemists	Dr. (Ms.) V.Patil, NCL

1.4 EARTH SCIENCES & TECHNOLOGY

1.4.1 SCIENCE, TECHNOLOGY & SERVICE

Microtectonics in the neotectonically active part of the Himalayan wedge

C-MMACS has initiated work towards the understanding of kinematics of deformation in the Himalayan mountain belt from the point of view of critical wedge theory which is emerging as the contemporary paradigm for understanding deformation in sedimentary wedges that evolve into a mountain belt in compressive regimes like the Himalayas. Work on the Darjiling-Sikkim-Tibet (DaSiT) Himalayan wedge has revealed that the middle part of the wedge is the location for neotectonic deformation as evident from earthquake hypocenter data and geologic evidence. Deformation microstructures developed in the quartz grains from the sandstone in the South Kalijhora Thrust (SKT) sheet close to the Main Boundary Thrust indicate that dislocation creep was due to the dominant quasi-plastic deformation mechanism here (Fig. 3). These quasi-plastic deformation microstructures were overprinted by microfracturing, related to elastico-frictional deformation, throughout the SKT sheet. These observations point to the fact that the deformation mechanisms changed fairly rapidly (in geological time-scales) from quasi-plastic during the initial stages of propagation of the SKT to elastico-frictional deformation mechanism at approximately the same depth. This points to fairly rapid erosion in the DaSiT wedge over the SKT sheet which probably led to the subsequent duplex formation in the middle part of the wedge.

Equivalent continuum analysis of jointed rocks

A simple practical method has been developed at C-MMACS to characterize the strength and stiffness of jointed rock masses. This method utilizes the concept of an equivalent continuum where the joints in the rock mass are taken into account through joint factors. The approach has been validated against experimental results for jointed rock masses with different joint fabrics and joint orientations and also with the results from explicit modeling of joints using FEM.

The model has been applied to calculate the deformation around a large power station cavern in shyloite rock at 200 m depth. The results match the observations to reasonable accuracies.

Acoustic emission monitoring

NGRI has developed a rapid multi-channel data collection system to elucidate the dynamics of fault nucleation using AE hypocenters under conditions of constant stress

(creep) loading. These conditions yield a better approximation to low strain rate condition in the Earth and allow for both quasi-static and dynamic crack growth to occur. This would assist in a better understanding of earthquakes and rock bursts.

Seismic structure of the Indian shield

For the first time stratigraphy of the upper mantle, beneath the central Indian shield has been investigated by NGRI using teleseismic 'P' waves recorded at Geoscope station at Hyderabad. Based on the analysis of P waves 297 earthquakes, a seismic discontinuity at 90km depth was inferred. The two principal mantle discontinuities inferred at depths of 406 and 659 km, which were close to the global average.

Lithospheric flexure associated with Krishna - Godavari basin

Gravity anomalies constrained by seismic data have been used by NGRI to examine the long term mechanical properties of the lithosphere beneath the Krishna – Godavari basin. The results suggested that the lithosphere, which was weak, during the early rifting stage has gained strength during sedimentation. The on shore dipping double gravity anomaly at the margin reflected a weak rifted continental lithosphere abutting a strong oceanic lithosphere. Comparison with the results of the similar investigations for the Bengal basin in the north and Cauvery basin in the south suggested increasing strength for the lithosphere from north to south.

Gas hydrates

NGRI under the on-going programme on gas hydrates processed more than 2000 line km of multichannel seismic data of Kerala-Konkan offshore region using advanced processing software and interpreted the seismic section to demarcate potential gas hydrate bearing zones.

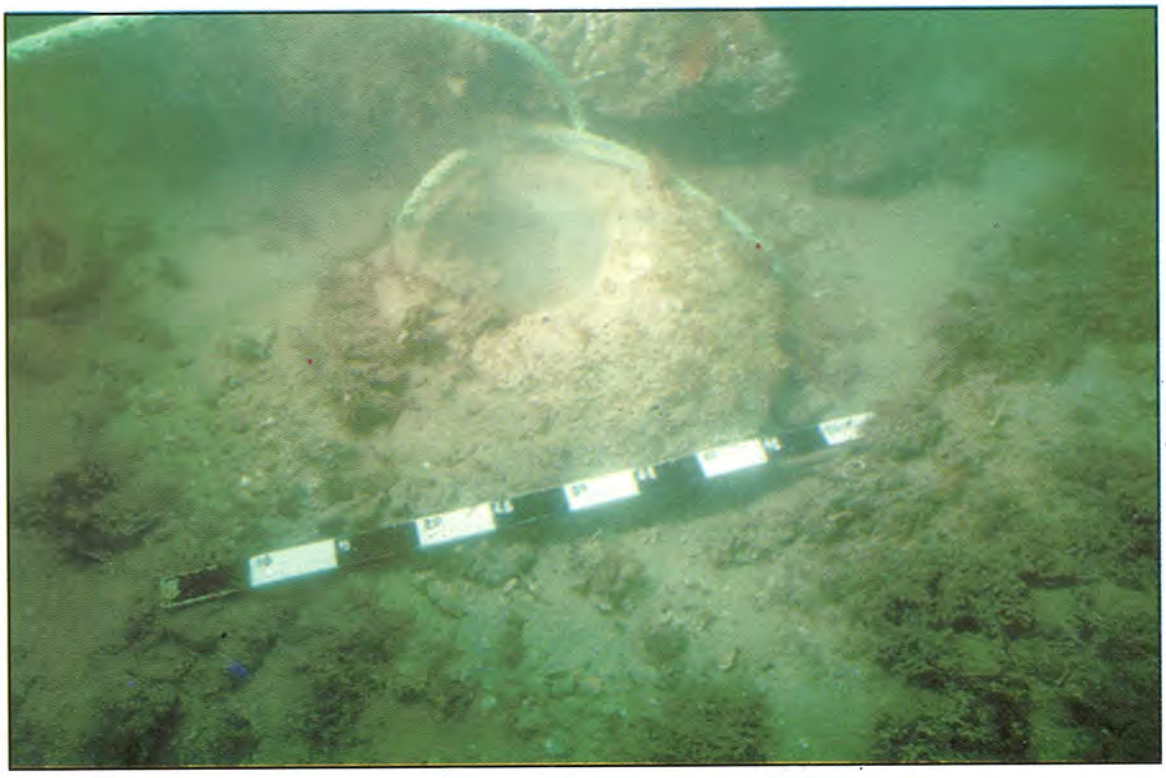
Influence of river Indus on shelf sedimentation

Based upon the analysis of about 10,000 line km of echosounding and bathymetric data and variations in mass accumulation rate along the NW continental margin of India (between Kori creek and Mumbai), it has been deduced by NIO that in the northern region (in the vicinity of the river Indus) the shelf-break occurs at a shallower depth. The gradient of the continental slope is also reduced from the northern region to the southern region. Rate of sedimentation is observed to be higher in the northern area which reduces southwards. From the above results it may be deduced that the main source of terrigenous detritus along the NW continental slope is from the Himalayan river Indus, with negligible supply from the peninsular rivers, particularly

on the outer-shelf/upper-slope regions of the southern area between Daman and Mumbai. Evidently, this leads to the piling up of the sediments on the slope, narrowing its width, fills the shelf, and also buries the physiographic features. High terrigenous supply is also found to induce the mass/gravity transfer due to piling and re-suspension of sediments on the shelf edge. Based upon the gradient of the slope, its width, and occurrence of exposed physiographic features, the areas which are under the intense influence of Indus sedimentation have been schematically demarcated.

Marine archaeological exploration in bet Dwarka

Archaeological explorations in Bet Dwarka by NIO revealed a circular lead ingot and an amphora pottery along with triangular and prismatic stone anchors at a water depth of 6 m opposite to the present day jetty. Intact bowl, and other early historic potsherds were found opposite to Khuda Dost Dargah at 4 - 6 m water depth. The amphora and the circular lead ingot of this type are reported for the first time from Indian waters. At Somnath, more than 20 single holed stone objects, triangular and prismatic stone anchors were noticed at 6-12 m water depth on the north-western side of present Somnath temple.



Objects found in marine archaeological exploration in Bet Dwarka

Modeling the Gulf of Kachchh

The Gulf of Kachchh is a semi-enclosed embayment where the tidal forcing play a dominant role in driving the waters. Also, the open ocean waters of the Arabian sea across the western boundary interact with the Gulf significantly. A 2-dimensional hydrodynamical model has been developed by NIO to simulate the tides and currents in the Gulf. Several runs of the model have been carried out to test its efficacy in reproducing tides and currents in the computational domain. The model is validated by comparing the simulated currents with the measured currents off Vadinar, Sikka and Mundra. The results showed good agreement between the measured and simulated tides and currents. The circulation showed a net transport towards Kandla along the northern rim of the gulf with a tendency to re-circulate, forming a clockwise circulation. On the contrary, the particles dropped in the central and western half of the Gulf, showed a net movement towards north, and then towards west along the northern rim of the Gulf, forming an anti-clockwise circulation. The western part of Gulf showed an inflow off Okha (southern Gulf) and outward flow off Chachhi (northern Gulf), forming a cyclonic circulation in the open boundary. The residual circulation also revealed the presence of several eddies in the Gulf.

Phosphatic nodules

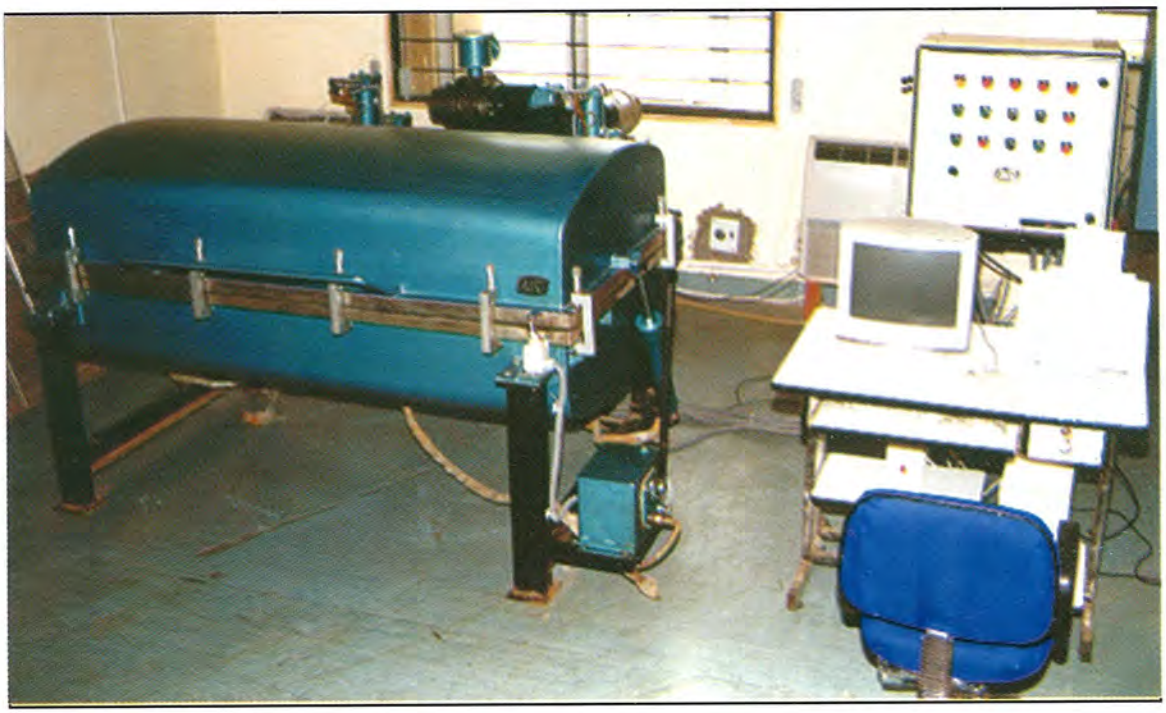
A sediment core collected from a bathymetric high off Goa on the western continental margin of India has yielded phosphatic nodules at various subsurface depths. The nodules are <1-5 cm in size, have carbonate flourapatite (CFA) as a single authigenic mineral phase, are free of detrital inclusions and have very high P_2O_5 content (30%). In addition, soft and hard phosphatic nodules have also been recovered by NIO from the eastern continental margin of India.

Study on phosphorites

Detailed investigations conducted by NIO on the quaternary phosphorites recovered from the continent margin off Chennai have indicated that these were laminated phosphatized microbial mats consisting of mechanically deposited elastic particles or of molds. SEM studies revealed that the laminated phosphate matrix is made up of thin sheets of tightly packed apatite globules, densely packed intertwined microfilaments. Cell-like structures resembling coccoid cyanobacteria or their botryoidal aggregates are common. Carbonate fluorapatite (CFA), low-magnesium and high-magnesium calcite are the major minerals. The microbial mats were most probably formed on the outer shelf during conditions of low sea level in which the microbial processes played a major role in direct phosphatisation of the mats. Detailed investigations on two types of high-grade Pleistocene phosphorites recovered from the western margin of India indicate that these were also comprised of hard, grey nodule composed of CFA and calcite as major minerals.

Automatic mechanical load tester for PV modules

NPL developed automatic mechanical load tester for PV modules has been set up at Solar Energy Centre (SEC), Gwai Pahari. PV modules were tested at simulated wind snow ice loads under static and dynamic load conditions.



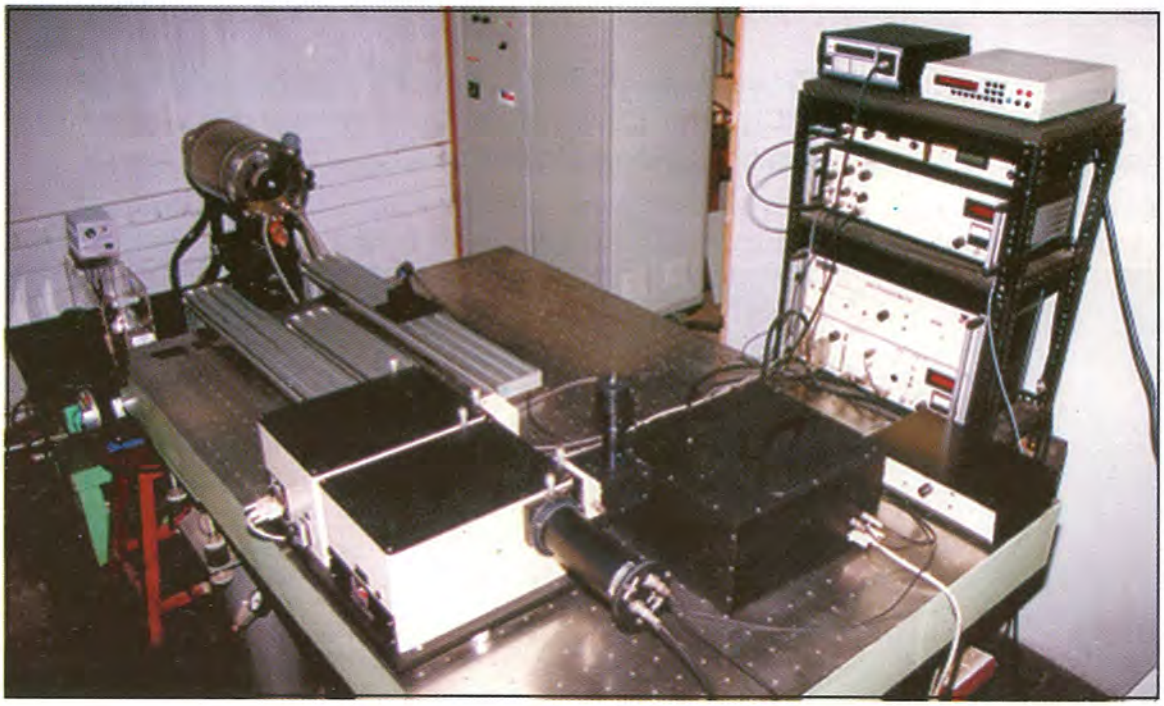
NPL developed automatic mechanical load tester for PV modules

Free air carbondioxide enrichment facility (Mid-FACE)

NPL has developed a medium-size Free Air Carbondioxide Enrichment Facility (Mid-FACE) for simulating the emission of carbondioxide gas in the atmosphere over an open field. This has been made available for use to agricultural scientific community of South Asia.

Primary standard of radiance

The primary standard of radiance, the black body source is being installed at NPL. With this facility becoming operational, NPL will be ranked amongst the few laboratories in the world which possess such a precise, highly stable, high temperature source. This source can be used as a primary standard of radiance for pyrometry and in the optical, ultraviolet and infrared spectral regions.



Primary standard of radiance

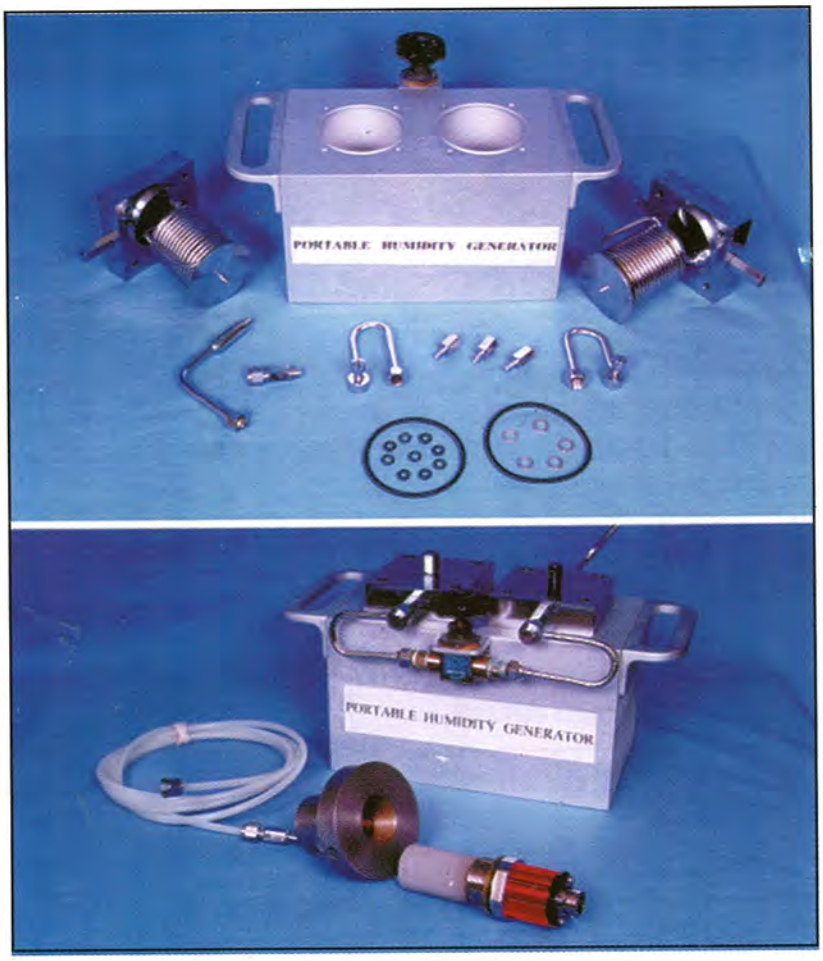
Portable relative humidity generator

A portable relative humidity generator based on two-pressure principle has been developed at NPL. Presently RH (at ambient temperature) in the range of 10-95% can be generated. Efforts are being made to incorporate temperature control so that RH at an elevated temperature can be generated. This has enabled providing of calibration services for hygrometers (RH range 10-95%).

1.4.2 HUMAN RESOURCE DEVELOPMENT

Programmes conducted by CMRI

- Five-day course on electrical maintenance procedure for explosion proof and flame proof equipment, statutory requirements thereof and prevention of oil fire;
- Course on mine environment, safety and health;
- Four-day executive development programme on stability analysis and ground control for underground coal mines;
- Executive training programme on recent advancement in underground climatic engineering, pressure balancing and cryogenic technology to improve ventilation and safety in mines; and



Portable Relative Humidity (Rh) generator

- Workshop on review of existing mining and environmental policies, legislations, standards and mechanisms for monitoring compliance.

Basin modelling course

A contact course on basin modelling was organised under SERC programme of the Department of Science and Technology (DST) at C-MMACS. The course was open to post-graduate students, researchers and teachers with a background in earth sciences. Eleven participants were selected for the course and they represented universities, research institutions and government organisations. This course brought out the applications of mathematics in basin modelling and exploration for natural resources such as oil, gas, groundwater etc.

International Training Course on ocean remote sensing

A 3-day International Training course on Ocean Remote Sensing was organised by NIO prior to the Pacific Ocean Remote Sensing Conference (PORSEC). The

training course was aimed at equipping Indian Ocean rim countries to build up capabilities to utilise the vast potential and opportunity of ocean remote sensing in ocean color, microwave remote sensing and high resolution data utility for coastal studies. In all 28 trainees participated out of which 7 were foreign participants from Vietnam, Indonesia, Mauritius and Iran.

Mass spectrometry workshop

The ninth workshop on Mass Spectrometry was conducted at NIO during 12-16 December. The workshop was jointly organized by NIO and Indian Society for Mass Spectrometry (ISMAS), Mumbai. It was attended by 150 specialists from India and overseas and covered different areas of application of mass spectrometery in food, agriculture and defence.

1.4.3 RECOGNITION & AWARDS

IMMA Excellence Award	Prof. D. D. Misra, CMRI
Mining Engineering Design Award	Dr. S. N. Maity, CMRI
Shri Hari Om Ashram Medal of PRL	Dr. Anil Kumar, NGRI
National Mineral Award, Mineral Society of India	Dr. H.C. Tiwari, NGRI
INSA Young Scientist Award UP Council of Science & Technology Young Scientist Award	Dr. V.M. Tiwari, NGRI
Krishnan Gold Medal	Dr. Y.V.B. Sarma, NIO

1.5 ENGINEERING SCIENCES & TECHNOLOGY

1.5.1 SCIENCE, TECHNOLOGY & SERVICE

Silicon micromachining technology

Anisotropic etching characteristics of silicon have been extensively used for realizing a variety of micorstructures for different applications. Aqueous alkaline etchants show preferential etching in certain orientations. A three component etchant based on KOH, water and 2-propanol was employed by CEERI to fabricate deep microchannels long and deep microchannels with smooth side walls and bottoms in (110)-oriented silicon wafers. These microchannels can be used as heat sink for the realization of high power laser sources but, such channels could also be used in many other applications areas as well.

Seismic data recorder and analyser

CSIO has developed a state-of-the-art intelligent seismic data recorder and analyser along with user friendly software for signal processing and seismic signal analysis. The seismic signal analysis software helps the user to detect quickly various parameters of the seismic event. The signal analysis software has also been found suitable for study of vibration and in site selection of buildings.

Glow discharge lamp – atomic emission spectrometer

CSIO has developed a glow discharge lamp atomic emission spectrometer that has a large linear calibration curve, minimum background and matrix effect, surface and depth profile analysis capabilities alongwith analytical capabilities of determining traces, in conducting and non-conducting samples. The development has the potential to convert direct reading spectrometer which may otherwise become obsolete to be retro when fitted with the glow discharge lamp and enhance their capabilities.

Snow data acquisition system

Management of snow avalanche disaster requires study of various snow parameters like snow temperature at various layers, snow depth, snow pressure, strain, ambient temperature etc. Among all these, the temperature measurement at various layers of snow is very important. Because the sudden change of temperature at various layers of snow helps in prediction of snow avalanche. CSIO has developed a low power



Snow data acquisition system developed by CSIO

consuming, portable, stand alone 28 channel data acquisition system for snow temperature profiling.

Portable stack opacity monitor

A portable stack, opacity monitor has been developed at CSIO. It is a low cost, high volume, electro-optical instrument, which can be used for monitoring pollution emanating from stacks & chimneys. The smoke opacity is measured in percentage as per ISO-14000. The instrument is based on the principle of attenuation of collimated beam of light emanating from a halogen lamp. It is calibrated by standard neutral density filter and measures the smoke opacity from 0 to 100%.

Trace moisture analyzer

An instrument, trace moisture analyzer for detection of moisture in the range of 0-1000 ppm based on micro and nano porous alumina sensors fabricated by tape casting and solgel technique respectively has been developed at CGCRI. The detection of gaseous moisture in ppm level is very important in industries dealing with gases particularly specialty gases. The measurement of moisture in gases in glove boxes as well as in industrial environment involving high quality welding, nuclear reactors, food packaging, pharmaceuticals, laser marking, submarine periscope purging etc.



Semi-automatic pick & place machine

are some of the important areas of application of trace moisture analyzer. The trace moisture meters currently in use are imported around the cost of Rs. 2.10 lakh per unit. CGCRI developed microporous sensors have significant advantage in performance compared to the conventional alumina sensor prepared by hyper thin film process. They possess high sensitivity, temperature stability and excellent long term stability. They can be operated without amplification, are not affected by electrical noise, require minimal signal conditioning and can be easily cleaned by organic solvent after long use. The cost of an indigenous moisture meter using such a sensor is estimated to be around Rs. 0.5 lakh.

Semi-automatic pick & place machine

CSIO has developed a semi-automatic pick and place machine (SAPP) for Fine Pitch and Standard Surface Mount Devices (SMDs). It is a low cost, high precision, vision guided, computer controlled electromechanical machine, has an assembly speed of upto 600 components per hour.

Tea-leaf plucking machine

IHBT in collaboration with CMERI has developed a tea-leaf plucking machine. The machine employs a scheme where the plucked leaves are collected in a collection



Tea leaf plucking machine developed by IHBT and CMERI

bag with the help of an integrated blower. It uses an air-cooled, 2 stroke 40.6 cc petrol engine capable of developing 2 HP at 7200 rpm and a cutter bar length of 1200 mm, these together generate a harvesting capacity of 1 hectare/day. Most of the parts of this light-weight, robust and durable machine have been made out of aluminium and can be carried by two persons along the hill slope.

5 MW S-band pulsed klystron

The design and development of Klystron/ RF power of 5.0 MW and average power of 10 kW operating in S-band) has been made at CEERI for the first time in the country. This involves design and development of parts/sub-assemblies and development of complex technologies. The operating beam power is 130 kV x 95 A, first lab prototype has been tested upto beam voltage of 100 kV with stable peak RF power of 3.5 MW.

Helix TWTs

Design was carried out by CEERI for the helix slow-wave structure and 4-stage depressed collector to achieve overall efficiency in Space Traveling Wave Tube (TWT). These TWTs would be used for satellite transponders as high power amplifier. The complete design of parts with dimensional details was handed over to BEL for its fabrication.



60 Hp tractor developed by CMERI

60 HP tractor

Development of agricultural machinery to suit the indigenous needs and conditions has been a continuing activity of CMERI. It has now designed a 35 HP tractor upgradable to 60 HP with features suited to Indian farm terrain and local implements. The knowhow has been licensed to a firm in Punjab.

Construction plaster

CBRI has developed an improved construction plaster by blending hemihydrate, anhydrite (II) and soluble anhydrite in different proportions. This gives a compressive strength of 15-17 Mpa. It could be used in both type of plastering i.e. finish coat and base coat. It gives highly glossy surface and replaces "neeru" used over coarse plastering. The construction plaster can be blended with exfoliated vermiculite or perlite aggregates for making lightweight thermal insulative plasters. It is envisaged that the use of this type of plaster will consume large quantities of waste phospho and fluorogypsum.

Fibre reinforced composite shuttering

Fibre reinforced composite sheets have been developed by CBRI for use as an alternative material for wood and plywood shuttering. FRP had demonstrated their

superiority over wood and its derivatives such as plywood, hard/chip wood etc. in such a way that they are ready for immediate use and do not require a finishing process, thereby reducing the cost of labour at site. They are lightweight, smooth, corrosion resistant, water-proof, easy to release and are expected to have more reuse cycles.

Utilization of marble dust in production of building bricks & blocks

A huge quantity of marble slurry waste is produced in processing of marble blocks for making slabs and tiles. This marble waste in powder form (marble dust) causes serious problem of health hazards and environmental pollution. CBRI has developed building bricks and blocks from the marble dust. CBRI developed CBRICK Machine and block making machine have been utilized for the casting of bricks and blocks.

Seismic design of reinforced concrete framed buildings

A knowledgebase seismic design software incorporating guidelines on: assuring the symmetry of mass and stiffness distribution; avoiding hinge formation at junctions and columns; providing energy absorption capacity, and avoiding structural discontinuity etc. developed at SERC has been tested and validated. The software was advantageously used in evaluating the safety of buildings in Ahmedabad after the recent earthquake.

Behaviour of RC beam column joints under cyclic load reversals

SERC, Madras conducted studies under a project sponsored by Board of Research in Nuclear Sciences to establish a database on the behaviour, strength and ductility of existing reinforced concrete beam-column connections used in Nuclear Power Plant (NPP) structures.

Coating system for high strength steel

CECRI has developed a coating system for application over high strength steel for protection against aggressive environment especially marine environment. The main problem tackled was the adhesion of the coating to the substrate material as the surface profile of the material was to be kept at very low value. An integrated system was developed which could give excellent adhesion to the basis metal without affecting any of the properties of the material.

Galvanized and zinc based alloy coated reinforcing bars

A systematic performance evaluation has been carried out by CECRI for the galvanized rebars with and without chromate treatment in tropical marine environment. This elaborate study utilized various electrochemical techniques such as potential time studies, electrochemical impedance spectroscopy, linear polarization

and gravimetric method. The performance was evaluated under dynamic loading conditions using cantilever model slabs inter cracked condition. The effect of galvanizing on the rebar was compared with the uncoated rebars in different exposure conditions, namely laboratory, marine and marine cum industrial environment.

Teaching package on structural steel design

A teaching package on structural steel design, to improve the knowledge of competence of civil engineers and teaching faculty of engineering colleges, was developed by SERC, Madras in collaboration with IIT, Chennai and Anna University, Chennai. The project was sponsored by Institute for Steel Development and Growth (INSDAG), Kolkata.

Passive control method for structures subjected to seismic loads

Passive energy dissipaters, may be economical and efficient in reducing the dynamic response of a given structure to seismic excitation. Viscoelastic (rubber based) and elastoplastic (metal based) types of passive energy dissipaters have been developed at SERC.

Pradhan Mantri Gram Sarak Yojana

The Prime Minister launched a nationwide Gram Sarak Yojana programme. The objective of the programme is to provide all weather road connectivity to all rural habitations with a population of more than 500 people by the year 2007. In this endeavour the Ministry of Rural Development, Govt. of India, has designated CRRI as the Principal Technical Agency for providing technical guidance to all the States and Union Territories of India. Design and specification of rural roads in diverse locations and the associated, training of field engineers and implementation and monitoring of the various phases of the programme are to be overseen by CRRI. CRRI organised a series of workshops on Rural Road Connectivity at Chennai, Kolkata and Guwahati with the active participation of various state level and regional level institutions. Various Universities and IITs, Regional Engineering Colleges and State Engineering Research Cells were identified for networking purpose. In the first existence standard formats have been developed for preparation of packages for the construction of rural roads connecting rural habitations with population of 1000 and for preparation of master plan of rural road network at the block level.

Pavement component layers properties

CRRI has developed a numerical scheme and a software package using FORTRAN 77 for determination of stresses, strains and displacements at any point in a multi-layered road system for a given surface load. Good comparison of the surface displacements given by the model and the experimental results obtained with Falling Weight Deflectometer (FWD) was obtained.

Traffic simulation model for Indian roads

CRRI has developed a traffic simulation model incorporating all types of roads and vehicles available in India. The model incorporates operating speeds, level of service, highway capacity and safety condition of the proposed roads and enables determination of the optimal road geometrics. The model has been validated using extensive field data collected from all the terrains of the country.

Traffic and transportation studies of Amravati

CRRI has carried out traffic and transportation studies of Amravati city to identify the current problems of traffic and to project the future needs of transportation. In the first phase, short term solutions for improving the traffic operations on the existing road system have been worked out. For the second phase, various surveys were conducted to analyse the travel needs of the residents. On the basis of data collected, travel simulation models are being developed to predict the travel needs and plan for the requisite transport system.

Software for design and maintenance of flexible pavements

CRRI has developed a software for design and maintenance of flexible pavements, both for new construction and for existing pavements. For existing pavements structural adequacy is checked and overlay provided if found inadequate as per guidelines of IRC-81, 1981, for new pavement the thickness is found using IRC 37, 2000.

Disaster knowledge network

Under GOI, UNDP umbrella programme, a 'Natural Disaster Network' which is a network of networks has been established at CRRI. The network will facilitate an interactive, simultaneous dialogue with all the players, major and minor both with in country and outside dealing with natural disaster.

1.5.2 HUMAN RESOURCE DEVELOPMENT

Training programmes by CRRI

CRRI organised various customised training programmes at various locations in the country at the request of user agencies:

- Quality improvement programme for the laboratory technicians of Contractors and supervision consultants engaged in NHAI project in North-South and East-West corridors;
- Training programme on traffic management for the personnel of Delhi traffic police;

- Design, construction and quality control of flexible pavements with special reference to rural roads for the engineers of Deptt. of Rural Development of Govt. of M.P., Bhopal;
- Materials, design, construction and quality control for flexible pavements including road drainage in high rainfall hilly region for engineers of Mizoram PWD, Aizawl;
- Materials, design, construction, quality control for flexible pavements and bridge works for engineers of Assam PWD, Guwahati;
- Highway design and management (HDM-4) for the engineers of Ministry of Communication, Royal Govt. of Bhutan, Bhutan, New Delhi;
- Preparation of master plan for rural roads, Nagaon, Assam;
- Materials, design, construction, quality control for flexible pavements for the engineers of Mizoram PWD, Aizawl; and
- For the engineers of Border Roads Organisation, Silchar.

Training programme on evolving an environmental vision

NEERI organised one day training programme on evolving an environmental vision for small scale industries with the support of Small Industries Development Bank of India. The training course was attended by more than 75 participants and 25 invitees from industrial, educational and marketing sectors.

1.5.3 RECOGNITION & AWARDS

Fellow, Indian National Academy of Engineers (INAE)	Prof. P.K.Sikdar, CRRI
CSIR Technology Shield (Engineering) for Engineering of Structures for Mitigating Damage due to Cyclones	Dr(s). T.V.S.R. Appa Rao, R. Narayanan, N. Lakshmanan, Venkateswarlu and S/Shri J. Shanmugasundaram & N.V. Raman, SERC, M

1.6 FOOD SCIENCE & TECHNOLOGY

1.6.1 SCIENCE, TECHNOLOGY & SERVICE

Acoustic enhancement of transmembrane flux

Acoustic field is employed for the enhancement of transmembrane diffusion of solute generally for drugs across skin. However no reports are available of the application of this principle for the enhancement of solvent flux in food sector. CFTRI established that enhancement of solute diffusion across membrane is due to the dependency of solute diffusion coefficient on process parameters like temperature and fluid flow; and the enhancement in solvent flux is based on the turbulence created in the boundary layer adjacent to the membrane, which in turn enhances the flux. This was demonstrated clearly by carrying out the experiments with concentrated non-Newtonian liquids. It gave insight into a new mechanism that occur in membrane process in presence of an acoustic field. The efforts may lead to development of strategies to tackle problem of low fluxes in membrane processes.

Enhanced phase demixing by microwave field

Aqueous phases demix slowly during aqueous two-phase extraction due to their close physical properties. There exists a need for development of a process for the enhancement of demixing rates so that expensive centrifuges can be replaced. CFTRI has applied microwave field for the aqueous two-phase dispersions and found that demixing rates are enhanced considerably. This method offers an simple alternate process that can be made continuous so that an efficient recycle reactor can be designed. It gives insight into the demixing process by throwing light on the relative contribution of the two processes, namely droplet coalescence and retardation of droplets by continuous phase.

Wheat flour fortification

A sizeable percentage of Indian population is malnourished. Fortification of staple food like wheat flour with vitamins and minerals is most effective tool to combat malnutrition problem. One third of the wheat produced in the country is consumed in the form of staple traditional foods after processing of wheat into '*atta*' in small plate mill '*chakkis*', CFTRI has developed for the first time a process to fortify the wheat flour at small scale *chakki* level. Separate nutrient pre-mixes containing iron, calcium and B-vitamins for different wheat products have been developed. Process of flour fortification ensures uniform delivery of nutrients into milled products. Different

traditional and bakery products like bread, biscuit and *chapati* prepared from fortified flour have been found highly acceptable. The fortified milled products have storage stability of minimum four months.

Speciality biscuits

In the country over 50% of the population particularly above 40 years suffer from several diet related diseases. Low fat and high fibre food products are helpful in such disorders and are thus in demand. Most of information on 'Health Bakery Products' is patented abroad. CFTRI is endeavouring to generate knowledgebase in this specialized area. Studies have been conducted to develop high dietary fibre and low fat biscuits. Biscuits thus developed using additives contained as high as 20% of bran flour and as low as 7% fat. The product has all the necessary quality attributes.

Mini dhal mill – Out reach to Indian rural areas

Mini dhal mill developed by CFTRI has the uniqueness of having three operations in a single unit i.e. dehulling of pulses, aspiration of husk and separation of dhal, run



CFTRI developed mini dhal mill

by 1 HP single phase motor. It is an efficient replacement for traditional pulse milling units like chakkies, plate mills or hullers used for similar purpose. The mini dhal mill has changed the pulse milling activity in rural sector by giving better recovery of good quality dhal (75-78%) and fillip to custom milling practices. The mini dhal mill is suitable for efficient dehulling of bold pulses like tur, bengal gram, peas, etc. The quality of dhal is comparable to that from large scale dhal mills. Thirty-five manufacturers have obtained fabrication license from CFTRI and more than 400 pulse producing farmers are using this mill. The development of the unit has triggered pulse processing activity in rural areas as many schemes are declared by the Directorate of Agriculture, Ministry of Agriculture and Co-operation and by the respective State Governments for propagation of mini dhal mills in the rural areas. It has also been selected for country wide propagation under UNDP project and over 200 machines have been distributed.

Bitterless protein hydrolysate from soy flour

Hydrolysis of legumes or flour converts long chain proteins of higher molecular weight into peptides of low molecular weight which have better digestibility. CFTRI has developed a new process for production of bitterless protein hydrolysate from soy flour. It utilizes a by-product which was otherwise discarded as a waste in other existing processes. The process has been scaled up for commercial utilization.

Natural food colour from Monascus sp.

Microbes are increasingly recognized as a natural source of food colouring substances. Parent strain and mutants of *Monascus purpureus* have been worked out at CFTRI for the production of colour pigments. The protocols for separation of orange pigments have been standardized. Stability studies have been carried out for the pigments produced by mutants of *M. purpureus* at different temperatures and pH levels. Large scale trials were under progress.

Shelf life extension through biopreservation

The process for biopreservation of vegetables has been standardized at CFTRI using a potent bacteriocinogenic culture of *Lactobacillus plantarum*. Processed vegetables are packed in unit packs and have a minimum shelf stability of six months at ambient temperature. The fermented vegetables can be consumed as such or used in the preparation of culinary food items. The lactic acid bacterial preservation is beneficial as it: improves nutritive value, palatability and digestibility; suppresses food borne pathogens and spoilage bacteria; and requires no chemical preservatives.

Micro propagation system for *Decalepis hamiltonni*

Decalepis hamiltonni is used extensively in various ayurvedic formulations and for preparing pickles. CFTRI has discovered insecticide property in the aromatic



Micro propagation system for *Decalepis hamiltonni*

roots of this plant and attributed the biological activity to 2-hydroxy 4-methoxy benzaldehyde. The plant is an endangered species and its cultivation practices are not yet established. There is inadequate supply of its root biomass. To overcome the problem CFTRI has worked out micropropagation protocol for root biomass generation using accelary / terminal buds. A novel method using ethylene inhibitors for pronounced rooting has also been developed.

Raw mango cutting equipment for pickle industry

CFTRI has developed a variety of raw mango cutting equipments viz., gadget for cutting with stone & without stone, a cutting machine for splitting mango in two halves and a slice cutting machine. All the four gadgets involve novelty and ease of use. The gadgets offer efficiency and are made up of S.S. 304. The small scale pickles industries will be benefited by the development as these equipment could raise their productivity.

Analogue of natural whisky lactone and coconut aldehyde

IHBT has developed a simple and convenient method for preparing an analogue of natural whisky lactone and coconut aldehyde by transforming a chemical compound

from a plant which grows abundantly in wild. Whisky lactone is found in traces in plants and several methods for its preparation have been reported but none of them is of industrial importance. The technique developed by IHBT is novel, economical and preparation of the analogue can be undertaken at commercial scale with ease. Analogue of whisky lactone is found in high quality alcoholic beverages Napolean whisky, Jamaica and cognac etc., as fragrance ingredient, insect pheromones etc. Coconut aldehyde is responsible for flavouring a wide range of food stuffs including baked goods and confectionary.

Analysis of food materials and samples

Over 2400 food samples from various sources both in the private, public and government sector were analyzed at CFTRI for quality evaluation to national/ international standards. This quality certification helped the industry to adopt good manufacturing practice to achieve excellence and to augment the international trade, thereby facilitating greater returns.

1.6.2 HUMAN RESOURCE DEVELOPMENT

Programmes conducted at CFTRI:

- Master degree in food technology — a two year programme leading to the award of M.Sc. (Food Technology) from University of Mysore. Twenty-four students from different states of India were admitted to the course during the year. Food industry in the country is immensely benefited by this programme in terms of meeting the requirements of adequately trained professionals.
- Certificate course in milling technology — a 10 months course specially designed for training of professionals to cater to the needs of roller flour milling industries in India and other developing countries. Twenty one students deputed from the flour milling industries in India, Ethiopia, Ghana, Kazakhistan, Mongolia, Uganda and Vietnam have completed the course. This course is one of its kind not only in India but also in whole Asia.
- Ph.D. Programmes — thirty five students registered for Ph.D. in subjects related to Food Technology.
- Short time projects — as a part of curriculum in most of the Universities and Engineering Colleges, the students have to undertake a short term project of 4-6 weeks to one year duration in an outside institute / organization. CFTRI offers the training to such students in its various R&D departments. One hundred and twenty four students were trained for a period of four weeks to one-year duration under this programme during the period under report.

- Short term training courses — a total of 37 courses during the year were organized of 1-2 weeks duration on different aspects of food science, food technology and food engineering. In these 413 participants were trained from industry, R&D institutions, Government agencies and universities.

1.6.3 RECOGNITION & AWARDS

Soilendra Krishna Mitra Memorial Award by All India Food Processors Association	Dr. V. Prakash, CFTRI
All India Biotech Association (AIBA) award	Dr. N.G.Karanth, CFTRI

1.7 INFORMATION SCIENCE & TECHNOLOGY

1.7.1 SCIENCE, TECHNOLOGY & SERVICE

Blasting software

A blasting software (Exploedge) has been developed by CMRI alongwith Tata Infotech Ltd. for modulation and optimization of rock blasting using commercial explosives. Various input and output parameters of Exploedge were tested at a colliery of TISCO. Based on the experimental results a number of measures have been suggested by CMRI for effective day-to-day drilling and blasting operations.

Rock formation - analysis of geo-technical properties

CMRI has developed an object oriented data base management system for analysis of data pertaining to geo-technical properties of rock formation. This software is useful for scientific planning of a longwall panel, estimating support resistance and understanding the caving behaviour of the overlying rocks.

Condition monitoring of bearings

A software has been developed at CMRI for condition monitoring of bearings. This software is expected to be helpful for maintenance engineers in keeping data on bearings, condition monitoring observations and to evaluate, display and plot the bearing performance indices.

CD-ROM databases

INSDOC has updated the following databases available in CDs:

- **National Union Catalogue of Scientific Serials in India (NUCSSI) Database:** It is a valuable information product which helps in locating the availability of about 41,000 S&T serials in the country. The database covers nearly 2,23,000 holdings data of over 423 S&T libraries in the country. A user friendly menu-driven retrieval software helps in searching the database on city/region, title, subject, keyword, individual library holdings. The database on CD helps the library professionals to rationalise acquisition policy of serials by encouraging resource sharing and economise their serial subscription.

- **Indian Patents (INPAT Database) :** INPAT on CD-ROM is a bibliographic database which provides information on nearly 47,000 records on patents granted in India from the year 1972 to June 2000. The database can be searched by a variety of parameters including keywords, applicant and inventor names, patent number, international classification code and country name. This is the first comprehensive electronic database on Indian patents.
- **Indian Science Abstracts (ISA) 1990-1999 :** This is a cumulative machine readable database of Indian Science Abstracts for the period 1990-1999. Twenty four issues of ISA are published every year and this CD-ROM database covers 10 years data having about 2.7 lakh records. This database is an excellent replacement for hardcopy of ISA resulting in considerable saving in shelf space and providing electronically searchable information on Indian Science. The database covers original scientific research work published in about 1000 Indian journals.

INSDOC-KIT abstracting

INSDOC has entered into an agreement with the Royal Tropical Institute (KIT) of the Netherlands to contribute bibliographic data to KIT's TROPAG database. KIT provides a monthly list of titles of articles published in Indian journals for which INSDOC prepares full bibliographic details (cataloguing, indexing, abstracting) in a format defined by KIT. A total of about 1000 records were processed during the year.

Research Journals

NISCOM continued to provide communication links amongst members of the scientific research community through publishing of thirteen scholarly journals of international repute. The total number of papers published were 1409 and the total number of pages printed in the research journals were 8519. In order to acquaint young research scientists with frontline research areas special issues were brought out on specific themes of contemporary relevance. The various special issues brought out were: Materials Science: Trends and Future (*Indian Journal of Engineering and Materials Sciences*, April-May 2000), Super-symmetry Breaking (*Indian Journal of Pure & Applied Physics*, June 2000), Results from First Five Years of Operation in MST Mode (*Indian Journal of Radio & Space Physics*, Aug. 2000), Photosynthesis Research in the Post-genomic Era (*Indian Journal of Biochemistry & Biophysics*, Dec. 2000), Accelerator Technology (*Indian Journal of Pure & Applied Physics*, Jan-Feb. 2001), Indicators of Industrial Innovation: Perspective (*Journal of Scientific & Industrial Research*, March 2001) and Environmental issues: Technology Options for Textile Industry (*Indian Journal of Fiber & Textile Research*, March – June 2001. To keep the scientific community abreast with the current developments in different areas of science and technology. Advance abstracts of the journals were brought out regularly

and sent to various R&D departments, research institutes and universities in addition to major abstracting, indexing and current awareness services.

1.7.2 HUMAN RESOURCE DEVELOPMENT

IGNOU study centre

INSDOC Headquarters and its Regional Centre, Chennai have been identified as the Programme Study Centre for the diverse programmes of Indira Gandhi National Open University (IGNOU), New Delhi, namely, Master of Library and Information Science (MLIS), Certificate in Computing (CIC), Diploma in Computer in Office Management (DCO), Bachelor in Computer Applications (BCA), Master in Computer Applications (MCA). INSDOC conducted counseling sessions, practical training/ seminars for the various courses of the above mentioned programmes. In all 3500 students were trained for various programmes of IGNOU.

1.7.3 RECOGNITION & AWARDS

Award of Urdu Academy, Delhi Award of West Bengal Urdu Academy, Calcutta (for the book in Urdu entitled "Haiwaniat Ki Dilchasp Duniya")	Mohd. Khalil, NISCOM

1.8 MATERIAL SCIENCE & TECHNOLOGY

1.8.1 SCIENCE, TECHNOLOGY & SERVICE

Biomimetic synthesis of nano sized inorganic materials

Nano sized inorganic materials possess exotic and unique physical and chemical properties. They are however difficult to produce chemically on a large scale. Various routes of synthesis of these materials suffer with poor control over size, morphology and agglomeration. Biomineralization has been found to be good approach in the synthesis of nano materials. Biomineralization, whose examples can be found in nature, is based on the in situ nucleation and oriented growth of inorganic crystallites in a bio polymeric matrix. These crystallites are characterized by uniform size, morphology, orientation and hierarchical structures and exist without agglomeration. Depending on the function of a biological organ different polymorphs of the same mineral are produced under almost similar conditions. In NML, it was successfully demonstrated that the strong acidic polysaccharides involved in the biomineralisation can be replaced by commonly available water soluble polymer hydrogels which not only provide a pre organized matrix but also chelates the cations through a combined effect of secondary bonding and physical entrapment. It has also been established that the nano sized cages present in the quaternary structures of commonly available proteins can be exploited as the nano sized reactors for the chemical synthesis of inorganic nano crystallites. The protein cages being formed as a result of hydrophobic and hydrophilic interactions regulate the morphology and orientation of the precipitated phase.

Carbon nanotubes synthesis

Carbon nanotubes are new generation materials with nanometer dimensions. Carbon nanotubes were prepared at NPL both as cathode deposit as well as deposits inside the chamber by applying DC arc discharge technique by using special graphite electrodes developed in-house.

Molecular self-assembly

Photo-dimmerized bilayer films of amino propyl triethoxy silane (APTES) attached with cinnamoyl moieties have been shown to produce good uniform planer orientation of nematic liquid crystals. NPL has grown such ordered, densely packed bilayer assembly by self-assembly (SA) technique on indium-tin oxide (ITO) coated glass

substrates and quartz plates. The bilayer film was photo-dimmerized by irradiating it with a linearly polarized UV-light to create an ordered anisotropic surface structure at the glass substrate, which in turn forces the uniform alignment of liquid crystals. The alignment direction is governed by the polarization direction of the UV-light and can be varied locally. Liquid crystal display cell were made and line patterns with a resolution of ~20 micron have been successfully stored.

Six filament high purity quartz fibre

CGCRI has developed a process for producing thin fused quartz fibre with the diameter ranging from 9 to 14 micron. These fibres are essential component for applications like fire proof cables in aircraft, insulation of high temperature reactors, missile rocket nozzles as radome structure and microwave transparent window with uniform dielectric constant. They are resistant to nuclear radiation and have very good thermal and mechanical properties. The process yield 50 gm/hr is under improvement while ensuring at the same time that the essential properties of the fibres are not affected. The fibres produced by CGCRI are being tested at DMRL, Hyderabad for making high strength composites.

Sm–doped filter glass as a laser cavity component

A special type of Sm–doped glass, property wise equivalent to KSF 5 and KSF 10 has been developed by CGCRI. Few plates of each variety have been fabricated in desired sizes and supplied to CAT, Indore to substitute the imported glass. CGCRI has also received orders for supply of this filter glass in double bore cavity configuration for fitting directly into the laser cavity. Neodymium doped glasses lasing at 1.06 μ and excited by a Xe lamp are of interest for numerous commercial and defence applications. Some of the major factors known to limit pump power conversion efficiency include solarisation (formation of colour centres in the laser rod) due to the Xe lamp's UV spectral component, amplified spontaneous emission (ASE) from the Nd^{3+} ions and their spectral mismatch in the Xe output power with strongest absorption bands of Nd^{3+} ions. In order to overcome these limitations CGCRI used a special type of glass doped with Samarian and codoped with other suitable sensitizer ions. This Sm glass codoped with other sensitizer ions absorbed at 1 micron the unwanted UV and IR radiation while transmitting and reinforcing the Nd^{3+} pump bands. It suppressed off–axial laser emissions from Nd^{3+} ions which might lead to ASE and solarisation effect. It enhances moreover the laser rod efficiency by 10-30%. This filter glass is being used in the laser cavity in different configurations such as in simple plate forms and in single or double bore cavities.

Novel fusion technique for glass joining

CGCRI has developed a novel technique to fuse together small pieces of glass to produce larger glass blocks with optical homogeneity across the fused plane. The

optical glasses in the country are usually produced in batch type pot furnaces which yield small glass junks of uncontrollable sizes. This makes it difficult to produce large blocks of optical glass. CGCRI has carried out the glass fusion trials with three varieties of glasses LBC, BSC and EDF. All these glasses were successfully fused to yield homogenous pieces of larger sizes which were evaluated at the ordinance factory, Dehradun for making lenses and 80% success rate has been reported.

Coal for steel, power and domestic use

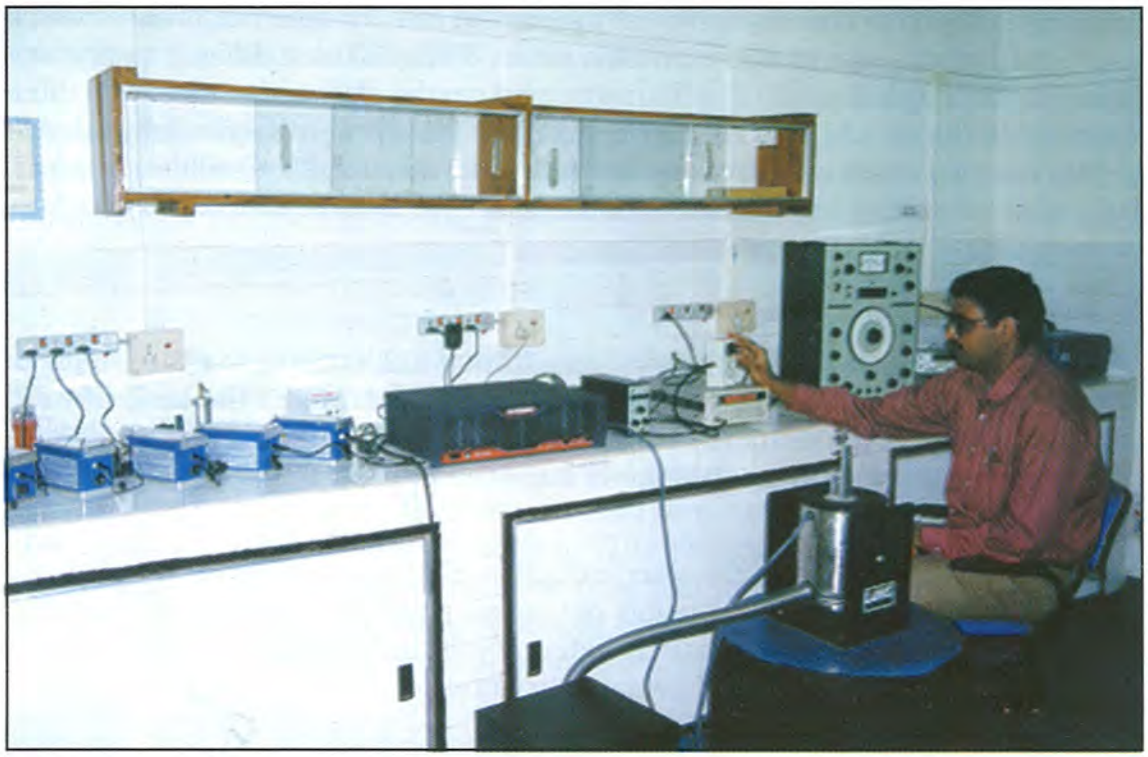
- CFRI was involved in planning, monitoring and supervising the supply of washed slurry from the mini-flotation plants installed on the basis of CFRI know-how to Burnpur Steel Plant. The washed product from the flotation plants was used partly as a substitute of imported coal, by IISCO as suggested by CFRI.
- CFRI was involved in the standardisation of the procedure of sampling and analysis at the unloading points of thermal power plants, washability studies on different non-coking coals including dry deshaling studies by selective drop breakage tests and experimental rotary breaker.
- CFRI was involved in the construction/ supervision of 48 Soft coke oven developed with pusher system, for private entrepreneurs.

Flyash based zeolites

NEERI has developed a process for production of flyash based zeolites (FAZs). Three zeolite phases viz. zeolite-A, zeolite-X and zeolite-Y have been identified with calcium binding capacity ranging between 500-600 meq/100g, 360-380 meq/100g and 400-500 meq/100g respectively. The high value of CBC for zeolite-A indicated its potential as a substitute for phosphatic detergent builder. Work was in progress to develop zeolitic membranes to target some selective toxic pollutants such as nitrate, chromate and arsenate etc.

SMC sulphide ore beneficiation plant: productivity improvements

Under North Eastern Region Development programme, RRL, Bhubaneswar undertook the task of improving the metallurgical process of the Sikkim Mining Corporation (SMC) Plant at Rangpo. The grade of copper has been improved to 24% in comparison to 18-19% Cu that was being produced in the plant. The Zn grade has also been improved to above 35% with recoveries exceeding 55%. Training to the operators was also imparted so that the results are consistently reproduced taking into account the wide fluctuations in the assay of the metal in the feed.



Seismograph calibration facility

Seismograph calibration facility

A well equipped facility for the calibration of seismographs has been developed at CMRI during the year. This facility would be specially helpful to the mining industry of seismographs for safe blasting operations in mines, tunnels and other excavation and construction work.

Refractory balls for cokeless cupola

NML has successfully transferred the technology of making refractory balls developed by it to a Jamshedpur based entrepreneur for commercial exploitation. These refractory balls are used as load support and heat exchanger in the NML developed cokeless cupola. These refractory balls have given satisfactory performance during trial runs of cokeless cupola at NML pilot plant as well as Agra demonstration foundry.

Pig iron low shaft furnace technology

A low shaft furnace of 25 ton/day capacity based on NML technology for the production of pig iron has been installed and commissioned for a client at Bhilai. The furnace has been operated to produce pig iron successfully from low grade indigenous raw materials.



Pig iron low shaft furnace developed by NML

Gallium recovery from bayer liquor

The use of ion exchange resin for gallium recovery from alkaline solution at RRL, Bhubaneswar has revealed that the chelating resin recovered gallium even from lean solutions (i.e. 100 mg/l) which was hitherto not possible by any technology known so far. An ion exchange column has been designed to produce 2 g/day/cell for gallium. Data has been generated on this column based on 1000l of bayer liquor collected from NALCO. With the growing demand for gallium worldwide, the necessity of providing an alternate technology for gallium metal is imminent. Gallium recovery from bayer liquor of alumina could be a promising step in this direction.

1.8.2 HUMAN RESOURCE DEVELOPMENT

Skill-cum-Technology Upgradation Programme (STUP) for women entrepreneurs

NML organized a Skill-cum-Technology Upgradation Programme (STUP) for women entrepreneurs at Davanagere, Karnataka on production and marketing of gift items made from low cost materials in collaboration with CSIR Polytechnology Transfer Centre, Bangalore and in association with District Industries Centre Davanagere and CSIR Rural Development Cell, New Delhi. It was sponsored by Small Industries Development Bank of India. A number of promising women entrepreneur participated in the programme and benefited by diverse techniques demonstrated for production of gift items from industrial material waste as well as cheaper low quality materials.

International symposium on processing of fines

An international symposium on processing of fines was held at NML. It provided a platform to diverse participants from different academic institutes, R&D organizations and industries, in India and abroad for exchanging their views and experiences in the field of national resources conservation and environmental pollutions control leading towards richer and cleaner millennium.

1.8.3 RECOGNITION & AWARDS

VASVIK Award, materials Science & Technology	Prof. P. Ramachandra Rao, NML

1.9 SOCIETAL SCIENCE & TECHNOLOGY

1.9.1 SCIENCE, TECHNOLOGY & SERVICE

Iron making process used by tribals of India

Tribals of India produce iron for making implements by experience using locally available ores and charcoal made of sal wood. Today this art is on the verge of extinction. NML has made efforts to document and develop the process further. NML has established two prototype furnaces, namely Bishunpur type of Chhotanagpur region and Bastar type of Chhattisgarh region for experimentation and further development. Scientific data with respect to temperature profile, thermodynamics and kinetics, ore and charcoal characterization etc. have been generated. Design modifications have been done (without losing cultural identity of the furnace) to utilize the waste heat. The conventional strenuous foot driven skin made bellows have been replaced by mechanical device for ease of operation. The modifications have shown encouraging results in respect of yield, productivity and efficiency of the furnace.

Traditional ceramics and rural pottery – activities for development in the north-eastern region

CGCRI initiated diverse activities for the development of traditional ceramics and rural pottery in the north-eastern region. A technology package is developed and commercialized for production of terracottaware utilizing common clays of Manipur region. The technology comprised improved body formulations as well as fabrication techniques like slip casting and jigger jolleying which significantly improved productivity, quality and range of products to include intricate shapes. Matching glazes as well as engobe were also developed from Manipur common clay. A number of artisans were given hands on training for the production of the terracottawares. Efforts were made near Imphal to develop pottery industry – Thongjao and Nungbi villages were selected for the purpose, to begin with, as they have clusters of some traditional potters. Suitable sites selected in these two villages were handed over to CGCRI under a lease agreement for creation of the suitable infrastructure and the work for the purpose has been initiated. Training was imparted to potential entrepreneurs from the region for manufacturing of FRP items and ceramic liner for domestic chullha.

Societal

Technology package for rural blacksmiths

Hand forging is the commonly used method by artisans in rural areas to make agricultural implements and tools. But the availability of the raw material varies from region to region that results in inferior quality products in terms of composition, hardness and wear resistance. NML has designed and developed a model to assess the quality of these products and also to provide S&T inputs to practicing blacksmiths. A technology package has also been developed that involves the preparation of standard raw materials of desired carbon level (backyard steel), forging and heat treatment schedule of 0.6-1.0% carbon steel, design and fabrication of fuel efficient furnace and mechanical hammer and demonstration and training of artisans. NML has imparted training to the supervisors and the associated artisans of the various field trials. The package has been highly acclaimed by the associated field groups.

Strategic Expansion of Carcass Utilisation and Recovery for Employment (SECURE)i for expansion of carcass recovery systems

As a part of the resource augmentation efforts, CLRI had commissioned 31 fallen carcass utilization plants under the Leather Technology Mission and the Integrated Rural Development Progamme (IRDP) of the Government of India. Technology has been down sized to meet the needs of the artisans. Bankability has been established for a processing capacity of 3-4 fallen animals per day. As a part of the resource mobilization efforts of CLRI, a strategic expansion of the existing units is being done. Stakeholders have been consulted for working out a viable plan for strategic expansion of carcass utilization and recovery for enabling rural employment. Problem areas have been identified. Effective carcass mobilization mechanisms, technology packages for fuller utilization of carcass byproducts, machinery operation are being put in place.

Fashion forecasting for leather and garment colours

India now leads in fashion forecasting of leather colours at Modeurop. Forecasts of the leather colours for the year 2002 have been made. Of the total number of 19 colours forecasted for shoe trends in 2002, 14 are from India. Of the total of 10 colours forecasted for garments, 9 are from India. The shade cards for the year 2002 are being made for the world by India. A Modeurop Material Bank has been established at CLRI, with support from the National Leather Development Programme, for the potential exporters to source leather for sample preparations of new products. The forecasting exercise has also included trend forecast for designs and products.

Marrying tradition & technology in leather products: Shanthiniketan bag

In the changing global market scenario, ethnic products of long Indian tradition could be challenged on account of productivity disadvantages. Traditional products made by hand would need to compete with machine made product with cost



Shanthiniketan bag developed by CLRI

advantages. A step has been taken by CLRI to identify some of the important ethnic products of Indian strength and develop technological measures to mechanize their production without loss of aesthetic value. An example is the Shanthiniketan bag. Now it is possible to produce the bag based on technological methods required for large-scale production. A similar effort has earlier been made for Kolhapuri chappal as well. These have been achieved through synergy of tradition with technology by CLRI.

Foot care solutions

Footwear is now a consumer product. CLRI has developed specialized footwear for foot care through special process and product innovations. These include footwear for diabetic and flat foot. These address special needs of people and are specifically customer oriented.

Energy efficient multi purpose biomass drier

RRL, Bhubaneswar has developed an energy efficient multi purpose drier which can dry food grains, food materials and industrial products and raw materials in a temperature range of 50°C to 200°C by using biomass as fuel. Drying is carried out in a complete pollution free environment. Due to very high thermal efficiency it saves energy in drying of various materials. It can be operated in all weather condition including rainy seasons. The device can replace electrically operated drier.

Electronic device for disinfecting drinking water on-line

ITRC has developed a device which could be used on-line for disinfection of water from *E. coli* & faecal coliforms based on the principle of anodic oxidation. The device



On-line electronic drinking water disinfection system

would be useful in providing safe drinking water continuously to small community, nursing homes & clinics, schools, restaurants etc. at a flow rate of approximately 500 litres/ hour. The device has been patented.

Low cost water filter

RRL, Bhubaneswar has developed a low cost water filter for filtration of raw turbid water into clean drinking water at a domestic scale. It is done through a terracotta filterdisc called terafil. Terafil is made of a mixture of clay, sand and sawdust. This is sintered at high temperature which creates micro porous structure. This terafil plate can be fitted with any container to serve as domestic water filter. All sediments and suspended particles alongwith significant quantity of excessive heavy metals and minerals like iron, nickel chromium, lead, fluoride etc. are also separated during filtration.

Garden for the blind

NBRI has developed under its newly launched eco-education programme, a garden for the blinds in the Botanic Garden campus of the Institute. In this garden a wide

variety of plants which bear either fragrant flowers or have aromatic rough leaves have been planted so that blinds can enjoy the beauty of the plants by way of smell and touch. Braille system has been used to educate the visually impaired persons for describing the features and plants.

Cultivation of Himgold

The extension activities carried out by IHBT have led to extensive cultivation of Himgold, a variety of *Tagetes minuta,* in northern plains of Punjab, Haryana, Uttar Pradesh and Uttranchal. Farmers of these states were earlier growing this as rabi crop which failed to produce quality seed material for standard quality oil. Studies at IHBT revealed that autumn winter crop practice in northern region produced quality seeds of high germination capability (>75%) and standard quality of essential oil with balanced ratio of three monoterpene ketones. The seeds were given to growers at different locations in North India for its multiplication. With IHBT knowhow on cultivation, processing and quality evaluation around 3.5 tons of Tagetes oil is produced annually in the state of Himachal Pradesh alone.

Essential oil formulation coated urea in water-logged paddy fields

CIMAP looking into the promising results of natural product coated urea in enhancing herb and essential oil yield of menthol mint, fertiliser use efficiency and inhibition of urease and nitrification, made efforts to verify the efficacy of the technology in farmers' field. Coated urea was applied to transplanted rice in 0.25 hectares of area and another part of same area was applied with non-coated prilled urea for comparison. It was established that fertiliser N use efficiency could be augmented by coating urea with natural essential oil by-product. About 25-35% of the urea N can be saved for the same targeted yield through this technology. The average fertiliser utilization efficiency also increased by 20-40%.

Fly ash use in agriculture

CFRI demonstrated fly ash soil amendment technology developed earlier on a large scale in farmer's fields/wasteland, in the vicinity of different thermal power plants in different soil types and climatic conditions on the cultivation of different crops and plantation of different plant species. The beneficial effects of fly ash/pond ash was demonstrated in improving the growth and yield of cereals, vegetables and cash crops; improving the fertility status of soil; lesser incidence of pests and weeds; early maturity of crops; and better workability in the field with no adverse effect on soil profile and field/ground water.

Societal

1.9.2 HUMAN RESOURCE DEVELOPMENT

Programs for women centred development

A programme on women centered development in footwear trade sponsored by Science City, Chennai was organized by CLRI at the Common Facility Centre (CFC), Perambur. About 150 women from the Arundhathiar community engaged in footwear production participated in this programme. Awareness on gender specific issues, skill based production, quality in footwear production, marketing opportunities for footwear made by the artisans, finance mobilisation mechanisms, investment opportunities was provided. Hands-on- practical training was also provided on footwear machinery at the Perambur commissioned under LTM. As a result of the awareness programme many of the artisans enrolled for the CFC membership.

2

CENTRAL MANAGEMENT ACTIVITIES

The constituent network of CSIR comprises of 40 laboratories and 80 field stations. These laboratories are multidisciplinary and multi locational, manned by around 22,000 committed staff. CSIR's affairs and activities are managed by the Director General with the assistance of a multifunctional and multidivisional HQs. under the overall guidance and direction of the Governing Body (GB) and Advisory Board (AB). The CSIR Society which has the Hon'ble Prime Minister of India as the President, provides the policy directions for the CSIR functioning. The Central Management Activities over the year are outlined here.

2.1 CSIR SOCIETY

The meeting of the CSIR Society was held on 20th September, 2000. Prof. Murli Manohar Joshi, Hon'ble Minister of Science & Technology and Vice President of CSIR chaired the Society meeting due to inability of the Hon'ble Prime Minister and President, CSIR to be present as he had returned from a foreign visit, late on the previous evening. The Hon'ble Finance Minister and other members participated in the meeting.

In his welcome address Prof. Joshi said that the Directors of CSIR had in 1998 adopted the 'Team CSIR' slogan later it was enlarged 'Team-India' initiative of Jai Vigyan Missions by the Ministry. He stressed that R&D pursued for high science and technology should be such that could directly impact the lives of the common man. He observed that efforts must be directed to R&D for low-cost, low-energy technologies, since India did not have much capital nor did it have abundant energy resources. Thus appropriate technologies had to be devised to suit local situations. Referring to the problem of drinking water in rural areas he said Vrihat Samhita described simple and useful applications of locally available herbs for water purification. This knowledge had been utilized by young researcher of NEERI to develop a process to purify water using clove oil. On the subject of energy Prof. Joshi noted that India had abundant solar energy resource and thus massive R&D should be mounted to harness it, at least for decentralized domestic energy requirements. He felt that the Indian industry preferred the technology of the West, which was often times not suited to Indian resource endowments. Thus Indian R&D had to strike out a new indigenous paradigm of technology development.

He thanked the Hon'ble Finance Minister (FM) for his presence in the meeting. He explained that the performance of Indian economy majorly depended upon S&T and thus FM's inevitable interest in S&T. The Hon'ble Prime Minister, he said, had promised that the funding for S&T would gradually be raised to 2% of GDP and he looked to the FM to fulfill this promise.

The Society meeting he said, generally was held only once a year. He felt that there should be meetings more often and perhaps Sub-Committees could be set-up to look into specific aspects of value to CSIR.

DG,CSIR gave a presentation titled 'To make the 21st Century India's Century. He gave an overview of the formidable R&D base that CSIR had created through its forty laboratories distributed all over the country and the highly qualified and competent human resource it had nurtured. He then elaborated on the performance achievements of CSIR over the past year, in the knowledge, industrial and societal sectors. On concluding he assured the Hon'ble Finance Minister that CSIR will discharge the heavy responsibility reposed by the nation in capturing technology leadership position through the New Millenium Indian Technology Leadership Initiative (NMITLI).

The members appreciated the presentation and commended the performance of CSIR. The Annual Accounts and Reports for the year 1998-99 were adopted. The Society considered the Report of the CSIR Review Committee for Civil Engineering Laboratories and the Governing Body decisions thereon. The Society appreciated the prudent action of CSIR to review its activities from time to time and concurred with the decisions of the GB to wind up SERC, Ghaziabad as a national laboratory.

The members gave extremely useful suggestions on the further moving CSIR from a good to a great organization. Some members suggested that the salary structures of CSIR be improved to attract the best talent, some suggested more flexibility and autonomy of operation and others that CSIR provide technological assistance to SME to face the challenges in the WTO.

2.2 GOVERNING BODY

The Governing Body of CSIR met thrice during the year i.e. on 2nd June, 2000, 27th December, 2000 and 15th February, 2001. All the meetings were attended by over 90% of the members. The GB in its meetings deliberated on diverse subjects and gave directions on several crucial issues. Some of those were on: (i) Recommendation of the CSIR Review Committee for Civil Engineering and winding up of SERC, Ghaziabad as a national laboratory; (ii) Amendments in CSIR Administrative Services & Recruitment & Promotion Rules 1982; (iii) Dr. Shyama Prasad Mukherji Fellowship to promote creativity; (iv) Mobility of staff between CSIR and other organizations of autonomous nature; (v) Amendments to the provision of sabbatical leave; (vi) Initiation of New Millenium Indian Technology Leadership Initiative (NMITLI) and funding of

nine project proposal under NMITLI; (vii) Guidelines on delegation of Powers to the Directors & Heads of National Laboratories; (viii) NCL Golden Jubilee Project on Combinatorial Chemistry; (ix) Refurbishing of a Wet-leased Ocean Research Vessel by NIO; (x) Revised pay structure and career progression scheme for Group IV, Scientists; (xi) Functional autonomy of R&D autonomous Institutes; and (xii) Closure of a few outreach centers. The recommendations and decisions are being implemented at the executive level.

2.3 DEPARTMENT RELATED PARLIAMENTARY COMMITTEE

The Department Related Parliamentary Committee on Science & Technology, Environment & Forest examines and recommends the demands of grants of the DSIR including CSIR. It also takes up for deliberation from time to time specific topics/ subjects of national S&T interests.

The Committee considered the demand of grants for the year 2000-2001 for DSIR and CSIR at its meeting held on 29th March 2001. Background notes for the meeting had already been furnished to the Committee. Based on the notes and the deliberations at the meeting, it sought response to a set of queries. This was duly furnished. The Committee recommended the grant sought and interalia noted as:

- The Committee commends the steps being taken by the Department in augmenting its scientific and industrial capabilities towards the economic and social development of the Country. The Committee however recommended that besides the on-going research projects, the Department should also support employment generating research such as research on Bamboo from which millions of people earn their livelihood world wide. This would help in generating employment among rural people.
- The Committee conveyed its appreciation for the efforts made to bring about reduction in the staff strength and sought for reduction of staff strength to 20,000 by the end of 10th plan.
- The Committee felt that in order to make available best talent it was necessary that at least the minimum needs of employees were taken care of in the fast changing world. It was necessary because the monetary benefits given by the Fifth Pay Commission had to a large extent been neutralized by high cost of services and rising costs of living.
- The Committee reiterated its earlier recommendation made in 73rd report that there was need to progressively modernize the CSIR Laboratories. The Committee observed that the process of modernization should be time bound and should also spell out precisely the areas of modernization. The Department should also ensure that the modernization matches the international standards.

- The Committee felt that CSIR should also consider introducing Scientific Research Scholarship to school leaving students in order to encourage them to pursue a career in S&T related areas. National Women Scientific Research Award could also be introduced for the outstanding women researchers to encourage their partnership in the mainstream.
- The Committee commended the efforts made by CSIR in maintaining its standards for Intellectual Property by setting a formidable goal of achieving 1000 Patents and 500 foreign Patents by 2001. The Committee, however, felt that the Department should create a Patent Facilitating Cell which should assist in writing, and completing of all formalities for filing of patents. Roving seminars should be conducted at regular intervals to create awareness on intellectual property rights and related issues.

2.4 Research Council (RC)

The Research Council in the laboratory is the primary source for high level professional inputs, and advice on R&D programme/project formulation and monitoring. The Research Council for the 39 laboratories were reconstituted with effect from January 2001 for a period of 3 years. Each RC comprises between 10 to 12 members and overall for the 39 lab, 280 high level/eminent scientists, technologists have been involved. The new RCs are to meet early in 2001 to undertake a SWOT analysis of the concerned laboratories.

2.5 Directors Conference

The three day Directors Conference was held from 19-21 January 2001 at Hyderabad. In a true Team CSIR spirit the meeting was jointly hosted by NGRI, IICT and CCMB. The Director's Conference was formally inaugurated by Prof. Murli Manohar Joshi, Hon'ble Minister for Human Resource Development, Science & Technology and Ocean Development and Vice President CSIR on 20th January 2001 at a public function hosted at IICT. Shri Bachi Singh Rawat, Hon'ble Minister of State for Science & Technology presided over the function. Dr R.A. Mashelkar, Director General, CSIR in his welcome address highlighted the scientific developments and achievements of CSIR. He appreciated NAL's contributions, the successful flight test of Light Combat Aircraft (LCA). He said that the year 2001-02 was likely to witness the successful flight testing of SARAS, the light transport aircraft developed by NAL. He described the launching of a unique inter-institutional program involving more than 18 CSIR laboratories for the development of new drugs from natural products as a landmark event in the history of CSIR. The success of the program had encouraged CSIR to undertake other such mega projects. The industry - R&D knowledge collaboration in the area of human genomics formed by CBT was described by him as yet another milestone in Indian science.



Hon'ble Minister, S&T Dr. Murli Manohar Joshi, inaugurating Directors conference

Shri Bachi Singh Rawat formally released the Hindi Journals "Jigyasa & Spandan" brought out by the CCMB and IICT respectively. The Minister lauded the basic objectives of these journals to propagate Hindi among the Indian scientific community. In his presidential address, the Minister highlighted the importance of natural product based research and the need for closer industry and CSIR collaboration in frontier areas of science and technology. He cited the NMITLI initiative of CSIR as a major effort in supporting high quality research which will lead to Indian leadership on the technological front.



Directors conference in progress



Shri Bachi Singh Rawat, MOS, S&T releasing the Hindi Journals'Jigyasa & Spandan'

In a very thought provoking inaugural address Prof. Joshi said:

"Whenever I attend CSIR programmes, I become nostalgic. It is something to do with my career and work in science, which started as CSIR-JRF. When I stand in front of you today, I get a feeling that even a Junior Research Fellow of CSIR can reach upto the position of Vice President of CSIR. This shows the vast scope and possibilities of CSIR and hence it is required to stretch its areas with utmost care and sincere work, actively and seriously. Two years back we attended the Director's seminar at Bangalore. We are meeting again today. It started yesterday and will continue tomorrow also. When we met last time it appeared as if we were waiting for Pokharan. Our meeting started and on the same day India did the Nuclear Test. Likewise we have Thrisool and many such scientific capabilities. Then the certification of Hansa III was also done on the same day. In a way that meeting provided a new dimension and direction to the country. May be we are meeting here in this context too. Agni was already shot. Agni was successfully tested and may be again it could be as an invitation for us. It is slowly becoming clearer to all, that our Indian scientists will show their capability and that day is not far for them go to moon too. Whatever is happening in the field of Science and Technology in the world, India also can perform at par and show the world. But now it is only a beginning. I am eagerly waiting for that day, when India could do whatever happens elsewhere. But again the world would find it difficult when India performs. India must go ahead as a leader in the areas of Science and Technology. We need to determine the course of

scientific innovation. India will lead, India shall not merely follow others. India will no more be a back bencher, leaving others going ahead of it. India innovates. India makes new discoveries and stops following. This is a new challenge in the areas of knowledge and science and let's all resolve to accept this challenge in this Millenium. I am sure, if we are all together to reach this goal, if we will work together with well focussed goals, then nothing is impossible.

During the past two years, I happened to meet many Scientists and many Ministers of Science of various countries and I happened to visit several laboratories. Now people look at Indian science with a different perspective. Sociologists may call this as a country of snakes and snake charmers, but the scientific word is looking at India as a country of knowledge and science and a country of Information technology, a country of Bio-technology, a country of Chemical technology, a country of Space science and a country of Atomic energy. I congratulate our scientists, whose continued efforts and hard work has changed the picture of the country and I hope they would make this picture of their motherland more brighter. Science and Technology of India is not merely limited to arms or Hi-technology, as is being known in the world. Indian science and technology is equally committed to the service of the common man and other research areas. Science for the common man has two aspects: the first one is that we make science so simple and easy that the ordinary man can understand it and come forward to utilise it. The second one is that the achievements of science, knowledge of science, and its profits must reach the common man. There is a strong need for the scientists to focus their attention on the problems and needs of the country. Energy is one among them. The country needs energy. Import of petroleum products alone is causing a big budgetary deficit. I am happy that our scientists are making serious efforts for oil. They are working constantly. But this alone is not sufficient. Oil resources are sure to get dried up today or tomorrow or day after or in next century of the next millennium. There is a limit for gas deposits too. There should be an unlimited source, which will not reduce even after billions of years. That is solar energy. I wonder, why our Indian scientists stopped working over it. It is very essential to tap this energy, by making its technology economically viable to us.

Very recently I had been to Germany. There they had decided to close down their nuclear sources and also decided to close down nuclear energy, nuclear plants and fulfill their energy needs with solar energy. Dependency on energy sources of oil, means that we do not have control on our energy and on whatever amounts of gas, naphtha and crude we import from other countries, we have no hold on them. Tomorrow if any sudden conflict crops up and if it extends vastly, international concentration precipitates on energy sources especially on petroleum resources and that specific country may not supply or may not be able to supply oil to us, which may cause many difficult situations and our progress gets obstructed. Energy is the major requirement for progress and development. It is therefore, on one side, we have to find alternative energy resources and on the otherside we need to strive for the easy and viable methods of availability of solar energy. I appeal to CSIR and other Scientific Institutes that they give their complete attention in this direction and save the country from the forthcoming energy catastrophe. If at all we

had succeeded in tapping the solar energy through easy and viable methods, we would not only serve our country in a greater way but also would be in a position to solve the energy problem of the entire world. This is a very important area and we need to give complete attention to it. Secondly, though I repeatedly mention this point to many friends from scientific community, I am again tempted to repeat that the processes that occur in nature or on earth are not of high energy processes. They occur on Sun. Only low energy processes do occur here. Actually there are two major factors required for development other than human resources; capital and energy. Right now we have the deficiency of both of them and unfortunately we acquire energy and capital both externally. This is not good for either security or self respect of any nation. Hence, we are to look at low capital and low energy processes. The western technology which is otherwise known as Hi-technology is of Hi-energy and Hi-capital intensive and its effects are vastly known in the world over. Whenever you invest a large amount of capital, you always look for means to get it back and you compete for it. To bring the prices low, you need to have cheap raw material and also need a big market. The market competition, cheap raw material and market attraction for your product to gain more and more returns is only the economic and social order of the capital gains. But an artificial need is created for these products, which are otherwise not required.

Few months back, I met the American ambassador, Sri Brezensky. We were talking at length on various international economical and political problems of the day. I just asked him about his opinion on what is presently going on with regard to the international consumption trends. There are many mutual conflicts, tensions and problems due to this trend. Is this trend in anyway leading to world peace? He too has agreed that whatever is happening is not proper. Then I asked him why he thinks so? He then narrated a personal incident. One day he was at home. He observed that his daughter is getting ready to go out. He asked her where is she going? She said, "Going to market". He asked, "Where is the need to go to market? What do you want to purchase?", She said "I will decide that only after reaching market". He said, "This made me think that she needs nothing in particular, still she feels that there should be some need, should go to market and make some purchases". This is how the artificial demand is created. But who is doing this? Obviously, only those producers and manufactures, who own these companies. My daughter has money, hence she can buy that product, whereas there may be several such people who may want to buy but can not do due to lack of money. Still the desire to possess may crop up in them also. Once that desire develops, it leads to ways and means. We have several such incidents in India. For example, any new item in the neighbour's house attracts us and we crave to go for it. This competition of consumption persists. That is why high capital intensivity is a natural ill-effect of hi-technology. Hence scientists must think very carefully and act carefully and therefore say that science must have ethics. Science and values are not separated. Science without ethics only can generate a society with economic trends, where 20% of the population consumes 80% and 80% of the population lives on only 20%. This is the actual condition for the present conflict. Let us look at our contribution in this. Whatever is the contribution of a capitalist

or an Industrialist, it is a different issue. They may be dealt with carefully. Our original low energy and low capital technology is required to be brought back again. This is possible and definitely not difficult. In fact we were separated from our ancient traditional low energy, low capital technology, after the British came to India. In 18th century, our production of iron and steel was four times more than that of England and Europe whereas now, inspite of the latest technology, our production is less than that of a single company in Korea. Then the cost of iron was 12 annas a maund. Even with the calculation of price fluctuations and rates of inflation, we were in very good position those days comparable to the international qualities. The British engineers in those days suggested the East India Company to use this very good quality steel produced in India for rail tracks and no imported steel required. The British Govt., declined the suggestion and gone for either it to be brought from Manchester or from Liverpool and with that, Indian industry was closed down. This is how the new technology game was played with us and 40 to 50 thousands of our people were forced to unemployment. It is therefore necessary that we ought to look at the social consequences, which is our major responsibility. We can not shirk by saying that ours is only research job and we handover the weapon, saying that use it the way you like. These ideas are to be viewed seriously. Specially the areas of bio-technology and genetics, where in depth thinking is a must. This is not an instrument just meant for study of creation and nature through philosophical approach but it has become very important to improve and develop the life style of common man. We must have deep thinking on these matters.

Many times on various international platforms during seminars this has been accepted by several learned persons that human values need be inculcated in education and science. Otherwise the entire world would be a 'Jungle raj' and no scientist would wish such a thing to happen. Yes, we must study the Nature, understand it and understand it more deeply. At the same time, none of us are willing to throw this human race into a catastrophe. Even, inspite of several scientific discoveries and technologies one billion human beings are sleeping with hungry stomach. This is a challenge for us and a future society is taking shape in front of us. Even inspite of several medical facilities for treatment, one and half million people are not receiving proper medical facilities and are suffering from many ailments. So the science and technology must find reasons for it and make treatment easy for them. Several diseases are reoccurring as a menace, which we have once declared as eradicated. We must think as to where lies the problem? If the farmers of Andhra Pradesh are forced to commit suicides because of your pesticides, then we must study the relationship of fertilisers, seeds and pesticides thoroughly. That is why I ask these questions to my friends from scientific community whenever I meet them. What should the direction of Science in India be? What should be the policy of our Science and Technology? What are the various roles of Government, Scientist and Industry and what should be their mutual relationship? Even though we are globalised now, we need not blindly accept whatever is being done and happening elsewhere in the world. The actual meaning of globalisation is, that we are on the same platform along with others and we have to work accordingly. We have to play an effective role, with which we can

attract and satisfy the world. This is the time that India gives something to the world not just receive from it.

I see doctors of Aryavaidyasala sitting in front of me here. I am pleased to note that CSIR has built up a strong bond with Ayurved, which would not only be capable of curing many diseases in India but also would be in a position to help people of the world. Our medicines which are simple extracts from renewable sources provide good health to all without causing any side effects simply because they are not from petroleum products. They are made from natural chemicals available in Nature. So it is possible, if we want, we can make this area economically and socially very strong. I am sure our country would anyhow become economically very sound. But I wonder at one point that how this science of ours was more used by Thailand and China than us? We are yet to make millions in this area where as they have gone into billions. Indeed we are store house for this knowledge and our Indian scientists do not look at it, they only look at the West. They obtain the abstracts of the western publications, take some problems and make projects from them. This tendency must come down. We must think from our side.

In the West, they have done a lot and very little is left further to do. Let them do whatever they want to do but what is our contribution? We publish papers. CSIR too has many research publications. But what is their international impact? How are we rated or being rated? The reason is whatever we are doing here, a major part of it is already done somewhere. It is neither basic nor innovative to receive appreciation or motivation to work on it. We seldom exhibit our original thinking capabilities. That is why I appeal to you to know our Indian scientific tradition. We have an ancient tradition. Many people think that it is mythical that India has any such tradition. Whenever I talk to friends, they keep saying "Sir, your views are such that they are not found in any scientific books ". Then I say," yes your science books don't find them. They are there in the mind of every common Indian. We have them in our books in India. Why don't you see them?" Recently I went to NEERI. I can see the Director here. I was moving in his laboratory as I always do. I met a young man. I enquired about his work. He said, "Very exciting work, sir; I am observing how the clove can kill the bacteria in water and water gets purified, safe and potable". He showed some pictures of his work. It shows how the clove extract can keep the bacteria away. Even the crude clove can also do some benefit. I said, "All this is right, we also know from childhood that clove oil is used for tooth pain. How did you get this?". He said, "Sir, I had a chance to see 'Brihat samhita'. We had a scientist here, who is retired now. He was knowing Sanskrit and learnt a lot from 'Brihat samhita'." Then he showed me that slok. Though I have seen it earlier several times, I never got it. I told him after seeing it, there is much more in it. If the well water is dirty, salty, brackish, awfully smelling, muddy, it is written in 'Brihat samhita', how to treat these conditions individually or collectively and in what proportions the treatment is required to be done.

You may be providing drinking water for Rs.15 per litre. Is this the technology? If a villager wants clean drinking water, do you tell that poor man, 'Yes I have a technology

for you and here is it for Rs.15/- a bottle, take it". He says then," I drink 10 bottles. So I need to spend Rs.150? My daily wage is Rs.75/- what do I do?" What do you do about it? Do you think this technology is suitable to the man from a village? Or can we find a way out for this? We must study "Brihat Samhita" deeply and correlate those sutras into present day context, like that young man is trying with clove extract. We must study how much extract is required, what are all the bacteria that get eradicated and what would be the percentage of extract required? This would help the clove growers of India indirectly. We would be in a position to provide clean drinking water even to common man. I keep going to Kerala. I have observed several times that they put a potali (a cloth pocket closely tied) and boil the drinking water during summer and rainy season . They put some things in that potali, which drives the diseases away. May be if any Keralite is here, he may know it better. Do you call it a technology? You call a technology only when NCL brings out a membrane? Yes, membrane is definitely a technology, a Hi-technology, but Hi-energy, Hi-capital intensive technology. Whereas this is a low-energy, low-capital with renewable resource technology. Why don't we work on it? This is just one example I give to our scientists. I can give many more such examples. You please do not neglect Sanskrit scriptures calling them mere mythology. Please study them.

I always keep saying to my friends from scientific community to study Sanskrit. This is actually the reason for my being fond of Sanskrit. I request every one of you to study Sanskrit. If you cannot study, may be you can appoint a person, who learnt Sanskrit; every laboratory may opt for a Sanskrit consultant according to their respective areas on which they may look for scriptures. I am sure you can give a technology that takes our country ahead of others in the world within five years. Every science is available in them. You need to refine them and need not always take as is said. Definitely you have to improve upon it. You must bring them to the present day context and I tell the same to our industrialists too. Please do not think that Information technology came from West and we are also working on it. We are infact copying them, forgive me. I am also fond of this technology. I also feel that it should come to us quickly. But I don't want us to be just typists. I don't want to be an IT typist. We have to work in the area of IT hardware also. We need to think that these days the information is communicated through connectivity media. You may take ground electrons of Helium. If two electrons, one on earth and the other on galaxy are there and they are in ground state, one will be spin-up the other one will be spin down. Out of them if you keep one on earth and take the other one to galaxy, which is at one billion light year distance, and if we make spin-up in place of down then it automatically becomes spin-up and facilitates much faster communication. You keep on spreading optical fibres worth crores and crores of rupees. When your study is in different direction, how do you think it is possible in the direction of super luminosity . Hence you should not just limit to make only Cyberabad, instead you must study on the Cyber space in the universe and you will and can do a lot. But unless no one mentions anything about it in West, we don't think in that direction in East. We need to change this tradition. You can definitely tell the world and show it by performing that if they are communicating though connectivity, that we are in the study of heart to heart talk even at crores of miles distance. We can influence minds of people.

It is possible today. Ten years ago this was impossible. Then cell phones and satellite communications were impossible. If at all you want to do, do some thing original, that in every field you can do.

Thus, I again and again appeal to my friends from scientific community that they pay more attention to original thinking. They write original papers, original books and do research on original problems. Initially you may have to spend more time and it may also not very proper. Hence I assure you, as long as I am in the Minister's position, you will not find any difficulty for such works provided you really wish to work. Frankly, I want to express that in this matter, there is no much response from the scientific community. I have started working on establishing a study centre for 'Study of Consciousness'. You can undertake work to study consciousness. How can brain be mind? You can work on this. Why do you limit yourself to tiny problems? Take bigger problems, which are cutting edge problems. Several such front line problems are there, which are related to human and universe, human reality. Now you please leave all those age old journals, which are in the same track. You leave Newtonian or to some extent Quantum Physics also, you come to New Physics, that is the Physics of Consciousness. Today's Physicists are worried about the labyrinthine world - who am I? is the major question. Where I have come from? what is my relationship with this world? with my neighbour? with nature? until when I am going to be on this earth? why have I come here? Even Noble Laureates are worried on these matters. These questions are being discussed in India since many years. I feel the need for you to work on these areas. Please do an advanced study on it.

A group of scientists are going to work with Satyam Computers, or Catalysts and Chemical technologies. It is required please go ahead. But my appeal to you once again is that a group of scientists should also work on the hidden secrets of creation and universe. I once again mention that you please do not neglect Upanishads and vedic literature taking them as mythology. They are abundant in scientific knowledge. If you read Schoedanger, you get to know that whenever he had a mental vacuum, he looked for solutions in Upanishads. If you ask Openheimer, what he felt on first atomic explosion, he refers to a slok in Geetha, that Arjuna uttered after seeing the Vishwarupa, "It is as if thousands of suns have appeared in front of him". That means he reads Geetha. The Turkish Prime minister does the translation of Geetha into Turkish and Hungarian Professor learns Sanskrit and translates Sanskrit scriptures into Maigeri language, it means that Sanskrit is not the language of mythology. It is not a dead language. It is the language of knowledge and science. Do not neglect it. Whatever you find useful in it, please take out, use it for the sake of society. This is the reason why I say that we need to be original. 'Originality' should be our 'speciality'. Whatever is happening elsewhere, that also you carry on. I have no objection to it. Alongwith that, you do what is not happening any where in the world. We will do it. We will make the world a wonderful place to live. A scientist who can bring out the secrets of nature shall definitely come from India. It will be once again a valuable guidance to the world from India that we

could give a message to the world that knowledge and science are not only means for material growth but also can provide an excellent egalitarian, just and a non-violent social order.

Let us all work for a new international economic and social order through using science in non-violent and non-exploitative ways and now the time demands great challenges in science. I believe that science must definitely go in this direction in 21st century and these matters are to be sorted over this way. You just can't be indifferent towards the problems of consumption and production thinking that it would be the domain of an economist. These questions are associated to our daily activities, social patterns and ultimately becoming reason for our political existence".

Prior to the inaugural function, Hon'ble Ministers and DG, CSIR visited IICT, CCMB and NGRI to launch the Centre for Chromatographic Fractionation for Bioactives at IICT and Genechip Microarray Facility at CCMB and Hostels for Research Scholars at CCMB/NGRI. They also visited the HFC-134a pilot plant of IICT.



Hon'ble M., S&T, Dr. Murli Manohar Joshi inaugurating Genechip Microarry Facility at CCMB

The first two technical sessions of the Director's Conference were held at IICT. Dr K.V. Raghavan, Director, IICT welcomed the distinguished gathering. Shri V.K. Shunglu, Comptroller & Auditor General of India (CAG) presented the challenges of Indian S&T system audits. The Directors of CSIR laboratories responded favourably to several new ideas proposed by Shri Shunglu. It was finally decided that CSIR will prepare a special note on flexible financial management system applicable for sponsored research projects with specific time and delivery targets.

Dr T.S. Prahlad, Director, NAL made an excellent presentation on saga of SARAS highlighting the current status, multi-institutional action plan and future challenges of test flying SARAS within this year. The participants appreciated the efforts of NAL in coordinating such a challenging programme with efficiency and dedication.

A special presentation on the CSIR multi-institutional program on "New Bioactives Discovery" was the highlight of the day. Vaidyaratna Dr. P.K. Warrier, Managing Trustee & Chief Physician of Arya Vaidya Sala, Kottakkal and Prof. R. Kumar, Chairman, Apex Committee of CSIR Coordinated Program were present as special invitees. Prof. Kumar in his opening remarks highlighted the objectives, progress and achievements of the bioactive discovery program. He indicated that this multi-institutional program has adequately demonstrated the formidable combined strength of Indian science in taking up globally challenging programs in the new drug discovery area. Dr. Warrier in his remarks highlighted the inherent strengths of CSIR-AVS collaboration in achieving exciting developments in a short span of three years. He



A session in progress during Directors conference

conveyed his appreciation of the transparent system of project management evolved by CSIR with special provision for sharing intellectual property rights of the participating teams.

Dr. K.V. Raghavan and Dr. G.N. Qazi, Directors of IICT and RRL, Jammu made a detailed presentation on project activities and successes that had been achieved. New anti-ulcer, cancer and anti oxidant formulations developed were discussed. Prof Joshi, appreciated the efforts of CSIR for taking up such a major inter-institutional program of national importance.

In the second technical session, Dr. Harsh K. Gupta and Dr. E. Desa, Directors of NGRI and NIO made a detailed presentation on resource survey and mapping with particular reference to gas hydrates. The tremendous potential offered by these resources in brightening the long term Indian energy scenario received special attention. Subsequent interactions with Directors highlighted the need for extensive exploratory investigations to achieve environmental safeguards.

The third technical session of the conference was held at CCMB. A special interactive session on "Enhancing the standards of R&D in CSIR" was held under the chairmanship of Prof Joshi, Hon'ble Minister. The interactions were very lively and purposeful. They covered vital issues pertaining to human resource management, modernization of facilities and capabilities and creating more conducive working environment.

An interesting presentation on "Creating Indian Genomic Valleys" was jointly made by Dr. Lalji Singh and Dr. S.K. Brahmachari, Directors of CCMB and CBT. Their presentation brought out the tremendous opportunities that happened to Indian science.

The concluding session was chaired by Prof. Joshi, Hon'ble Minister. He expressed satisfaction over the outcome of the Directors' Conference and stressed the need to quickly implement important decisions taken during the meeting to quicker the pace of CSIR activities in the new millennium.

2.6 CSIR Foundation Day

The fifty-eighth foundation day of CSIR was celebrated by the HQs. and all the laboratories with enthusiasm. The main function was held at National Physical Laboratory, New Delhi. Prof. Murli Manohar Joshi, Minister for Human Resource Development and Science & Technology and Vice President of CSIR was the chief guest. Shri Bachi Singh Rawat, MOS for S&T presided over the function. Shri Rahul Bajaj was invited to deliver the Foundation Day Lecture. The Shanti Swarup Bhatnagar Prize winners for the year 2000 were announced and CSIR Technology Awards - 2000 and CSIR Young Scientist Awards - 2000 were presented (for the awardees please see RPBD/HRDG segment).



Celebration of fifty-eighth CSIR Foundation Day

Dr. R.A. Mashelkar, Director General, CSIR paid rich tributes to Dr. Shyama Prasad Mukherji. He extended a warm welcome to Prof. Murli Manohar Joshi, Shri Bachi Singh Rawat and Shri Rahul Bajaj. He introduced Shri Rahul Bajaj as the doyen of the Indian industry well known for his forthright views and requested him to deliver the Foundation Day Lecture.

Shri Rahul Bajaj said that it was a very special privilege and an honour for him to have been invited to deliver the CSIR Foundation Day Lecture. He wished a very happy birthday to CSIR and to the 23,000 strong CSIR family spread over 40 laboratories from Kashmir to Kanyakumari. He congratulated the winners of CSIR Young Scientist and Technology Awards. Shri Bajaj said in recent years, CSIR had made remarkable strides and was poised to play an even greater role in the country's scientific and industrial progress. Some of the laboratories had even achieved global recognition. He said, in Dr. Mashelkar India not only had an outstanding scientist but also an outstanding manager with a business sense. He conjectured that it was the combination of science and commerce that was enabling him to transform CSIR. He felt that for any organisation, to move forward, it needed team work amongst its employees and its leader; he had no doubt that under the present leadership, CSIR would make India proud of its achievements.

He said that success of Indians abroad, not in Silicon Valley alone but elsewhere too had opened up the eyes of the world, about the capabilities of Indians. During the period 1980-2000, India was the 5th fastest growing economy in the world out of 130 large and medium countries. During the next 10 years, he felt it could be the 3rd



Shri Rahul Bajaj delivering CSIR Foundation Day lecture



Hon'ble Minister, S&T, Dr. Murli Manohar Joshi presenting CSIR Young Scientist Award

fastest growing economy after China and Ireland. On purchasing power parity basis, India was 6th largest economy in the world and was expected to be the 3rd largest by 2010, just behind the US and China. He exhorted that India must have research laboratories and industrial companies which were second to none in the world. It



CSIR Young Scientist Awardees with the Hon'ble Minister, S&T, Dr. Murli Manohar Joshi, Hon'ble Minister of State, S&T, Shri Bachi Singh Rawat, Shri Rahul Bajaj and Dr. R.A. Mashelkar

should also have at least 100 truly global Indian companies by 2020. He posed the question "When all of us want these things to happen, and when we are so talented, why is it then that this has not happened even 53 years after independence?" Shri Bajaj then postulated the reasons for it and the possible solutions.

The World Economic Forum had ranked India 49th in competitiveness and China was 41st. Clearly India was losing out on three issues: Labour, Cost of Capital and Infrastructure, Shri Bajaj said. He felt enough external liberalisation had been done: foreign capital was freely allowed in almost every industry and goods were being imported without any restriction.

More internal liberalization was needed. He quoted the Financial Times of London writing that WTO was a nightmare for developing nations. A United Nations appointed study team had rejected the idea of linking trade with human rights, labour and environmental standards. He cautioned about such attempts and said that it was nothing but an effort to create non-tariff barriers against imports from developing countries. He suggested that for the medium term competitiveness, India had to focus on the technological prowess. During the last nine years a new generation of companies had come into existence in Information Technology, Telecommunications & Pharmaceuticals. They were driven by knowledge and were surging ahead on the basis of technology, and it was technology that could completely re-write India's competitiveness story, added Shri Bajaj.

Investment in R&D was the bedrock for creating a better tomorrow, whereas US spent 2.9% of GDP on R&D, Japan 2.7% and Europe 1.2%, India spent only 0.8%.

Furthermore, 80% of Indian R&D spending was done in the government, while it should not be over 50%. India had a tremendous comparative advantage over the West, as a large percentage of the Indian population was and would be young even by 2015. The need was to train these young, bright minds and give them the freedom and the space to innovate and create. They have to act in partnership. CSIR should lead the way for R&D institutions to look at the future in a scientific and entrepreneurial manner, he said.

He quoted Alvin Toffer as saying: "The illiterate of the 21't century will not be those who cannot read and write but those who cannot learn, unlearn and relearn", and buttressed it further with a slokas from the Atharva Veda which says "We must learn to happily progress together or miserably perish together. Man can live individually but can survive only collectively." He therefore stressed on all Indians getting together, to move India on a high growth orbit.

Prof. Murli Manohar Joshi in his address reiterated that India must innovate, it must lead and not follow. Prof. Joshi stressed that to make this happen the government, scientists and industrialists will have to work together.

Endorsing the various views expressed by Shri Rahul Bajaj, Prof. Joshi said that: "after attaining Independence, we had not tried to properly assess our true potential. We had never tried to find out why India was an advanced nation for thousands of years, before the foreign invasions and colonial rule and why in the past it had a high share of global trade. After Independence, we held the notion that scientific developments were taking place only in the West and we should therefore learn from them, get the technologies from there. And it continued. We did not bother to see that Indians have the capability for high-level fundamental research and can develop their own technologies. All this has adversely affected our education system and economic progress.

He said we could still enhance our share in the world market through correct policies. To develop competitive hi-tech we need capital and energy. But at present we are deficient in both of these. In fact, the major reason for our budgetary deficit is the import of energy. This is happening because we want to follow the West. We have not tried to exploit our energy resources, e.g. solar and biomass energy necessitating a review of our energy policies.

An in-depth study of the socio-economic concerns was needed to evolve development and growth models appropriate to our needs. We should work for reducing our dependence on imported technologies because what we get from outside is old technology. This way we shall never be able to lead but only follow. Also, we should develop technologies that are employment-orientated and at the same time help in the economic growth of the country. We should identify 10 areas and try to attain international leadership in these, in say, 10 years time. We should have a larger number of Indian brands that are recognized all over the world.

Expressing his concern over the increasing gap between the developed and the developing nations, Prof. Joshi stressed the need for 'Sustainable Consumption' in place of Sustainable Development'. Quoting Gandhiji that "Nature has enough for every body's needs but not for anybody's greed".

Unveiling the portrait of Dr. Shyama Prasad Mukherji, Prof Joshi paid rich tributes to this great patriot, parliamentarian and academician. He was the youngest Vice-Chancellor of Calcutta University (1934-38) who had a bright dream for the growth of science and industry in the country. He was the first Vice President of CSIR, after Independence. In commemoration of the birth centenary of this great leader, Prof. Joshi announced the institution of 25 research Fellowships, christened as Dr. Shyama Prasad Mukherji Fellowships five each in Physics, Chemistry, Biology, Mathematics and Earth Science, which will be of Rs. 10,000 per month. The candidates appearing for 'NET' will have to compete in one additional paper for creativity.

Shri Bachi Singh Rawat, Minister of State for Science & Technology, in his presidential address said, "I am happy to note that CSIR is contributing to the growth of nation on diverse fronts, ranging from nurturing human resource for R&D to the development of technologies in strategic areas. Referring to the CSIR Young Scientist and Technology Award winning works he said, "I am glad to see a great diversity in the award winning accomplishments which range from hi-tech to the appropriate technology for soft coke. On one hand, IIP has been awarded for its contributions to the area of petroleum refining and on the other, SERC, Chennai, for its contributions towards mitigating damage to structures owing to cyclones. Expressing his concern that in spite of great strides in S&T in the country, the achievements have not been fully utilized by the industry to capture the economic benefits for the nation. Shri Rawat said, "To create a niche in the world market we cannot depend on borrowed and licensed technologies. We have to have our own technology base, even if we have to build upon the technologies borrowed earlier. Indian economy needs to drive more and more strength from technology led export and export of technology. For this, we may have to reassess, redistribute and reposition our intellectual capital and material resources. To enhance the technological base, to create more Indian brands in the world market is the main challenge before the scientists and technologists of this country. He also stressed the need for synergy between R&D institutions and industry".

Congratulating the award winners, Shri Rawat urged the awardees to stride to greater heights and not rest on their present laurels.

3

HEADQUARTER ACTIVITIES

The HQs. functions as a proactive nerve center for strategic planning; a catalyst and manager for change; repository of organizational learning, for policy guidelines and regulatory framework; intellectual property management for budgetary and financial allocations; an interface with government, parliament, apex umbrella industry and financial organizations; window for international collaboration; supporting extramural human resource development; legal matters; and vigilance support. Some of the activities during the year are covered here.

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

The Division acts as the interface between the CSIR laboratories and the Planning commission, on the one hand and overarching user agencies, financial bodies and industry associations on the other. It is responsible for devising the overall Plans for the CSIR and for devising the preparation of the laboratory-wise Plans. It acts as a watchdog of organizational business processes and procedures. Some of the more salient activities taken-up were:

Annual Plan 2001-2002 and Tenth Five Year Plan (TFYP)

Considering that 2001-2002 was the terminal year of the Ninth Plan and the plan programmes had to be brought to culmination, no new programmes /activities were thus proposed. The Annual Plan was formulated with an outlay of only Rs. 336 crore as against the allocation of Rs. 328 crore for the year 2000-2001. This was based on an extensive Zero Based Budgeting (ZBB) exercise undertaken by the Division in association with the Finance Division. The plan was deliberated and discussed with the Planning Commission and an allocation of Rs. 334 crore very much what CSIR had sought was agreed to.

The Government constituted a Working Group for the formulation of the Tenth Five Year Plan (2000-2007) for the DSIR & CSIR under the Chairmanship of Secretary, DSIR & DG, CSIR. The Working Group was serviced by the Division. A base document

was prepared for the first meeting of the group interalia on the approach, strategy and objectives for the TFYP. To work out detailed R&D plans for CSIR, the Working Group constituted fourteen sectoral subgroups for Aerospace, Biology and Biotechnology, Chemicals, Earth Resources and Natural Hazards Mitigation, Ecology & Environment, Electronics and Instrumentation, Energy, Food & Food processing, Health Care, Drugs & Pharmaceuticals, Housing & Construction, Information Dissemination and Products, Leather, Materials, Metals, Minerals and Manufacturing and Rural Development. The subgroups also serviced by the Division started functioning as per the TOR & guidelines formulated.

Efforts were made by the Division to seek exemption from the mandatory earmarking of budgetary allocation of 10% for the North-Eastern Region (NER). The exemption was sought on the premise that CSIR R&D outputs and activities were of benefit to diverse sectors and regions and CSIR & DSIR were already contributing for development of NER. Thus CSIR was granted exemption from 2001-2002 for making specific budgetary allocations for NER.

Unit for Research & Development of Information Products (URDIP)

CSIR has set up a Unit for Research and Development of Information Products (URDIP) at Pune with the objective of harnessing the synergy in the Information Technology area by networking the activities within and outside CSIR to develop marketable information products. The Unit started its operation, from the new premises in Pune, from November 2000. A multimedia laboratory was established and inaugurated by DG,CSIR. A database on traditional medicinal plants titled as 'Health Heritage' was brought out in CD format. It is an archival 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 scientific research during the past forty years. The first CD covers 50 medicinal plants most widely used in Ayurveda. Later CDs planned will cover other plants too. URDIP has taken up work to bring out full text database of patents granted to CSIR in CD format and web enabled services.

Development and commercialisation of bioactive molecules

The mammoth integrated programme involving 20 CSIR laboratories, 7 universities and three well known entities in the traditional system of medicine is coordinated by the Division. It had reached the stage of yielding useful results. The second phase of the programme was accordingly devised. Approval of EFC was obtained for consolidating and enlarging the programme over the next 3 years with an outlay of Rs. 32 crores. Based on the leads obtained, 36 dedicated discovery groups have been set-up for cancer, tuberculosis, filaria, malaria, hypertension, ulcer, hepatoprotective - cum immunomodulation, inflammation, Parkinsonism, depression and memory enhancer. As a result two entirely new antiulcer preparations have been

designed and formulated. Both of them have shown higher antiulcer activity as compared to the best drug clinically used for antiulcer activity. Short term toxicity studies are being completed and clinical trial protocols are being worked out. A new drug delivery system has been designed to target the drugs to cancer tissue of the liver. The drug entrapped in virosome is delivered into the cytosol through membrane fusion. New mechanisms for bioenhancing activity of piperine have been elucidated. Also two more plant extracts, besides piperine, have been found to yield bioenhancing activity, better than piperine. The programme has yielded 18 international patents, 7 new molecular targets and identification of 2 new bioactives.

Pilot plant for preparation of feedstock for microcrystalline waxes

The Division in view of its acknowledged expertise in management of technology has been assigned the special responsibility to put up the first ever pilot plant based on SPD technology to process vacuum residues. The SPD equipment was received at Calcutta in April, 2000 and was transported in trucks to the site in Digboi, Assam by May, 2000. The erection of the unit began in June/ July, 2000 and was completed in September, 2000. The structurals for the pilot plant were designed by EIL, work carried out by AOD under the supervision of UIC, Germany. The distillators, 7m high and 2m in dia. operate at a very high vacuum of 0.01 mbar and at temperatures of 400°C, thus an advanced test technique was devised to detect leakages in vacuum caused by as small as a hair gap. The plant was put to trial runs in December, 2000. A few teething operational problems were encountered in the trial runs. These problems were being resolved with the assistance of the supplier and the unit was expected to be commissioned in mid 2001.

Polytechnology Transfer Centres (PTCs)

CSIR has its PTCs located in the capital of seven states viz. Ahmedabad, Bhopal, Bangalore, Calcutta, Hyderabad, Lucknow and Patna. PTCs continued to assist amateur entrepreneurs and tiny, small and medium scale units to resolve their S&T problems, interact closely with the respective state Government and help disseminate S&T knowledge and catalyze business for CSIR laboratories. During the year in total PTCs attended about 3200 industrial enquiries, visited 550 industries, and identified 1200 problems which were appropriately tackled and satisfactorily resolved with the help of laboratories. PTCs organized about 150 demonstrations, workshops and training programmes and catalysed transfer of 40 CSIR technology.

Business development and marketing of knowledgebase

The Division continued its proactive assistance to laboratories for business development and marketing of knowledgebase in diverse fields. A total of 140 license agreement were executed for CSIR's intellectual property and contracts worth Rs. 420 crore for contract R&D and consultancy were in hand during the year. The



An agreement signing ceremony in progress with CMI, India at CSIR Hqs.

knowhow licensed for the first time during the year are given at Annexure III. The Division's proactive efforts led to signing of an agreement with M/s Opportunia Enterprises Pvt. Ltd. to market CSIR's knowledgebase (details in overview).

CSIR Technology Awards 2000

Applications for the CSIR Technology Awards were invited. Thirty two nominations were received which were processed by the Division for the consideration of the Technology Awards Selection Committee. The criteria for selection of awards was visible and sustained industrial/ economic/ societal impact of a high order. Only four Technology Awards could be awarded for the year. They were: for Biological Sciences & Technology to CCMB, Hyderabad - for developing a novel salt inducible expression system in *E. coli*; for Engineering Technology to CFRI, Dhanbad - for developing designs for a novel, ecofriendly, energy efficient and cost effective Device (oven) for production of soft coke and two shields, namely: for Process Technology to the teams at IIP, Dehradun, EIL and CPCL - for the development of NMP based refining technology for simultaneous production of quality lube oil base stocks (LOBS) and high BMCI extract; and (b) for Engineering Technology to the Wind Engineering Group at SERC, Chennai - for developing advanced analytical & computational





Hon'ble Minister S&T, Dr. Murli Manohar Joshi presenting CSIR Technology Awards

methodologies, experimental facilities and techniques in the field of wind engineering of buildings and structures including technologies for mitigating damage to structures due to cyclones.

Security & sensitivity clearance

The Government mandated that any contracts and contacts with foreign entities seek prior security and sensitivity clearance as per prescribed procedures and guidelines. The Division was assigned this responsibility of scrutinising all proposals from CSIR involving any foreign element and processing these appropriately. During the year 100 security and sensitivity clearances were processed.

New Idea Fund (NIF) Scheme

The project proposals for support under the NIF were invited, thirty five proposals were received. The proposals were processed for peer review by the Expert Committee in place for the purpose. The review of individual Experts indicated only a very few proposals qualifying the minimum standards of creativity laid for selection. Therefore the presentation by the Project Investigators(PI) to the NIF Expert Committee was not found to be tenable and was thus deferred. DG,CSIR then personally wrote to the Directors of the laboratories impressing the need to nurture creativity and exhorting more proposals. Thus no new NIF proposals could be supported during the year.

Interministerial linkages

The Division represented CSIR on various Committees of Government namely Ministries of Chemicals & Petrochemicals, Petroleum & Natural Gas, Environment & Forest, Health & Family Welfare, Department of Biotechnology, Department of Scientific & Industrial Research, Department of Indian Systems of Medicine etc.

3.2 INTERNATIONAL S&T AFFAIRS DIRECTORATE (ISTAD)

During the year, ISTAD facilitated foreign deputation of 689 CSIR scientists. Of these, around 186 were deputed for participation in international conferences/ seminars, 77 for training, 119 for ad-hoc visits, 172 under bilateral exchange programmes, 113 under fellowships & leaves and 6 as experts under UNDP project. Partial travel assistance was approved for about 405 non-CSIR scientists for participation in international conferences/symposia/seminars of relevance to CSIR. ISTAD also continued fortifying the bridges of understanding with the overseas Science and Technology partners of CSIR so as to develop synergies between the two. The major activities during the year were with the following countries:

Bangladesh

DG, CSIR India was invited by the Ministry of Science and Technology, Government of the People's Republic, Bangladesh to deliver the keynote address on

the event of the Birth Centenary of Dr. Qudrat-i-Khuda, founder of Bangladesh Council of Scientific and Industrial Research.

A six-member Bangladeshi delegation interested in medicinal & aromatic plants, on a study tour to India, visited RRL Jammu, NBRI, CIMAP, CDRI, ITRC. As a result CSIR was called upon to assist Bangladesh CSIR in setting up an institute similar to CIMAP and to train its scientists.

Czech

A 3-member CSIR delegation visited Czech Republic and reviewed the S&T cooperation. Fifteen new collaborative projects were taken up for implementation in the field of coal, supercritical fluid chromatography, gas separation, ceramics, neural networks, carbon-carbon composites, hormones etc.

Germany

CSIR-FZJ: An Indo-German joint workshop on Health Effects of Fibers and Particles was organised by ITRC with 10 German and 7 Indian experts. Of the 23 ongoing projects, 6 were completed and 5 new ones initiated.

NAL – DLR Cooperation Three scientists from NAL participated in the joint DLR-NAL workshop on "Pressure Sensitive Paint" held at Institute of Fluid Mechanics, Goettingen.

Japan

NIO and Japan Marine Science & Technology Centre agreed to collaborate in Oceanographic R&D including in joint expeditions.

Malaysia

The first Joint Committee Meeting between India and Malaysia was held in New Delhi. The Joint Committee decided to have Joint Seminars/Workshops in the areas of: Ayurvedic System of Medicine (in Malaysia); Advanced materials (in India); Vaccines Development (in India); and Bio-Informatics (in Malaysia).

Myanmar

A three member delegation from Myanmar visited NPL, National Accreditation Board of Laboratories and Bureau of Indian Standards to study the Indian capabilities in the area of Standards, Metrology and Quality Control. They have requested for India's assistance to improve the corresponding systems in Myanmar.

Poland

The S&T cooperation between CSIR and Polish Academy of Sciences was reviewed by a 3-member CSIR delegation deputed to Poland. A few new areas of cooperation were identified.

Russia

Under the Indo Russian Integrated Longterm Programme of S&T cooperation operated by DST, 22 joint projects were under implementation at various CSIR laboratories in the area of Engineering & Electronics Materials; Laser Science & Technology; Catalysis; Water Technology; Engineering Sciences; Earth Sciences; Life Sciences; Ecology & Environmental Protection etc.

Slovak

The S&T cooperation between CSIR and Slovak Academy of Sciences was reviewed. New programmes were initiated covering areas of : magnetic fluids and their composites; high tech super conductors; pharmacokinetics and polymers.

Sudan

A working programme between CSIR and the National Centre for Research, Sudan was prepared and signed. The areas selected for cooperation were : toxicity of plants; aromatic & medicinal plants; anti-malarial drugs; neem; scientific instrumentation, specialised data bases & information retrieval.

Thailand

A high level delegation from the Thailand Institute of Scientific & Technological Research (TISTR), visited India to review the existing CSIR-TISTR S&T programme. It was agreed to organise a joint workshop in the area of technology transfer and cooperation, for translation of TISTR popular science books & journals and exchange of popular science books & journals brought out by NISCOM.

UNDP-GOI Umbrella Programme

Workshops organized under the TOKTEN, UNISTAR & TCDC Umbrella Programme were: International Workshop on Sustainable Strategy for promoting Export Competitiveness in Knitwear Industry at Tirupur (Tamil Nadu) ; Brainstorming Workshop on Herbal Drugs Activity at RRL, Jammu; Brainstorming Workshop on National Natural Disaster Knowledge Network, CRRI, New Delhi.

USA workshops

Indo-US workshops were organized on biotechnology and pharmaceutical products development at CBT, NCL and CCMB. The focus was on : Policy issues governing IPR and technology management in India and the USA ; Indian industry's experience in technology management, government-industry-institute interactions, and Expectations and challenges of public funded R&D institutions in licensing technologies, building awareness on patent procedures and policies and technology assessment and transfer.

3.3 HUMAN RESOURCE DEVELOPMENT GROUP (HRDG)

CSIR efforts to pioneer S&T human resource development nationally were widely acclaimed. Two new initiatives mounted during the year, were the unique Shyama Prasad Mukherjee Fellowship that seeks to accord special incentive to young research fellows who exhibit creativity. A novel system was devised to identify creative researchers. The scientific community has acclaimed this programme to bring in excellence in R&D. The other initiative was the launch of integrated Ph.D. programme from the Bachelors stage. Initially it has been introduced in Biomedical Research in collaboration between Dr. B.R. Ambedkar Centre for Biomedical Research, Delhi University & CBT. Some of the more significant activities were as under:

Shanti Swarup Bhatnagar Prizes 2000

The Shanti Swarup Bhatnagar (SSB) Prize for science and technology managed by the group is awarded annually to scientists (who are not more than 45 years of age) for outstanding research work done primarily in India during the past five years. The SSB prize for the year 2000 was awarded to ten scientists.

Young Scientist Award 2000

The CSIR Young Scientist (YS) Award is given annually to CSIR scientists below 35 years of age in various fields of science and technology. Five scientists selected for the year 2000 were presented the award by Prof. Murli Manohar Joshi, Minister of Science & Technology and Human Resource Development on the CSIR Foundation Day 2000.

Junior Research Fellowship (JRF)

HRDG continued to organize the National Eligibility Test for the award of JRFs. The acceptability and popularity of NET has been constantly on the rise and the number

of candidates applying for the examination has multiplied over the years. A total of 73,555 applications were registered for the two NET examinations conducted during the year, of these 46,421 candidates appeared for the test and 1870 were selected for award of JRF.

Senior Research Fellowship (SRF)

Applications for SRFs and RAs were invited twice during the year on all India basis. Discipline-wise expert Committees evaluated and finally selected 445 candidates for the award of SRF.

Research Associateship (RA)

A one year RA ship is awarded directly to young research workers who have shown promise in original research and are pursuing their Ph.D. besides those who have completed their Ph.D. During the year a total of 960 applications were received out of which 327 candidates were selected for support.

Senior Research Associateship (Scientist Pool Scheme)

The erstwhile Scientist Pool scheme continued to support highly qualified Indian Scientific and Technical personnel trained in India or abroad for temporary placement. During the year 107 SRA's were awarded of which 82 joined. A total of 19,949 applicants have been selected up to March 2001; of these 10,486 joined the Pool Scheme.

Total Extramural HRD Support

Year	JRF	SRF	RA	SRA	Total
1999 - 2000	985	1982	939	410	4316
2000 - 2001	1404	2595	1248	320	5567

Extramural Research Schemes and Special Support Programmes

CSIR provides research grants to scientists and faculty members in the Universities with the objective of improving the overall scientific and engineering research in the country. About 200 research proposals out of a total of 530 were recommended during the year for support. In addition, 550 ongoing schemes were renewed.

In the sponsored research scheme the science part of a project is conducted at University, a CSIR laboratory takes up the applied research part and/ or technology development and the industry the commercialization or utilization of the technology.

Forty new proposals were received during the year and seven were recommended for support and 67 renewed.

Emeritus Scientist (ES) Scheme

Financial assistance was provided to superannuated outstanding scientists under the Emeritus Scientist (ES) scheme to enable them to pursue R&D and/ or write books/ monographs. One hundred and one new schemes were received of which twenty nine schemes were recommended for support while ninety four were renewed.

Travel and conference grants

Travel grant is provided to young researchers from academia for presenting papers at international conferences held abroad. The travel Grant Committee held eleven meetings during the year and considered 404 applications and recommended 218 cases. This Committee also considered 410 proposals from scientific societies/ institutes/ departments for support to organize national/ international conferences/ symposia/ workshops, and recommended 355 cases for support.

Intramural training programmes

In order to enhance the managerial skills of the Scientists, two training programmes on Management of R&D were arranged at the Administrative Staff College of India, Hyderabad. About 60 CSIR Scientists were benefited from these courses.

CSIR Programme of Youth for Leadership in Science (CPYLS)

The scheme continued to receive wide spread appreciation and accolades from both parents and students alike for the kindling of interest for pursuance of Science. Over one thousand top students of class X examination from all over the country participated in the two open days programme organised by the CSIR laboratories. Each of these students was accompanied by one of their guardians.

3.4 SOCIETAL & TECHNOLOGICAL MISSION DIVISION (STMD)

The Division coordinates the mission oriented programmes and activities in the CSIR including participation of CSIR in national mission programmes and those mounted by other agencies/departments.

Technology Mission on Oilseeds, Pulses and Maize (TMOP&M)

CSIR is designated as the nodal agency for Mini-Mission-II related to R&D on post harvest and processing technologies on oilseeds, pulses and maize. The Division helped mobilize around Rs. 900 lakh for the 38 ongoing and 17 new programs launched during the year. The new programmes envisaged an outlay of Rs. 590 lakh. The salient new programmes supported were for:

- Development of ceramic membrane modules for ultra filtration of vegetable oils for physical refining (CGCRI/IICT);
- Development of rhizosphere competent bioinoculants for application in pulses (NBRI);
- Large scale studies on 1 TPH maize dry milling pilot plant for commercial varieties of maize (CFTRI); and
- Development of sulphur glass frits (SGF) incorporating NPK fertilizer for delivery to oilseeds & pulses crops (CGCRI).

● Establishment of demonstration palm oil mills

In an effort to popularize palm oil cultivation and processing small capacity demonstration units were to be set-up in the states of Gujarat, Goa, Tamil Nadu & Orissa. Accordingly specification for 2.5T FFB/hr palm oil mills were drawn-up and bids invited by CSIR/RRL Tvm. After detailed evaluation of offers received and techno-commercial discussions with machinery manufacturers and suppliers, three project engineering companies were selected for implementing the projects. Contractual agreements were executed between CSIR, the beneficiaries and the project engineering firms for execution of the project. Continuous and tight coordination and monitoring was mounted by the Division to ensure timely completion of the project.

● Modernisation of huller rice mills in Uttar Pradesh

CSIR is implementing the project on modernization of rice hullers mills in UP by providing Rs. 25,000 as grant to the beneficiary and the bank provides the residual amount as loan to adopt rubber roller sheller for dehusking and cone polishing. The Division arranged for meetings with branch managers of Bank of Baroda to finalize the mode and mechanism for disbursal of the grant and loan. Three target districts were selected in the first instance with a view to modernize 1000 of the 5000 hullers estimated to be operating in UP.

● Establishment of 1 tpd oil expellers

MERADO, Ludhiana of CSIR has developed 1TPD, efficient and cost-effective, oil expeller to replace the traditional ghani especially for mustard & rap seeds. A 75%

subsidy on cost of the oil expeller is given to the beneficiaries. The Division ensured timely supplies to the beneficiaries in Assam and other states by MERADO, Ludhiana by tight monitoring and timely release of funds.

Mission for tea

Several CSIR laboratories are carrying out R&D related to diverse aspects of tea ranging from genomics of tea, to plucking machine for tea, to processing of tea, to automation of processing, to health effects of tea etc. Accordingly, meetings were organized with the tea industry, Ministries of IT and Commerce and CSIR laboratories to explore the possibilities of mounting mission for improving the productivity & quality of tea and enhancing the demand for it. As a result of these efforts, an integrated project on automation of tea industry was identified to be launched under the aegis of Ministry of Commerce (the administrative Ministry for the Industry).

Societal development

The Division continued its efforts to catalyse societal and economic development of the rural sector. Accordingly technologies developed by CSIR laboratories having relevance to different facets of rural scenario as well as micro and small scale industries were compiled in the form of a book, which was released on by Hon'ble Minister of State (S&T) on the occasion of CSIR Foundation Day. The book provides profiles of 365 technologies, categorised under five sectors, viz. Food and agro based; Building and construction; Drinking water; Environment and sanitation; Cultivation and processing of economic plants; Cottage and small scale industries (including leather processing, pottery, metal working, energy, fibres, stationery and miscellaneous items). This publication has proved useful for interaction with user ministries, departments, state development agencies, NGOs as well as Indian missions in developing countries. The contents of the book are also available at CSIR website. It is also being translated in several Indian languages.

Two special booklets were also brought out on CSIR technologies suited for Tripura and Arunachal Pradesh. They were distributed in these two states.

Human Resource Development

The Division organized/assisted in organization/sponsored/participated in a number of seminars/workshops during the year, namely:

- 3rd National Seminar on "Edible Rice Bran Oil" at Goa in Collaboration with Solvent Extractors Association (SEA) of India;
- National seminar on "Science-Industry Interface on Maize: Production, Processing and Utilisation" at Palampur in collaboration with Indian Society of Agriculture Biochemist;

- National seminar on "Indian Oilseeds and Edible Oil Sector: Challenges Ahead" at IICT Hyderabad in collaboration with OTAI (South Zone);
- National seminar on "Popularization of Oil Meal Usage in Compound Cattle, Poultry and Aqua Feed" at Pune in collaboration with Solvent Extractors Association (SEA) of India;
- National seminar on "Mustard Seed Processing: Emerging Challenges" at New Delhi in collaboration with Mustard Research & Promotion Consortium;
- National seminar on "Technology Status of Oilseeds & Oil Processing Industries in the Millenium" at New Delhi in collaboration with OTAI (North Zone); and
- International seminar "India Soy Forum 2001" in collaboration with Soybean Processors Association of India.

3.5 INTELLECTUAL PROPERTY MANAGEMENT DIVISION (IPMD)

The Division is charged with the implementation of the Intellectual Property Management Policy of CSIR. Among other the Division developed new strategies to enhance the value and the volume of CSIR's IP. Accordingly it deputed its scientists to laboratories to assist them in identifying patentable developments and improving upon their skills in drafting of IPR documentation. The outcome was astounding, leading to more than doubling of foreign patent filings from 199 to 452 during the year and copyright to 29, trademarks to 28.

In order to keep abreast of developments in IP management, the Division deputed twelve of its staff for training abroad arranged by Japan International Co-operation Agency (JICA), in administration of IP and Examination Practices, to the World Intellectual Property Organisation (WIPO) training course on Practical Aspects of Patent Information (at the Netherlands).

3.6 UNIT FOR SCIENCE DISSEMINATION (USD)

The USD continued to play a pivotal role in image building and public relations. It liaised with the print & electronic media and arranged coverage of various activities besides projecting products/processes/know-how developed by CSIR in major S&T expositions. It organized three major press conferences, two for NISTADS and a meet of DG,CSIR with senior editors of newspaper and issued 10 press releases. USD participated in five major Indian and 3 foreign S&T expositions. It catalysed the coverage of 30 CSIR technologies on the Turning Point Programme on TV.

4

DATELINE CSIR

April 2000	
8th	IICT received the ISO-9002 accreditation from M/S TUV, Germany for its wide range of Analytical services.
8th	The 42nd Foundation Day of NEERI was celebrated. Dr. D.N. Tewari, Member, Planning Commission was the Chief Guest at the function and Prof. V.K. Gaur, Distinguished Professor, IISc., Bangalore presided over the function.
10th	CSMCRI celebrated Foundation Day. Dr. R.A.Mashelkar, CSIR delivered the Foundation Day Lecture. A meeting of the CSMCRI customers was also organized.
12th – 13th	CMRI organized a two-day seminar on workers health with special reference to Indian industries in Hindi as a mark of completion of the year-long celebration of Rajbhasha Golden Jubilee Year. It was inaugurated by Dr. Nambar Singh, Former Professor of JNU, New Delhi.
18th – 20th	NBRI organized the 2nd Interaction Meet on Review of better Opportunities for Young Scientists in Chosen Areas of Science & Technology (BOYSCAST) Fellowship. Forty BOYSCAST Fellows, sponsored by DST to visit abroad, assembled from all parts of the country to present the work undertaken by them abroad and its utilization in the present set up.
22nd	CFRI Foundation Day: Prof. J.L. Chakraborty, Former Professor, Bengal Engineering College, Shibpur, Howrah delivered the Foundation Day lecture on "Future of Energy Scenario". Prof. R. Natarajan, Chairman, RC-CFRI gave presidential address which was followed by the release of CFRI Newsletter.
24th	An Advanced Center for Polymers formally inaugurated by Dr. R.A. Mashelkar, DG CSIR on the Foundation Day of CLRI.

May 2000	
2nd	A national workshop on Neem was organized by NBRI at CSIR Science Centre, New Delhi.
11th	CSIR and Constituent Laboratories celebrated National Technology Day. CDRI organized Regional level brainstorming session held under the New Millennium Indian Technology Leadership Initiative (NMITLI). CLRI organized a Regional Consultation Meeting of NMITLI in Chennai in association with SERC and CSIR Madras Complex. IMT celebrated Technology Day by organizing several programmes for the general public and students. A pictorial exhibition on research programmes and capabilities and a video presentation of some of technological achievements were put up. NEERI celebrated the Technology Day by conducting a brainstorming session on New Millenium Indian Technology Leadership Initiative. The brainstorming session was attended by various professionals from VRCE, CIIMS, Govt. Medical College, Govt. Dental College, J.N.R.D.C., R.R.S.S.C., M/s Indo Rama, Agricultural experts, retired Professors and Scientists. National Technology Day was celebrated at NML. The theme of the programme was the New Millennium Indian Technology Leadership Initiative (NMITLI). A brainstorming session on the Role of NML in Technology Development was held.
12th	IMT organised a meet New Millennium Indian Technology Leadership Initiative wherein invited representatives from University & industry and research scientists from IMT, CSIO and NIPER put forth their creative best ideas which if funded could have commercial implications. The meeting was attended by about 100 participants and generated a lot of interest and enthusiasm among them.
19th	Anti-terrorism day was observed by CSIR and its constituent laboratories.
31st	Sri Bachi Singh Rawat, Hon'ble Minister of State for Science & Technology, Govt. of India visited IICT & interacted with research groups on natural products based drug & agrochemicals.

June 2000	
5th	ITRC celebrated world environment day. The theme for the day was 2000: The Environment Millenium, time to Act. On this occasion a environmental survey report of Lucknow city was released. Dr. K.S. Parikh, Indira Gandhi Institute of Developmental Research, Mumbai was the chief guest. Prof. A. K. Sinha, Director, Birbal Sahni Institute of Paleobotany presided over the function. NEERI celebrated World Environment Day. Shri Paritosh C. Tyagi former chairman of Central Pollution Control Board (CPCB) was the Chief Guest.
6th	Dr. S. Narayan, I.A.S., Secretary, Ministry of Petroleum & Natural Gas, Govt. of India, New Delhi, laid the foundation stone for Science Block at NGRI.
7th	IHBT Annual Day. Dr. R.S. Paroda, DG, ICAR and Secretary, DARE was the chief guest, delivered the foundation day lecture on Biodiversity Management for Sustainable Agriculture. Dr. R.A. Mashelkar presided over the function. IHBT Annual Report was released by Dr. Paroda. Technology Adoption awards were given to two tea planters by Dr. Mashelkar for adopting CSIR technology.
10th – 14th	CFTRI participated in the Food Expo 2000 held on the occasion of Annual Meet of Institute of Food Technologies at Dallas, U.S.A.
26th – 28th	Biosys, CASA, ICAR and IHBT organized a planning workshop to develop a pilot project for Establishment of Sustainable Community Based Medicinal/Aromatic Plant Product Industry in H.P. Dr. V.L. Chopra inaugurated the meet.
July 2000	
4th	11th Sidhu Science Lecture on 'Natural Products Chemistry-A Retrospect & Prospect' delivered at IICT by Prof. Sukh Dev, Dr. B. R. Ambedkar Centre for Biomedical Research, New Delhi.
4th	Second Sub-Committee of the Committee of Parliament on Official Language conducted an inspection in six Central Govt. offices in Chandigarh. The Committee also visited CSIO. It was led by Dr. Laxmi Prasad, Deputy Chairman of the main committee. Besides Dr. Laxmi Prasad, the committee comprised of five members of Parliament.

7th – 8th	National Symposium on Mechanisms of Transcription & DNA-Protein Interactions was organized at IMT. Nearly 20 scientists from all over the country attended the symposium and presented their research findings.
18th – 20th	National Conference on 'Recent Trends in Biotechnology and Biocontrol Approaches of the New Millennium' at IICT under the joint auspices of Loyola College, Chennai & Loyola Aquatic Insect Biodiversity Society (LABS) was organised.
August 2000	
2nd	A high level Vietnamese delegation comprising H.E. Mr. Pham Sy Tam, the Ambassador E&P of the Socialist Republic of Vietnam, Mr. Pham Van Vu, Science Counsellar to India and the Ambassador's Private Secretary visited NBRI.
17th – 19th	A two day seminar on "Supervision of Research in Universities" was organized by the Association of Indian Universities (AIU) in collaboration with the NIO and Goa University. H.E. Shri Mohd. Fazal, Governor of Goa & Chancellor of Goa University was the chief guest and inaugurated the event.
25th	Symposium on "Challenges in Allergy & Infectious Diseases organized by CBT in collaboration with the College of Allergy and Immunology and Association of Clinical Biochemists of India.
26th	Dr. Murli Manohar Joshi, Vice President, CSIR visited NEERI. He went around various Divisions of the Institute and took keen interest in the work being carried out on the environmental biotechnology aspects, instrumental analysis as well as the use of modern tools of Information Technology such as Geographical Information System and Mathematical Modelling for the design of various systems. While addressing he stressed that in addition to sustainable development, sustainable consumption should be the approach towards solution of the environmental problems. He felt that the presently used Water Intensive Sewerage System needs to be replaced by an alternative system which uses less water. He said we should, as far as possible, adopt such systems which consume less energy and give high output and do not cost much.

September 2000	
1st – 14th	Hindi Pakhwara was celebrated in CSIR and its constituent laboratories. During this period several competitions viz., Hindi Essay Writing, Hindi Vocabulary, Hindi Calligraphy, Hindi Typing and Hindi Quiz were held to promote progressive use of Hindi.
12th – 13th	CSMCRI organized the national symposium on the seaweeds of India: Biodiversity and Biotechnology. Ninety-nine delegates attended the symposium. The symposium was conducted in eight technical sessions. Ten keynote addresses were delivered and eighty-five research papers were presented and deliberated upon.
14th – 15th	3rd Information Technology meet of CSIR laboratories was held at NML, wherein 15 CSIR laboratories and some commercial IT institutes participated.
18th – 20th	National Seminar on Environment Management in Drugs & Pharmaceutical Industries was organized at IICT by the Indian Society of Environmental Science & Technology (ISEST), Mumbai.
21st – 22nd	Parliamentary S&T Committee visited NCL.
25th – 26th	A two-day National Workshop on Trends in Ocean Sciences in 21st Century (TOS2K+) was organized by the Regional Centre of NIO at Visakhapatnam to commemorate the Silver Jubilee celebrations of the Centre. The workshop was inaugurated by Mr. K. Ratnaprabha, IAS, Development Commissioner, Visakhapatnam Export Processing Zone. The inaugural function was followed by a lecture by Dr. E. Desa, Director, NIO on "Gas Hydrates – A potential fuel resource" under S. Balakrishna Endowment Lecture organized by Andhra Pradesh Academy of Sciences.
26th	CSIR Foundation Day: Prof. Murli Manohar Joshi, Minister (S&T) and VP, CSIR presented the 2000 CSIR Young Scientist Awards and CSIR Technology Awards. Bhatnagar Awards for the year 2000 were announced. Shri Rahul Bajaj delivered the Foundation Day Lecture. The day was celebrated in all the CSIR constituents with great enthusiasm. Some important events in the laboratories were: CDRI: Prof. P.N. Tandon, President, National Brain Research Society, delivered an invited lecture on New opportunities for innovative therapies – some leads from neuroscience research.

	IMT: Foundation Day Lecture was delivered by Prof. Raghvendra Gadagkar, Chairman, Centre for Ecological Sciences, Indian Institute of Science, Bangalore on the topic "Cooperation and Conflict in Animal Societies". ITRC: Open Day observed for students and public. "Life Sciences: perspectives in the 21st Century" - a lecture was delivered by Prof. Indira Nath, INSA, S.N. Bose Research Professor, AIIMS, New Delhi. NIO: Institute was kept open for public in general and students in particular. Essay and debate competitions were held in various categories of students prior to the occasion and winners were awarded in the function.
27th	Shri Bachi Singh Rawat, Hon. Union Minister of State for S&T, inaugurated the multipurpose field laboratory complex at CIMAP.
October 2000	
16th – 18th	CLRI in association with the Carl Duisberg Gesellschaft (CDG) organized an Expert Committee meeting and a Management Training on Comparative Environmental Positioning of Indian Leather Industry in the World Market at Chennai.
17th – 21st	International Conference on Women with the theme 'Biotechnology, Environment & Non-Conventional Energy' held at IICT under the aegis of CSIR & the Third World Organisation of Women Scientists (TWOWS), Italy.
31st	Vigilance Day: The Birth day of Sardar Vallavbhai Patel, the first Home Minister of Independent India and Dy. Prime Minister was observed as Vigilance Day in all the CSIR laboratories. A pledge taking ceremony was held for adapting honesty and transparency in the activities of day-to-day life.
November 2000	
1st	NBRI celebrated its Annual Day. Dr. M. Thangavelu, Former Advisor WHO for Non-Communicable Diseases for South Asia presided over the function and delivered the 20th Silver Jubilee Lecture, entitled Plants & Life.

6th – 7th	National Seminar in Hindi "NAI SAHASTRABADI MAIN URJA VIKAS AUR PARYAWARAN SURAKSHA : SAMASYA AUR SAMADHAN" was organized at CFRI to celebrate the Golden Jubilee Year of Rajbhasha. Renowned educationist and former Vice-Chancellor of Gorakhpur University, Prof. B.M. Shukla was the Chief Guest.
4th – 5th	National Seminar on Prospects and Constraints of Chemical and Allied Industries in India was jointly organized by CFRI and the Institution of Engineers (India) Dhanbad. The seminar was inaugurated by Dr. R.A. Mashelkar, DG,CSIR, New Delhi.
5th – 7th	CSIO hosted the Zonal Group III of XXIII Shanti Swarup Bhatnagar Memorial (Outdoor) Tournament. Teams participated were from NCL; CLRI; RRL, Bhubaneswar; RRL, Jammu; RRL, Bhopal; INSDOC; CBT; NEERI; NML; CGCRI; and NIO. They took part in Cricket & Volleybal competitions.
23rd – 24th	For the first time in the history of CSIR Joint Meeting of Research Councils of CLRI and NEERI was held at CLRI. Areas of collaboration were identified. Issues related to the leather processing sector were discussed and strategic plans evolved.
26th	NML Golden Jubilee valedictory function was organized. Dr. A.P. J. Abdul Kalam, Principal Scientific Advisor, Govt. of India was the chief guest. Laboratory's annual report was released by Dr. J.J. Irani, Managing Director, Tata Steel. To mark the occasion a book on Metallurgy in India – A Retrospective was also released by Dr. Kalam.
27th – 28th	IMT conducted the second CSIR Programme on Youth for Leadership in Science in its campus by organizing several programmes for the meritorious students. Dr. D. Balasubramaniam, Research Director, L.V. Prasad Eye Research Institute, Hyderabad delivered a special lecture entitled Opportunities in New Biology. An exhibition on IMT's knowledgebase, computer modeling capabilities and laboratory experiments was held. The students actively participated in these events. On the second day a science quiz was held, the winners were presented science books by Dr. S. Mallick, Head, HRDG, CSIR HQs.
December 2000	
9th – 10th	The Annual Chrysanthemum & Coleus Show was organized by NBRI.

January 2001	
9th	Under Bright Sparks Programme of the British Council, Prof. Ian Hutchinson, University of Manchester, U.K. visited Chandigarh and delivered a public lecture at IMT on Gene & Immunity.
15th – 16th	NBRI organized the CSIR Programme on Youth for Leadership in Science (CPYLS). The programme was inaugurated by Dr. Nityanand, an eminent scientist and Ex-Director of the CDRI. The visiting students were briefed about various ongoing R&D activities and experiments.
19th – 20th	Participated at Chem-Expo India 2001 Exhibition (Chemical Weekly) held at World Trade Centre, Mumbai.
20th – 21st	CSIR Director's Conference at IICT: Prof. Murli Manohar Joshi, Hon'ble Minister of Human Resource Development, Govt. of India & Vice-President , CSIR inaugurated the Conference. The Annual Rose & Gladiolus Show was held at NBRI. The best entries were given certificate & prizes.
23rd	Final report containing the outcome of geophysical studies carried out in Kutch region for Hydrocarbon exploration was handed over to Sri Kuldeep Chandra, Executive Director, KDMIPE by Dr. Harsh K. Gupta, Director, NGRI.
23rd – 25th	15th CATSYMP and IPCA-2 International Conference at NCL organized.
24th	IMT celebrated its 17th Foundation Day. Foundation Day Lecture was delivered by Dr. R.A. Mashelkar, FRS on IPR and Economic Development: New Indian Challenge. The lecture was presided over by Prof. N.K. Ganguly, DG,ICMR. Dr. Amit Ghosh, Director. IMT presented the Annual Report of the Institute.
30th	A calibration Center for seismographs was inaugurated by Shri Bachi Singh Rawat, Minister of State for Science & Technology at CMRI.
February 2001	
1st	CDRI organized a programme under CPYLS. The students were addressed by Prof. S.S. Agarwal, Director, SGPGI. Visits to laboratories and exposure to experiments related to drug research was organized.

8th – 10th	3rd International Conference on Metrology in New Millennium and Global Trade (MMGT-2001) was organized by NPL and Metrology Society of India. It was inaugurated by Shri Bachi Singh Rawat, Honorable Minister of State for Science & Technology.
12th – 14th	CFTRI organized WHO Biennium Programme on Food Safety, in collaboration with DGHS/WHO, New Delhi.
16th	CDRI celebrated its 50th Foundation Day. Mellanby memorial oration on Proteomics in drug development was delivered by Peter Morse Larsen.
23rd - 2nd March	IUGS EC meetings organized at NGRI. Eminent scientists from various countries participated in this meeting. Apart from the EC meetings a one day seminar was organized on the occasion of Science Day.
26th – 27th	CSIO organized CPYLS Programme. Prof. G.S. Kalkat, V.C., PAU, Ludhiana was the Chief Guest. Dr. J.K. Chabra, Scientist CSIO, gave the inaugural lecture entitled Fibre Optics in Communications and Sensors. Capt. Rattan Singh presided over the function. Brochure on Mini Essential Oil Distillation Unit was released by Dr. Kalkat. Students were exposed to diverse S&T knowledgebase of IHBT and some hands on demonstrations were given.
28th	The National Science Day was celebrated in all the CSIR laboratories. The laboratories were kept open for visits, special lectures were organized and science quiz and essay competitions were held for school children. IHBT: Prof. Alok Bhattacharya, School of Life Sciences, JNU, N. Delhi delivered the keynote lecture on "Biology in the new millennium". Dr. P.K. Khosla, V.C., Ch. Sarwan Kumar University of Agriculture, Palampur presided over the function. Certificates were also distributed to the participating students of CPYLS programme. Dr. Khosla also released a technical folder on the two varieties of *Tagetes minuta* released by the Institute. IMT: Inter-college debate competition was held entitled Is mankind the ultimate step in evolution?. A total of 14 participants from 7 college participated in the event. It was well attended by a large number of people / students from various colleges and other research institutes. Prizes were given to the best debating team and also to the best debaters, for and against the motion.

	ITRC: A few scientists of ITRC visited various schools of Lucknow and delivered lectures on scientific topics to make the students up to date with the recent trends and various openings in basic sciences. The center observed this day as Open Day for public and students. An exhibition of the institutional activities was organized. Mr. O.N. Vaid, IAS, Secretary, Information Technology & Electronics, UP Govt. presided over the function. NML: Several important personalities from industry, research and public administration spoke to a large audience consisting mostly of high school students and teachers on the theme – Information Technology for Science Education.
March 2001	
3rd - 9th	NGRI organized Indo-Italian Workshop on Seismic Risk Evaluation. The workshop recommended three Indo-Italian collaboration projects under the "Umbrella Scheme" of Seismic Hazard Assessment, Microzonation and Risk Evaluation on Mega cities of India.
7th	NCL organized Indo-US Technology Management Workshop on Public – Private partnership in Biotechnology and Pharmaceutical product development in association with ISTAD, CSIR HQs.
13th – 18th	IICB coordinated the organization of the World Brain Awareness Week in Calcutta and adjoining areas. A total of 620 participants comprising of school students, parents of mentally ill children & general public benefited by the activity.
21st – 27th	27th Workshop on Respiratory Allergy: Diagnosis and Management was jointly organised by CBT and VP Chest Institute.

Annexure-I

INTELLECTUAL PROPERTY FROM CSIR DURING 2000-2001

LAB	PATENTS				COPY-RIGHTS	TRADE MARKS	
	INDIA		ABROAD		INDIA	INDIA	ABROAD
	FILED	GRANTED	FILED	GRANTED	FILED	FILED	FILED
CBRI	4	2	0	0	0	0	0
CBT	1	1	10	1	6	3	0
CCMB	0	0	24	1	0	0	0
CDRI	10	10	8	6	0	0	0
CECRI	13	8	3	2	0	0	0
CEERI	2	1	0	0	1	0	0
CFRI	7	1	4	0	0	0	0
CFTRI	61	2	26	1	0	0	0
CGCRI	25	2	3	1	0	0	0
CIMAP	10	1	38	7	0	0	0
CLRI	14	3	10	0	1	0	0
CMERI	5	2	0	0	0	0	0
CMRI	6	0	0	1	0	0	0
CRRI	0	0	0	0	0	0	0
CSIO	0	0	4	0	0	0	0
CSIR(SCH)	10	0	6	0	0	0	0
CSMCRI	6	1	5	0	0	0	0
IHBT	5	0	63	1	0	7	10
IICB	2	2	18	0	0	0	0
IICT	40	11	72	4	0	4	2
IIP	12	1	16	1	0	0	0
IMT	0	1	6	1	0	0	0
ITRC	3	2	0	0	1	0	0

NAL	6	0	1	0	3	2	0
NBRI	3	0	13	0	0	0	0
NCL	92	32	63	16	1	0	0
NEERI	0	0	0	4	3	0	0
NGRI	0	0	0	0	0	0	0
NIO	1	0	27	0	0	0	0
NML	7	7	0	0	3	0	0
NPL	5	2	8	3	3	0	0
RRL(Bhub)	10	2	0	0	0	0	0
RRL(Bhop)	1	3	0	0	0	0	0
RRL(Jm)	17	8	0	0	0	0	0
RRL(Jt)	20	10	1	4	0	0	0
RRL(T)	12	3	23	2	0	0	0
SERC(M)	0	0	0	0	7	0	0
TOTAL	410	118	452	56	29	16	12

Annexure – IA

FOREIGN PATENTS GRANTED – 2000-2001

LAB & TITLE	INVENTORS	*COUNTRY & PATENT NO.
CBT		
Microbial composition and its use in the neutralisation of alkaline waste waters.	Dayaram, M.S., Sharma, A., Kumar, A., Kumar, R. and Vishwanath, G.S.	GB 2342924
CCMB		
Process for identifying mutagens.	Bharatan, S. M., Reddy, M. and Jayaraman, G.	EP 1002872
CDRI		
Methods for preparing 1-[4- arylpiperazin-1-yl]-3-[2- oxopyrrolidin / piperidin-1-yl] propanes.	Sinha, N., Jain S., Saxena, A. K., Anand, N., Saxena, R.M. and Dubey, M.P.	US 6084097
Mycobacterium tuberculosis specific DNA fragment.	Srivastava, R., Kumar, D. and Srivastava, B.S.	US 6114514
Novel substituted 1,2,4-trioxanes as antimalarial agents and process of producing the substituted 1,2,4-trioxanes.	Singh, C. and Puri, S.K.	SL 12044
1-[4-arylpiperazin-1-yl]-3-[2-oxopyrrolidin/ pipe ridine-1-yl]propanes and their use in medical treatments.	Sinha, N., Jain, S., Saxena, A.K., Anand, N., Saxena, R.M., Dubey, M.P., Ray, M. and Pat, G.P.	US 6150367
Novel substituted 1,2,4-trioxanes as antimalarial agents and process of producing the substituted 1,2,4-trioxanes.	Singh, C. and Puri, S.K.	SA 2000/1642
CDRI+CI		
Formulation of dihydratemisinin for the control of wide spectrum of malaria.	Jain, D.C., Bhakuni, R.S., Sharma, R.P., Kumar, S. and Dutta, G.P.	SL 11674
CECRI		
Green emitting Tb3+ activated borate phosphors used in low pressure mercury vapour lamps and a process for synthesizing the same.	Subba Rao, G.V. and Sankar, R.	US 6090310

*AU=Australia, EP=European Patent, GB=Great Britain, KE=Kenya, PE=Peru
SL=Sri Lanka, SU=Soviet Union (Russia), US=USA, VI=Vietnam

Blue emitting Ce3+ activated borate phosphors used in fluorescent lamps and TV tubes and a process for synthesising the same.	Subba Rao, G.V. and Sankar, R.	US 6165385
CFTRI Noodles/Vermicelli from maize (corn, *Zea mays* L.) and a process for its preparation.	Sowbhagya, Chakrabhavi, M., Ali and Syed, Zakiuddin	US 6083551
CGCRI Synthetic granite tiles and a method of producing the same from beach sand garnet.	Kumar, A., Banerjee, G., Das, D. K., Nar Singh, Haldar and S.K.	US 6063720
CIMAP 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 Kumar, S.	SL 12045
Process for the isolation of Z & E Gugulsterones from aerial branches of *Commiphora wightii* (Guggul).	Agarwal, S.K., Tajuddin., Siddiqui M.S., Kumar, S., Khanna, A.K. and Ramesh, C.	US 6086889
Process for the production of important Taxol analogues 10-Deacetyl Taxol A,B and C.	Chattopadhyay, S.K., Kumar, S. and Sharma, R.P.	EP 1028116
A process for the simultaneous production of artemisnin and essential oil from the plant *Artemisia annua*.	Jain, D.C.,Tandon, S.,Bhakunt, R.S., Siddique, M.S., Kahol, A.P., Sharma, R.P. and Kumar, S.	US 5955084
Method for the use of alpha arteether as an anti-bacterial and anti-fungal agent.	Kumar, S., Khanuja, S.P.S., Santha Kumar, T.S., Jain, D.C., Srivastava, S., Bhattacharya, A.K., Saikia, D., Kumar, A., Darokar, M.P. and Sharma, R.P.	US 6127405
A formulation useful as a herbal cream for cracked heels and palms.	Dindra, R.L., Gupta, R., Shukla, Y.N., Dwivedi, S. and Kumar, S.	US 6126950
Process for the production of 4-Aryl-2-butanols from *Taxus wallichina*.	Chattopadhyay, S.K., Sharma, R. P. and Kumar, S.	US 6184367
CMRI Arch useful for withstanding effect of rockburst occurring in underground mines/tunnels.	Maity, S., Dhar, B.B. and Ghosh, P.R.	US 6102628

IHBT		
An improved method of tea propagation.	Prakash, O., Sood, A., Sharma, M and Ahuja, P.S.	KE KE 103
IICT		
Process for the production of esters.	Veldurthy, B., Lakshmi, K.M., Choudary, P.M., Raghavan, K.V. and Rao, K.K.	EP 1013632
Pesticidal dry powder formulation enriched in azadirachtin upto 88%.	Sankaran, AVB., Marthandamurthi, M., Akkewar, D.M., Ramgopal, V.S.S., Subramanyam, M., Srihari, V., Parthasarathy, T.N., Rao, A.N., Murthy, J.V.S. and Muneem, M.A.	AU 718833
Method for producing (+) (2s,3s) - 3- (2-Aminophenylthio)-2-Hydroxy-3(4'-Met Hoxyphenyl)-propionic acid.	Sadanandam, Y.S., Shetty, M.M., Ansari, I.A., Yadav, J.S. and Rama Rao, A.V.	US 6130352
Herbal formulation useful as a trerapeutic and cosmetic applications for the treatment of general skin disorders.	Diwan, P.V.R., Sitaraman, B.S., Ramakrishna, S. and Raghavan, K.V.	US 6200570
IIP		
Catalyst comprising oxides of silicon, zinc and aluminium used for the preparation of LPG and high octane aromatics and a process for preparing the same.	Pradhan, A.R., Viswanadham, N., Suresh, S., Ray, N., Shanker, U and Rama, T.S.	US 6177374
IMTECH		
Process for the isolation of a nontoxinogenic vibrio cholerae strain and a process for preparing cholera vaccine from said vibrio cholerae strain.	Muthukumarappa, T., Ghosh, A., Sharma, C., Gupta, N., Mukhopadhyay, A., Kole, H., Nair, G.B and Ghosh, R. K.	US 6106843
NCL		
Process for the preparation of new transition metal complexes.	Chaudhari, R.V., Seayad, J. and Majeed, S.A.	US 6069253
Process for oxidative conversion.	Choudhary, V.R., Uphade, B.S. and Mulla, Sar.	US 6087545
Microbial process for the production of D(-)-N- Carbamoylphenylglycine.	Gokhale, D.V., Bastawde, K.B., Patil, G., Kalkote, U.R., Joshi, R.R., Joshi, R.A., Ravindranathan, T., Jognand, V. V., Gaikwad, G.B and Nene, N.S.	US 6087136

(2r,3s,22r,23r)-2,3,22,23-Tetrahydroxy-24-Ethyl-Beta-Homo-7-Oxa-5-Alpha-Cholestan-6-one and a process for preparing the same.	Hazra, B.G., Joshi, P.L and Kumar, T. P.	US 6090952
Enantioselective resolution process for Arylpropionic acid drugs from the Racemic mixture.	Yadav, N.K., Kulkarni, B.D. and Khomane, R.B.	US 6093830
Process for the preparation of iburofen.	Chaudhari, R.V., Majeed, S.A. and Seayad, J.	US 6093847
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.	Srinivasan, S., Iyenger, R., Raut, K.G. and Swaminathan, S.	US 6118012
Halophilic pseudomonas strain having Accession No. NCIM 5109 (ATCC 55940) and a process for preparing D(-)N-carbamoylphenylglycine using said strain.	Sudge, S.S., Bastawade, K.B., Gokhale, D.V., Joshi, R.R., Kalkote, U.R., Ravindranathan, T.	US 6121024
A process for the preparation of adipic acid.	Robert,.R. and Ratnasamy, P.	EP 0784045
Process for the preparation of polyurethane spherical particle.	Lalgudi S.R. and Swaminathan, S.	US 6123988
Process for preparing Diltiazem.	Kbushan, L.B., Jayachandran, B.E., Khushan, L.V., and Ravindranathan, T.	US 6180785
Process for simultaneous preparation of sex specific and gender – neutral semisynthetic amplicons useful for sex determination.	Ranjekar, P.K., Parasnis, A.S. and Gupta, V.S.	US 6180345
Supported catalyst useful for Friedel -crafts reactions and process for the preparation of aralkylated aromatic compounds using the catalyst.	Choudhary, V.R., Jana, S.K. and Kiran , B. P.	US 6180557
A process for polymerization of olefins.	Senserma, S. and Sivaram, S.	US 6187882
Process for the activation of pervoskite type oxide.	Choudhary, V.R. and Banerjee, S.K.	US 6197719

Method and an apparatus for the identification and/or separation of complex composite signals into its deterministic and noisy components.	Viruthiamparambath, R., Kulkarni, B.D., Dixit, N.M and Vaish, N	US 6208951
NEERI		
Silica enriched fly ash based Zeolite-Y for use in automotive catalytic converters.	Kumar, L.N., Rayalu, S and Khanna, P.	GB 2339774
Producing silica enriched flyash based Zeolite-Y.	Kumar, L.N., Rayalu, S and Purushottam, D	GB 2339775
Process for the synthesis of flyash based Zeolite-A.	Labhasetwar, N.K., Rayalu, S and Khanna, P.	GB 2345056
NEERI (M)		
Universal support for the synthesis of oligonucleotides.	Kumar, P and Gupta, K.C.	US 6090934
NPL		
Formulation for iron chelation.	Kumar, S.A., Sudarshan, K., Harsh, P., Rattan, K.S., Ghansham, D.	AU 716895
Device useful as a master/slave clock for transmitting standard time over a telephone network and a telephone network incorporating the device for transmitting and receiving standard time.	Banerjee, P.	US 6091804
Conducting polymer membrane and a process for the preparation of the same membrane.	Ramadhar Singh, Chandra, S., Singh, H., Narula, A.K and Broor, S.	US 6156202
RRL (J)		
A sealing device useful for providing air-seal self controlled discharge of product from a process equipment such as a vertical shaft kiln.	Dutta, D.K., Ahmed, W., Barkakati, P., Bora, J.J., Kalita, S.C., Barkataki, A., Goswami, P.C and Borah, U.C.	VI 1257
An improved vertical shaft kiln useful for manufacturing cement and other allied produce, improved vertical shaft kiln and controlled discharge device.	Borah, U.C., Barkakati, P., Dutta, D.K.,Bora, J.J., Phukan, P., Dey, N.C., Ahmed, W., Kalita, S.C., Bordoloi, D and Baruah, A.	SU 2151325

A sealing device useful for providing air-seal self controlled discharge of product from a process equipment such as a vertical shaft kiln.	Dutta, D.K., Ahmed, W., Barkakati, P., Bora, J.J., Kalita, S.C., Barkataki, A., Goswami, P.C and Borah, U.C.	SU 2151352
A sealing device useful for providing air-seal self controlled discharge of product from a process equipment such as a vertical shaft kiln.	Dutta, D.K., Ahmed, W., Barkakati, P., Bora, J.J., Kalita, S.C., Barkataki, A., Goswami, P.C and Borah, U.C.	PE 000479
RRL (T)		
Process for preparing YBCO super conducting films on a ceramic substrate.	Koshy, J., Thomas, J.K., Kurian, J., Yadava, Y.P and Damodaran, A.D.	US 6121206
Ceramic substrate for bi-cuprate superconductors and a process for preparing the same.	Jacob, K., Kurian, J., Sajith, POO K., Krishnan, S.K., Jose, R., John, A.M and Damodaran, A.	US 6140275

IHBT		
An improved method of tea propagation.	Prakash, O., Sood, A., Sharma, M and Ahuja, P.S.	KE KE 103
IICT		
Process for the production of esters.	Veldurthy, B., Lakshmi, K.M., Choudary, P.M., Raghavan, K.V. and Rao, K.K.	EP 1013632
Pesticidal dry powder formulation enriched in azadirachtin upto 88%.	Sankaran, AVB., Marthandamurthi, M., Akkewar, D.M., Ramgopal, V.S.S., Subramanyam, M., Srihari, V., Parthasarathy, T.N., Rao, A.N., Murthy, J.V.S. and Muneem, M.A.	AU 718833
Method for producing (+) (2s,3s) - 3- (2-Aminophenylthio)-2-Hydroxy-3(4'-Met Hoxyphenyl)-propionic acid.	Sadanandam, Y.S., Shetty, M.M., Ansari, I.A., Yadav, J.S. and Rama Rao, A.V.	US 6130352
Herbal formulation useful as a trerapeutic and cosmetic applications for the treatment of general skin disorders.	Diwan, P.V.R., Sitaraman, B.S., Ramakrishna, S. and Raghavan, K.V.	US 6200570
IIP		
Catalyst comprising oxides of silicon, zinc and aluminium used for the preparation of LPG and high octane aromatics and a process for preparing the same.	Pradhan, A.R., Viswanadham, N., Suresh, S., Ray, N., Shanker, U and Rama, T.S.	US 6177374
IMTECH		
Process for the isolation of a nontoxinogenic vibrio cholerae strain and a process for preparing cholera vaccine from said vibrio cholerae strain.	Muthukumarappa, T., Ghosh, A., Sharma, C., Gupta, N., Mukhopadhyay, A., Kole, H., Nair, G.B and Ghosh, R. K.	US 6106843
NCL		
Process for the preparation of new transition metal complexes.	Chaudhari, R.V., Seayad, J. and Majeed, S.A.	US 6069253
Process for oxidative conversion.	Choudhary, V.R., Uphade, B.S. and Mulla, Sar.	US 6087545
Microbial process for the production of D(-)-N- Carbamoylphenylglycine.	Gokhale, D.V., Bastawde, K.B., Patil, G., Kalkote, U.R., Joshi, R.R., Joshi, R.A., Ravindranathan, T., Jognand, V. V., Gaikwad, G.B and Nene, N.S.	US 6087136

(2r,3s,22r,23r)-2,3,22,23-Tetrahydroxy-24-Ethyl-Beta-Homo-7-Oxa-5-Alpha-Cholestan-6-one and a process for preparing the same.	Hazra, B.G., Joshi, P.L and Kumar, T. P.	US 6090952
Enantioselective resolution process for Arylpropionic acid drugs from the Racemic mixture.	Yadav, N.K., Kulkarni, B.D. and Khomane, R.B.	US 6093830
Process for the preparation of iburofen.	Chaudhari, R.V., Majeed, S.A. and Seayad, J.	US 6093847
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.	Srinivasan, S., Iyenger, R., Raut, K.G. and Swaminathan, S.	US 6118012
Halophilic pseudomonas strain having Accession No. NCIM 5109 (ATCC 55940) and a process for preparing D(-)N-carbamoylphenylglycine using said strain.	Sudge, S.S., Bastawade, K.B., Gokhale, D.V., Joshi, R.R., Kalkote, U.R., Ravindranathan, T.	US 6121024
A process for the preparation of adipic acid.	Robert,.R. and Ratnasamy, P.	EP 0784045
Process for the preparation of polyurethane spherical particle.	Lalgudi S.R. and Swaminathan, S.	US 6123988
Process for preparing Diltiazem.	Kbushan, L.B., Jayachandran, B.E., Khushan, L.V., and Ravindranathan, T.	US 6180785
Process for simultaneous preparation of sex specific and gender – neutral semisynthetic amplicons useful for sex determination.	Ranjekar, P.K., Parasnis, A.S. and Gupta, V.S.	US 6180345
Supported catalyst useful for Friedel -crafts reactions and process for the preparation of aralkylated aromatic compounds using the catalyst.	Choudhary, V.R., Jana, S.K. and Kiran , B. P.	US 6180557
A process for polymerization of olefins.	Senserma, S. and Sivaram, S.	US 6187882
Process for the activation of pervoskite type oxide.	Choudhary, V.R. and Banerjee, S.K.	US 6197719

Method and an apparatus for the identification and/or separation of complex composite signals into its deterministic and noisy components.	Viruthiamparambath, R., Kulkarni, B.D., Dixit, N.M and Vaish, N	US 6208951
NEERI		
Silica enriched fly ash based Zeolite-Y for use in automotive catalytic converters.	Kumar, L.N., Rayalu, S and Khanna, P.	GB 2339774
Producing silica enriched flyash based Zeolite-Y.	Kumar, L.N., Rayalu, S and Purushottam, D	GB 2339775
Process for the synthesis of flyash based Zeolite-A.	Labhasetwar, N.K., Rayalu, S and Khanna, P.	GB 2345056
NEERI (M)		
Universal support for the synthesis of oligonucleotides.	Kumar, P and Gupta, K.C.	US 6090934
NPL		
Formulation for iron chelation.	Kumar, S.A., Sudarshan, K., Harsh, P., Rattan, K.S., Ghansham, D.	AU 716895
Device useful as a master/slave clock for transmitting standard time over a telephone network and a telephone network incorporating the device for transmitting and receiving standard time.	Banerjee, P.	US 6091804
Conducting polymer membrane and a process for the preparation of the same membrane.	Ramadhar Singh, Chandra, S., Singh, H., Narula, A.K and Broor, S.	US 6156202
RRL (Jt)		
A sealing device useful for providing air-seal self controlled discharge of product from a process equipment such as a vertical shaft kiln.	Dutta, D.K., Ahmed, W., Barkakati, P., Bora, J.J., Kalita, S.C., Barkataki, A., Goswami, P.C and Borah, U.C.	VI 1257
An improved vertical shaft kiln useful for manufacturing cement and other allied produce, improved vertical shaft kiln and controlled discharge device.	Borah, U.C., Barkakati, P., Dutta, D.K.,Bora, J.J., Phukan, P., Dey, N.C., Ahmed, W., Kalita, S.C., Bordoloi, D and Baruah, A.	SU 2151325

A sealing device useful for providing air-seal self controlled discharge of product from a process equipment such as a vertical shaft kiln.	Dutta, D.K., Ahmed, W., Barkakati, P., Bora, J.J., Kalita, S.C., Barkataki, A., Goswami, P.C and Borah, U.C.	SU 2151352
A sealing device useful for providing air-seal self controlled discharge of product from a process equipment such as a vertical shaft kiln.	Dutta, D.K., Ahmed, W., Barkakati, P., Bora, J.J., Kalita, S.C., Barkataki, A., Goswami, P.C and Borah, U.C.	PE 000479
RRL (T)		
Process for preparing YBCO super conducting films on a ceramic substrate.	Koshy, J., Thomas, J.K., Kurian, J., Yadava, Y.P and Damodaran, A.D.	US 6121206
Ceramic substrate for bi-cuprate superconductors and a process for preparing the same.	Jacob, K., Kurian, J., Sajith, POO K., Krishnan, S.K., Jose, R., John, A.M and Damodaran, A.	US 6140275

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	Dr. M.M. Joshi Minister for Human Resource Development and Science & Technology Anusandhan Bhavan Rafi Marg New Delhi 110 001	Vice-President
3	Shri Yashwant Sinha Minister of Finance North Block New Delhi 110 001	Member
4	Shri Murasoli Maran Minister of Industry Udyog Bhavan New Delhi 110 011	Member
5	Prof. R. Narasimha (Chairman, CSIR Advisory Board) Director National Institute of Advance Studies Indian Institute of Science Bangalore 560 012	Member
6	Shri Jamshed J. Irani Managing Director Tata Iron & Steel Co. Limited (TISCO) Jamshedpur 831 001	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. Hari Gautam Chairman University Grants Commission Bahadur Shah Zafar Marg ew 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
12	Dr. A.P.J. Abdul Kalam Principal Scientific Adviser to the Govt. of India 319, Vigyan Bhavan Annexe Near Vigyan Bhavan Maulana Azad Road New Delhi 110 001	Member
13	Shri Arun Bharat Ram President, CII Confederation of Indian Industry (CII) 23-26, Institutional Area Lodi Road New Delhi 110 003	Member
14	Shri Ramesh Burman Dabur India Limited Punjabi Bhavan 10, Rouse Avenue New Delhi 110 002	Member
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
18	Shri Arun Bhatnagar Secretary Department of Rural Development Krishi Bhavan Dr. Rajendra Prasad Road New Delhi 110 001	Member
19	Shri Vinay Kohli Secretary Ministry of Information Technology Electronics Niketan 6, CGO Complex, Lodi Road New Delhi 110 003	Member
20	Shri M.K. Kaw Secretary Department of Education Ministry of Human Resources Development Shastri Bhavan Dr. Rajendra Prasad Road New Delhi 110 001	Member
21	Prof. Goverdhan Mehta President Indian National Science Academy Bahadur Shah Zafar Marg, ITO New Delhi 110 002	Member
22	Shri C.M. Vasudev Secretary (Expenditure) Ministry of Finance Government of India North Block New Delhi 110 001	Member-Finance*
23	Dr. T. Ramasami Director Central Leather Research Institute Adyar Chennai 600 020	Member*
24	Prof. S.K. Brahmachari Director Centre for Biochemical Technology Near Jubilee Hall, University Campus Mall Road Delhi 110 007	Member*

25	Shri H.S. Singhania President J.K. Organisation Nehru House 4, Bahadur Shah Zafar Marg New Delhi 110 002	Member*
26	Shri Vivek Singhal 24, Palam Marg Vasant Vihar New Delhi 110 057	Member*
27	Prof. C.L. Khetrapal Distinguished Professor Centre of Biomedical Magnetic Resonance Sanjay Gandhi Post Graduate Institute of Medical Sciences Rae Bareli Road Lucknow 226 014	Member*
28	Prof. Ashoka Chandra Special Secretary Department of Education Ministry of HRD Shastri Bhavan New Delhi 110 001	Member*
29	Prof. R. Kumar Fellow Jawaharlal Nehru Centre for Advanced Scientific Research Indian Institute of Science Campus Bangalore 560 012	Member*
30	Prof. V.S. Ramamurthy Secretary Department of Science & Technology Technology Bhavan New Mehrauli Road New Delhi 110 016	Member*
31	Dr. R. Katoch Adviser (S&T) Planning Commission Yojana Bhavan Sansad Marg New Delhi 110 001	Member*
32	Dr. R.A. Mashelkar, FRS Director-General Council of Scientific & Industrial Research Anusandhan Bhavan Rafi Marg New Delhi 110 001	Ex-officio Secretary of CSIR Society & Chairman GB

*As member of CSIR Governing Body

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	Dr. M.M. Joshi Minister for Human Resource Development and Science & Technology Anusandhan Bhavan Rafi Marg New Delhi 110 001	Vice-President
3	Shri Yashwant Sinha Minister of Finance North Block New Delhi 110 001	Member
4	Shri Murasoli Maran Minister of Industry Udyog Bhavan New Delhi 110 011	Member
5	Prof. R. Narasimha (Chairman, CSIR Advisory Board) Director National Institute of Advance Studies Indian Institute of Science Bangalore 560 012	Member
6	Shri Jamshed J. Irani Managing Director Tata Iron & Steel Co. Limited (TISCO) Jamshedpur 831 001	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. Hari Gautam Chairman University Grants Commission Bahadur Shah Zafar Marg ew 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
12	Dr. A.P.J. Abdul Kalam Principal Scientific Adviser to the Govt. of India 319, Vigyan Bhavan Annexe Near Vigyan Bhavan Maulana Azad Road New Delhi 110 001	Member
13	Shri Arun Bharat Ram President, CII Confederation of Indian Industry (CII) 23-26, Institutional Area Lodi Road New Delhi 110 003	Member
14	Shri Ramesh Burman Dabur India Limited Punjabi Bhavan 10, Rouse Avenue New Delhi 110 002	Member
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
18	Shri Arun Bhatnagar Secretary Department of Rural Development Krishi Bhavan Dr. Rajendra Prasad Road New Delhi 110 001	Member
19	Shri Vinay Kohli Secretary Ministry of Information Technology Electronics Niketan 6, CGO Complex, Lodi Road New Delhi 110 003	Member
20	Shri M.K. Kaw Secretary Department of Education Ministry of Human Resources Development Shastri Bhavan Dr. Rajendra Prasad Road New Delhi 110 001	Member
21	Prof. Goverdhan Mehta President Indian National Science Academy Bahadur Shah Zafar Marg, ITO New Delhi 110 002	Member
22	Shri C.M. Vasudev Secretary (Expenditure) Ministry of Finance Government of India North Block New Delhi 110 001	Member-Finance*
23	Dr. T. Ramasami Director Central Leather Research Institute Adyar Chennai 600 020	Member*
24	Prof. S.K. Brahmachari Director Centre for Biochemical Technology Near Jubilee Hall, University Campus Mall Road Delhi 110 007	Member*

25	Shri H.S. Singhania President J.K. Organisation Nehru House 4, Bahadur Shah Zafar Marg New Delhi 110 002	Member*
26	Shri Vivek Singhal 24, Palam Marg Vasant Vihar New Delhi 110 057	Member*
27	Prof. C.L. Khetrapal Distinguished Professor Centre of Biomedical Magnetic Resonance Sanjay Gandhi Post Graduate Institute of Medical Sciences Rae Bareli Road Lucknow 226 014	Member*
28	Prof. Ashoka Chandra Special Secretary Department of Education Ministry of HRD Shastri Bhavan New Delhi 110 001	Member*
29	Prof. R. Kumar Fellow Jawaharlal Nehru Centre for Advanced Scientific Research Indian Institute of Science Campus Bangalore 560 012	Member*
30	Prof. V.S. Ramamurthy Secretary Department of Science & Technology Technology Bhavan New Mehrauli Road New Delhi 110 016	Member*
31	Dr. R. Katoch Adviser (S&T) Planning Commission Yojana Bhavan Sansad Marg New Delhi 110 001	Member*
32	Dr. R.A. Mashelkar, FRS Director-General Council of Scientific & Industrial Research Anusandhan Bhavan Rafi Marg New Delhi 110 001	Ex-officio Secretary of CSIR Society & Chairman GB

*As member of CSIR Governing Body

Annexure – V

MEMBERS OF ADVISORY BOARD

1. Prof. R. Narasimha
Director
National Institute of Advance Studies,
Indian Institute of Science
Bangalore – 560 012

2. Dr. R.A. Mashelkar
Director General, CSIR

3. Dr. K.V. Raghavan
Director
Indian Institute of Chemical Technology, Uppal Road
Hyderabad – 500 007

4. Dr. Krishan Lal
Director
National Physical Laboratory
Dr. K.S. Krishnan Marg
New Delhi- 110 012

5. Dr. T. Ramasami
Director
Central Leather Research Institute
Chennai – 600 020

6. Prof. Goverdhan Mehta
Director
Indian Institute of Science
Bangalore – 560 012

7. Dr. N.R. Narayana Murthy
Chairman
Infosys Technologies Ltd.
Electronic City Office
3rd Cross, Hosur Road
Bangalore – 561 229

8. Dr. K. Anji Reddy
Chairman
Dr. Reddy's Laboratories Ltd.
7-1-27, Ameerpet
Hyderabad – 500 016

9. Shri Kumarmangalam Birla
Chairman
A.V. Birla Group of Companies
Industry House, 6th Floor
159, Church Gate Reclamation
Mumbai-400 020

10. Shri H.F. Khorakiwala
Chairman cum Managing Director
Wockhardt Ltd.
Pharma Search House
72/73 Worli Hill Estate
Dr. BG Kher Marg, Worli
Mumbai – 400 018

11. Prof. Partha N. Mukherji
Director
Council for Social Development
Sangha Rachna
53, Lodi Estate
New Delhi – 110 003

12. Prof. V.S. Ramamurthy
Secretary
Deptt. of Science & Technology
Technology Bhavan
New Mehrauli Road
New Delhi – 110 016

13. Dr. (Mrs.) Manju Sharma
Secretary
Ministry of Science & Technology
Deptt. of Biotechnology
Block 2, 7-8th floor, CGO Complex
Lodhi Road
New Delhi – 110 003

14. Dr. N.K. Ganguly
Director General
Indian Council of Medical Research
Ansari Nagar, P.B. 4911
New Delhi – 110 029

15. Shri Ajit Kumar
Secretary
Department of Industrial Policy & Promotion
Ministry of Industry, Udyog Bhavan
New Delhi – 110 011

