# O V E R V I E W

The Council of Scientific and Industrial Research, a multilocational network of national laboratories/institutes, has the mandate to undertake research and development projects in diverse fields of science and technology, with emphasis on applied research and utilization of results thereof. There are at present 38 research establishments including five regional research laboratories. Some of the establishments have also set up experimental, survey field stations to further their research activities and 39 such stations attached to 16 laboratories are functioning at present.

In general, all the laboratories are well equipped for undertaking basic and applied research, including development work. Many of them work on industrial raw materials and have research programmes on their beneficiation, testing and standardization. Many problems of industry, and even of pure science, being multi-disciplinary in character require for their solutions, the knowledge and techniques of more than one branch of science and call for team-work. CSIR laboratories have created facilities for such team-work; the 38 laboratories provide synergistic, discipline specific, research platforms.

During the Tenth Five Year Plan, CSIR has conceptualized network projects involving various CSIR laboratories and other R&D establishments. The results of networking are very encouraging.

The Annual Report 2005-06 presents CSIR's S&T contributions in the sectors such as Aerospace Science & Technology, Biology & Biotechnology, Chemical Science & Technology, Earth Resources & Natural Hazards Assessment, Ecology & Environment, Energy, Food & Food Processing, Health Care, Drugs & Pharmaceuticals, Housing & Construction, Information Dissemination & Products, Leather, and Material, Minerals, Metals & Manufacturing. Various activities related to Central Management and Headquarters are also detailed in the Report. The section on 'Dateline CSIR' lists the significant events that took place at various CSIR constituent laboratories during the year.

Some of the notable achievements of the year 2005-06, as presented in this report, are:

**Anti-leukemic compound from *paan* leaves**

IICB scientists have isolated from the leaf of the betel plant (*piper betel*) a compound that is able to induce death of cancer cells in chronic myeloid leukemia (CML) — a type of cancer that attacks white blood cells. Locally known as *paan,* the leaf is widely chewed by people in the Indian subcontinent as an aid to digestion. The compound, that has the same structure as chlorogenic acid (*Chl*), kills cancerous CML cell lines without harming normal cells.

**New lead molecule for malaria**

NIO has reported that the crude extract prepared from a marine organism (mussel) by the enzyme-acid hydrolyzing process shows a potent anti-malarial

activity, when examined for *in-vitro* cultures of *Plasmodium falciparum* in human erythrocytes. The molecular entity responsible for anti-malarial activity was isolated & characterized. These molecules present themselves as promising candidate drugs for malaria and may be used in conjunction with conventional drugs. The active compound is relatively cheap to obtain and can readily be prepared in bulk without killing the mussel. The Mumbai-based company M/s Shreya Life Sciences has been licensed to commercialize the drug.

**Oral delivery of insulin & Hepatitis B vaccine**

IICT has developed a process for the oral delivery of Insulin and also of Hepatitis B vaccine. This new invention is a boon to the diabetic population showing the reduction of blood glucose levels comparable to that of the injectable insulin. The preclinical toxicity studies have been planned and the clinical trials in India and Europe will be taken up simultaneously later. Similarly, the oral delivery of Hepatitis B vaccine has demonstrated the generation of anti-body titres to a single dose of oral delivery is comparable to that of injectable Hepatitis B vaccine. This technology will deliver Hepatitis B vaccine through oral route. Oral administration of this vaccine provides the easiness in administering the vaccine to the infants and children.

**Bioactive integrated orbital implants**

CGCRI has designed and fabricated two varieties of porous hydroxyapatite-based orbital implants which have been clinically tried in more than 100 patients at different hospitals in India, as yet with no report of post-operative complications. One of the significant advantages of these Hap implants over the glass/polymeric material is that they become invested with fibro-vascular tissues of the orbit and provide natural movement to the eye. This artificial eye is very light (less than 2 gms) and costs only Rs. 2000/- compared to around Rs. 25000/- for the imported ones. Technology has been transferred to M/s IFGL Bioceramics Ltd., Kolkata.

**Collagen-based biomaterials**

CLRI has developed Gelatin micro spheres wherein SSD loaded collagen membranes have been evaluated for wound healing. It was found that wound healing is accelerated by ~ 60%. Batch process for soluble collagen and four wound care management products has been standardized.

**Fawn birth by artificially insemination**

CCMB has achieved successful delivery of a live fawn by artificial insemination of a female deer. This is the first successful artificial non-surgical intra-vaginal insemination in the spotted deer in India, which led to the birth of a fawn. With this, India has joined Australia and United States of America, the only two other countries to achieve this remarkable feat using the same procedure. This success could form the basis for future attempts to increase the numbers of other endangered deer species and other animals in our country.

### Control of quiescence in muscle stem cells

CCMB established a culture model of quiescent satellite cells using $G_0$ synchronized myoblasts. Studies at CCMB suggests that regulation at multiple levels from chromatin modulation of transcription to regulation of cytoskeletal and membrane dynamics, and metabolic controls of nutrition, energy and cellular redox state co-operate to sustain the arrested progenitor cell, prevent precocious differentiation and maintain signal responsiveness.

### Arsenic and Iron removal plant

CGCRI has developed technology for arsenic and iron removal based on ceramic membrane technology for the production of safe drinking water from contaminated ground water. The technology has been transferred to industry. CGCRI has installed eight community models of arsenic and iron removal plants of capacity of 2500 litre per day which are operating in West Bengal. Sixteen iron removal plants are under installation in eight North Eastern States. The technology conforms to WHO standards and has led to employment generation.

### "CIM-ASVIKA" multi-utility portable distillation unit

CIMAP released a low cost and simple to operate multi-utility portable distillation unit "CIM-ASVIKA" useful for the farmers in rural areas and small scale entrepreneurs. Features include low cost portable type unit specially designed for producing high quality natural rose water. It can also be used for extraction of spices and other aromatic oils. It has pure stainless steel construction with long life, efficiently designed with shell and tube condenser for proper condensation and complete oil recovery. It can be operated with firewood, agro wastes, LPG/kerosene burners. There is no pollution at workplace due to provision of chimney and can be operated even by laypersons.

### Synthesis of FEMA GRAS approved flavouring agent: 4-vinylguaiacol

4-Vinylguaiacol and other 4-vinylphenols are the most extensively studied class of natural compounds due to its widespread applications in food and alcoholic beverages, flavouring substances and as intermediates in the preparation of polymers and copolymers useful in coatings, electronic applications, ion exchange resins, photo resists, etc. IHBT has developed a unique and novel process for the synthesis of 4-vinylphenols in microwave curtailing the two step process into a single step in an environment friendly manner. The method developed imbibed the principles of green chemistry and reflects the advantages over the existing protocols. Also, the cost of production is reduced manifold.

### PWM amplifier for electromechanical actuator

CEERI has developed integrated position control system for an underwater guided vehicle. It has pulse width modulation scheme for high efficiency bi-directional PWM scheme for improved stiffness, conforms to mil 883 environmental specification with cost and reliability competitive with other international products.

### Myoelectric arm

CSIO, in collaboration with CMERI, has developed lab model of myoelectric arm. The prototype was tested on patients at National Institute for Orthopaedically Handicapped (NIOH), Kolkata. The patients were able to perform many mechanical activities with this arm, viz. drinking water, writing, plucking flowers, picking and placing of objects from one place to another.

### 20KW radio frequency quadruple (RFQ)

CMERI, in collaboration with Variable Energy Cyclotron Centre (VECC), Kolkata has designed, developed and fabricated 20KW Radio Frequency Quadruple (RFQ). The RFQ is operating at 33.7 MHz accelerated 21 KeV $3^{+16}O$ beam from the ECR up to an energy level close of 500 KeV. The beam achieved a transmission efficiency of almost 100%, a remarkable record in this area of high technology. The unit has been installed at VECC, Kolkata.

### Indigenous Molecular Beam Instrument

NCL has developed a simple, compact and economically viable Molecular Beam Instrument (MBI). Catalytic reactions are, in general, too complex and information on the elementary steps is not easily available. MBI enables study of heterogeneous catalytic reactions on active metal surface in a clean environment under vacuum and provides fundamental information about the catalytic reactions, such as, transient kinetics and kinetic parameters. Such vital information helps to derive the mechanistic pathway of complex reactions. With high local coverage on the substrate under clean environment, MBI bridges the pressure gap between the real-world catalysts working at atmospheric or higher pressure and other conventional experiments carried out under high vacuum.

### Ultrafiltration membrane-based water purifier

NCL has developed an ultrafiltration membrane with pores too small to permit viruses and bacteria. Special additive used in the dope solution for membrane casting controls membrane porosity and offers membranes with desirable pore size. It operates on normal tap water pressure (0.5 bar) and does not require electricity.

### Small tractor

CMERI has developed a 10HP small tractor named as **Krishishakti** to aid farm mechanization. Weighing at 800 kg it has single cylinder, water cooled, 10HP diesel engine and has automatic draught control with lifting capacity of 450 kg.

### Long afterglow luminescent powder

NPL has developed long decay phosphor powder which can be processed into many different media and can be used in a variety of applications. The applications include back lighting of liquid crystal displays, bank notes, enamels and ceramic tiles, flexible & rigid plastics for switches and consumer goods, warning signs, accident prevention, etc.

### Health assessment of bridges and other structures

SERC has designed fiber optic sensor based structural health monitoring towards predicting the time-dependent losses in prestressing steel and evaluating the stress condition of concrete in the beam. A post-tensioned prestressed concrete I-beam of 5.2m long has been prepared and instrumented with embedment type and surface mounting type EFPI fiber optic sensors at mid span and one quarter span. Adjacent to fiber optic strain sensors, surface mounting type vibrating wire strain gauges were also instrumented to compare the response of fiber optic strain sensors. Strain and temperature values from all the sensors were recorded during prestressing and applied prestressing. Monitoring the performance of the instrumented prestressed concrete I-beam has been carried out over 225 days. Time-dependent prestress losses have been computed from the measured data and these values compare closely with American Concrete Institute (ACI) method.

### Dynamic fog forecasting system

C-MMACS has developed and calibrated a visibility model Fog Forecast Engine which is a combination of high performance computing, new generation dynamical meso-scale models, advanced data analysis and informatics. The platform has been tested in an operational setting since November, 2005 for Delhi Airport, with a web-based sales management system. The forecasts for the winter of 2005-06, communicated to a number of scientists for post-forecast validation, have been fairly accurate with only three misses and two (marginal) false warnings. An on-site validation, through a meso-scale observation network is already under implementation.

### Recognition of CSIR scientists

Contributions of CSIR scientists are continuously being recognized both at the national and international levels. Dr. R.A. Mashelkar, DG-CSIR has been awarded TWAS medal (2005) by the Academy of Sciences for the Developing World and the Star of Asia Award (2005) of Business Week (USA). Dr. S. Sivaram has been conferred the prestigious Padmshree Award for Science & Engineering. Besides these, CSIR scientists have bagged Shanti Swarup Bhatnagar Award, elected as fellow of Indian Academy of Sciences, Indian National Science Academy, National Academy of Sciences, Indian National Academy of Engineering, etc.

### Excelling in scientific & industrial research output

CSIR's basic research contributions scored an all time high in terms of number and international recognition. A total of 3018 basic research papers have been published in internationally peer reviewed journals with an average impact factor per paper of 2.01. CSIR was granted 178 patents abroad while filed 570 patents. It has secured 22 copyrights and 4 trademarks as well.

The year also witnessed an all time high generation of external cash flow of Rs. 341 crore from its contract R&D.

# RESOURCE BASE: 2005-06

| | | |
|---|---|---|
| 1. | Infrastructural | Number |
| • | Laboratories/Institutes | 38 |
| • | Outreach Centers | 39 |
| 2. | Human | |
| • | Total Staff | 18293 |
| ▪ | Total S&T Staff | 12984 |
| ➢ | Scientists (Group IV) | 4635 |
| ➢ | Technical (Group III) | 2996 |
| ➢ | Technical (Group II+I) | 5353 |
| ▪ | Total Administrative & non-technical (includes isolated staff strength) | 5309 |
| 3. | Financial | Rs. Crore |
| • | Government budgetary support | 1453.49 |
| ➢ | Government plan allocation | 713.00 |
| ➢ | Government non-plan allocation | 740.49 |

# PERFORMANCE: 2005-06

| | | | |
|---|---|---|---|
| 1. | Science Output | Numbers | |
| • | Papers contributed | | |
| | ➢ Number | 3018 | (2688) |
| | ➢ Average Impact Factor per paper | 2.007 | (1.899) |
| • | Patents | | |
| | ➢ Filed in India | 407 | (418) |
| | ➢ Filed abroad | 570 | (500) |
| | ➢ In force in India | 1147 | (1240) |
| | ➢ In force abroad | 1205 | (990) |
| 2. | National S&T Human Resource Development | | |
| | ➢ Research Fellows/Associates Supported | 7075 | (7640) |
| | ➢ Emeritus Scientists in position | 125 | (119) |
| | ➢ Pool Scientists (SRAs) in position | 150 | (186) |
| | ➢ Research Schemes supported | 769 | (760) |

*Figures in parenthesis correspond to the previous year 2004-05*

# I

# S&T CONTRIBUTIONS

CSIR during the Tenth Five Year Plan has undertaken major network projects across CSIR laboratories. The aim of the projects evolved is to synergise the vast competencies developed over the years in CSIR laboratories and to implement them in a network mode. CSIR is currently operating 56 projects in a network mode. The projects *interalia* encompass establishment of capabilities in the newer S&T areas, generation of technological know-how and strategic options over a wide spectrum of science & technology, human resource development etc.

Basic research is the major source of advancement of knowledge in science and provides the foundation for development of newer generic technologies for the future. CSIR has to continuously upgrade its core competencies and plan new research areas so as to provide the needed capability for successfully competing in the realm of emerging technologies for the years to come. The core competencies to be continuously developed are in the areas of aerospace science & technology, modern biology and biotechnology, chemistry, geophysics, oceanography, material science, computer aided studies, expert system, parallel computation etc.

The following sections record some of the significant achievements, both under network and non-network modes.

## 1.1 AEROSPACE SCIENCE & TECHNOLOGY

NAL is a major player in India's aerospace programmes. It has developed a world class capacity for design, development and fabrication of large components of advanced composites for civilian and combat aircraft, structural testing and analysis, aerospace electronics and systems, innovative capabilities in surface engineering etc. The activities are focused on design, development, fabrication and airworthiness, testing of small civilian aircraft and on creating, maintaining and providing high class expertise and world class test and certification facilities.

### 1.1.1 Progress made under Network projects

Some of the significant achievements project-wise are:

**I. Catering to specialised aerospace materials**

The objective of the project is to formulate and execute a structured programme on development and characterization of different specialized aerospace materials and to provide materials related technological services to aerospace organisations.

**Progress so far:**

Significant progress has been made in developing low cost carbon fibres. Some variants of the pressure sensitive paints have been developed, two of which can withstand 50 blow downs in the NAL high-speed wind tunnel without any performance deterioration.

**II. High Science & Technology for National aerospace programmes**

The main objectives of this programme are to enhance the capabilities for generating crucial design and certification data for aerospace systems; to enhance the knowledge base through R & D activity for increased self-reliance and freedom; and build up new and critical facilities in the area to minimize dependence on foreign test facilities.

**Progress so far:**

Application of pressure sensitive paints as a diagnostic tool for complex and 3D separated flows at high speeds has been found to be very satisfactory. Numerical techniques have been developed for modeling multiple damages in smart composites. Fabrication techniques for manufacture of glass epoxy composites (flat and cylindrical) using combination of braiding and resin injection has been demonstrated. Algorithms for on-line flight data/path reconstruction and parameter estimation, multi sensor and multi target tracking and fusion have been developed. Air Traffic Models have been simulated for Airports like Bangalore International Airport and Cochin International Airport.

**III. Spearheading small civilian aircraft design, development & manufacture**

The objectives of the project are to design and develop stretched HANSA; civil aircraft R&D, civil aviation & policy, research & market analysis; indigenous development of critical LRUs with particular relevance to small aircraft; and weight optimization and other improvements of SARAS to production standards.

**Progress so far:**

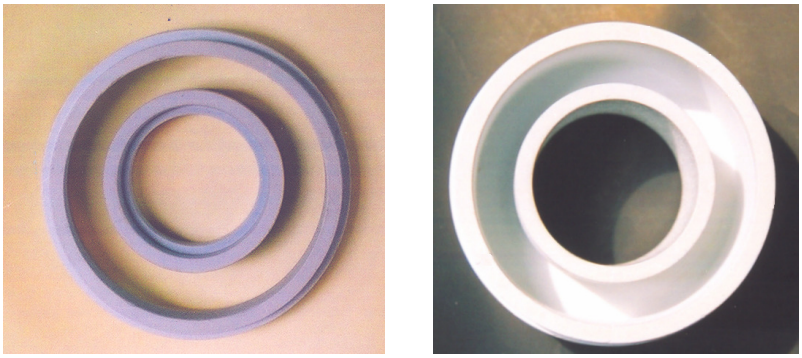
Configuration of the 4-seater aircraft (HANSA stretched version) has been finalized. Landing gear actuator was designed and fabricated. Assembly jigs for weight optimised structure for SARAS were designed.

### 1.1.2 Scientific achievements under non-network programmes

**Boron nitride based components for strategic applications**

CGCRI is the only organization in India which makes hexagonal boron nitride (h-BN) based components starting from the preparation of the raw boron nitride powder and consolidating it in the desired shapes as per the requirements of the end user. h-BN has some special properties including machinability, high thermal conductivity and low electrical conductivity. Composites based on h-BN have very good abrasion

resistance properties. Boron nitride-silica components have been supplied to ISRO, Bangalore for application in Hall Effect thruster assembly for space craft propulsion. Boron nitride powder was synthesized in the Institute's pilot plant. Composite of boron nitride with reactive silica in appropriate proportion is presently used for the purpose of obtaining lower density, lower secondary electron emission and higher sputter resistance.



BN-$SiO_2$ Ceramic Discharge Chamber (Two different designs) of Hall Effect Thruster for ISAC, Bangalore

**Wind turbine blades**

NAL has developed fabrication techniques for manufacture of large FRP blades for harnessing wind energy. Fabrication of two blades (one set) for a 300kW wind turbine was completed during the year and blades were under field testing at M/s. Sangeeth Group, Coimbatore.

wind turbine blade

**Domes for Air Combat Simulator**

NAL has completed the fabrication and trial assembly for the first of the two domes of HAL's Air Combat Simulator project. These 9m diameter twin domes will be used by IAF for housing Combat Simulators for training of combat pilots under simulated conditions.

Twin domes of Air Combat Simulator for pilot training

**Acoustic test facility**

CARTOSAT I (IRS P5) FM, a remote sensing satellite of ISRO was tested for qualifications at the Acoustic Test Facility of NAL. This satellite has since been launched and is presently in orbit. This constitutes a major input to the Indian Space Programme.

### 1.1.2 Recognition & Awards

| | |
|---|---|
| CSIR Prize for Engineering Technology 2005 for "Development of Advanced Composite Technologies for Aerospace Applications" | NAL team, represented by M/s M. Subbarao and H. N. Sudheendra |
| Aeronautical Society of India's Swarna Jayanti Award for the year 2005 | Shri K. M. Gaddikeri, NAL |
| Raman Research Fellowship for 2005-06. | Dr. S. Mukherjee, NAL |

NAL participated in 93rd Indian Science Congress. The emphasis of the Congress was on rural development. NAL stall depicted various activities like medium scale wind turbine, aerodynamic bus design, solar pond, NALSUN- black chromium coating for solar water heaters etc.

## 1.2 BIOLOGY & BIOTECHNOLOGY

CSIR has emerged as leading public funded R&D agency with many of its laboratories contributing significant R&D outputs and technologies in the areas of genomics, proteomics, molecular biology, immunology, bio markers, bio molecules etc. CSIR laboratories achieve excellence in the field both through network and non-network modes. Some of the major accomplishments are provided below.

### 1.2.1 Progress made under Network projects

Some of the significant achievements project-wise are:

**I. Exploration and exploitation of microbial wealth of India for novel compounds and biotransformation process**

The project envisages to exploit microbial diversity of the country using both culture dependent and culture independent methods, with ultimate goal of its commercial exploitation as a major source of biotechnological products and processes.

**Progress so far:**

21 new taxa (genera and species) have been discovered and more than 6000 cultures isolated from unique niches. 10 promising leads including Caerulomycin as anticancer and immuno suppressive agent were discovered. The technology "Biotransformation of nicotinic acid into 6-hydroxyl nicotinic acid" has been transferred to an industry (M/s Jubilant Organosys Ltd.,). 15 metagenomic libraries have been made and are being screened.

**II. Molecular biology of selected pathogens for developing drug targets**

The project envisages in-depth study of molecular biology of a few pathogens for developing drug targets, namely for *Mycobacterium tuberculosis*, *Plasmodium, falciparum, Leishmania Donovani, Fungal pathogens (C. albicans* and *A. fumigatus*), *Enteric pathogens (V. cholerae, S. dysenteriae* and *H. pylori*).

**Progress so far:**

***Mycobacterium tuberculosis*- LigA as a novel drug target:** The crystal structure of the adenylation domain of the *M. tuberculosis* LigA with bound AMP has been reported for the first time. A novel class of inhibitors viz. $N^1N^n$-bis(5-deoxy-α-D-xylofuranosylated) diamine was identified using *insilico* docking calculations. Assays involving *M. tuberculosis* LigA, T4 ligase and human DNA ligase I show that these compounds specifically inhibit LigA from *M. tuberculosis*. Assays involving LigA deficient bacterial strains show that *in vivo* inhibition of ligase by the compounds causes the observed antibacterial activities. It has also been demonstrated that the compounds exhibit *in vivo* specificity for LigA over ATP-dependent ligase. This class of inhibitors holds out the promise of rational development of new anti-tubercular agents.

***Plasmodium falciparum*- Apicoplast as a drug target:** A study was carried out on the *P. falciparum* apicoplast as a newer drug target for anti-parasitic drugs with translational inhibitory activity. Results thus provide conclusive evidence for the translational status of the apicoplast and confirmed it as the site of action of antiparasitic drugs such as thiostrepton.

***Leishmania donovani*- Tryptothione reductase:** A 96-well micro method was developed for the screening of antileishmanial compounds using recombinant LdTR.

Standard drugs as well as 20 newly synthesized antileishmanial compounds of pyrimidine series were screened using this method. Among them melarson oxide and trivalent antimony significantly inhibited the recombinant enzyme.

### III. Developing cell & tissue engineering

The project targets to develop methodologies for growing cells and tissues (of animal origin) *in-vitro* and induce them to perform differentiated functions; to develop biomedical devices as substitutes for a defective organ or its parts; to develop methodologies for the transplantation of cells and tissues grown *in-vitro* into hosts including humans; and *in-vitro* production of pancreatic β-Cells for transplantation in type I diabetic patients.

**Progress so far:**

**Plant systems**

A free cell system for induced expression of shikonins has been established for large scale production of this colorant. A new vector system for the anti-rabies vaccine in tobacco plant has been developed, which produces a protein that induces a protective immune response in mice. A glass fermentor based growth of *Swertia chirata* and *Rauwolfia serpentina* has been achieved in the lab and the technology is to be transferred to the field.

**Animal systems**

Cybrids of dendritic cells and infected macrophages, and a DNA vaccination system have been developed to obtain protective immune response in experimental animals against Leishmania. A new diagnostic system, using O-AcSG and anti-achetenin-H antibodies, for diagnosis of childhood acute lymphatic leukemia has been developed. Proteomic characterization of side population stem cells from bone marrow of rats and mice has been done and these cells have been transplanted in chronic and acutely damaged liver models.

### IV. Toxicogenomics of polymorphism in Indian population to industrial chemicals for development of biomarkers

The project aims to understand the molecular basis of the toxic response, identify the biomarkers for toxic exposure, and screen the individuals in the population that are genetically predisposed for differential toxic response. It will help to design suitable strategies for reducing the risk of the chemicals, mitigation and treatment of the toxic response, and adoption of preventive methods for the susceptible individuals.

**Progress so far:**

Transcription profiles, ‘molecular signatures’ were determined after toxic exposure to the model compounds lead and poly-aromatic hydrocarbons. Single nucleotide polymorphism was identified in various genes that influence the toxicity of arsenic in the affected population. ‘Microsomal epoxide hydrolase’ genotypes were identified that are a risk factor for lung cancer in north Indian population. Blood proteomic

biomarkers were identified that are significantly altered after exposure to lead or arsenic.

### V. Designing animals and plants as bio-reactors for proteins & other products

The project envisages designing of transgenic plant, animal, and yeast bioreactors, to develop genetic transformation technology in novel hyper expression systems, to exploit cells as bioreactors for production of high value biopharmaceuticals and to construct Gtases library for biotransformation (glucosylation) of natural products.

**Progress so far:**

Native AAT and Cecropin genes were cloned and the later is ready for hyper-expression in target systems. Efficient high yield homogenically pure AAT and cenropin protocol developed

### VI. Medicinal plant chemotypes for enhanced marker and value added compounds

The project envisages to enhance the production of around 20 commercially important high value drug molecules present in medicinal plants viz. *Artemisia annua, Acorus calamus, Bicopa monnieri, Cathranthus roseus, Picrorhiza kurroa* etc.

**Progress so far:**

Sufficient genetic base for variability with respect to targeted chemoprofiles for chemovar development has been established/generated for all the plants except for Commiphora and Swertia. Several new marker molecules have been identified in *Chlorophytum, Podophyllum, Swetia, Andrographis and Bacopa*. Also new bioactive derivatives of major markers have been developed in *Acorus, Picrorhiza and Andrographis*. Chemovars of *Artemisia, Andrographis, Chlorophytum, Bacopa* developed and released for commercial cultivation by Indian farmers/drug industry. Seven pathway/metabolite specific genes have been identified and sequenced in *Catharanthus* and *Picrorhiza* for metabolic engineering work.

### VII. Development and commercilisation of new bioactives and traditional preparation

The objectives of the project are to discover new single molecules as drugs and take them to the IND stage for diseases of interest to India and to the international community; discover and develop herbals which function through different mechanisms including metabolic activation and are based on synergism; introduce combination drugs including the use of bioenhancers which themselves are not drugs but increase the effectiveness of the drug; introduce formulations and novel delivery systems which may be target specific; and discover and develop new herbal pest management agents which influence the pests in the desired fashion but are safe for humans.

**Progress so far:**

Around 16000 samples (12000 plants and~ 4000 microbial) have been screened for various diseases. Presently, there are 65 discovery groups on promising entities for 20 disease conditions. Out of 65 discovery groups 13 groups have reached advanced stages of single molecules (9 samples) and herbal preparations (4 samples). The four herbal formulations are for ulcer, dementia and cancer and nine single molecules are for cancer, dementia, hypertension, leishmania, hepatoprotective and immunostimulatory.

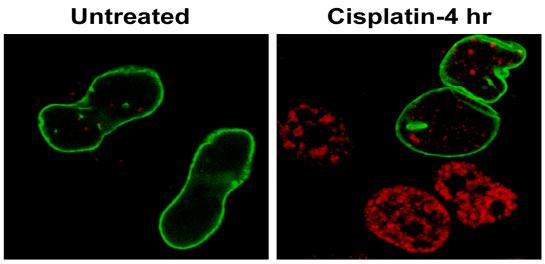
### 1.2.2 Scientific achievements under non-network programmes

Apart from network projects, CSIR labs. have made noticeable S&T progress in non-network mode also. Some of the significant achievements during the year are highlighted below:

**Role of disease-causing *lamin* mutants in nuclear functions**

CCMB expressed *Lamin A* cDNAs with disease-causing mutations as green fluorescent protein (GFP)-tagged constructs in cultured cells. *Lamin A* mutants causing *Emery-Dreifuss* muscular dystrophy were aberrantly assembled into nuclear aggregates and disrupted endogenous *lamin A*. The nuclear membrane protein emerin, which cooperates with lamin to organize chromatin, was mislocalized upon expression of these mutants as well as mutants causing Hutchinson-Gilford progeria syndrome *in-vivo*. The ability of cells expressing these mutants to form DNA repair foci comprising phosphorylated histone H2AX in response to mild doses of cisplatin or UV irradiation was markedly diminished, unlike the nearly normal response of cells expressing wild-type GFP-lamin A. Mutants that were impaired in the DNA damage response also mislocalized Ataxia-telangiectasia-mutated-and-Rad3-related (ATR) kinase in untreated cells. Results suggest that a subset of lamin A mutants can hinder the response of key components of the DNA repair machinery to DNA damage by altered interactions with chromatin.

**Cells expressing the lamin mutant progerin (green) do not form repair foci (red) in response to DNA damage**

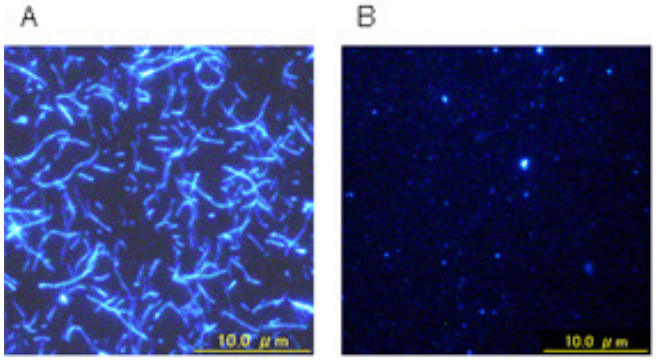


### Control of quiescence in muscle stem cells

CCMB established a culture model of quiescent satellite cells using $G_0$ synchronized myoblasts. Studies at CCMB suggests that regulation at multiple levels from chromatin modulation of transcription to regulation of cytoskeletal and membrane dynamics, and metabolic controls of nutrition, energy and cellular redox state co-operate to sustain the arrested progenitor cell, prevent precocious differentiation and maintain signal responsiveness. Gene transfer and pharmacological disruption were also used to delineate the signaling pathways that lead to arrest and modulate the transcription factor MyoD, a regulator of differentiation competence. It is suggested that mechano-chemical signaling pathways modulate transcription factor expression, and thereby regulate cell fate.

### Effect of αB-crystallin on amyloid fibril formation

CCMB studied the structure-function relationship of αB-crystallin and the role of phosphorylation in its chaperone activity towards amorphous aggregation as well as ordered amyloid fibril formation of peptides and proteins. The expression of αB-crystallin is known to be elevated in several neurodegenerative diseases including Parkinson's and Alzheimer's diseases. Study showed that αB-crystallin can prevent the fibril formation of Aβ-peptides which are known to be involved in the Alzheimer's disease. Phosphorylation-mimicking mutations of αB-crystallin result in significant increase in its chaperone activity towards amorphous aggregation of proteins, but not towards amyloid fibril formation, indicating phosphorylation-state specific interaction of αB-crystallin. It has been demonstrated that a critical balance in hydrophobic and hydrophilic interactions is required for amyloid fibril formation, particularly in the case of β2-microglobulin, the protein involved in dialysis-related amyloidosis. αB-crystallin prevents the amyloid fibril growth of this protein.




Thioflavin T stained amyloid fibrils of $A\beta_{1-40}$ formed (A) in the absence and (B) in the presence (B) of αB-crystallin viewed under the evanescent field microscope.

### "CIM-ASVIKA" multi utility portable distillation unit

CIMAP released a low cost and simple to operate multi-utility portable distillation unit "CIM-ASVIKA" useful for the farmers in rural areas and small scale entrepreneurs. Features include low cost portable type unit suitable for specially

designed for producing high quality natural rose water. It can also be used for extraction of spice and other aromatic oils. It has pure stainless steel construction with long life, efficiently designed with shell & tube condenser for proper condensation & complete oil recovery. It can be operated with firewood, agro wastes, LPG/kerosene burners. There is no pollution at workplace due to provision of chimney and can be operated even by any layperson.

"CIM-ASVIKA"

**Rose concrete plant**

CIMAP has developed an improved technology for the production of rose concrete and absolute. Detailed designs and specifications were prepared for setting up a rose concrete plant having two extractors of 50 kg flowers per batch capacity. The plant also consists of a unit for purification and odour removal of the organic solvents prior to extraction. The plant has been designed for maximum efficiency and inbuilt solvent recovery system and a breather system so as to minimize the solvent losses and keep the technology eco friendly.

**A novel chemoselective method for the formylation of sterols**

CIMAP has developed a novel method for the formylation of secondary sterols. Vilsmeier reagent (DMF-$POCl_3$) was used as an efficient formylating agent. The reaction is simple, efficient and in mild reaction conditions (10$^{o}$C to room temperature) gives formate esters in good yields (40-91%). Other functional groups such as phenol, aldehyde, acetate and aryl methyl ether were found intact under the reaction conditions. Thus, this reaction may be useful in the synthetic steroidal chemistry where the protection of secondary alcoholic group is required.

**Complete genome analysis of lily and geranium viruses**

IHBT amplified and sequenced the complete genome of an isolate (LI) of *Cucumber mosaic virus (CMV)* from lily (*Lilium longiflorum*) with the help of internal primers designed using conserved regions of the whole genome. CMV isolate LI was readily transmitted by aphid *Myzus persicae* in non-presistent manner. Recombination events were observed in movement protein (MP) gene of CMV LI. A complete coat protein (CP) gene of cucumber mosaic virus infecting geranium was amplified using degenerate primers and sequenced. On the basis of sequence homology, it was concluded that CMV-infecting geraniums in India belong to subgroup II. These are the first reports of the complete genome of CMV infecting lily from India and CMV and PNRSV infections on geraniums. The information on the genome of these viruses will help to develop strategies to combat the viral diseases in lily and geraniums in order to propagate disease-free material for production of quality flowers.

**Synthesis of FEMA GRAS approved flavouring agent: 4-vinylguaiacol**

4-Vinylguaiacol and other 4-Vinylphenols are the most extensively studied class of natural compounds due to its widespread applications in food and alcoholic beverages, flavouring substances and as intermediates in the preparation of polymers and copolymers useful in coatings, electronic applications, ion exchange resins and photoresists etc. IHBT has developed a unique and novel process for the synthesis of 4-vinylphenols in microwave curtailing the two step process into a single step in an environment friendly manner. The method developed imbibed the principles of green chemistry and reflects the advantages over the existing protocols. Also, the cost of production is reduced manifold.

**“HIMBALA” and “HIMKACHARI”**

IHBT has developed one composite cultivar of *Valeriana jatamansi* “HIMBALA” suitable for cultivation in western Himalaya at locations situated above 1300 m altitude and one cultivar of *Hedychium spicatum* “HIMKACHARI” suitable for locations situated around and above 1300 m altitude.

The average yield of dry roots of “HIMBALA” is 1 t/ha 2 years after planting. Roots contain about 4 % valepotriates (dry matter basis) and 0.4% essential oil in fresh roots. The average yield of fresh rhizomes of “HIMKACHARI” is 12 t/ha 2 years after planting. Rhizomes contain 0.75 % essential oil on dry weight basis.

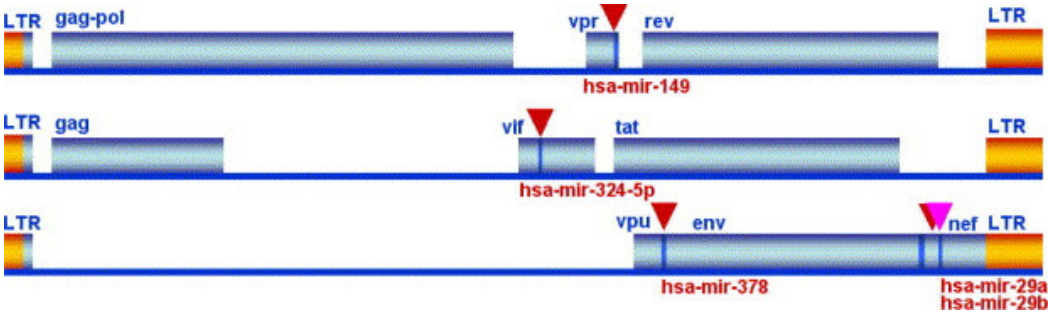
Himbala Himkachari

**An efficient round cut method (RCM) for emasculation of rose flowers**

IHBT has developed a novel method for emasculation of roses. The method involves making a round cut in the thalamus near the base of the clayx and a longitudinal cut along the buds, anthers, petals and calyx were totally removed exposing only styles and stigmas of the flower bud within a fraction of minute. The efficiency of RCM was compared to the standard approach during two years based on crosses between two cultivars of scented roses viz., *Rosa damascena* and *R. bourboniana* and found to be cost-effective and time-saving. It is recommended for all rose breeders**.**

**Targets for human encoded microRNAs in HIV genes: a bioinformatics approach**

IGIB has reported, for the first time, screening of HIV-I genome computationally using human micro RNAs for identifying targets. MicroRNA expression profiles from microarray based experiments have shown that these potential antiviral human microRNAs are expressed in T cells, the normal site of infection of HIV-I virus. These mRNAs also showed differences in expression from person to person implying that these levels could predict susceptibility to the virus. Human micro RNAs can target crucial HIV-1 genes including the *nef* gene which plays an important role in delayed disease progression.




Positions of the five microRNA targets on the HIV-1 genome. Triangular marks: Relative positions of the microRNA targets in the genome. Blue bars: Genes. Bold vertical lines: gene boundaries.

**SEAPATH**

IGIB has developed 'SEAPATH' which is a unique software tool specially designed to overcome functional problems for prediction of virulent proteins. It focuses on identifying adhesins or adhesin like proteins from sequenced genomes. The underlying architecture of this tool is artificial neural networks. It uses decisive parameters to assess whether a protein is an adhesin. The software not only identifies the known adhesins but also helps in narrowing down the search and enhances the accuracy percentage in annotations of proteins as adhesins. Several novel adhesins were identified in major pathogenic organisms. This tool would be a major breakthrough for rapid drug development.

**BOD biosensor**

IGIB has developed biochemical oxygen demand (BOD) sensor which determines BOD in 10 minutes and provides a novel and quick estimation of biochemical oxygen demand of waste water. BOD measurement of waste water using this process is rapid, reproducible and effective as compared to conventional titration based method. This invention finds wide commercial application and is applicable to waste waters having variations in degree of biodegradability viz., low, moderate and high. The device consists of an immobilized microbial membrane, a dissolved oxygen probe, a multi meter with black box and a computer for software application as well as display monitor with a printer.

**New species of microbes from unique environmental niches in India**

IMTECH has focused on the characterization of the microbial diversity of unique ecological niches of India using both culture dependent and culture independent approaches. In addition to checking functional diversity of these organisms, rich species diversity was also found from some these niches. Several new taxa including a novel genus and novel species like, *Paenibacillus assamensis, Actinoalloteichus spitiensis, Kitasatospora sampliensis* have already been described in IJSEM during 2005-06. Publications describing two Rhodococcus kroppenstedtii, new genera and six novel species are currently in press.

***Trichoderma harzianum* as biopesticide and biofertilizer**

NBRI has developed a formulation of *Trichoderma harzianum* which can be used as biopesticide and biofertlizers. The formulation not only controlled most of the soil borne diseases but also increased the yield of several test crops like sunflower, mustard, soybean, chrysanthemum etc. In addition, the biochemical characteristics of mustard also showed a significant improvement over control treatments. The treatments also reduced the white rust disease incidence in mustard and also reduced the *Alternaria* disease incidence significantly. The total phenol content in different parts of mustard viz. leaves, stem, straw and seeds showed an increase over control after treatment with the consortium of *Trichoderma*.

**New cultivars of Gladiolus**

NBRI developed and released two new cultivars of Gladiolus, namely 'Urvashi' and 'Neelima', for public this year during Annual Rose and Gladiolus show of the Institute. Gladiolus 'Urvashi' is a hybrid developed by crossing two exotic varieties of *Gladiolus* namely 'Eurovision' (red flowered as male parent) x 'Snow Princess' (white flowered as female parent). Gladiolus 'Neelima' is a hybrid developed by crossing two exotic varieties of *Gladiolus* namely 'Tropic Sea' (dark blue flowered as male parent) x 'Snow Princess' (white flowered as female parent).

***In-vitro* production of Chrysanthemum aspermy virus-free chrysanthemum plants**

NBRI has produced *in vitro* Chrysanthemum Aspermy Virus (CAV) free chrysanthemum plants by shoot meristem culture. This is the first report of producing CAV-free chrysanthemum plants from *Chrysanthemum morifolium* cv. Pooja in India. The virus-free plants under glasshouse conditions showed normal growth and flowering without showing any symptom of ring spot disease.

***Withania somnifera:* hybridization of contrasting morpho- & chemo- types**

RRL-Jammu has incorporated desired traits like higher leaf biomass and *Withaferin*-A in a few $F_1$ hybrids produced in which 300 crosses between two contrasting elite accessions of *Withania somnifera* (AGB002 x AGB025). Reproductive effort (RE2) exhibited higher value in cultivated morphotype AGB 025 (24.52%) than the wild morphotype AGB 002 (11.75). In this highly self pollinated crop, differences in percent fruit set, seed set and germination between autogamy and xenogamy were found to be statistically significant ($P<0.01$). Tissue culture procedure has been standardized for recovery of putative hybrids. The procedure developed was utilized for recovery of plantlets via axillary shoot proliferation. The regenerated plants were transferred to soil after hardening under Green house conditions.

*Withania somnifera* : hybridization

**New chemotypes of C*ymbopogon flexuosus***

RRL-Jammu has reported for the first time, two novel pharmacologically active chemotypes of *Cymbopogon flexuosus* (Nees ex Stend.) Wats namely RRL(J)CF HSR and RRL(J)CF HP rich in (+)-1- bisabolone (30-40%) and isointermedeol rich (20-30%). Essential oil as well as isolated (+)-1- bisabolone from RRL(J)CF HSR exhibited strong antibacterial activity (*in-vitro*) against Gram positive bacteria such as *Bacillus ceresus*, *B.subtalis* and *Straphylococcus aureus*. Essential oil as well as pure isolated isointermedeol from RRL(J)CF HP exhibited anticancer activity.

RRL(J)CF HP

RRL(J)CF HSR

**Micropropagation protocol for *Swertia chirata***

RRL-Jammu has established a reproducible, high throughput (survival 90%) micropropagation protocol of *Swertia chirata* from axillary shoot proliferation utilizing shoot tips and nodal explants. Comparative morphological, molecular and chemical fidelity of the regenerants showed that *in-vitro* raised plants were at par with the parental populations. This procedure is faster than conventional method and moreover, induction of plantlets directly from the tissue without intervening callus is of potential value for *in-vitro* multiplication of genetically uniform plants and storage of the genotype

**Promising alternative source of carvone**

RRL, Jammu has developed an alternative and additional source of carvone from *Mentha longifolia var. incana*, designated as RRL(J) ML4/ ANANT CARVOMINT. *Mentha* belongs to family *Lamiaceae* and yields essential oil of commercial value with wide applications in flavorings of foods, mouthwash, toothpaste, gum lotions and candy etc.

Under the screening trial, one of the accession RRL(J) ML4 of *Mentha longifolia var. incana* has been isolated through mass selection technique which exhibited the appreciable quality and quantity of carvone content (60-70%) and limonene (15-20%) in its essential oil yielding 38-40 tonnes of fresh herbage/ hectare & 160-175 kg essential oil/hectare.

**Remediation and management of coal mining waste land of North Eastern Coalfields of Margherita**

RRL-Jorhat has undertaken the i*n-situ* remediation study of overburden dumping site due to coalmine activity of North Eastern Coal Fields, Margherita. Herbaceous plant species (*Axonopus compresus*), Monocot species *Eupetorium*, some wild bamboo species, essential oil bearing plants Citronella and lemon grass, *Lianes Mimosa*, *Mugo, Dhanshya* and Tree species *Gomari* (*Gmelina arborea*), Sisso (*Delbergia sisso*) were screened to cultivate in coalmine overburden dumping site. It was observed that the plant growth promoting rhizobacteria (PGPR) mediated plant growth and survival was enhanced. The population density and microbial biomass of the experimental plot were also enhanced.

### 1.2.3 Human Resource Development

**CCMB**

- Hands-on training course on "RNAi in Gene Knockdown & Viral Resistance" organised during 25$^{th}$ Feb to 10$^{th}$ March, 2005. 20 persons participated from all over India.
- A two day symposium on "RNAi and microRNA in Development and Health" held 300 persons from all over India participated.
- CCMB conducts Summer training programme for M.Sc. students every year in the month of May-June. During the year, about 34 M.Sc. students were chosen on a national basis for a hands-on research training. They spent about 8-10 weeks working as trainees in various laboratories with a stipend and free accommodation. On successful completion of their course, they were awarded certificates.

- During the year, 42 M.Sc. students have carried out their 6 months Project work in the area of human genome diversity in tribal populations.

**CIMAP**

**Training to foreign students/delegates**

CIMAP organised various training programmes for foreign students few of these are listed below:

- TWAS Fellowship for Post-doctoral research and advance training at CSIR Lab.;
- DBT-TWAS Biotechnology Fellowship 2005-06;
- training under Royal Nepal Academy of Sciences and Technology (RONAST) S&T Cooperation;
- training to Thailand delegation; and
- training of Saudi Arabian Standard Organization (SASO) staff in CSIR labs under SASO-CSIR Technical Cooperation programme

**Winter school**

CIMAP organized CSIR-sponsored Winter School on "Recent Techniques in Gene Cloning, DNA Analysis and Functional Genomics ".

**IGIB**

- Educational workshops (biannual) to educate medical practitioners on allergens were conducted in collaboration with Vallabh Bhai Patel Chest Institute, Delhi;
- Three-day session for better understanding of “Responsibility as a Teacher” for Delhi University college teachers was organized; and
- The institute adopted two schools “Sarvodaya Kanya Vidyalaya, Delhi” and “Sarvodaya Bal Vidyalaya, Delhi”, and two colleges “K. M. College, New Delhi” and “Sri Venkateshwara College, New Delhi” where IGIB scientists delivered lectures.

**IHBT**

IHBT conducted various training programmes in the following areas:

- “Cultivation, processing and quality evaluation of medicinal & aromatic crops.” Thirteen participants attended;
- “Quality tea production”. A total of hundred planters from different tea growing regions of the state attended the training;
- “Plant tissue culture- technology and applications”. 12 participants attended,

- “Propagation, value addition and market linkages of medicinal plants”. 21 participants attended; and
- “Production of virus free planting material of important cut flower crops – a practical course”. 33 participants attended.

**NBRI**

Training programmes organized on

- Quality production of biopesticides and their use;
- Biofertilizers;
- Dehydration of flowers and foliage and floral craft; and
- Cultivation & processing of plants used in nutraceuticals/functional foods.
- Gladiolus & Tuberose.

A 4-day “Faculty Training & Motivation Programme for School/College Teachers” conducted.

**RRL-JAMMU**

- RRL, Jammu conducted a six-month training programme for 18 students of the Birla Institute of Technology & Science, Pilani;
- One scientist from Nepal was trained at the laboratory in the area of cultivation & utilization of medicinal and aromatic plants; and
- Eighty engineering/post-graduate students from Indian universities & colleges were trained in the field of biotechnology, tissue culture, medicinal chemistry, pharmacology and molecular biology. The duration of training programme varied from one to six months.

**RRL-JORHAT**

- Training on cultivation of medicinal & aromatic plants and mushroom;
- Training for scientific cultivation and dehydration of flowers;
- Workshop on medicinal plants of Arunachal Pradesh;
- Training on non-traditional plantation crops in Bodoland Territorial Area District; and
- Science Motivation Programme.
- CPYLS organized for students from the states of Assam, Nagaland, Manipur, Mizoram, Sikkim, and Tripura.

### 1.2.4 Recognition & Awards

| | |
|---|---|
| Honorary D.Sc. degree, Uttar Pradesh Rajarshi Tandon Open University, Allahabad<br>Elected as Honorary Fellow, Biotech Research Society of India<br>Chosen for Swami Sukhdevanand Rishi Samman in the field of Genetics. | Dr. Lalji Singh, CCMB |
| DAE-SRC Outstanding Research Investigator | Dr. L.S. Shashidhara, CCMB |
| Fellow of Indian National Science Academy<br>Member of the Advisory Board of European Biophysics Journal, UK | Dr. A. Chattopadhyay, CCMB |
| Elected Fellow of the National Academy of Sciences, India<br>Fellow of the Indian Academy of Sciences | Dr. R. V. Sonti, CCMB |
| Member of National Academy of Medical Sciences, India | Dr. G.R. Chandak, CCMB |
| INSA Medal for Young Scientist – 2005. | Ms. P. Kshetrapal, CCMB |
| 'FICCI Award' 2004-05, in the area of Rural Development. | CIMAP |
| 12$^{th}$ International Congress Commemoration Award 2005;<br>Eminent Scientist Award by Uttar Pradesh Council of Agricultural Research (UPCAR) | Dr. D.D. Patra, CIMAP |
| EOAI-SOM Award 2003-05 for 'KOSI'- a new variety of *Mentha arvensis* | Dr. N. K. Patra and team, CIMAP |
| Honorary Fellow of Biotech Research Society of India<br>Prof. P.K. Bose Memorial Award 2004 by Indian Chemical Society, Kolkata | Prof. S. K. Brahmachari, IGIB |
| M. Sundaramma Young Scientist Award | Ms. Anamika, IGIB |

| | |
|---|---|
| UCB-ICAAICON Award for Young Scientist | Ms. Dolly Kumari, IGIB |
| Honorary-Fellow and Life Membership by International Research Society for Complementary & Alternative Medicine, Risk Factor Modification Center, St. Michael's Hospital, University of Toronto, Canada | Dr. R. Tuli, NBRI |
| CSIR Technology Award-2005 | Dr. R. Tuli, Dr. P.K. Singh, Shri M. Kumar, Shri. C.P. Chaturvedi & Dr. S V. Sawant., NBRI |
| 'Prakrati Ratna' Award by Prakrati "The Nature", Lucknow.<br>'Creativity and Innovation Excellence Samman 2005' by Lucknow Management Association. | Dr. P. Pushpangadan, NBRI |
| Innovative Young Biotechnologists Award 2005 by DBT, New Delhi.<br>INSA Young Scientist award by Indian National Science Academy. | Dr. S. V. Sawant, NBRI |
| Prof. Bashir Ahmad Razi Medal -2006) of Association for Plant Taxonomy (APT) | Dr. D.K. Upreti, NBRI |
| Fellow, Biotech Research Society of India<br>Member Core Team of World Bank – GRA Partnership on Indigenous Knowledge | Dr. G. N. Qazi, RRL-Jammu |
| Y S Muthy Medal of the Indian Botanical Society (IBS) | Dr. B. S. Bhau, RRL-Jorhat |
| Dr Biraj Mohan Das Memorial Award of Assam Science Society (Life Sciences) for the year 2005 | Dr. D. Kumar B.S, RRL-Jorhat |

## 1.3 CHEMICAL SCIENCE & TECHNOLOGY

CSIR enjoys immense credibility with the chemical industry especially in the areas of agrochemicals, catalysts, and chemical intermediates-subsectors characterized by high level of innovativeness. Some of the significant achievements in network and non-network projects are presented below:

### 1.3.1 Progress made under Network projects

### I. Development of catalysis and catalysts

The project envisages development of novel mesoporous materials that includes Nano tubes and Nano particles and evaluation in catalytic oxidations.

**Progress so far:**

A novel catalyst system has been developed for converting epoxides (like ethylene oxide, propylene oxide styrene oxide) and $CO_2$ to cyclic carbonates. The work has been scaled up to bench level.

### II. Developing green technologies for organic chemicals

The project targets to develop good processes for bioactives from medicinal plants, value-added organic chemicals from biomass and agro industrial wastes, alkylation and oxidation of aromatic compounds, fluoroorganics by chemical/electrochemical methods and novel mesoporous nanomaterials.

**Progress so far:**

Extraction and isolation of Artemsinin in 5Kg batch was achieved. Development and demonstration of process for organoflouro compounds such as Trifluoroethanol, Heptafluoropropane (FM200), 1,1,1-trifluoro-2-2- dichloroethane (HFCFC- 123) and preparation of perfluoroisobutyric acid by Electro Chemical Fluorination (5Kg) was carried out.

### III. Globally competitive chemicals, processes and products

The project aims to develop new generation technologies for high demand chemicals and strategically important chemicals for the country, e.g. novel bioactives, alternative fuels, new natural functional dyes etc.

**Progress so far:**

Upscaling of Taxol side chain and Diltiazem using supported catalysts achieved 50g and 100g batch of isonicotinamide and INH were standardized up to 95% yield of high purity INH.

### IV Development of novel polymeric materials

The project aims to use sustainable raw materials for the preparation of specialty polymers such as Organic-Inorganic hybrids and nanocomposites, UV/E-beam

curable coatings and adhesives, functional polymers for chiral separations specialty polymers for petroleum industry and specialty polymers from renewable resources.

**Progress so far:**

Copolymers of n-alkyl methacrylates and n-alkyl fumarates with controlled architecture were synthesized by Atom Transfer Radical Polymerization (ATRP). Tailor made (meth) acrylate based additives were evaluated on waxy Indian crude oils as pour point depressants. Synthesized polymers were evaluated on Safrai and Borholla crude oils of M/s Oil & Natural Gas Commission Ltd. as pour point depressants.

### 1.3.2 Scientific achievements under non-network programmes

Some of the significant achievements in projects being implemented in non-network mode are listed below:

**Fouling resistant membranes in desalination and water recovery**

CSMCRI has prepared low molecular weight cut off (MWCO<1000 Da) polyethersulfone nanofiltration membranes and polyamide brackish water thin film composite membranes containing negatively charged and/or neutral hydrophilic functional group on the surface by surface modification of the membranes by *in situ* redox polymerization of acrylate monomers. The NF membranes exhibited separations of 68–85% for $Na_2SO_4$, 19–31% for $MgSO_4$, 10–26% for NaCl and 2–12% for $CaCl_2$ with water permeation rates of 10–50 l/$m^2$ h at the operating pressure of 4 kg/$cm^2$ for 2000 ppm feed solution. The NF membranes were tested for water recovery from reactive dye effluents containing solutes sizes in the range of 600–1000 Da along with salt solution and were found to reject the dyes >99%. The permeation rate of high flux membranes reduces gradually with time and reached to about half of the original flux after 3 h of permeation. The original water fluxes have been recovered by simple water washing of the membranes. Surface modified RO composite membranes have shown good fouling resistant properties for brackish water desalination.

**Improved process for the recovery of sulphate of potash (SOP) from sulphate rich bittern**

CSMCRI has developed a novel integrated process for the recovery of sulphate of potash (SOP) from sulphate rich bittern. The process requires only bittern and lime as raw materials. Kainite type mixed salt is obtained by fractional crystallization of the bittern. Kainite is converted into schoenite with simultaneous removal of NaCl in a single step and the filtrate (schoenite end liquor, SEL) is used for production of KCl. The schoenite is reacted with aqueous KCl to yield SOP and the filtrate (Kainite end liquor, KEL) is recycled in the kainite to schoenite conversion step. The production of KCl from SEL is carried out with the aid of dipicrylamine (DPA). Lime is treated with DPA in water for the production of highly soluble calcium dipicrylaminate

$Ca(DPA)_2$, which in turn treated with SEL to produce insoluble potassium dipicrylaminate K(DPA) with >95% yield. The isolated K(DPA) is treated with 1:1 HCl to produce KCl and insoluble DPA, which can be recycled for the production of $Ca(DPA)_2$. The aqueous KCl thus obtained is treated with schoenite to prepare SOP, purity 90-92%. The KEL obtained along with SOP is recycled to generate schoenite. Utilization of all effluent and intermediate streams allow for an overall SOP yield >89% w.r.t. the potash content in the mixed salt.

**A cost effective process for the preparation of solar salt having high purity and whiteness**

CSMCRI has developed a novel route for the production of high purity solar salt with improved whiteness. The improvements realized are partly on account of elimination of suspended impurities like gypsum and clayey matter in the brine, which may otherwise be carried along with the brine in the crystallizer and finally end up in the salt, and partly due to the improved crystal size and morphology that minimizes embedded impurities in the salt. Rain-washing of the heaped salt has resulted in a salt with greatly reduced calcium and sulphate impurity levels hitherto not achieved in solar salt production in the world. The process requires no additional time or infrastructure and additional cost works out to <Rs. 15.00 per ton of salt. The process is simple and can be implemented on a commercial scale and India can become a competitor in the world salt market.

**Enhancement of anti-tubercular activity of extract of *Salicornia brachiata***

CSMCRI has reported enhancement of anti-tubercular activity of active fraction isolated from *Salicornia brachiata*. The invention also discloses the non-toxic nature of the fraction and positively identifies sucrose as its main constituent. Pure sucrose is shown to have no anti-tubercular activity indicating thereby that activity of the fraction resides in one or more of the minor constituents. The minor constituents are shown to be relatively low molecular weight entities and a chromatographic technique is disclosed for separating them from the bulk sucrose to probe their activities and structures in detail, as also the possibility of their synthesis if the leads thrown up are novel.

**Catalytic oxidation of styrene with molecular oxygen using metal ion exchanged zeolites**

CSMCRI has carried out catalytic epoxidation of styrene to styrene oxide with molecular oxygen using cobalt containing zeolite. Catalytic epoxidation of styrene-to-styrene epoxide was achieved using molecular oxygen in presence of $Co^{2+}$ exchanged zeolites. Molecular oxygen from air is also useful for the epoxidation reaction at atmospheric pressure. The presence of adsorbed water molecules in the catalyst also increases the styrene conversion without affecting the styrene oxide selectivity. Various alkali and alkaline earth cationic promoters were introduced into the zeolite catalyst to increases the styrene oxide selectivity. The present invention

explores the effect of adsorbed water molecules and alkali and alkaline earth metal cationic promoters in the cobalt exchanged zeolite catalyst, on the styrene conversion and styrene oxide selectivity for the catalytic epoxidation of styrene to styrene oxide with molecular oxygen.

**An improved process for preparation of magnesium oxide**

CSMCRI has introduced an improved process for the preparation of MgO of high purity (>99%) from salt bitterns via intermediate formation of $Mg(OH)_2$ obtained from the reaction of $MgCl_2$ and lime, albeit indirectly, i.e., $MgCl_2$ is first reacted with $NH_3$ in aqueous medium and the slurry is then filtered with ease. The resultant $NH_4Cl$-containing filtrate is then treated with any lime, to regenerate $NH_3$ while the lime itself gets transformed into $CaCl_2$ that is used for desulphatation of bittern so as to recover carnallite and thereafter $MgCl_2$ of desired quality required in the process. The crude $Mg(OH)_2$ is dried and calcined directly to produce pure MgO.

**Biopesticide formulations**

IICT has developed a process for biopesticide formulation (10,000 ppm) from the seeds of *Annona* (custard apple) and *Pongamia* (Karanja) and transferred the technology to M/s. Sri Biotech, Hyderabad. The formulations prepared from the extract of the seeds of *Annona* (custard apple) and *Pongamia* (Karanja) are effective in controlling the insect pests of several crops and are not phytotoxic. These biopesticides are eco-friendly, safe and biodegradable.

**Defluoridation of ground water in Nalgonda district**

IICT designed and installed a Reverse Osmosis (RO) pilot plant for generation of drinking water from a ground water source containing 5 ppm of fluoride in Myalaram Village, Nalgonda, Andhra Pradesh. The pilot plant produces 600 litres/hr of fluoride-free drinking water at an operating pressure of 8kg/cm$^2$. The water containing <0.5 ppm of fluoride and about 20 ppm of total dissolved solids (TDS) which constitute essential nutrients required by humans, is produced from the raw water containing 1200 ppm of TDS. The rejection of total dissolved solids is ~98% and fluoride 92%. The flux is generally maintained at 25 litres/hr/m$^2$ and quantity of water recovered for drinking is about 65%. The remaining 35% water is the reject for disposal which is proposed to be used for washing of clothes or gardening applications in the future. The operating cost including membrane replacement, power cost and system maintenance comes to 4-5 paise per litre. The plant is expected to provide safe drinking water for a village population of approximately 1035 people in 207 hamlets.

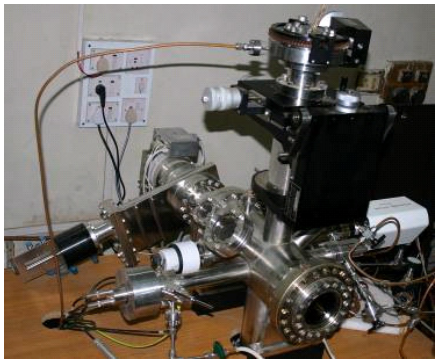
**Oxidation of alcohols and vic-diols with $H_2O_2$ using catalytic amounts of n-methylpyrolidin-2-one hydrotribromide**

IIP has developed a methodology which is highly efficient for the oxidation of various secondary, primary alcohols and 1,2-diols to corresponding ketones, aldehydes and 1,2-diketones respectively using catalytic amount of MPHT and hydrogen peroxide

as oxidant. A variety of secondary alcohols, 1,2-diols and primary alcohols were selectively oxidized in excellent yields to their corresponding ketones, 1,2-diketones and aldehydes with aqueous 30 % hydrogen peroxide in refluxing acetonitrile in presence of catalytic amount of N-methylpyrrolidin-2-one hydrotribromide (MPHT).

**Indigenous Molecular Beam Instrument**

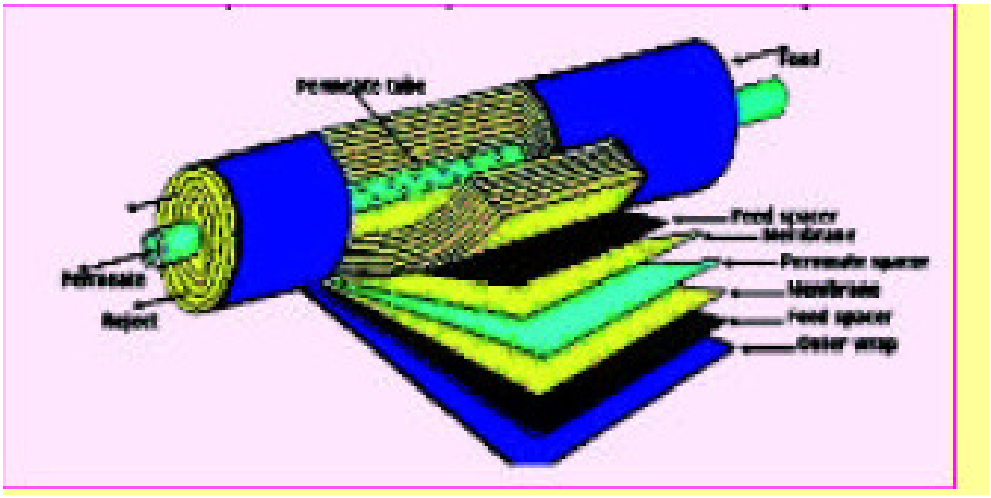
NCL has developed a simple, compact and economically viable Molecular Beam Instrument (MBI). Catalytic reactions are, in general, too complex and information on the elementary steps is not easily available. MBI enables study of heterogeneous catalytic reactions on active metal surface in a clean environment under vacuum and provides fundamental information about the catalytic reactions, such as, transient kinetics and kinetic parameters. Such vital information helps to derive the mechanistic pathway of complex reactions. With high local coverage on the substrate under clean environment, MBI bridges the pressure gap between the real-world catalysts working at atmospheric or higher pressure and other conventional experiments carried out under high vacuum.



Indigenous Molecular Beam Instrument

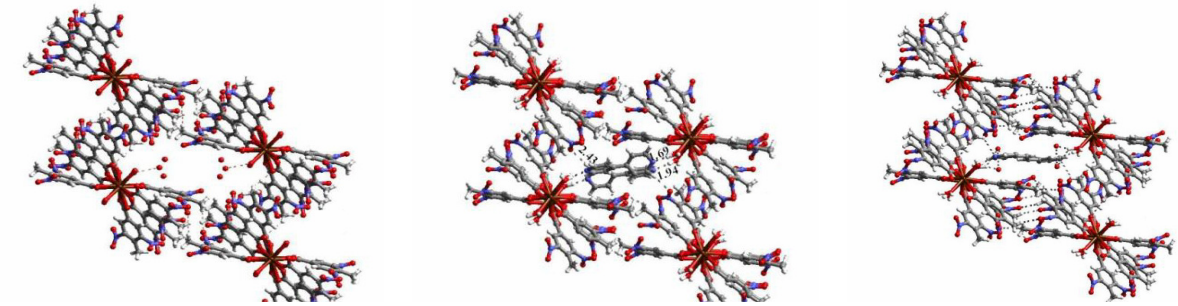
**Ultrafiltration membrane-based water purifier**

NCL has developed an Ultrafiltration membrane with pores too small to permit viruses and bacteria. Special additive used in the dope solution for membrane casting controls membrane porosity and offers membranes with desirable pore size. It operates on normal tap water pressure (0.5 bar) and does not require electricity.



**Open-frame networks in coordinated polymers through hydrogen bonds**

NCL used 3,5-dinitro-4-methylbenzoic acid to study the influence of both the types of bonds, carboxyl group (-COOH) and hydrogen bonds by the nitro (-$NO_2$) and methyl (-$CH_3$) groups, on the resultant assemblies. Single crystals in the form of golden yellow needles, obtained from the hydrothermal methods (synthesis at elevated temperature and pressure), revealed the formation of a porous assembly stabilized by C–H···O hydrogen bonds, as characterized by single crystal X-ray diffraction. The channels thus formed were occupied by six water molecules, which were held to the host network through O–H···O hydrogen bonds. The thermal studies and powder X-ray diffraction analysis revealed that this assembly is stable up to 300° C even after loosing the guest water molecules. Further, the reactions with some aza-donor ligands like, 4,4'-bipyridyl, 1,2-bis(4-pyridyl)ethane and 1,2-bis(4-pyridyl)ethene, also yielded host guest assemblies, with the aza-donor compounds acting as the guest

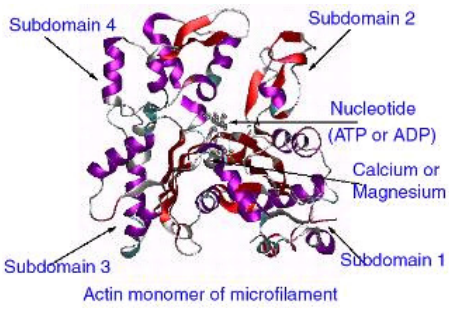


metal-organic frameworks showing the channels occupied by water, 4,4'-bipyridine and 1,2-*bis*-(4-pyridyl)ethene respectively

**Enantioselective total synthesis of microcarpalide and sapinofuranone B**

NCL developed a practical and efficient total synthesis of two very important molecules, microcarpalide and sapinofuranone using a common intermediate and asymmetric catalysis. The salient structural features associated with microcarpalide are the presence of a *trans*- double bond at C7-C8 and four stereogenic centres. The synthetic strategy devised at NCL for microcarpalide is based on a convergent approach which utilises 1,4-butanediol as one of the common achiral starting

materials to synthesize both the target compounds. The asymmetric dihydroxylation has been executed to generate all the stereogenic centres in high enantioselectivity. The regioselective opening of an epoxide with various nucleophiles to establish exclusively the *trans*-olefin geometry and Yamaguchi protocol to achieve the lactone moiety were employed as the key steps.




**Detergent alcohols**

NCL has developed a new iron based catalyst which could oxygenate linear higher alkanes using tert-butyl hydroperoxide to ketones and alcohols primarily. With dodecane, the catalyst gave about 20% conversion of the alkanes with ketone and alcohol selectivity in the range of 60–70%. The catalyst was also efficient for the oxidation of other linear alkanes in the range $C_{10}$ to $C_{16}$ and even commercially available alkane mixtures were oxygenated to corresponding secondary alcohols and ketones. This catalyst was also prepared on granular supports so that a continuous operation could be feasible. A supported Pd catalyst has also been developed which is also active and selective in the oxidation of higher alkanes to alcohols and ketones. The synthesis of tert amyl hydroperoxide was also standardized and catalysts were developed for the oxidation of isopentane to TAHP in good yield.

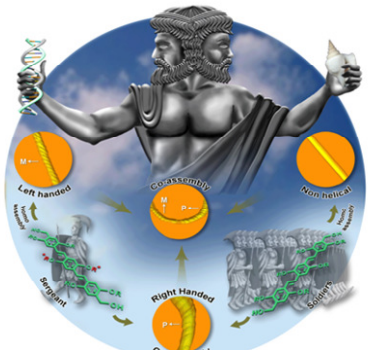
**Self-Assembled Nanotapes of Oligo(*p*-phenylenevinylene)s: Sol–Gel-Controlled Optical Properties in Fluorescent *p*-Electronic Gels**

RRL-TVM. Has reported a rationale approach to the design of supramolecular organogels of all-*trans* oligo(*p*-phenylenevinylene) (OPV) derivatives, a class of well known organic semiconductor precursors. Self-assembly of these molecules induced gelation of hydrocarbon solvents at low concentrations (< 1 mM), resulting in high aspect ratio nanostructures. Electron microscopic and AFM studies revealed twisted and entangled supramolecular tapes of an average of 50-200 nm in width, 12-20 nm in thickness and several micrometers in length. The hierarchical growth of the entangled tapes and the consequent gelation is attributed to the lamellar type packing of the molecules, facilitated by cooperative H-bonding, π-stacking and van der Waals interactions of the OPV units. Gelation of OPVs induced remarkable changes in the absorption and emission properties, which indicated strong electronic

interaction in the aggregated chromophores. The findings may open up windows for the design of a new class of functional soft materials and nanoarchitectures based on π-conjugated organic semiconductor type molecules, thereby providing access to manipulate their optical properties. The work has been highlighted in the front cover page of Chem. Eur. J. (*Chem. Eur. J.* **2005**, *11*, 3217-3227).


**Transcription and amplification of molecular chirality to oppositely biased supramolecular π-helices**

RRL-Tvm has illustrated the “sergeants and soldiers” approach with the help of gel forming chiral and achiral oligo(*p*-phenylenevinylene)s to induce helicity to co-assembled π-gels. The induction of chirality occurs through inversion of helicity resulting in opposite handedness with mirror image CD spectra at very low composition of the sergeants. During the process an unprecedented formation of mutated diastereomers with fused *M*- and *P*- helices were observed. These phenomena were supported by the CD spectral studies and AFM morphological images. It is the first visual evidence for the formation of supramolecular diastereomers and stereomutated π-helices originated from common chiral centres through AFM techniques which are complemented by circular dichroism spectroscopy. The picture below shows the first example for the creation of fused left- and right handed helical structures from conjugated molecules which is a rare example in Nature, similar to the one like the double faced Greek God *Janus*. The work has been highlighted in the front cover page of Angew. Chem. Int. Ed. (*Angew. Chem. Int. Ed.* **2006**, *45*, 1141-1145).




### 1.3.3 Human Resource Development

**NCL**

- Conducted training programme on 'Micropropagation, plant tissue culture', for researchers at GE's JW Technology Centre and workshop on 'design and scale-up of catalytic multiphase reactors'.

### 1.3.4 Recognition & Awards

| | |
|---|---|
| **Honorary Doctorates in Science and Engineering:**<br>• D.Lit. *(Desikottama)*, Visva Bharati, Santiniketan (2006)<br>• Lucknow University, Lucknow (2006)<br>• Mohanlal Sukhadia University, Udaipur (2006)<br>• Guru Nanak Dev University, Amritsar (2005)<br>• Maharishi Dayanand University, Rohtak (2005)<br>**Election to Prestigious Academies and Scientific Bodies (India and Abroad*)*:**<br>• Foreign Associate, US National Academy of Sciences, USA (2005) | Dr. R.A. Mashelkar, FRS, DG-CSIR |

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|---|---|
| • Fellow, Indian Association for the Cultivation of Science, Kolkata (2005)<br>• President, Indian National Science Academy (2005)<br>**Awards:**<br>• Suryadatta National Award (2006) by Suryadatta Group of Institutes, Pune<br>• Asutosh Mookherjee Memorial Award (2005) by Indian Science Congress Association<br>• The TWAS medal (2005) by TWAS, the Academy of Sciences for the Developing World<br>• Baroda Sun Award (2005) by Bank of Baroda, Mumbai<br>• Star of Asia Award (2005) of Business Week (USA)<br>• Maharashtra Bhushan Award (2005) by Government of Maharashtra, Mumbai for contributions to science and technology;<br>**Professorship:**<br>• Honorary Professor, Banaras Hindu University (2005) | |
| The Fellow of the National Academy of Sciences (FNASc)<br>Associate Editor of Journal of Electrochemical Society, USA<br>MRSI-ICSC Superconductivity and Material Science Annual Prize | Prof. A.K. Shukla, CECRI |
| NIIS Meritorious contribution Award | Dr G. Venkatachari, CECRI |
| N.M. Sampath Award | Dr. P. Veeramani, CECRI |
| Vikram Sarabhai Award for the Year 2003-2004 on membrane technology in solving the environmental problem associated with water | S/Shri V.J. Shah, P.K. Ghosh, S.V. Joshi, C.V. Devmurari, J.J. Trivedi, A.P. Rao and R.M. Kawa, |

| | |
|---|---|
| pollution. | CSMCRI |
| CSIR award for Chemical Technology 2005 | IICT |
| CRSI Medal | Drs. M. Vairamani & A. Kamal, IICT |
| Daimler-Chrysler Environment award 2005 on "Bio diesel from eroded soils of India" | Dr. P.K. Ghosh and Shri M.R. Gandhi, CSMCRI |
| IDMA best patent award 2004-2005 | IICT patent on anticancer agents |
| Goyal Prize (2003) in Organic Chemistry by Kurukshetra University | Dr. J.S. Yadav |
| Prof. J.G. Kane Memorial award | Dr. R.B.N. Prasad, IICT |
| CRSI medal for organic chemistry | Dr. A. Kamal, IICT |
| AVRA young scientist award | Dr. S. Chandrasekhar, IICT |
| Dr. S.D. Tirumala Rao award 2004 | Dr. B.V.S.K. Rao, IICT |
| O.P. Narula young scientist award 2005 | Dr. M. S.L. Karuna, IICT |
| Padma Shri (Science and Engineering)<br>Shri Dhirubhai Ambani Oration Award by the Indian Institute of Chemical Engineers for the year 2005 | Dr. S. Sivaram, NCL |
| The Academy of Sciences for the Developing World (TWAS) prize in Chemistry for the year 2005<br>JC Bose National Fellowship | Dr. K. N. Ganesh, NCL |
| CSIR Technology Award for the Chemical Technology (2005) | Drs. R.B.N. Prasad, V. Kale, B.V.S.K. Rao, P.P. Charabarti, B.L.A. Prabhadevi, Ms. K.N. Prasanna Rani and Shri S.K. Roy, IICT<br>S/Shri P.P. Barve, Ghike, Y. Gupte, W. Shinde, R. V. Naik, Drs. J. G. Wadkar, S. Devotta, Mrs. A.N. Bote, R. A. Kulkarni and |

| | |
|---|---|
| | Shri C.N. Joshi, NCL |
| Materials Research Society of India (MRSI) medal (2006) | Dr. U. Natarajan, NCL |
| CSIR Young Scientist Award in Engineering Sciences (2005) | Dr. K. Guruswamy, NCL |
| Prof. N. S. Narasimhan Award | Dr. S. P. Chavan, NCL |
| Prof. G. V. Bakore Memorial Award of Indian Chemical Society for the year 2003 | Dr. R. V. Chaudhari, NCL |
| Fellow of Royal Society of Chemistry | Dr. V. R. Pedireddi, NCL |
| LABDHI-RDE (RDE – Research, Development & Education) award by Shri Labdhinidhan Charitable Trust | Dr. A. A. Natu, NCL |
| Fellow of the National Academy of Sciences, India | Dr. R. C. Boruah, RRL-Jorhat |
| J.C. Bose Fellowship | Prof. T.K. Chandrashekar, RRL-Trivandrum |
| Fellowship of Indian Academy of Sciences, Bangalore<br>Member of Editorial Board, J. of Photochemistry & Photobiology: A | Dr. S. Das, RRL-Trivandrum |
| Member of Editorial Board, 'Resonance'<br>Member of International Advisory Board of the Chemistry Asian Journal, Wiley-VCH, Germany | Dr. A. Ajayghosh, RRL-Trivandrum |
| MRSI medal 2006 | Dr. K. George Thomas, RRL-Trivandrum |
| Editor, Bioresource Technology, Elsevier, UK<br>Elected Fellow of Biotech Research Society of India | Dr. A. Pandey, RRL-Trivandrum |

## 1.4 EARTH RESOURCES & NATURAL HAZARDS ASSESSMENT

Two CSIR laboratories NGRI and NIO are exclusively devoted to R&D for earth resources. R&D programmes, both through Network and Non-network projects, were taken up for new hydrocarbon resource location, estimation of recharge of ground water systems, mineral explorations and seismic studies as under:

### 1.4.1 Progress made under Network Projects

#### I. Study of mesozoic sediments for hydrocarbon exploration

The objectives of the project are application of new strategies of integrated geophysical studies of seismic refraction, gravity, magnetotellurics and deep resistivity sounding for the delineation of mesozoics basins in areas covered by Deccan Traps which are likely to contain oil and gas; investigation of unexplored areas for hidden Mesozoic sediments for oil and gas; and location of prospective hydrocarbon potential structures in the study area.

**Progress so far:**

Magnetotelluric data acquisition at 111 stations have been completed. Preliminary processing and modeling for 75 stations have also been completed and presented in a national seminar in IGU annual meeting, Bhopal, 2005. Gravity Data acquisition of 4700 (2000+2700) stations in Central India is complete. The gravity base data is processed and loop errors are calculated. Thirty-one deep resistivity soundings measurements for delineation of Mesozoic basins in areas covered by Deccan Traps in the eastern part of Deccan Syneclise area carried out. Prefield reconnaissance survey of seismic refraction studies along 300km has been completed. Bathymetry and shallow seismic data acquired in Gulf of Kutch and data analyzed.

#### II. Development of techniques and methodologies for exploration, assessment and management of ground water

The project aims at development of techniques and methodologies and integration of the available advanced geophysical and hydrogeochemical data to thoroughly investigate various aquifer systems in hard rocks, delineation and characterization of the fractured and Island aquifer systems to understand the recharge mechanism as well as geochemical contamination and simulation of flow and mass transport and development of techniques to simulate the process of artificial recharge and test their effectiveness for a value added groundwater management in hard rocks.

**Progress so far:**

Fracture delineation of 96 geo-electrical soundings in about 63 sq km area was carried out which has predicted the thickness of weathered / fractured zone from 1.6 to 48.5 m below ground surface. Likewise natural recharge rate was evaluated for tracer-injected sites of Wailapalli and Ghatiya watersheds of Andhra Pradesh.

Geochemical maps showing the distribution of fluoride and uranium have been prepared which show very high concentrations of fluoride in rocks and soil samples. Resource-cum-recharge well with a dia of 8 m and depth of 15 m and a Capture well developed. Interpretation of geophysical investigations has been carried out to delineate aquifer zones on the island.

### III. Tectonic and oceanic processes along Indian ridge system and back arc basins

The project proposes to concentrate on Carlsberg ridge (CR)- Central Indian ridge (CIR) and Andaman backarc spreading system to understand the tectonic and oceanic processes that are occurring at these dynamic plate boundaries.

**Progress so far:**

Multi-disciplinary investigations have been conducted along the Carlsberg and Central Indian Ridge segments in the Indian Ocean by undertaking two cruises on board ORV Sagar Kanya. During these oceanographic expeditions of SK-201 and SK-207, about 11,176 km swath bathymetry, seabed sampling at 14 locations, and water column data at 55 locations has been acquired. Extraction of Helium from water samples and analysis for $^{3}He/^{4}He$ ratio were attempted for the first time on especially collected samples. New insights into the tectonic evolution of the Andaman basin have been provided based on the integrated analysis and interpretation of multibeam bathymetry, magnetics, and seismological data. These results provided, for the first time, information about the topographic fabric and the tectonic configuration of the backarc spreading center. Younger age of opening to the backarc basin than the previously proposed ages was suggested.

### 1.4.2 Scientific achievements under non-network programmes

**Overpressure detection from seismic amplitude versus offset (AVO) response: an application to gas hydrates**

The high overpressure in the free-gas zone underlain by gas-hydrated sediments changes the seismic velocity and hence affects the AVO response appreciably. Therefore the effect on AVO due to overpressure is to be evaluated before making quantitative assessment of gas-hydrates. Besides, knowledge of overpressure helps in planning the drilling process to avoid potential geo-hazard due to abnormally high pressures. The AVO response of both P-P and P-S reflections from BSR for possible detection of overpressure in the free-gas-bearing zone is estimated. The theoretical computation shows that high and negative AVO anomalies for P-P reflected waves indicate a high overpressure condition.

**Laboratory studies of gas hydrates**

NGRI has synthesized LPG gas hydrates, which contain about 80% of propane. Propane hydrates are formed at lower pressure (0.172 Mpa) and at around 273.1 K. A special reactor was fabricated to synthesize gas hydrates. Hydrates thus formed

were transformed into a bottle and after a partial melting was lit to flame at the opening.

**Exploration of Puga geothermal field, Ladakh using magnetotellurics**

NGRI has carried out wide band (1000 Hz - 0.001 Hz) magnetotelluric (MT) study to understand the crustal electric structure of the Puga geothermal field located in the Ladakh Himalayas. The time series measured at 35 MT sites, distributed along three parallel profiles covering the geothermal field, is processed to obtain the best MT transfer functions at every site. The modeling studies show a surface low resistive (5-25 Ohm-m) region of ~ 400 m thick, correlating well with the thermal manifestation in the area, and an anomalous conductive zone (~ 10 Ohm-m) commencing at a depth of ~ 2 km. The possible presence of potential geothermal resources makes the area for significant exploitation of geothermal energy. If developed properly, this area can produce electric power at a place where it is badly needed due to the lack of conventional resources and would be eco friendly due to geo-heat energy.

**Constraints in using cerium-anomaly of bulk sediments as an indicator of paleo bottom water redox environment**

NIO has revealed that the total rare earth elements abundance in a 5 m long sediment core from the Central Indian Ocean Basin shows nearly two fold increase (167-314 ppm) with the core depth and strongly co-varies with Mn, Ti, P and smectite content. The cerium (Ce)-anomaly in marine sediments is used as one of the promising tools to trace paleo bottom water redox conditions. The Ce-anomaly is positive in the top 4 m and negative between 4 and 5 m of core, suggesting oxic and suboxic environments respectively. The redox condition inferred by the Ce-anomaly is compared to a number of other redox sensative parameters to test its realibility. These include Mn content, total organic carbon, U/Th, authigenic U, Cu/Zn and V/Cr ratio that all are suggestive of deposition of sediment under oxygenated bottom water conditions. Thus, the negative Ce-anaomaly observed between 4 and 5 m core depth does not represent a suboxic environment, but more likely is due to the retention of a negative Ce-anomaly caused by the presence of authigenic phosphate and Fe-rich smectite. Therefore, it is suggested that the Ce-anomaly of bulk sediments as an indicator of paleo ocean bottom water redox conditions needs to be used with a caution.

**Nitrogen uptake by size-fractionated phytoplankton in mangrove waters**

NIO has studied seasonal changes in the uptake of nitrogenous nutrients (nitrate, nitrite, ammonium and urea) in 2 size fractions (netplankton: 20 to 200 μm; and nanoplankton: 0.8 to 20 μm) in relationship to the phytoplankton species composition in mangrove waters on the west coast of India. Seasonal changes in particulate organic nitrogen in the nano- and netplankton fractions were similar, whereas those of chlorophyll varied, showing high values in nanoplankton in pre-monsoon and in

netplankton in monsoon and early post-monsoon months. Nitrogen uptake as the sum of all 4 nutrients was similar between net- (150 nmol $NI^{-1}h^{-1}$) and nanoplankton (184 nmol $NI^{-1}h^{-1}$), but differed substantially according to the N compound. Netplankton were responsible for > 90% of the nitrate taken up, and nanoplankton for > 80% of the ammonium uptake. Netplankton also took up ammonium 31 nmol $NI^{-1}h^{-1}$, 20% of the total N taken up, whereas nitrate uptake (3 nmol $NI^{-1}h^{-1}$) in the nanoplankton amounted to only about 2% of the total N uptake. The size-dependent differences in the utilisation of nitrate and ammonium appear to be further enhanced by a reduction in nitrate uptake through increased water temperatures and a greater repression of nitrate uptake in the nanoplankton than in the netplankton at ambient ammonium concentrations of > 0.5 μ mol N $h^{-1}$.

**Influence of diatom exopolymers and biofilms on metamorphosis in the barnacle *Balanus amphitrite***

NIO investigated the influence of diatom (Bacillariophyceae) films and EPS (>1000 molecular weight) on metamorphosis in the acorn barnacle *Balanus amphitrite* Darwin, a dominant fouling organism, using axenic and non-axenic films. It was observed that the EPS produced by diatoms are of similar nature, however, the proportion of monosaccharides varies with species, indicating a potential role for influencing larval metamorphosis. Free EPS of axenic diatoms had no effect, whereas biofilm EPS induced larvae to metamorphose. *Amphora* spp. produced more biofilm EPS, but had relatively weaker effects than *Navicula* spp. Axenic diatom films also facilitated larval metamorphosis (depending on species and cell density) in some cases, suggesting that the cues provided by the diatoms themselves can also mediate invertebrate larval metamorphosis in the absence of microbial films. Non-axenic diatom films (which had higher cell densities) and biofilm EPS promoted metamorphosis to a greater degree than those of axenic diatoms. Enhancement of metamorphosis depend on diatom species and its density in the films, as well as on the composition of their EPS. Differential responses of barnacle larvae to different diatom species and their EPS indicate that each diatom species provides a different set of physico-chemical signals to settling larvae.

**Tolerance and immobilization of cobalt by some bacteria from ferromanganese crusts of the afanasiy Nikitin Seamounts**

NIO has examined bacteria isolated from cobalt-enriched ferromanganese crusts on the Afanasiy Nikitin Seamounts in the Equatorial Indian Ocean for their ability to tolerate, and immobilize cobalt in unamended seawater and seawater amended with 0.01% glucose. Retrievable bacterial counts in the form of CFU (colony forming units) on media supplemented with 1 mmol Co $l^{-1}$ (58 mg Co $l^{-1}$) and 1 mmol Mn $l^{-1}$ (54 mg Mn $l^{-1}$) were in the range of $1.71 \times 10^4 - 1.05 \times 10^5$ $gm^{-1}$ (wet wt) of crust, respectively. Most of the isolates (14/24) were pigmented and showed taxonomic affinities to *Flavobacterium* sp. Two representative isolates were tested for their

tolerance of cobalt. It is observed that in the amended medium, the isolates tolerated up to 1 mmol Co $l^{-1}$, whereas in unamended medium they tolerated upto 10 mmol Co $l^{-1}$. Microscopic observations of cultures incubated with 10 mmol Co $l^{-1}$ showed the occurrence of an extracellular slime layer, which may be responsible for immobilizing the cobalt from the liquid phase. Since the isolates were naturally occurring bacteria from crusts, they could be more environmentally acceptable and safe if used for metal recovery and bio-leaching.

### 1.4.3 Human Resource Development

**NIO**

- Faculty Training and Motivation Program for Science Teachers conducted, attended by 22 science teachers.
- Long Hydrography Course for Naval Officers, 8 officers attended.
- A two-day "CSIR Programme on Youth for Leadership in Science (CPYLS)" was organized for 60 top SSC rankers (2005).

### 1.4.4 Recognition & Awards

| | |
|---|---|
| Fellow of International Geophysical Union | Dr. T. Harinarayana, NGRI |
| CSIR Young Scientist Award for the year 2005 | Dr. M. Gauns, NIO |
| Marie-Curie International Fellowship of the European Union | Dr. S.M Gupta, NIO |
| Muslim Woman Scientist for the year 2003 | Dr. S. Wahidullah, NIO |
| Raman Research Fellowship for the year 2005-06 | Dr. V.P Rao, NIO |
| Silver medal by Acoustical Foundation of India | Dr. B. Chakraborty, NIO |

## 1.5 ECOLOGY & ENVIRONMENT

CSIR has been a major contributor in providing S&T inputs to evolve national policies and to ameliorate environmental problems. CSIR, has developed expertise in air, water and soil quality management, effluents onshore, offshore & atmospheric environment, near space environment, ionospheric chemistry, stratosphere –

mesosphere coupling, 'toxic & hazardous' waste management etc. CSIR is achieving these goals both through network and non-network programmes. Significant scientific achievements are outlined below.

### 1.5.1 Progress made under Network projects

#### I. Pollution monitoring, mitigation systems and devices with applications to environmental assimilative capacity in select regions

The project envisages developing innovative sensors, indicators and instruments for pollution monitoring and study of assimilative capacity of environmental media for pollution mitigation.

**Progress so far:**

Environmental assimilative capacity of following select regions was estimated. Central India – Part of Chhindwara, MP and Nagpur, Maharashtra, Northern Indian Hilly Terrain- Bilaspur-Sundarnagar-Mandi region in Himachal Pradesh, Coastal Region-Visakhapatnam District. AP.

#### II. Industrial waste minimization and clean up

It is proposed to dematerialize the resource intensive activities of industries into more appropriate environmental technological solutions aimed at waste minimization, cleanup and remediation. It is also envisaged to go in for development of futuristic, niche and cost-effective technological interventions for at least ten highly polluting categories of industries.

**Progress so far:**

NOx conversion at 60% at lab level by selective catalytic reduction achieved. Bioremediation of (heavy metals) contaminated soil curried out. Mandaman dump – metal contaminated site surveyed for screening of heaving metals (Cd, As). Standardization of analytical method for $H_2S$, DMS, Methyl and ethyl mercaptans achieved. A fast method of enzyme assays for laccase and other enzymes for bleaching wood pulp of Century Paper Mill was developed.

#### III. Impact of anthropogenic perturbations on oceanographic - atmospheric processes in and - around India in the context of global change

The major objective of this project is to improve understanding of natural variability (from Diurnal to decadal) and to develop the capability to differentiate anthropogenic influence through long-term time series measurements.

**Progress so far:**

Time-series measurements showed consistent occurrence of hypoxia along the Goa coast following the southwest monsoon. Occurrence of plankton blooms associated with higher concentrations of climatically important gases were found. Several samples collected from Indo-Gangetic plain, Deccan Plateau and other areas

revealed accumulation of nitrate and nitrous oxide in ground waters. Both nitrification and denitrification are found to be responsible, through stable isotope measurements, for the formation of nitrous oxide, which is a greenhouse gas.

### 1.5.2. Scientific achievements under non-network programmes

**Biomethanation of municipal solid waste**

NEERI has developed a cost effective two phase biomethanation process for municipal waste. Studies reveal that in acid phase, solid concentration of 15-20% gives optimum COD and volatile fatty acid concentration. Optimum retention time for acid phase is 9-12 days. It has also been observed that if alkali treatment with 0.1% of NaOH solution is applied prior to initiation of the acid phase, maximum COD mobilization could be achieved. In methane phase studies, it was observed that a slurry of 10% solid concentration contributes in early initiation of methane generation. The methane generation starts after 30-40 days within pH range of 5.6-5.8. 75-85% COD reduction is achieved with biogas yield of 4-10 litres per kg of volatile solids. The biogas contains 45-50% methane. The optimum retention time for methane phase is 5-6 days.

Two- phase biomethanation process

**Appropriate composting process for municipal solid waste**

NEERI has carried out windrow-composting by adopting different aeration mechanisms in the windrows (aeration from the bottom, aeration from the sides aided by perforated GI pipes etc.). Studies reveal that after a period of 8 weeks, substantial reduction of fermentable organic matter and total carbon occurs. In a windrow with bottom aeration, maximum reduction (39%) of C/N ratio was observed. Studies were conducted to assess the effect due to addition of inorganics like diammonium phosphate, sodium hexametaphosphate and alkali treatment. Experiment was also conducted on application of combined anaerobic and aerobic treatment of the MSW. It has been observed that if MSW is anaerobically treated for 5 days followed by aerobic treatment, compost of C/N ratio 18-19 is obtained.

**Cold setting fly ash brick with high ash content**

RRL Bhubaneswar developed an innovative process for conversion of oxides of aluminum-silicate mineral system to hydroxylated structures under atmospheric condition on making cementation materials to develop cost effective green

technologies for utilization of various solid wastes in manufacture of building construction materials, ceramic, and heat and acid resistance products. The process has been worked out in the manufacture of cold setting building brick with the use of 80 to 97% by weight of fly ash. The bricks are resistant to water, sulfate and alkali. The properties of high ash (more than 80%) content building bricks of 230x110x75mm size range from 70 to 200kg/cm$^2$ of crushing strength, 6 to 16% of water absorption and 1380 to 1650kg/m$^3$ bulk density. The bricks are also resistant to heat up to 1000$^0$C without any significant change in physical properties. The average production cost of fly ash brick is about Rs 1.50 depending upon the availability of raw material at site.

Cold setting building bricks with 95% fly ash

Cement free concrete blocks of fly ash

### 1.5.3 Human Resource Development

**NEERI**

- Training progamme on "Drinking Water Quality Surveillance and Monitoring the system, Urban and Rural Water Supply", and
- Municipal Solid Waste Management.

**RRL-Bhubaneshwar**

- Thirty five students of B.Tech./M.Tech./M.Sc./M. Pharma. from various educational institutes of Orissa and outside state received short term training of two months.
- Eight B.Tech./ M.Sc. students are continuing their full semester project work.

### 1.5.4 Recognition & Awards

| | |
|---|---|
| United States-Asia Environmental Partnership Environmental Leadership Award 2005 | Drs. S. Devotta & R. Kumar, NEERI |
| CSIR Technology Award 2005 for the Chemical Technology | Dr. S. Devotta, NEERI |

| | |
|---|---|
| Eureka Forbes Young Scientist Award 2005 | Ms. S. R. Verma & Ms. Asifa Quereshi, NEERI |
| Indian Institute of Metal (IIM) Bhubaneswar Chapter Award for the year 2005 for contributions to plasma processing of materials and materials research. | Dr. B.B. Nayak, RRL-Bhubaneshwar |
| National Metallurgists Day (NMD)-Metallurgist of the Year Award - 2005 | Dr. P.S. Mukherjee, RRL-Bhubaneshwar |
| Mahesh Prasad Purohit Memorial Award 2005 | Dr. S. Sahoo, RRL-Bhubaneshwar |
| Rajiv Gandhi Samman Award instituted by the Department of Science & Technology | Dr. S.K. Singh, RRL-Bhubaneshwar |

## 1.6 ELECTRONICS & INSTRUMENTATION

CSIR laboratories of this sector have reported the development of several specialized products, notable among them are Ion-sensitive field effect transistor (ISFETs) and Optical fibre amplifier etc. CSIR is the repository of high-tech knowledge in microwave & traveling wave tubes and klystrons & magnetrons. Its capabilities in semiconductors have provided tailor-made hybrid microcircuits for the Indian space programme and other applications. CSIR's achievements are highlighted in following subsections:

### 1.6.1 Progress made under Network projects

#### I. Special electron tube technologies for large scale applications

The project aims at technology development for fabrication and characterization of high power electron tubes, their components like RF windows, multistage depressed collectors, high current density cathodes and other components, plasma devices and integrated pulse power systems.

**Progress so far:**

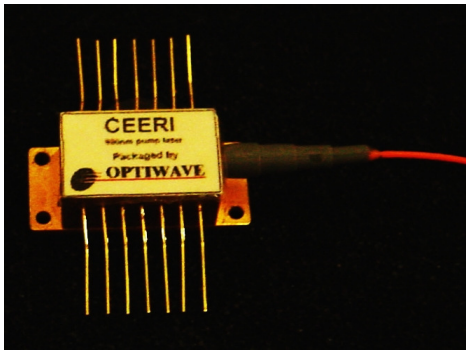
An rf window was designed and fabricated using 99.5% alumina. The windows were subjected to cold rf test and the results are quite satisfactory. One complete 4-stage collector assembly with POCO graphite electrodes and feed through was assembled. One pulse power system (40KV/10A) has been developed for characterization of Thyratron.

## II. Development of key technologies for photonics and opto electronics

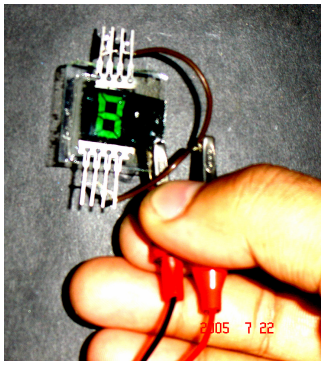
It is proposed to develop indigenous technology and packaged products for a number of key components and devices, which play vital role in future communication technology and have enormous market potential such as Optical amplifiers, In-fibre Bragg grating, Arrayed planar waveguide components and Organic light emitting diodes (OLED).

**Progress so far:**

Erbium doped Fibre Amplifier (EDFA) was developed and commercially launched on 28th August, 2005 through an agreement with M/s Network Systems Technology (NeST). The EDFA modules are now being used by some of the major CATV service providers. Facility for testing EDFA for WDM (wavelength division multiplexing) has been created at CGCRI to cater to the needs of the industry. A 980nm 14 PIN packaged pump laser module has also been developed which is a vital component of EDFA. Typical Output power of the device is 90-100mW. A seven segmented OLED device has also been fabricated and successfully demonstrated.




pump laser module



OLED

## III. Developing capabilities and facilities for micro-electromechanical systems (MEMS) and sensors

The project aims at development of MEMS based chemical and biosensors, microstructures for Lab-on-a-chip type application in different chemical and biological fields, and micro-cantilever beam array biosensors. These developments are to be transferred to industry for commercial exploitation.

**Progress so far:**

Modified set of masks (4 levels) has been made for the micropump to be used in the TAS system. For composite polymer gas sensor, MEMS micro cavities in the sizes of 250x250, 300x300, 500x500 and 500x600 micron and with a depth of 40 micron have been fabricated using UV LIGA technique with Al electrodes at the bottom of the cavity. A potassium-selective ISFET device developed under the project which has been applied to the determination of $K^+$ ion concentrations in human, blood

serum. A process for enzyme immobilization by cross-linking in photocurable polymer has also been developed.

### IV. Electronics for societal purposes

The project aims to develop electro-optic systems for sorting, grading, packaging & storage of agricultural products, prosthetic instrumentation and medical instruments calibration and natural hazards mitigation.

**Progress so far:**

Several applications have emerged out of the work carried out as a part of this project. Experiments have been conducted on spectral characteristics for different external defects like bruises and cuts in apples. Hydraulically operated artificial knee joint with rotary vane system, damping system and hydraulic chamber has been developed. The prototype of programmable functional electrical stimulation system has been developed for which preliminary clinical trials have been conducted on a paraplegic patient at Government Medical College & Hospital (GMCH), Chandigarh. Algorithm and software for estimation of magnitude of earthquake has been developed. Lab testing of engineering model of Weak Motion Recorder has been completed. Data Acquisition System has been developed for acquiring/logging data of various geotechnical sensors required for monitoring the landslide. For data analysis & interpretation (at local control station), necessary software modules for the sensors have been developed. Spoon feeding robot system & myoelectric arm have been developed and tested in-house.

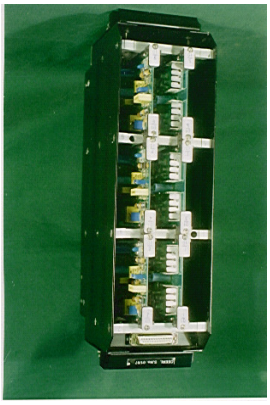
### 1.6.2 Scientific achievements under non-network programmes

**Plastic waste sorting for recycling**

CEERI has developed the technology, for the first time in India, for sorting of plastic waste for recycling. The technology can directly be used by several plastic waste reprocessors to segregate five different kinds of polymers and recover valuable raw materials for reuse. It is based on non-contact near-infrared spectroscopy of the plastic waste objects moving on a conveyor belt. A few novel chemometric algorithms have been developed for automatic detection and sorting of five popular kinds of plastics namely PE, PP, PVC, PET and PS.

**PWM amplifier for electromechanical actuator**

CEERI has developed integrated position control system for an underwater guided vehicle. It has pulse width modulation scheme for high efficiency bi-directional PWM scheme for improved stiffness, conforms to mil 883 environmental specification with cost and reliability competitive with other international products.



PWM amplifier

**Smart card based intelligent fuel dispensing machine**

CMERI has developed Smart card based intelligent fuel dispensing machine which provides an ideal low-cost automated solution for drawing a programmable quantity of fuel from the storage tank. The system comprises a storage tank equipped with a flow-controlled solenoid valve and a sensor. The sensor senses the amount of fuel drawn from the storage tank and actuates the flow-controlled solenoid valve to stop after the requisite volume of fuel is dispensed. Data like amount of oil to be dispensed or amount of subsequent money for a particular volume can be fed through a front-end microprocessor based key terminal that stores the data for dispensing oil from the tank. A sensor installed in the tank measures that amount of dispensed liquid and displays it on the front panel with its price to be paid. Optional printout form a micro printer can also be obtained showing the volume of fuel dispensed, amount to be paid with date, day & time. The system utilizes a 89C512 RD2 – programmable micro controller, a battery for real time clock, a 4*4 keyboard matrix, a 4*20 character LCD display, a +5v supply, a RS232 connector and a Smart card based system for providing the requisite features.

**Microcontroller-based clinical chemistry analyser for measurement of various blood biochemistry parameters**

CSIO has developed an inexpensive clinical chemistry analyzer. This is an open system in which any reagent kit available in the market can be used. The system is based on the principle of absorbance transmittance photometry. The developed system incorporates light source, an optical module, interference filters of various wave lengths, peltier device for maintaining required temperature of the mixture inflow cell, peristaltic pump for sample aspiration, graphic LCD display for displaying blood parameters, patients test results and kinetic test graph, 40 columns mini thermal printer, and also 32-key keyboard for executing various functions.

**Characterization of transition metal oxide ceramic material for continuous thermocouple and its use as NTC Fire Wire Sensor**

CSIO has characterized the ceramic powder of $Mn_3O_4$ and $La_2O_3$ for NTC behavior and the same has been used as $CT^2C$ (continuous thermocouple) sensor in the form of a thin metal cable to detect over-heating. These materials have mega ohm resistance at room temperature and showed exponential drop in resistance with the rise in temperature over a temperature range of 100-400$^0$C. It has been observed that as the concentration of $La_2O_3$ increases from 0 to 10% the NTC behavior drops from 400 to 260$^0$C. The material showed reproducible NTC characteristics over the temperature range 400-260$^0$C with decreasing thermistor constant values (B = 9588, 9210, 8500, 5170, 3330 $K^{-1}$) and activation energy ($\Delta E$ = 826, 794, 733, 445, 287 MeV), respectively. The decrease in activation energy of the ceramic powder with increase in $La_2O_3$ concentration makes it possible to fabricate thermal sensors which can be used in different temperature ranges.

**Interferometric moiré pattern encoded security holograms**

CSIO has developed a simple method for making interferometric moiré pattern encoded security holograms. These security holograms contain multi-fold concealed and encoded anti-counterfeit security features which can only be decoded by using an encoded key hologram. The concealed codes in these holograms are recorded with an encoded feature, so that they remain invisible to the counterfeiters thereby enhancing the anti-counterfeiting ability of security holograms. In the final reading process, specific moiré-like fringe pattern gets formed on the security hologram, only when a reconstructing beam generated from the encoded key hologram illuminates this hologram. Further, a careful spatial filtering results in the generation of a specific moiré pattern in the observation plane and it gets disappeared when perfectly repositioned. These can also be used as security codes for better protection against counterfeiting in embossed holograms. Recording schemes for the formation of such security holograms and typical experimental results have been described.

**Fire Safety Sensor for LCA Phase IA and II**

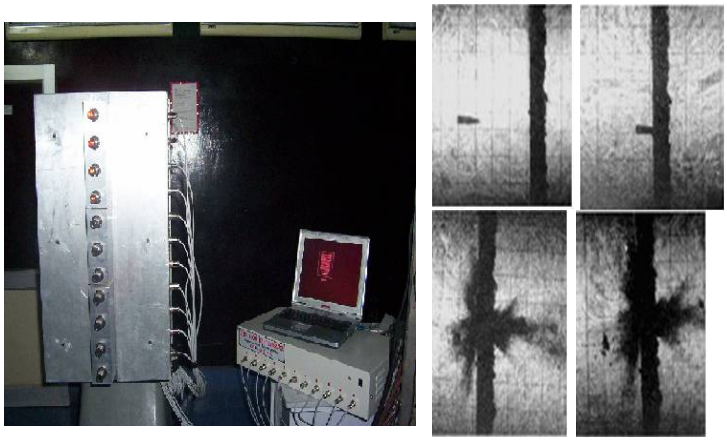
CSIO has designed and developed the continuous fire safety sensor of various lengths 10 ft and 10-50ft` by interconnecting 10ft sensors along with end connectors for Light Combat Aircraft and for other strategic devices, meeting the required qualification test MIL grade specifications.

**Night driving filter, Phase II**

CSIO has designed & developed Night Driving Filter for use in the automobiles during night driving. The device used during night driving protects eyes from the blinding glare produced by the headlight of the approaching vehicles. The device comprises a gradient density absorbing film deposited upon glass/plastic substrate by vacuum coating and also anti-reflection coating on both surfaces of the substrate.

## Multiple laser diode based system for shadowgraphy

To study the impact of the projectiles particularly just before and after they hit the target, flash shadowgraphy is being widely used. CSIO has designed and developed multiple laser diode sources having 100% Depth of Modulation (DoM), operated at few volts, which can be controlled more precisely using ultra short TTL pulses to provide exposure of few hundred nanoseconds. In international scenario, there is no report available about the use of multiple low power compact laser diodes to record flash shadowgraphs. The laser diodes are not only highly energy efficient and compact, but also amenable to precise control of exposure and delay timings in the range of nanoseconds. It is for the first time in the world that multiple laser diode based flash shadowgraphy based technique is developed.



**Microcontroller based Ozone monitor**

CSIO has developed a Micro controller based ozone monitor which is based on the principle of absorption of UV light by the ozone molecule. The degree to which the source light is attenuated depends on the path length, ozone concentration and wave length of light source. A UV lamp source, optical filter, a medium path column of absorption cell and a photodiode detector with a broad pass band centered at 253.7 nm wavelength has been used. The optical selectivity of source and detector together is such that better than 99.5% of the system response is near about 254 nm. The absorption co-efficient of ozone molecule at this wavelength is very high. In general, Beer-Lambert's law has been used to determine the ozone concentration.

### 1.6.3 Human Resource Development

**CEERI**

- Practical training to 17 students from IIT, Delhi on `Fabrication of NMOS poly-gate transistor"; and
- Institute has been identified as one of the Resource Centres under the DIT-sponsored project, `Special Manpower Development for VLSI Design and Related Software: Phase-II'.

**CSIO**

- Training programme conducted on "Preventive maintenance and repair of bio-medical instruments" at various district headquarters in Rajasthan;
- 12th Management Development Programme on "Operation, Maintenance and Repair of Biomedical Equipment" (14th September - 8th November 2005);
- 6th Management Development Programme on "Operation, Maintenance and Repair of Analytical Equipment" (18th January -14th March 2006);
- Training Programmes on "Repair & Maintenance of Bio-Medical Instruments" for Hospital Technicians/Doctors organized; and
- EDP conducted on "Ppreventive maintenance and repair of bio-medical instruments".

**Indo-Swiss Training Centre**

High-grade technical training is being imparted by conducting the following three courses:

- 3-year Diploma in Instrument Technology;
- 4-year Advanced Diploma in Mechatronics & Industrial Automation; and
- 4-year Advanced Diploma in Die & Mould Making.

### 1.6.4 Recognition & Awards

| | |
|---|---|
| IETE Hari Om Toshniwal Gold Medal for Innovative Research in the area of Nanotechnology | Dr L. M Bharadwaj, CSIO |

## 1.7 ENERGY

In the early years CSIR played a major role in the establishment of the coal washeries in the country. It has been working on developing new approaches to coal fines beneficiation and recovery from the washeries, design of mini flotation plants

etc. It has assisted the steel industry to decide on coke blends; the power industry in evolving washing strategies and the myriad of small and medium sized beehive coke units in the coal belt of India to efficiently produce coke with minimum pollution from inferior coals. It has been a pioneer in the developmental efforts in coal gasification and conversion of coal to liquid fuels. CSIR is synergising its strengths existing in different laboratories by networking to develop technologies/products required by the Indian industry. Some of the achievements are outlined below:

### 1.7.1 Progress made under Network projects

### I. Developing new generation fuel and lubricants

It is targeted to develop liquid fuels and ethanol production from biomass, biodegradable lubricants from vegetable oils & sugars and to set up emissions norms.

**Progress so far:**

**Gas to liquid technologies for dimethyl ether (DME) and Fisher Tropsch (FT) fuels**

As a part of this project 41 FT and 13 DME synthesis catalysts were prepared and evaluated. 19 FT and 3 DME catalysts for screening and comparison on high pressure fixed bed reactor system were developed. 40% selectivity to middle distillates from syn gas achieved

**Liquid fuels and ethanol from biomass**

Ethanol production from rice and wheat flour using commercial thermostable enzyme and yeast and also from starch by simultaneous liquefaction, saccaharification fermentation by using thermophiles has been reported. A 14 fold increase was marked in cellulose production by SSF process using T. reesei.

**Biodegradable lubricants from vegetable oils, sugars, starch and cellulose**

Ethyl Hexyl Trans ester, epoxy ester and toluene alkyl esters based lube base stock were prepared using ricebran, mahua, neem, karanja, castor, and linseed oil. Metalworking fluids, 2T oil, hydraulic oil, insulating oil, gear oil, lithium greases, solvent-thinner were formulated as per BIS specifications.

**Catalysts for atmospheric residue processing**

Four catalysts, namely CoMo on 1% phosphoric acid treated alumina, CoMo on 2% silylated alumina, CoMo on Florinated alumina and CoMoP alumina (Phosphorous addition *in-situ*), sulfided by 10% hydrogen sulfide in hydrogen were prepared, characterized and evaluated. Five HDM, catalysts were also prepared, characterized and evaluated with feed as mixture of short residue.

### II. Coal characterization & resource quality assessment for specific end-users

The project aims at petrographic characterization and coking behavior of coal, gainful utilization/value addition of North East (NE) coal directly or after suitably blending; developing appropriate technology for carbonization/combustion and/or after sulphur cleaning by suitable process and also the recovery of precious and rare metals from pyritic wastes, if possible; mathematical modeling for prediction of composition of gas as a function of operating parameters and properties of coal for gasification reactions.

**Progress so far:**

The possibility of desulphurization of high sulphur coals of North Eastern region of India explored through fixed bed. Experiments conducted so far explored the feasibility of sulphur removal upto a desirable extent. Thermal treatment of NE coals at higher coal carbonization temperature also opened up some avenues for partial desulphurization as well as possibility of coke making incorporating some additives. A nano-particle based material developed & characterized.

### III. Quality enhancement of coal for its efficient utilisation

The project envisages to identify the optimum beneficiation strategy of non coking coals to meet the needs of different end users; to assess the effect of blending of coals, (indigenous & imported) on efficiency of power generation and evolving strategies of blending of dissimilar coals. Use of Computational Fluid Dynamics (CFD) as a modeling tool of the different sub-processes like spiral, cyclone and flotation for improving the design and performance of existing systems has also been amended as an objective.

**Progress so far:**

Conventional beneficiation scheme of Non-coking coal where washed coarser fraction blended with finer fraction for power generation is not suitable for MCL coals. Production of low ash clears for sponge and cement industries through Jig or heavy media bath system has been observed suitable for MCL coals.

## 1.7.2 Scientific achievements under non-network programmes

### Physico-chemical characterization and catalysis on SBA-15 supported molybdenum hydrotreating catalysts

IIP has prepared SBA-15 supported Mo, CoMo, NiMo catalysts. The supports were characterized by surface area, pore size distribution, and X-ray diffraction. The finished catalysts in oxide state were characterized by surface area analysis and X-ray diffraction in the region where the molybdenum oxide lined are seen. The sulfided catalysts were examined by oxygen chemisorption at low temperatures and the catalytic functionalities of these catalysts, viz. hydrodesulfurization and

hydrogenation were evaluated on sulfided catalysts which are comparable with $Al_2O_3$- and $SiO_2$-supported catalysts.

**Adsorption technology for the desulphurisation of FCC naphtha**

IIP has developed an adsorption process for the desulphurisation of FCC naphtha which contains the maximum level of sulphur compounds and also forms the major component of a refinery gasoline. Refining operations use conventional hydrodesulphurisation processes to bring down the sulphur levels in gasoline to meet environmental limits. This process offers a low cost option, operating at lower pressures and with lower hydrogen requirements compared with conventional processes. Sulphur levels have been reduced to < 70 ppm from 990 ppm in a typical FCC naphtha. One of the most promising applications for the process is an add-on to conventional hydrodesulphurisation where it can be used to produce ultra low sulphur gasoline.

### 1.7.3 Human Resource Development

**IIP**

- Training Programme on “Advances in Instrumental Analytical Techniques”;
- Two days Training Programme cum Workshop on “Deposit rating of two-wheelers Engine Components”;
- IIP-RTI Seminar on “Technologies for gasification of carbonaceous feed stocks and syngas utilization”;
- Training Programme on “Petroleum Refining Technology” for Officers of M/s Indian Oil Corporation, M/s Esaar Oil Ltd. and M/s Chennai Petroleum Corporation Ltd.;
- Training program on “Vehicular Pollution for Transport personnel MRTH”;
- Training Program on “Laboratory Practicals” for personnel of NTPC”; and
- Training Programme in the field of “Petroleum Products” for officers of Saudi Arabia Standard Organisation (SASO).

### 1.7.4 Recognition & Awards

| | |
|---|---|
| State Intellectual Honour ‘UTTARANCHAL RATNA’2005 | Dr. D. Chamola, IIP |
| INSA Medal for Young Scientist for the year 2005 for contribution in Chemical Sciences | Dr. (Mrs.) S. L. Jain, IIP |

## 1.8 FOOD & FOOD PROCESSING

In the area of food and food processing, CSIR is contributing several novel and cost-effective and easy-to-operate techniques and processes for food grains storage, conservation and processing, and has developed various technologies for low cost-nutritious foods, and food preservation, convenience foods, non-conventional foods, spice products, fruit & vegetable preservation, packaging & transportation, besides appropriate and improved designs for a range of machinery for processing, milling etc. Three network programmes are being implemented in this area.

### 1.8.1 Progress made under Network projects

#### I. Positioning Indian nutraceuticals and nutrigenomics in a global platform

The project envisages repositioning India's leadership in the area of nutraceuticals and nutrigenomics through study of molecular basis of bioactives for the preventive, curative and management of several systematic and chronic ailments. The focus is on the health benefits from a variety of plant resources and their ingredients, which may ultimately pave way for this approach called nutrigenomics.

**Progress so far:**

Identification of dietary habits related health benefits concerning the following nutraceuticals and nutrigenomics: oligo- and polysaccharides speciality oils and fats, spices as adjuvancts, natural additives (antioxidants, steviosides and carotene), and quality proteins. Nutrigenomic database has been created. Regeneration and transgenic system of Tea and Potato standardized.

#### II. Nature, nature-identical or similar biomolecules

India is a country with rich biodiversity and also with established traditions in use of biomolecules for health, nutrition and a host of other useful purposes. In spite of huge demand for such biomolecules throughout the world, their availability is limited and the country even depends on import of a number of biomolecules. The project targets to develop commercially exploitable biomolecules.

**Progress so far:**

A process has been developed for cost effective production of vanilla plantlet by screening and characterization of abundantly available targeted plants leading to a process for the preparation of γ- butyrolactones and their derivatives using microwave and ultrasound conditions. Food grade microbes rich in cellulase, peroxidase and β-galactosidase were used to enhance vanilla flavour during curing of vanilla beans. An eco-friendly process for extraction of vanillin from vanilla pods has been developed. Pilot scale extraction of green tea from pruned tea leaves was completed. Three different synthetic oryzanol samples were prepared using soybean, sunflower and rice bran oil phytosterols and are being evaluated for cholesterol lowering property.

### III. Establishment of genetically modified food referral facility

It is imperative for the Government to have testing or referral centers in place with well-developed robust methods to accurately quantitate Genetically Modified Organisms (GMOs) in foods and food ingredients to assure compliance with threshold levels of GM products and evaluate their safety. The project aims to establish a referral center for food and food products, which will boost export of these items based on their declared absence or presence of the GM component.

**Progress so far:**

Quantified measurements using competitive PCR and TaqMan$^{TM}$ Real Time PCR technology for the insect resistance maize and herbicide tolerant soya have been studied. Number of primer pairs was designed to amplify different regions of the transgene both in maize and soya. A texturised vegetable protein prepared from GM-soya (RUR soya-pesticide resistant) was evaluated. The GMFRF, a state-of-the-art facility for the testing of GMOs has been setup. Both DNA and protein based methods have been optimized for the detection of herbicide tolerant soya and insect resistance maize seeds.

### 1.8.2 Scientific achievements under non-network programmes

In addition to network activities, CSIR laboratories have been involved in basic and application oriented R&D in non-network mode also. Some of the achievements are presented below:

**ACE inhibitors**

CFTRI has synthesized two tripeptides by solid phase FMOC-chemistry using rink amide MBTH resin. The sequence of the peptide was verified by amino-terminal sequence analysis and amino acid composition. The ACE inhibitory activity was evaluated using porcine kidney and lung ACE. The peptide was found to be a competitive inhibitor of both lung and kidney ACE. The peptide was stable to in-vitro digestion with pepsin, pancreation and a combination of these two. This suggested that the peptide would be bioavailable if administered through the oral route to cure Hypertension.

**Utilization of fish processing wastes**

CFTRI has assessed the quantitative and qualitative distribution of carotenoids in different body components of four species of shrimp (*Penaeus monodon, Penaeus indicus, Metapenaeus dobsoonii* and *Parapenaeopsis stylifera*) harvested from shallow waters off the Indian coast. The highest total carotenoid contents were observed in the head (1531.1μg $g^{-1}$) and carapace (104.7 μg $g^{-1}$) of P. stylifera, Astaxanthin and its mono and diesters were the major carotenoids (63.5-92.2% of total carotenoids) present in the carotenoid extracts from the shrimps, while the extracts contained low levels of β-carotene and zeaxanthin. The major fatty acids in

the carotenoid extracts were palmitic, heptadecanoic, palmitoleic, stearic and oleic acids.

### Preparation of the curcuminoids of high purity

CFTRI has evaluated individual curcuminoids, such as curcumin, bisdemethoxycurcumin and demethoxycurcumin, for their antioxidant activities by in vitro model systems, such as the phosphomolybdenum and linoleic acid peroxidation methods. Antioxidant capacities of the extracts, as ascorbic acid equivalent (μmol/g) were in the order: curcumin>demethoxycurcumin>bisdemethoxycurcumin. In comparison with butylated hydroxyl toluene (BHT), at 100 ppm, the anti-oxidant activity, by linoleic acid peroxidation, was found to be highest with curcumin, followed by demethoxycurcumin and bisdemethoxycurcumin. The data obtained by the *in vitro* models clearly establish the antioxidant potencies of individual curcuminoids. This is the first report on antioxidant activity of individual curcuminoids using the phosphomolybdenum method and linoleic acid peroxidation method.

## Garlic as neuro and immuno modulator

CFTRI has demonstrated the presence of a glycoprotein of molecular weight 12-13KD in addition to two non-glycoprotein agglutinins or lectins of 2 subunits of approximately 12.5KD each by Glycoprotein staining of raw garlic extract. The new glycoprotein of subunit molecular weight 12-13KD has been detected in raw garlic extract, which appears to be immuno modulatory. Analysis of dried garlic powder indicates that it lacks the 50-55KD protein representing alliance and/or high molecular weight agglutinin of raw garlic. The propensity of `fresh garlic powder' to attenuate incidence of embryopathy and oxidative stress in pregnant rats rendered diabetic (streptozotocin induced) during the early gestation period as well as the beneficial consequences against oxidative damage in fetal tissues has been established.

### Effect of process parameters on transmembrane flux during direct osmosis

CFTRI has come up with a new concept of mixed solutes as osmotic agent to overcome the problems of cross contamination of osmotic agent into the fruit juice. Direct osmosis is a non-thermal membrane process employed for the concentration of fruit juices at ambient temperature and atmospheric pressure, thereby maintaining the organoleptic and nutritional properties of fruit juices. Aqueous solution of sucrose (0 to 40% w/w) – sodium chloride (0 to 26% w/w) combination has been investigated as an alternative osmotic agent. The sucrose-sodium chloride combination can overcome the drawback of sucrose (low flux) and sodium chloride (salt migration) as osmotic agents during direct osmosis process. The effect of the hydrodynamic conditions in the module and feed temperature (25-45$^0$C) on transmembrane flux has been evaluated. The ascorbic acid content was well preserved in the pineapple juice concentrate by direct osmosis process.

**Swing Technology**

The Swing Technology (to process fresh/dry spices for essential oils, oleoresins and active principles) developed by the RRL-Trivandrum, was licensed to the two largest spice oleoresin companies in the country, namely M/s Synthite chemicals, Cochin, and M/s Plant Lipids, Cochin. The process was demonstrated for several spices including onions, garlic and chilli in the commercial facility of M/sSynthite chemicals as well as in the RRL, pilot plant. The licensing to M/s Plant lipids was followed by successful process demonstration on fresh turmeric and fresh ginger in their premises. Swing Technology has thus been accepted and appreciated as truly generic technology by the largest spice processors in the country. Swing Technology has been licensed to 7 industries.

### 1.8.3 Human Resources Development

**CFTRI**

- 35 short-term training programmes were conducted including 8 custom-made programmes.

### 1.8.4 Awards & Recognition

| | |
|---|---|
| Young scientist award by Association of Food Scientists & Technologists | Shri S. Debnath, CFTRI |
| Editor-in-Chief of Journal of Food Science and Technology, Association of Food Scientists and Technologists of India, Mysore | Shri N.S. Mahendrakar, CFTRI |
| Member of Plant Tissue Culture-Association of India (PTCAI) | Dr. N. Bhagyalakshmi, CFTRI |

## 1.9 HEALTH CARE, DRUGS & PHARMACEUTICALS

CSIR has developed several cost effective and innovative processes for several generic drugs. Herbal drugs were standardized and pharmacopeial standard for Ayurvedic drugs were laid. In addition CSIR is developing cost-effective and commercially viable technologies for a wide range of essential drugs, such as for anti-cancer, anti-virals, anti-bacterials, anti-glaucoma, anti-inflammatory, analgesics, and cardio-vascular among others. This has given much needed fillip to Indian drug industry to emerge as the largest producer of generic drugs in the world. CSIR laboratories are working in network mode within themselves and with some

pharmaceutical companies. Some of the significant achievements project-wise are given below:

### 1.9.1 Progress made under Network Project

#### I. Asthmatic and allergic disorders mitigation mission

The emphasis is on to explore the mechanism of actions of the preparations / molecules on specific target sites to strengthen the claim with a view to mitigating asthmatic and allergic disorders covering biochemical, immunological, genetical and pharmacological aspects.

**Progress so far:**

Twelve lead molecules that inhibit one or more specific targets of bronchial asthma (i.e. 5-Lipoxygenase, cytosolic phospholipase A2, phosophodiesterase F4, cytokines) have been synthesized and purified. One of the molecules (5-Lipoxygenase inhibitor) has been tested *in-vivo* in mouse model for anti-asthmatic activity. Toxicity studies in animal model indicate high therapeutic window for the molecule (approximately thousand fold). Other lead molecules are being evaluated for *in-vivo* anti-asthmatic activity and toxicity. Predictive medicine and genetic polymorphism studies associated IFN-gamma and IL-4 with asthma in North Indian population. Mustard seed and pollen have been identified as common allergens in Indian population.

#### II. Newer scientific herbal preparations for global positioning

The project aims to develop effective standardized herbal formulations for use as health promoters, or for treating various disorders, adaptogens and immunomodulators etc.

**Progress so far:**

Twenty eight medicinal plants have been evaluated for adaptogenic, immunomodulatory, anti-oxidant & antilipidemic activities. Three Positive Health Promoter formulations (PHP-Anti aging/PHP-Cancer/PHP-Diabetes) have been designed from five identified promising plants in consultation with Ayurvedic experts.

#### III. Predictive medicine using single and repeat polymorphism

It is proposed to build an Indian SNP (Single Nucleotide Polymorphism) database of common diseases and drug response related genes, which is in the larger interest of human health in general and predictive medicine & drug response in particular in the country.

**Progress so far:**

About 1700 samples belonging to 44 distinct endogamous populations for SNPs have been validated. 467 SNPs have been discovered representing all the major linguistic lineages and zones in the country. 950 non-overlapping genes have been

identified and located based on their relevance to various complex and monogenic disorders. 63 populations have been identified from different large and isolated subpopulations of 4 major linguistic lineages that are Indo- European, Austro-Asiatic, Dravidian and Tibeto-Burman from different geographical zones viz.North, South, East, West and Central. Two genomic regions representing 140 SNPs i.e. 6 Mb region which could be potentially involved in schizophrenia and BPAD and 0.4 Mb gene involved in SCA12 has been analysed in 1695 samples.

**IV. Drug target development using *in-silico* biology**

The project aims to create and develop in-house capability in drug target development using *in-silico* biology; to design programmes for developing new software, which enables identification of therapeutic targets; to design and develop new tools for predicting toxicity and drug response *in-silico*; and to generate qualified and trained IT professionals for pursuing research in the area of bioinformatics.

**Progress so far:**

A comparative genomics method has been developed to identify non active site (structural determinants) of proteins as drug targets. Human micro RNA (miRNA) was identified as a potential therapeutic for HIV infection. Five new nontoxic targets have been predicted for *Mycobacterium tuberculosis*. A novel method for human GPCR protein prediction in human genomes has been developed. Potential candidate genes for Schizophrenia and Bipolar disorder using genetic information, pathway modeling and text mining software have been identified.

**V. Animal models and animal substitute technologies**

The project aims to influence the process of new drug development and toxicity/ safety evaluation of drugs/chemicals. It is envisaged to introduce state-of-the-art technologies for new drug development, which will reduce the average time taken for development of new drugs by 2-3 years from the current average of 12-14 years in addition to providing better understanding of the drug action and targets.

**Progress so far:**

Following facilities for screening & testing of new drug entities have been established: Yeast and Drosophila models for screening of anticancer drugs; two hepatotoxicants established in mouse model for detecting hepatotoxicity of the NCEs at levels lower than the doses which cause pathological changes; model based on *Mycobacterium aurum* developed for screening of the antitubercular NCEs. and Regulatory genotoxicity assays established.

### 1.9.2 Scientific achievements under Non-network programmes

CSIR laboratories, apart from working in networking mode, carry their R&D activities in non-networking mode also. Some of the scientific achievements are highlighted below:

**Specific DNA probes and oligonucleotide primers for PCR–based 'Tuberculosis Diagnostic Kit'**

CDRI has developed a sequence specific DNA probe for detection of *Mycobacterium tuberculosis* which is isolated from a λgt11 library of *M. tuberculosis* by DNA:DNA hybridization using genomic DNA as probe followed by subtractive hybridization with cocktail of other mycobacterial DNA. This led to identification of CD192, a 1291 bp fragment of *M. tuberculosis* containing repetitive sequences, which produced positive hybridization signals with *M. tuberculosis* DNA within 30 min. The oligonucleotide primers designed from this sequence for development of PCR based assay were evaluated directly in clinically diagnosed cases of pulmonary tuberculosis and tubercular meningitis along with controls in collaboration with KG Medical University, SGPGIMS and Command Hospital, Lucknow, GSVM Medical College, Kanpur, PGIMER, Chandigarh and JALMA, Agra. The sensitivity and specificity of 90 and 100 % in sputum samples; 70 and 100% in cerebrospinal fluids and 78 and 100% in pleural effusion samples has been observed. The detection of amplification product has been developed on two formats for commercialization. One format uses solid phase capture and sequence specific detection of PCR product while the second format is the quantitative Real Time PCR using Sybr Green and Taqman probe. Both assays allow detection of M. tb in clinical samples within 48 hrs. The technology has been transferred to M/s Biotron Healthcare India Pvt. Ltd. Mumbai.

**Structural and functional features of the *streptococcus pyogenes* bacteriophage hyaluronate lyases**

CDRI has reported for the first time hyaluronate lyase having an oligomeric structure. Limited proteolysis and GdmCl denaturation studies demonstrated that the terminal region of the hylP2 protein is flexible whereas, the C-terminal portion has a compact conformation. A functionally active C-terminal fragment (S128-K337) of *hylP2* protein has been isolated, and was stabilized in trimeric configuration. Structural and functional studies on isolated domain demonstrated that the active site of the *hylP2* protein is present in the C-terminal portion of the enzyme and this domain is also responsible for the stabilization of the trimeric conformation of the *hylP2* protein. Detailed comparative functional studies with full-length protein and C-terminal domain demonstrated that the N-terminal portion of the enzyme modulates the enzymatic activity of C-terminal domain and is also responsible for specificity of enzyme for polysaccharide substrate.

**Anti-ulcer compounds**

CDRI studied the anti-ulcer activity of WG176P against cold restraint stress (CRU), aspirin, alcohol, pyloric ligation and chronic acetic acid induced ulcer models in rodents, and histamine induced duodenal ulcer model in guinea pigs and compared them with standard drugs omperazole and sucralfate. It showed significant anti-ulcer activity against all acute and chronic ulcer models. Among the various batches, one batch showed a very significant anti-ulcer activity. It also increased mucin secretion.

Antiulcerogenic and ulcer healing properties of plant extract 38C002/4483 was evaluated and found that 38C002/4483 decreased the incidence of ulcers and enhanced the healing of ulcers. Therefore, 38C002/4483 seems to be curative and prophylactic peptic ulcer. Compound 4484/C002, F005, F010 and K016 showed significant anti-ulcer activity was also found in 4627A001.

**Anti-leukemic compound from paan leaves**

IICB has discovered that a substance isolated from the leaf of the betel plant (*piper betel*) is able to induce death of cancer cells in chronic myeloid leukemia (CML) -- a type of cancer that attacks white blood cells. The compound, that has the same structure as chlorogenic acid (*Chl*), kills cancerous CML cell lines without harming normal cells. Experiments were restricted to *in-vitro* studies on commercially available CML cell lines and primary CML cells from patients. *In-vivo* studies were limited to nude mice model that were transplanted with human CML xenografts. After extracting and purifying chlorogenic acid from betel leaves the researchers used this and its sodium salt NaCl in several CML cell lines purchased or obtained as gift from the United States, Italy and Japan. The primary cells for the *in-vitro* tests came from four CML patients attending a local hospital. Currently, there is just one drug available for treating CML-Gleevec, manufactured by the multinational Novartis. However, from the laboratory to the market, the *paan* leaf compound has yet to traverse a long developmental path.

**Immunobiological studies on experimental visceral leishmaniasis**

IICB's studies helped to understand the cause of defective cell mediated immune response in visceral leishmaniases and also to design an effective vaccine. It further shows that parasitised macrophges show increased membrane fluidity coupled with defective antigen presenting function. These defects could be corrected by decreasing membrane fluidity by liposomal delivery of cholesterol. Host protective antigen has also identified which is kinetoplasid membrane protein (KMP)-11.

**Slow solvation dynamics at the active site of an enzyme: Implications for catalysis**

IICB studied using a fluorescence probe, acrylodan, site-specifically attached at cysteine residue C229, near the active site. The picosecond time-dependent fluorescence Stokes shift indicates slow solvation dynamics at the active site of the enzyme, in the absence of any substrate. The solvation dynamics becomes still slower when the substrate [glutamine or tRNA (Gln)] binds to the enzyme. A mutant Y211H-GlnRS was constructed in which the glutamine binding site is disrupted. The mutant Y211H-GlnRS labeled at C229 with acrylodan exhibited significantly different solvent relaxation, thus demonstrating that the slow dynamics is indeed associated with the active site.

**Oral delivery of Insulin & Hepatitis B vaccine**

IICT has developed oral delivery of Insulin and Hepatitis B vaccine. This new invention is a boon to the diabetic population showing the reduction of blood glucose levels comparable to that of the injectable Insulin. Similarly the oral delivery of Hepatitis B vaccine has demonstrated the generation of anti-body titres to a single dose of oral delivery comparable to that of injectable Hepatitis B vaccine. Oral administration of this vaccine provides the easiness in administering the vaccine to the infants and children.

**Recombinant Staphylokinase, a fibrin-specific clot-buster drug**

IMTECH has developed a process for high-level production of recombinant Staphylokinase. Staphylokinase is produced intracellularly using genetically engineered strain of *Escherichia coli*. Recombinant Staphylokinase is produced at high level using fed batch fermentation and purified protein is recovered after cell lysis and column chromatography. Patents for this technology have been filed in several countries to protect the IPR. The technology is currently being scaled-up with a commercial partner.

**Applied and basic insights into bioremediation pathways for nitro-aromatic pollutants**

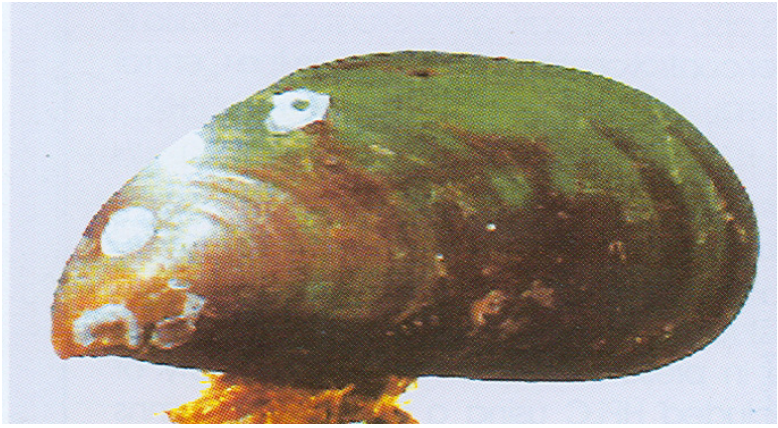
IMTECH has studied the biochemistry and molecular biology of biodegradation of nitroaromatics (NACs). Degradation pathways of some of the lab-isolates (*Ralstonia* sp. SJ98, *Burkholderia cepecia* RKJ200, *Arthrobacter protophormiae* RKJ100) have been elucidated and included in the University of Minnesota Biocatalysis/Biodegradation Database. To assess the efficiency of PNP degradation and stability of the selected strain RKJ100 in the PNP-contaminated site, field studies were successfully conducted under conditions optimized earlier in microcosm and pot studies. 7 Kb genomic fragment containing seven ORFs was cloned from SJ98 (AY574278). The total microbial diversity of a NACs-contaminated site was also studied using ARDRA as well as changes in community pattern by T-RFLP. A method has been designed named 'tag and chase' to track the degradative strain during bioremediation.

**Aspartic proteases inhibitors: implications in drug development**

NCL has isolated a bacterium (*Bacillus* sp.) that lives under extreme environmental condition and produces an aspartic protease inhibitor (ATBI). ATBI has been characterized for its inhibition against HIV-1 protease, pepsin, and the protease from the fungus *Aspergillus saitoi*. The inhibitor is found to be a hydrophilic peptide with a molecular mass of 1147 Da. Sequence homology exhibited no similarity with the known peptidic inhibitors of HIV-1 protease. Investigation of the kinetics of the enzyme-inhibitor interactions revealed that ATBI is a non-competitive and tight binding inhibitor of HIV-1 protease.

**New lead molecules for malaria**

NIO has prepared the crude extract by the enzyme-acid hydrolyzing process from a marine organism (mussel) which shows a potent anti-malarial activity, when examined via *in-vitro* cultures of *Plasmodium falciparum* in human erythrocytes. The molecular entities responsible for anti-malarial activity was isolated & characterized. These molecules present themselves as promising candidate drugs for malaria and may be used in conjunction with conventional drugs. The active compound is relatively cheap to obtain and can readily be prepared in bulk without killing the mussel. The Mumbai-based company M/s Shreya Life Sciences has been licensed to commercialize the drug.



**Assessment of declining effect of the antioxidant capacity and phenolic contents in Indian herbal teas due to long storage**

ITRC has carried out studies to assess the declining effect due to long storage of the anti oxidant capacity and phenolic contents, thereby affecting adversely the beneficial effects of Indian herbal teas. The changes in the stability of antioxidant capacity with time and its relation to the phenolic content were evaluated in 8 Indian herbal teas. These herbal teas are claimed to have multiple bioactivities from anti stress to anti hypertensive and memory enhancer. Anti oxidant capacity was determined over a period of 15 months from the date of their procurement using assays for SOD mimetic activity, LPO inhibitory capacity and total thiol content. These activities were found to decrease positively with time. The study assume significance as most of the herbal teas available in the local market in India do not carry any information regarding time limit in use so as to maintain the beneficial effects of Indian teas.

**Assessment of toxic metals contaminants in food grade silver foils**

ITRC has carried out studies to assess the toxic metal contaminants in food grade silver foils. FAO/WHO Joint Expert Committee on Food Additives (JECFA) has

included silver in the list of food additives but specifications are not prescribed and also Indian legislation has laid down a purity requirement of 99.9%, leaving scope of 0.1% margin of contamination. Of the 178 foils analysed, 161 (90%) contained silver, whilst 10% were fraudulently made up of aluminium. In the case of silver foils, 46% of the samples adhered to the desired purity requirement of 99.9%, while 54% had a lower silver content. Copper was present in 86.3% of the silver foils, while chromium, nickel and lead contamination was found in over 54% of samples. Cadmium levels were detected in 28% of the silver foils and manganese was present in 6.8% of samples. In silver foils showing metal contaminants, average levels were found for nickel (487µgg-1), lead (301µgg-l), copper (324 µgg-1), chromium (83µgg-1), cadmium (97µgg-1) and manganese (43µgg-1), The observations justify the need to prescribe limits for some metals in food-grade silver foil.

**A new plant based hepatoprotective: Liv –1**

RRL, Jammu has licensed end-to-end package for single plant based herbal drugs as hepatoprotective against alcoholic and viral cirrhosis. The product is standardized based on two identified chemical markers. The formulation has been licensed to M/s Madley Pharmaceuticals Ltd., Mumbai. The company after conducting the proof of concept in humans has finally launched the product as Liv-1 in both tablet and syrup forms. The efficacy is concentration dependent where the $ED_{50}$ is 25 ± 5.0 mg/kg, p.o , $ALD_{50}$ > 2000 mg /kg, p.o. and the therapeutic index is 80. Liv -1 is a standardized fraction, based on well-defined isolated and chemically characterized standardized markers, exhibits significant hepatoprotection against hepaptotoxin in animal studies. The product exhibits at least 50% more hepatoprotective potential than any available commercial herbal formulation. The drug can be used both as preventive and curative against hepatic disorders.

### 1.9.3 Human Resource Development

**CDRI**

- The Institute continued to participate in DST sponsored Kishore Vaigyanik Protsahan Yojna; and
- Institute organized the CSIR Program on Youth for Leadership in Science (CPYLS) and during 27-28 December 2005. 9 meritorious students of Uttar Pradesh participated.

**IICB**

- Summer training programme organized for 58 M.Sc. or M.Tech. students of different disciplines of different universities.

**IMTECH**

- Summer training programme for M.Sc. (Biotechnology): 27 students participated;
- Winter training programme for M.Sc. (Biotechnology): 4 students participated;
- Institute has signed an MoU with Panjab University wherein scientists will participate in various teaching programmes of the University and the University will recognize and accredit scientists for guiding doctoral thesis;
- CPYLS programme: 27 students participated; and
- Training programmes on "Maintenance and identification of cultures".

**ITRC**

- Hands-on training course on Genomics & proteomics, and
- A five-day training on analysis of pesticides and other organics

### 1.9.4 Recognition & Awards

| | |
|---|---|
| Panjab University Pharmaceutical Science Oration Award 2004<br>Platinum Jubilee Lecture Award from Indian Science Congress, Ahmedabad<br>Prof. V. Ramakrishna Memorial Lecture Award of IIT, Delhi<br>Gujral-Bhargava Memorial Oration Award of KGMU, Lucknow | Dr. C.M. Gupta, CDRI |
| CSIR Young Scientist Award-2005 in Chemical Sciences | Dr. A. K. Mishra & Dr. A. Kumar, CDRI |
| Dr. D.N. Prasad Memorial Oration Award and Gold | Dr. G. Palit, CDRI |

| | |
|---|---|
| medal of Indian Council of Medical Research | |
| Elected Fellow, West Bengal Academy of Science & Technology (2006) | Dr. A. K. Giri, IICB |
| Kshanika Oration Award by ICMR<br>Elected Fellow, Indian Academy of Sciences | Dr. C. Mandal, IICB |
| Elected Fellow, Indian Academy of Sciences | Dr. H. K. Majumder, IICB |
| Shanti Swarup Bhatnagar Award for the year 2005 | Dr. J.N. Agrewala, IMTECH |
| Pitamber Pant National Environment Fellowship award<br>Fellow of Association of Microbiologists of India | Dr. R.K. Jain, IMTECH |
| National Bioscience award | Dr. G.P.S. Raghava, IMTECH |
| Editorial Advisory Board of "Bioprocess and Biosystems Engineering" | Dr. P.R. Patnaik, IMTECH |
| Elected member of National Academy of Medical Sciences | Dr. A.B. Pant, ITRC |

## 1.10 HOUSING & CONSTRUCTION

CSIR has developed techniques and technologies covering the whole gamut of construction activities right from foundations to construction equipments. Newer and innovative building components developed have greatly helped the building industry to standardize optimal structural elements. In the area of structural engineering, CSIR laboratories have specialized in making design and analysis of special and complex structures such as high rise, long span, suspended, offshore, ships etc. and in the integrity assessment of these structures. CSIR is also known for its contribution to the roads sector through designs and constructions techniques of rigid and flexible payments using local skills and material resources. CSIR is excelling in these areas both through network and non-network modes.

### 1.10.1 Progress made under Network project

CSIR is operating three network projects. The achievements during the year are presented below.

**I. Developing new building construction materials and technologies**

It is envisaged to develop low cost/ alternative building construction materials such as bricks, blocks, tiles, boards, cement/ concrete products, fibre reinforced composites, wood substitutes, coatings, sealants, paints, pigments etc. to replace/

supplement the conventional building materials which are in short supply in the country.

**Progress so far:**

Several small yet useful processes were developed, such as: (i) a process for making clay fly ash bricks demonstrated at commercial plants, (ii) a wood substitute from agro-industrial wastes with polymeric binder- composites using paddy husk powder and plastic waste, (iii) jute polymer based composites using marble slurry, polymers and fire retardant Jute fibres developed and evaluated, (iv) corrosion resistant conducting coating systems for reinforcing bars-coatings based on epoxy and acrylic resin formulated, and evaluated. Results indicate epoxy based coatings are superior to acrylic based coatings. Control of pollution from mixed feed lime shaft kilns and small capacity fixed Chimney brick kiln-SPM level of lime kiln reduced by 30% by using improved scrubber and packed Bed Demister Unit. SPM level of brick kiln reduced by 50% by constructing Gravitational Settling Chamber (GSC) with a stack height above 30 m.

**II. Design analysis and health assessment of special structures including bridges**

Early detection of structural health degradation can help in prevention of catastrophic failure. One method of health monitoring is by the use of fibre optic sensors, which allows the acquisition of valuable information about the structural integrity, environment and behaviour of structures, without damaging the chemical and physical properties of the materials used in the structure. This would develop expertise in applying these sensors to real life problem.

**Progress so far:**

Studies relating to advanced analysis and design methods for steel frames, and experimental investigation of frame connections have been completed. Wind tunnel experiments were performed on three sectional models of cable stayed bridge decks viz., Model A - open channel section, Model B – open channel section with fins and Model C – box girder section with fins. Wind tunnel investigation on across-wind response of prismoidal structures having different cross sectional shapes under atmospheric wind has been completed. A data base for fatigue and fracture behaviour of pipes and elbows has been developed for in-house use. Experimental studies were carried out for evolving suitable procedures for embedding fiber optic sensors in concrete structures. Suitable techniques have been developed to protect the sensors against damages during concreting and compaction. A few studies were conducted on health assessment of actual structures including a flyover bridge at Visakhapatnam and railway bridge at Tiruttani.

### III. New and improved road technologies

The project aims to provide the cutting edge technologies for developing the required road infrastructure with reference to construction materials for specific purposes, drainage systems, road management systems, information systems, and models for traffic measurement systems etc.

**Progress so far:**

Performance evaluation of test section of micro-surfacing using natural rubber latex has been carried out. Screening and characterisation of feed stock for modification of bitumen by molecular alteration in short residue by polymerisation and condensation have been completed. HPC sections laid at CRRI campus and at Dhaula Kuan are under periodic evaluation. Repair of roads with high performance concrete and high performance fibre reinforced concrete has been carried out. Vinyl ester based polymer concrete specimens have been made for compressive strength, stress-strain, flexural strength, split tensile strength, impact resistance, thermal resistance, bond strength to concrete substrate. Optimum polymer dosage for compressive strength was 13% from workability point of view.

### 1.10.2 Scientific achievements under Non-network programmes

**Flooring & paving tiles**

CBRI has developed a method to utilize the sanitary waste in the production of heavy-duty flooring/ paving tiles utilizing specially developed hard cement matrix to bind the waste together. The process is economical, simple and the product can be used for industrial floorings and also as paving blocks of high quality far exceeding BIS specifications.

**Acid-resistant tiles**

CBRI has developed a process to bind the sanitary waste into acid-resistant tiles and bricks with an acid resistant ceramic binder. The binder provides the liquid phase, required for sintering the waste to strongly bind it into acid-resistant tiles and bricks. The quality of tiles and bricks so produced conform to BIS requirements and are economically viable. The work has opened up new possibilities of studying other ceramic wastes like pottery waste, electric insulator waste, blast furnace slag, flyash etc. for utilization in the production of high strength construction components like curb stones, high tare traffic pavers, beam receptacles/ bearing blocks etc by ceramic binding processes. Construction components requiring high chemical and acid resistance can also be produced using these wastes.

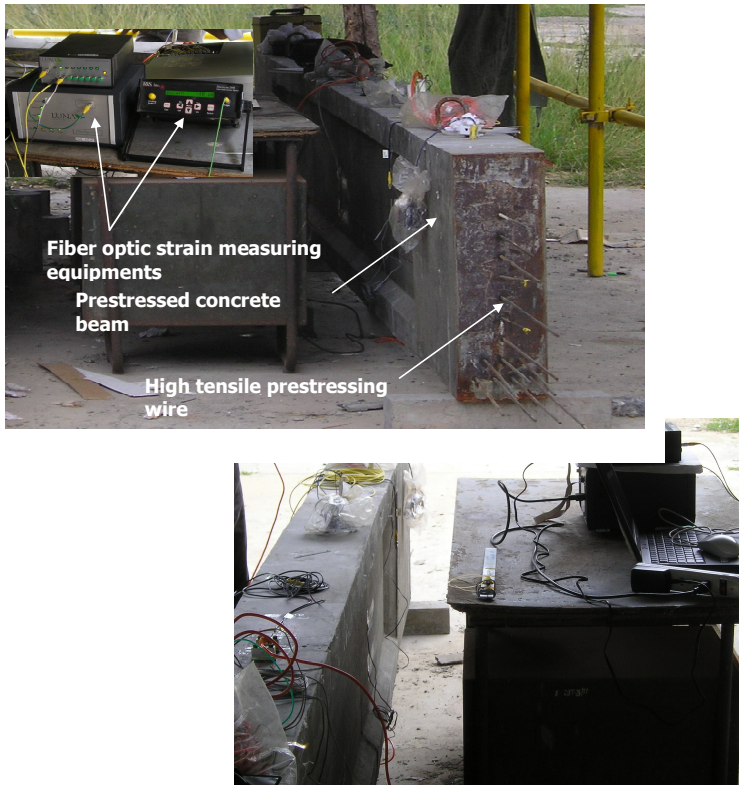
**Vibration control of buildings and structures subjected to multi-axial excitation**

SERC has tested two pairs of laminated bearings made of natural rubber with two different shore hardness values using a specially fabricated fixture. In the test program, excitation frequency, applied axial load and the shear deformations were

varied. From the measured response parameters, the force-displacement hysteretic loops were obtained. Using these hysteretic loops, dynamic characteristics of the isolator specimens like dynamic stiffness and damping were calculated, and further, the values of storage modulus, loss modulus and the loss factor of these specimens were evaluated. The study showed that the stiffness of the isolator specimens decreased with increase in axial load and shear deformation.

**Health assessment of bridges and other structures**

SERC has designed fiber optic sensor based structural health monitoring towards predicting the time-dependent losses in prestressing steel and evaluating the stress condition of concrete in the beam. A post-tensioned prestressed concrete I-beam of 5.2m long was prepared and instrumented with embedment type and surface mounting type EFPI fiber optic sensors at mid span and one quarter span. Adjacent to fiber optic strain sensors, surface mounting type vibrating wire strain gauges were also instrumented to compare the response of fiber optic strain sensors. Strain and temperature values from all the sensors were recorded during prestressing and applied prestressing force was computed. Monitoring the performance of the instrumented prestressed concrete I-beam has been carried out over 225 days. From the results, good comparison was observed between the strain values measured by fiber optic strain sensors and vibrating wire strain gauges. Time-dependent prestress losses have been computed from the measured data and these values are comparing closely with the ACI method.




Health monitoring of prestressed concrete beam using fiber optic sensors

### 1.10.3 Human Resource Development

**CBRI**

- Exhibitions, training programmes, orientation programmes, interactive meets etc. are organized as part of a continuing extension activity of CBRI catering to the local requirements of cost, safety and comfort in rural and urban housing.
- **Training/Orientation Programmes**

  8 science teachers of selected schools and colleges of Roorkee were trained under the CSIR programme on Faculty Training Motivation and adoption of schools and colleges by CSIR Labs.

- **Interaction/ Awareness Meets**

➢ Under the CSIR Proramme on Youth for Leadership in Science (CPYLS), 12 brilliant students who have passed Class X examinations securing top positions in Uttranchal at CBRI, Roorkee participated along with their parents/ teachers

➢ Interaction meetings were held with more than 100 science students from SSDPC Girls' Degree College and GIC School Roorkee and their teachers with the scientists of CBRI under the CSIR programme on "Faculty Training Motivation and Adoption of schools and colleges by CSIR Labs." One week Workshop was also arranged on "New Emerging Areas of Science".

**CRRI**

Training programmes on

- 'Wind analysis modulus';
- 'Usage of jute geotexties in PMGSY roads';
- 'Highway engineering materials and construction technologies'; and
- 'Soil investigation and ground improvement techniques for highway projects'

**SERC**

- National Programme for Capacity Building of Engineers in Earthquake Risk Management;
- The Annual Technical Symposium of Structures Panel of AR&DB;
- Workshop on 'CSIR E-Journals Consortia;
- CSIR Programme on Youth for Leadership in Science (CPYLS); and
- CSIR automobile industry get-together on advanced manufacturing technologies.

### 1.10.4 Recognition & Awards

| | |
|---|---|
| Raman Research fellowship | Dr S. A. Jayachandran, SERC |

## 1.11 INFORMATION DISSEMINATION & PRODUCTS

Realising the inevitable explosive growth in the IT sector and knowledge based society powering the current century, CSIR laboratories have evolved strategies to derive the benefits from the rich data and information base greater and the update of domain knowledge possessed. One of the major initiatives towards this is to work in Network mode.

### 1.11.1 Progress made under Network projects

#### I. Comprehensive traditional knowledge digital library (TKDL)

The project envisages to collect and collate traditional knowledge that exists in public domain by creating a database on this knowledge in five international languages i.e. English, German, French, Spanish and Japanese and making these available to patent examiners throughout the world to prevent the grant of bad patents. The codified knowledge of the country will be converted into easily accessible and retrievable patent application digital format.

**Progress so far:**

Database has been created on Traditional Medicinal formulations comprising 13 million A4-size pages of data on transcribed 62,000 formulations in Ayurveda; 60,000 formulations in Unani; and 1,300 formulations in Siddha. Other achievements include i) value addition to the database on medicinal plants for 500 species, ii) digitization of more than 50,000 herbarium specimens, iii) preparation of datasheets for 750 primary information and over 8,000 secondary information on Tribal Knowledge, iv) creation of five video films on Tribal Knowledge, v) preparation of TKRC on Traditional Foods and collection and entry of data on 70 traditional cuisines, and vi) preparation of TKRC on Traditional Architecture and construction Technologies and entry of 105 items in the data entry software.

TKDL has been receiving wide international coverage, 76 news papers covered TKDL in their articles in the month of December, 2005 only. Some of the leading newspapers which covered TKDL include Washington Post, London Times, Wall Street Journal, etc.

EPO, USPTO, UKPO, Japanese Patent Office, and Swedish Patent and Trademark Office have requested to have an access to TKDL database on Indian system of medicine under non-disclosure agreement for search & examination purposes. EPO has guaranteed confidentiality and proper usage control of the TKDL database.

TKDL has made an impact worldwide as one of the effective method of defensive protection of TK. Several countries and organizations have shown keen interest in creation of TKDL for their own countries with the objective of defensively protecting their own TK.

### II. National science digital library (NSDL)

The project aims to contribute to national development by reaching the un-reached i.e. science & engineering students of undergraduate, postgraduates level located in far flung areas by making them available e-learning facility and access comprising curriculum-ware-text books, help books, question banks, etc.; to facilitate access to remote areas at level similar to Metros; to contribute in preparing future scientists, researchers and engineers and ultimately to have professional of high calibres in large numbers; to design and adopt/adapt state-of-the-art technologies in digital library solutions suiting the national needs.

**Progress so far:**

Working Groups in twelve subject disciplines were constituted which short-listed the e-books and their likely contents, and the authors for writing various chapters. Some technical documents including Software Requirement Specifications (SRS) for NSDL Portal, Detailed Project Report (DPR) of NSDL, Request for Proposal (RFP) for Data Centre, Project Management Plan (PMP) and Quality Assurance Plan for the project were finalized.

### III. Consortium access to electronic journals

The project aims at providing CSIR S&T staff electronic access to S&T literature worldwide to strengthen the facilities for pooling, sharing and electronically accessing the CSIR information resources; and to nucleate the culture of electronic access with a view to catalysing the evolution of digital libraries.

**Progress so far:**

Agreements with 11 international publishers were made and as a result all CSIR labs are able to access 3300 journals. The post agreement monitoring for all the above 11 publishers is being done regularly. Usage statistics of 11 publishers are being regularly organized and loaded on search interface & monitoring system gateway so that user labs can use it. A Search Interface Gateway and Complaint Monitoring System has been developed, intended for user-friendly access to journals available in consortium from various publishers. The monitoring system also has a built-in system to manage and record the problems of the users while accessing E- journals of various publishers.

### 1.11.2 Scientific achievements under Non-network programmes

**Dissemination of information to S&T Community**

NISCAIR publishes nineteen scholarly journals of international repute, covering all the major disciplines of science and technology. Two of the its journals, namely *Indian Journal of Traditional Knowledge (IJTK)* and *Medicinal and Aromatic Plants Abstracts (MAPA)* have been included in the coveted list of 'Prior Art Journals' used for prior art search before grant of patent(s) by the International Search Authorities. India is one of the 13 nations whose journals have been included in this list. The papers published in the journals are indexed and abstracted in most of the international indexing and abstracting journals and thus provide international exposure to Indian R&D workers. The contents and abstracts of all the periodicals are regularly updated on the NISCAIR's website: www.niscair.res.in. Special issues were brought out by various journals on specific topic from time to time.

**Subscriber base and impact factor**

Continuous efforts towards improving the quality and subscriber base of the journals are yielding very good results. There has been a steady increase in the subscriber base (~ 20 % per annum) and many of the NISCAIR journals are covered by the Science Citation Index and have an impact factor varying from 0.087 to 0.509, quite respectable among Indian journals.

**Science popularization**

NISCAIR publishes three well-circulated popular science magazines, *Science Reporter* (English monthly), *Vigyan Pragati* (Hindi monthly), and *Science ki Duniya* (Urdu quarterly) apart from a number of popular science books and an encyclopedic science dictionary, with a view to generating awareness about scientific developments and creating a scientific temper among the students and common men. The institute also focuses on the R&D activities of CSIR labs through the newsletters—*CSIR News* and *CSIR Samachar*.

**Science Reporter**

Launched in 1964, *Science Reporter,* entered into 43rd year of publication in 2006. This is one of the oldest English language popular science monthlies published in India, enjoying a wide readership throughout the country. During the year it continued with its objective of providing to its readers topical coverage of issues in various fields such as information technology, wildlife, environment, space, nuclear technology, health and biotechnology as well as light reading material such as humour, amazing scientific facts, profiles of scientists, science projects, inventions and discoveries and much more. Special issues were brought out on specific topics time to time.

**Vigyan Pragati**

This widely circulated monthly popular science magazine in Hindi was launched in 1952. Running in its 55th year *Vigyan Pragati* endeavors to introduce its readers with the important current events/issues in an easy to understand manner. Special issues on various topics are also brought out from time to time. All columns of the magazine are not only very interesting but are also capable of creating inquisitiveness in the mind of its readers. It has various columns as Science News; Science Quiz; Chitrakatha; Career; Honours and Awards; etc.

**Science Ki Duniya**

*Science Ki Duniya*, the quarterly popular science magazine in Urdu, is one of the widely read Urdu magazines in the country. It entered into 32nd year of publication in 2006. *Science Ki Duniya* continues to disseminate information on current scientific topics in an easy-to-understand and attractive manner. During the year, it covered articles on *Tsunami*; allergy; gastric ulcer; DNA secrets; biotechnology; spirulina; homeland security; coral; heart attack; diabetes; hypertension and high blood pressure; herpes; e-governance; stem cells; pneumonia; etc.

**CSIR News**

*CSIR News*, the fortnightly newsletter of CSIR is intended to serve as a useful link among the various CSIR establishments and to communicate activities/accomplishments of the Council to other R&D organizations, universities, S&T agencies/departments, industry and other users, mass media, etc. Launched in 1950, it also disseminates information regarding CSIR to other countries through Indian missions abroad and foreign missions in India. Several special issues on different occasions were brought out during the period, viz. (i) Technology Day celebration, (ii) CSIR Society Meeting, (iii) CSIR Foundation Day and (iv) CSIR Diamond Jubilee Technology Award (2004) and Shanti Swarup Bhatnagar Prizes (2004-05). Other issues covered were CSIR e-Journal Consortium, 'A quick Search Reference Guide' and 93rd Indian Science Congress. The issue on Indian Science Congress published speeches of Dr. Manmohan Singh, Prime Minister of India, Shri Kapil Sibal, Minister for Science & Technology and Ocean Development, and Dr. R.A. Mashelkar, Director General, CSIR.

**Bharat Ki Sampada**

*Bharat Ki Sampada- Prakritik Pradarth* is a scientific encyclopedia in Hindi Language. This encyclopedia, launched in 1969, is the Hindi version of 'Wealth Of India – Raw Materials' covering the raw materials of India in terms of plants, animals and minerals.

Ten volumes and two supplements of *Bharat Ki Sampada* have already been published. The XI volume shall cover 110 articles whereas remaining 46 articles

shall form Volume XII. In addition, Volume XII will also have a cumulative index of *Bharat Ki Sampada* Series.

Out of 110 articles, scheduled for publication in Volume XI, 97 articles have already been updated, translated and edited. These articles have also been data entered and are in the process of conversion into digital form.

**Raw Materials Herbarium & Museum (RHMD)**

RHMD houses authentic samples of economically important raw materials of plant, animal and mineral origin of India to cater the needs of scientists, researchers, industry, entrepreneurs, students and the public. At present, it holds 6478 plant specimens, 190 zoological specimens, 207 mineral samples, and 2000 carpological samples ( crude drugs, roots, seeds, bark, wood, etc.). Over 1000 visitors comprising students, teachers, researchers, scientists, entrepreneurs etc., visited the herbarium during the year. Based on the infrastructure facilities and expertise available with RHMD, a consultancy service against payment of moderate fee is being offered since January 1994 with the objective of helping students, research scientists and pharmaceutical industries.

**Online information retrieval services**

NISCAIR helps by providing a list of research papers in the scientists' field of interest during a specified period. During the period, a total of around 93 orders have been registered for translation from ten foreign languages (Chinese, Czech, Dutch, French, German, Hungarian, Japanese, Polish, Portuguese, Russian, Slovak and Spanish).

**NISCAIR website and full-text search of selected NISCAIR journals on website**

NISCAIR website, http://www.niscair.res.in, is being hosted on NISCAIR's own server. Content pages along with abstracts of the papers published in all the NISCAIR journals/magazines are being made available regularly. Full contents of nine research journals are available on NISCAIR's website. Efforts are being made to provide full contents of all the remaining NISCAIR journals on web. This has helped in increasing the reader base of these journals. Citations of papers published in these journals have also increased, thereby improving overall impact factor of these journals.

**Facility Management Software**

NISCAIR has also developed and deployed some generic small applications, which can be deployed in other CSIR laboratories. These include:

*Document Management Information System (DMIS):* In NISCAIR as well as in various other laboratories of CSIR, DMIS enables the controlling officer of an organization/division/section to view the movement of the documents and take

appropriate decisions. Moreover, file status can be checked, and any officer can know the status of his file or receipt instantaneously.

Other user friendly software developed and used by NISCAIR are: Attendance Monitoring System (AMS), Online Submission of Application for Recruitment, Reception Management System (RMS) and Vehicle Management System (VMS).

**IT literacy programme**

NISCAIR has brought out a series of seven simple-to-use, practical books on various subject areas of IT in English. Some of these books have been also translated in nine Indian languages, viz. Hindi, Punjabi, Tamil, Kannada, Gujarati, Marathi, Bangla, Malayalam and Urdu, with a view to enhancing IT literacy among a much wider cross-section of the society. Already 65 of the 70 translated versions have been brought out and the rest are in various stages of processing. Over 55,000 copies of these books have already been sold. Bulk purchase orders for the IT books have been made by National Council for the promotion of Urdu Language, Ministry of HRD, Govt. of India; Department of IT, Chandigarh Administration, Chandigarh and Delhi Government.

**Attitude-behaviour consistency: an empirical study of Indian scientists**

NISTADS explored the attitude-behaviour consistency among scientists (n = 490). The results showed five dimensions of scientist's research-related attitudes: a) attitude towards utilitarian aspects of research; b) attitude towards scientific research per se; c) attitude towards institution; d) attitude towards professional-self and e) attitude towards individual self. The study reaffirms the attitude-behaviour consistency hypothesis in the field of science. Attitudes pertaining to the professional characteristics are explained more by the nature of the scientific role rather than by the biographical features of respondents. The study also revealed that scientist's position on various dimensions varied with the stage of her/his career.

### 1.11.3 Human Resource Development

**NISCAIR**

- Training to students of B.E., B.Tech, M.E., M.Tech, M.C.A & M.Sc,
- Continuation of the two year academic programme "Associateship in Information Science",
- Short Term Courses on Information Technology for Information Management,
- Organised two courses on Library Automation and Resource Sharing,
- On-the-job Attachment Training Programmes for SDC sponsored candidates, and

- SAARC Workshop on “Recent Developments in Library and Information Science and Creation of Digital Libraries”.

## 1.12 LEATHER

Central Leather Research Institute is the largest leather institute in the world. Through inputs of S&T and extension activities it has been transforming the leather industry to a modern, vibrant, environment responsive industry. CSIR’s pioneering inputs have been at all stages of the industry’s activities starting from techniques for flaying of dead animals to storage of skins, using ‘no’ or ‘less’ salt, to appropriate time saving and low pollution tanning and processing techniques, to ‘low chrome’ and ‘no chrome’ tanning chemicals, to modernization by computerization of net operations in tanning, to new techniques for generating value added specialty leathers, to computer aided designs for footwear, garments, and goods, fashion colour forecasting export certification and not the least of all in creating the human resources needed for the leather industry and the R&D in the sector. It had successfully mounted a pioneering Leather Technology Mission for the sustainable development of the Indian leather industry with vast grass-roots coverage. The network programmes address the needs and priorities of the country

### 1.12.1 Progress made under Network projects

#### I. Standardization of technologies for bioresources for and from leather

The project envisages consolidating lead processes and products and developing technologies with commercial applications.

**Progress so far:**

Bench scale processes for a total of seven bio-products (lipase and protease) for use in leather processing have been standardized. Three collagen products commercialized for human health care applications. A ‘Knowledge network’ on the area has been formed.

#### II. Environment friendly leather processing

The project aims to design, develop and disseminate through appropriate measures viable technologies environment friendly leather processing in India at near-zero environmental risk; to develop technologies for reducing the consumption of water in leather processing; to secure technology options for reducing the TDS level.

**Progress so far:**

A number of small yet useful achievements have been reported, such as: (i) basket of technologies for reduction of TDS to <5000 ppm developed and demonstrated, (ii) reduction of waste waters from 17 liters for processing raw skins and hides into wet blue developed and standardized. The process has been engineered and a pilot plant is being commissioned under private-public partnership mode at CLRI, (iii) technology packages for zero liquid discharge from leather processing activity

developed. Prototypes and pilot plant including membrane bioreactor, forced evaporation system, winning water from wastes for leather, Zero Emission Research Initiative for Leather commissioned, (iv) a bench scale (10 L capacity) reactor for nitrification and denitrification process for treatment of tannery wastewater designed and fabricated, and (v) a prototype for electro flocculation system for sectional waste waters designed and fabricated. RO plant with 50 $m^3$ water production capacity in 20 hrs operations designed and fabricated.

### 1.12.2 Scientific achievements under Non-network programmes

**Engineering shoe design**

Some of the initiatives in footwear science and engineering include toe caps for protective footwear, development of therapeutic footwear. CLRI has developed custom made shoes based on specific foot measurement. By using rocker bottomed sole, the pressure from the forefoot of patients can be off-loaded Rocker bottomed sole reduces the angle of flex so that the foot remains relatively flat and the energy spent is less. The ulcer is at rest and devoid of friction. Muscle strains are reduced and chance of healing is enhanced. The extra depth PU unit sole has a special tread for better grip and traction with a specially derived angle of slant to give the rocker effect, which is essentially used to offload pressure.

**Foot-care product design**

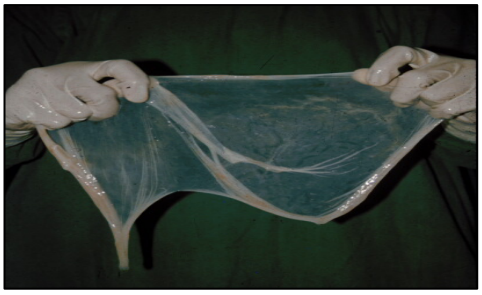
CLRI has designed rehabilitation sandals for comfort and pain mitigation in children with flat foot deformity. These sandals have been designed as a medical-aid with anatomically shaped step-on sections, which have been mathematically derived. This is useful both for prevention as well as for medical treatment of fallen arches. Special footwear has been designed for leprosy patients by taking biomechanical principles into consideration to recognize high stress areas of the foot and deal with them before ulceration occurs.

**Combining leather with other materials for volume market products**

CLRI has designed and developed new combination products of non-woven materials and leather with a view to position India in the low price and high volume segment of leather products. Innovative products with aesthetic appeal and cost effectiveness have been designed and fabricated. Exclusive and exotic products for home furnishing from CLRI innovations, offer a new avenue for novel design applications.

**Collagen based biomaterials for human health care applications**

CLRI has developed Gelatin microspheres and evaluated SSD loaded Collagen membranes for wound healing. It was found that wound healing is accelerated by ~ 60%.



Collagen based biomaterial from Amniotic Membrane

**Pickle liquor recycling**

CLRI has standardized two approaches, viz., recycle/reuse of pickle liquor for the subsequent batches as well as resorting to pickle free alum–chrome combination tanning systems. A recycling methodology for pickle liquor with appropriate replenishments has been standardized. The use of potash alum for the pH reduction process has been successfully employed in place of the conventional process. Significant levels of reduction in TDS are obtained through both approaches. Pickle liquor recycling and pickle free alum chrome combination tanning systems offer viable technology options to overcome problems of TDS in the effluent.

**Connective tissue biology**

CLRI has standardized a novel rat model for acute myocardial infarction using the surgical technique of coronary artery ligation. This study conclusively shows that initiation of complement activation is observed to be significant at the $8^{th}$ h of acute myocardial infarction induced by coronary artery ligation in rats. A tetrapeptide derivative developed has been found to have antinociceptive activity as shown by tail-flick model and acetic acid induced writhing in rats. It also exhibits antipyretic effect as demonstrated by lipopoly saccharide – induced pyrexia model in rats. The study demonstrates that this tetrapeptide derivative suppresses the proliferation and induces apoptosis in cultured synovial fibroblasts from collagen induced arthritis in rats. This study also confirms that this tetrapeptide inhibits nitric oxide level in cultured synovial fibroblasts. An alternative therapy is developed for the treatment of arthritis in rats.

**Reversing process steps in leather**

CLRI has innovated a new process paradigm using narrow pH profile processing of leather as well as reversing process operations. Operations, which are normally carried out as post tanning steps have been carried out at pre-tanning stage with considerable benefits in material economy and reduction in process wastes.

**Electro catalytic oxidation**

CLRI has developed a technique based on generation of high concentration of hydroxy radicals for oxidizing organics at a faster rate. The reactor used for the

generation of hydroxy radicals consists of non expendable anodes and cathodes and nickel impregnated meso porous activated carbon which forms the third phase. It constitute several electrochemical cells and generate a high concentration of hydroxy radicals. Thus, the wastewater of any strength can be treated using low electrical energy input.

**Biotechnology of leather: towards cleaner processing**

NCL has screened several enzymes for application in leather manufacture. Two proteases, a lipase and an amylase were found to be suitable. Optimization of protease production with respect to media composition, age of the stock, age and medium inoculum, pH and temperature were carried out in shake flasks. The production of both the proteases was scaled up in 5 L instrumented fermentor and yields were comparable to those obtained in shake flasks. Protease 1 was also scaled up in 100 L fermentor. Maximum yields were obtained of Protease 1 and Protease 3 in 60-72 h and 120 h, respectively. Complete dehairing of skins and hides was achieved with 0.5-2% Protease 1 and Protease 3 without lime and sulphide. Based on the evaluation trials conducted at CLRI, both the proteases viz. NCL Protease 1 and NCL Protease 3 were selected as lead products for enzymatic dehairing for commercialization.


## 1.13 MATERIAL, MINERALS, METALS & MANUFACTURING

CSIR laboratories have played a significant role in the development of special materials for aerospace, defence and sophisticated industrial sectors viz. electronic materials such as amorphous and polycrystalline silicon, ferrites, gallium, luminescent phosphors for display, piezoelectric, high purity alumina, conducting polymers, silver pastes; aerospace materials such as high density carbon-carbon composites, Nalar - a Kevlar equivalent high strength fibre, aluminium – lithium alloys, high performance industrial materials such as silicon carbide, silicon nitride bonded silicon carbide, silicon carbide whiskers; aluminium-metal matrix and aluminium-graphite composites; special glasses for optical fibres, infrared range

finders, laser glasses radiation shielding glasses and sol-gel techniques for glass coatings etc.; and superconducting materials.

CSIR has made significant contributions to all aspects of mining operations, especially in coal mines (to the exclusion of only heavy mining equipment). CSIR studies and efforts on subsidence prediction and control have enabled the extraction of coal locked up in pillars and underneath surface structures and water bodies. CSIR has been the principal source for designing appropriate mine ventilation systems and now for the mine disaster management in the country. CSIR is getting an edge in these areas both through Network and Non-network projects. The progress achieved is presented in following paras.

### 1.13.1 Progress made under Network projects

### I. Custom tailored special materials

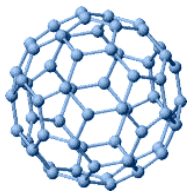
Advanced information and communication technology and ultra-fast processing devices are based on custom tailored special materials. It is envisaged to generate strong knowledgebase and up-to-date expertise by developing new generation materials like novel non-linear optical materials, bio-molecular electronic materials and functional nano-materials. The knowledgebase would be needed by both the Indian industries and also the strategic sectors to remain globally competitive in terms of technological and financial advantages.

**Progress so far:**

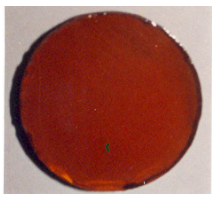
Gold (Au) nanocluster doped films in $SiO_2$ and mixed $SiO_2$-$TiO_2$ hosts have been prepared on glass substrates and characterized by different techniques. Also a process for solid state processing of $Ba(Mg_{1/3}Ta_{2/3})O_3$ , $Ba(Zn_{1/3}Ta_{2/3})O_3$ and $(RE)TiNbO_6$ and $(RE)TiNbO_6$ ceramics has been developed. Porous nano alumina powder and tape cast multi layer composites (MLC) of 3, 5, 10 and 20 layer configurations prepared to about 63 to 70% theoretical density, showed much higher failure energy (10 -70 $KJm^{-3}$) than that (4.38 $KJm^{-3}$) of the porous nano alumina single tape. A new series of $La_2Mo_2O_9$ based oxides of the general formula $La_2Mo_{2-x}Nb_xO_9$ where $x \leq 0.4$ were prepared by a citrate-nitrate combustion process and the electrical and thermal properties were evaluated. The composition with the lowest Nb-doping, viz. $La_2Mo_{1.94}Nb_{0.06}O_9$, exhibited a conductivity of 0.113 S/cm at 800$^oC$, which is nearly double that of the undoped material and this is the highest value so far reported in this family of oxides.

**Fullerene (C60) doped glasses for non-linear optical (NLO) application**

Fullerene has large number of $\pi$ -electrons on its surface and hence sensitive to light. High concentration C60-doped bismuth borate glasses are synthesized by using chemical bond formation ability of C60 with Bi and B. Color of the glass varies with the extent of the reactions.



Structure of Fullerene(C60)



Virgin Glass


Fullerene doped Glass

## II. Capacity building for coastal placer mineral mining

In spite of having maximum enriched placer deposits, India continues to play a minor role in the marine mineral export compared to other dominating countries that have lesser potential than India. There is a high scope to improve the status of Indian placer export market through the development of indigenous mining and processing technology especially for buried placers and offshore resources. It is aimed to enhance the capability of country's technologies in the field of placer mining. The output of this work would put India as a global leader in this field, besides appreciable economic returns from the export potential.

**Progress so far:**

Ground Penetrating Radar (GPR) has been attempted along many profiles ( 8 profiles during two field seasons) to find out the thickness of placer mineral layers. Validation of GPR data with ground truth has been established. About 10 km along Malvan Coast, South Maharastra and few beaches of Goa have been surveyed for placer mineral exploration. New deposit has been reported. Geo-statistical modelling of few selected deposits completed for some placer deposits. About 10km of virgin coast of west Bengal has been regularly sampled and the percentage of placer minerals are being assessed. The field data shows more deposits in dune areas upto the depth of 6 m. Bio-indicator method for placer exploration has been established based on pellets crated by the coastal fauna. Field data have been collected and analysed. Knelson and other concentrators are being experimented for placer mineral separation with different gains. Demonstration of column floatation techniques have been demonstrated successfully for the separation of sillimanite and garnet. Computer software named PLACER FLOW has been developed and demonstrated to various placer mineral processing companies.

## III. Developing capabilities in advanced manufacturing

The project aims to explore the applications of advanced manufacturing methods and to upgrade the indigenous expertise both in manufacturing automation and near net shape manufacturing to become self-reliant.

**Progress so far:**

The dental implant (with threaded/smooth surface) made of Ti-6A1-4V alloy developed and coated with hydroxyapatite (HAp). Human trials with the implants were also carried out with this technique at Main Hospital, Durgapur before dental surgeons. The HAp coated dental implants are being evaluated *in-vitro* and *in-vivo* and the results are encouraging. Yet another component was optimization of process parameters for Metal Injection Moudling for use in the production of engineering components.

**IV. Biomineral processing for extraction of metal values from ores and concentrates and wastes**

The project aims at bioleaching of low grade copper ores of Malanjkhand (0.3%Cu); Bioleaching of uranium (UCIL, 0.026% U); Strain improvement; Continuous down-stream processing for recovery of metal values (10 litres/hr capacity).

**Progress so far:**

Bioleaching of low grade copper ore of Malanjkhand (0.3%) was carried out in shake flasks by varying parameters like pH, pulp density and particle size. Leaching kinetics was studied using mixed culture containing acidophilic microorganism. The copper recovery was around 40% in 50 days at a pulp density of 20%. Likewise, bioleaching of Uranium (UCIL 0.02% U) was carried out using acidophilic microorganism by varying parameters like pH, pulp density and particle size. Uranium recovery was more than 70% in 30 days of leaching.

**V. Technology for engineering critical analysis**

The project aims at development of technology for engineering critical analysis of the following components: pressure vessels and pipelines of the thermal and nuclear power plants, petrochemical and process industries; airframes and aeroengine components; infrastructural assets of the transportation industry: e.g. concrete and steel bridges, railway wheels and railway and tracks; offshore structural components.

**Progress so far:**

Experiments on Inconel 718, En steel, medium carbon steels and Al alloys have been conducted using BIT and conventional mechanical test wherein microstructural evaluation and hardness measurements were carried out. Conceptual design was made for a PORTABLE-BI SET-UP. For enhancing component performance by grain boundary engineering, first phase of thermo-mechanical treatment was carried out. Analytical studies were conducted and phenomenological mathematical models developed to quantitatively predict the ash particle erosion behaviour on coal fired boiler components. Further, as a part of this project the following model based simulation codes were developed: EROSIM-1 (A Computer Code for the Prediction of Erosion rate in Boiler Components) is the first version of the code applicable to coal-fired boiler components at elevated temperatures. On the basis of available

data on the steel grades related to erosion behaviour, the model incorporates the following grades of steel: Carbon steel, 1.25Cr-1Mo-V , 2.25 Cr –1Mo, 12Cr-1Mo-V, 300 and alloy 800.

**VI. Upgradation of SI Base units, National standards of measurement & creation of a network of Calibration and testing laboratories and preparation & dissemination of CRMs**

The project has the mandate to upgrade Base Units and National Standards of measurements for: Mass, Luminous Intensity, Time; Chemical Metrology: upgradation of apex level calibration facilities in the following parameters- Mass, AC Power & Energy, AC Voltage & Current, Length, Force, Temperature, Ultrasonics, Acoustics, networking of calibration and test facilities existing in 12 CSIR laboratories for providing high quality testing and calibration facilities to users in all parts of the country at a reasonable cost and in a reasonable time; Preparation, certification and dissemination of certified reference material.

**Progress so far:**

Four training courses have been organized for traceable and globally acceptable calibration services to Indian industry throughout the country at minimum cost and in minimum time. Temperature & Humidity and Vacuum standards were Peer Reviewed by Technical Peers from PTB and NIST. A new CRM of high grade Gold Geochemical Reference Material (BND 3401.01) has been prepared by NPL in collaboration with NGRI, and M/s Hatti Gold Mines Co. Ltd. (HGML), Hatti, Dist. Raichur, Karnataka State. It is a first CRM, which was prepared under a collaborative programme with any industry.

### 1.13.2 Scientific achievements under non-network programmes

Some of the significant achievements under non-network programmes are given below.

**Arsenic water treatment plants**

CGCRI has developed technology for water treatment for the removal of arsenic and suspended particles. The process based on ceramic membrane technology is also suitable for the removal of iron from water. The basic components of this hybrid system are, i) absorption of arsenic by colloidal media particles suspended in water, and ii) application of membrane based separation technique for solid liquid separation using ceramic micro-filtration membrane module. The salient features of the technology are: simultaneous removal of arsenic and iron from highly contaminated groundwater below the limits recommended by WHO; modular design with flexible production capacity; semi-automatic user friendly operating procedure, capable of being operated even by female community members; and low sludge volume. A number of units have been installed in West Bengal and North Eastern States.

**Arsenic removal from ground water by an electrochemical method**

NML has designed, fabricated and retrofitted to the domestic water treatment system an electro-coagulation cell (2 litre capacity). Experiments were conducted with different concentrations of As (III). The results indicate that more than 95% of arsenic could be removed. The proto type system was field tested at many places in West Bengal near Kolkata (24 parganas Dist.) where the ground water is contaminated with arsenic. The system is effective in removing arsenic from ground water from 500-1000 ppb to below 10 ppb.

**Al-based metallic glasses through evolution of nano-phases**

NML has investigated melt-spun and annealed Al-alloys containing 6 to 8 atomic % Ni and 4 to 7 atomic% La using X-ray diffractometry (XRD), transmission electron microscopy (TEM), hardness measurement and small angle neutron scattering (SANS). XRD and TEM study revealed that ribbons were fully amorphous. SANS measurement shows that there exists concentration fluctuations inside the ribbons. Nanosized particles were formed upon annealing the ribbons. SANS measurement of the annealed samples revealed two different distributions of particles. It has been reported that the crystallization pathways during heating depends on amount of rare earth elements. For example, in $Al_{94-x}Ni_6La_x$ (x = 4 to 7) amorphous alloys, the crystallization proceeds through two stages. The temperature of first crystallization peak increases, whereas the temperature for the second drops with rising La content. For Lanthamun concentration above 6 atomic%, a bcc-metastable phase formed instead of fcc-Al (Fig.1). Similarly in $Al_{92-x}Ni_8La_x$ alloys, the bcc metastable phase formed above the La content of 5 atomic% and below it fcc-Al phase formed. The hardness of the alloy increases with the progress of nanocrystallization (Fig.2) followed by catastrophic failure of materials at a temperature where the second crystallization sets in and the amorphous matrix breaks down.

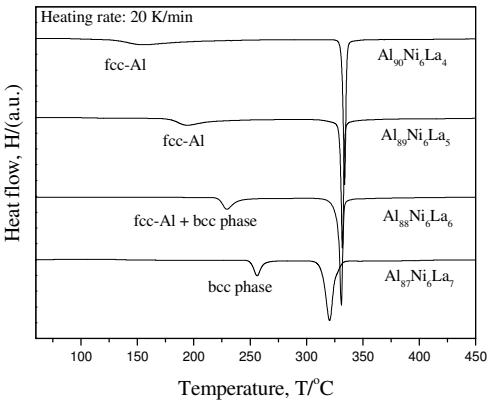



Fig 1 Crystallization peak temperatures and pathways in different Al-Ni-La amorphous alloys.

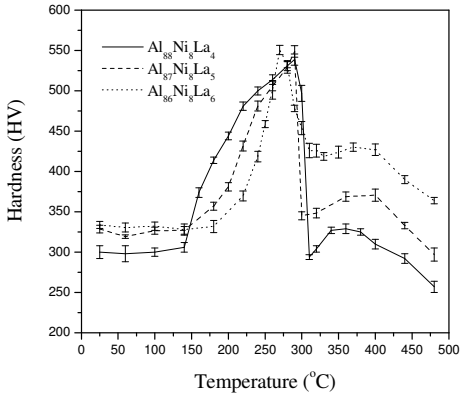
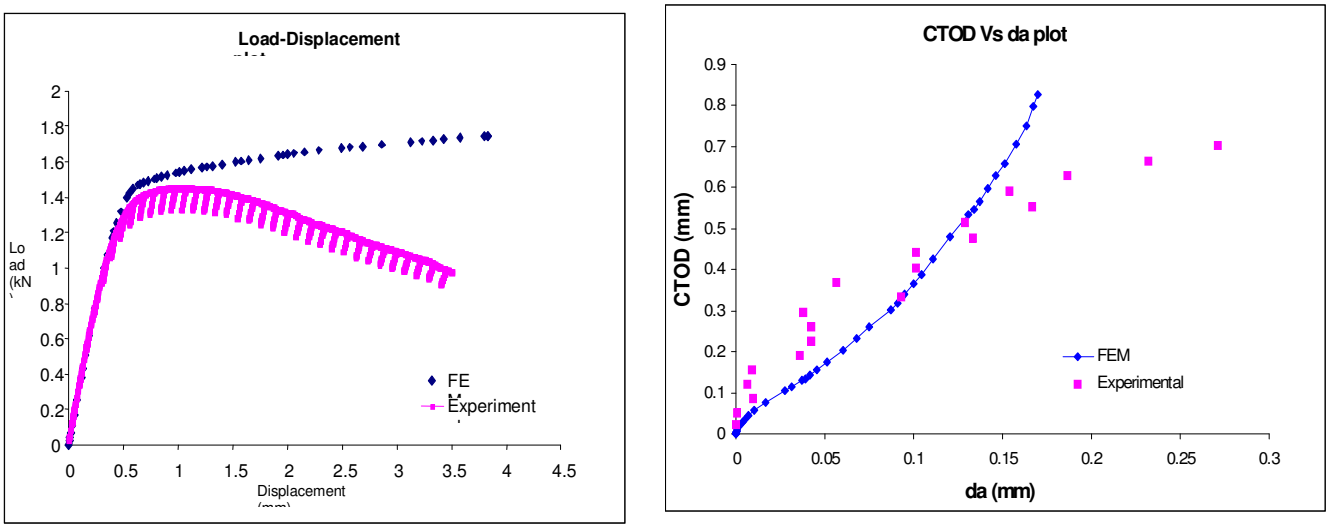



Fig 2 Microhardness evolution with temperature of different Al-Ni-La amorphous alloys.

## Modelling of crack tip blunting using finite element method

NML has developed a menu-driven software named *Fracture Data Analyser* (FracDA) which can calculate various parameters like load, displacement, crack tip opening displacement and simultaneously plot various graphs and also compare the data obtained from experimental data and FE analysis. The user is required to input the data obtained from finite element analysis. The input data includes the time step, reaction force, crack mouth opening displacement (CMOD) and displacement due to virtual crack extension. The user is also required to input geometry specifications of the specimen and material properties, i.e. the Young's modulus, the Poisson's ratio and the yield stress. The software has options to include geometry of two specimen types: three-point bend specimen and CT specimen. This software also has the capability to display various plots like load-displacement curve, CTOD and *J*-integral values with respect to the extension of crack length from FE data and compare them with the same generated from experimental data. It serves as a useful tool for evaluating the FEM data vis-à-vis that generated experimentally. Thus, it can validate and verify the FE data immediately after performing the FE analysis.




FracDA output plots

## Microstructural and hardness assessment of service exposed first and second stage stator blades of gas turbine

NML has assessed the suitability of the stator blades of V 94.2 Siemens–make gas turbine of National Capital Power Station, NTPC for further use with/without rejuvenation treatment by evaluating microstructural degeneration incurred during the service exploitation with minimal invasive non-destructive replica method without damaging the blades. Microstructural analysis and rebound hardness of different regions of the airfoil were made and compared with the unaffected regions of outer segment of stator blades. Based on the high degree of coarsening of precipitates

and significant reduction in the hardness in the different regions of the airfoil of both the stages, it was recommended that the 1st & 2nd stage stator blades should be given rejuvenation heat treatment to reclaim the original microstructure and properties. The hipping could be incorporated in the rejuvenation schedule if grain boundary cavitation is observed.

**Failure mode analysis/metallurgical examination of Viper aeroegines Jet Pipe below assembly ex aircraft U-719**

The viper aeroengine jet pipe bellow assembly ex aircraft U-719, failed owing to bellow burst. NML has carried out failure analysis for the same. Circumferential cracking was observed at a number of locations on the component. Sampling was done from two such cracked locations i.e. one from corrugated (austenitic stainless steel, type S30900) and other from non-corrugated region. The hardness value, optical and scanning electron microscopy examinations revealed that the crack initiation occurred by intergranular decohesion owing to overheating induced intergranular precipitation of brittle phases. Usually fatigue crack moves from the location of tensile to compressive type of stressed location i.e. from outer to inner surface. Here crack initiated from the inner surface and propagated towards the outer surface and circumferential direction i.e. from compression to tensile side by fatigue mechanism. During service exposure, perhaps due to sudden rise in temperature, at the inner surface compressive stress changed to tensile stress. Absence of dimple rapture indicates failure took place in the brittle mode, which was caused by overheating during service exposure. This analysis has enabled the Indian Air Force to take necessary precautions to prevent such failures in future.

**Process for preparation of nanomaterials**

NPL developed a novel process to produce nanomaterials on commercial scale. The technique has many control parameters to adjust particle size, morphology etc. of nanomaterials produced. The process has diverse applications, as preparation of nanomaterials is very important nowadays as these materials are finding newer and crucial high-tech applications everyday. Some of the applications are high-resolution displays, smart windows, dye-sensitized solar cells, sensors for various applications, batteries, large value capacitors and others.

**High ductility Mg-alloys employing hot extrusion process**

NPL has conducted systematic experimentation using variety of Mg-alloys and employing different extrusion ratios and extrusion dies, such as, port-hole die, contoured and conical dies to produce tubes and circular rods using hot extrusion by optimising various process parameters. The extruded products were extensively characterized for metallurgical and mechanical properties. It was observed that after optimisation of process parameters, some extruded Mg-alloys exhibited remarkable ductility of more than 25% with moderate values of tensile strength. Spray-forming technique by depositing the atomised droplets on a water-cooler copper substrate

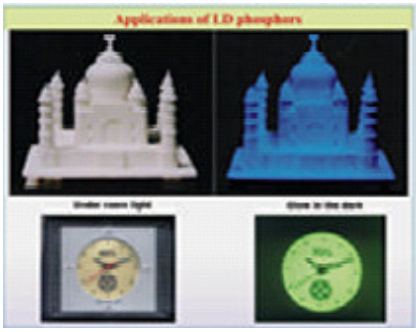
has also been attempted... After optimising various spray-forming process parameters the porosity levels in the spray-formed deposit were found to be around 2-3% with fine equiaxed microstructure and having an average grain size of about 20-40 microns throughout the core of the deposit, as compared to 150-600 microns observed for mother cast alloys. These spray formed deposits exhibited improved average values of mechanical properties : UTS = 222 MPa with elongation of 8.5%, as compared to the properties of the cast alloy used for spray forming which are : UTS = 123 MPa with a elongation of 3.3%.

**Synthesis of SiC nanofibers**

NPL has developed a new and novel technique to synthesize SiC nanofibres (SiCnf) by employing alkoxides as silica source and polymer or pitch as carbon source and heating the mixture to 1400$^{o}$C followed by oxidation to obtain SiCnf which were characterised by SEM, TEM, IR, Raman and X-Ray studies.

**Long decay phosphor**

Long decay phosphors find applications in emergency escape route markings and for locating important objects in time of black-outs intentional or otherwise. Green light emitting phosphor is most common. In order to get complete and full colours in dark, long decay phosphors emitting in other primary colours of Blue and red are very important. NPL has developed a process to prepare blue light emitting long decay/persistence phosphor excitable with ambient light. It has persistence time of 6-8 hrs.



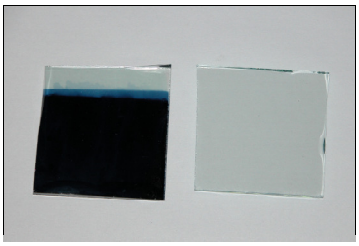

**Electrochromic nanostructured tungsten oxide films by sol-gel**

NPL has reported that as-deposited sol-gel derived amorphous tungsten oxide films transform into nanostructured films with an interconnected framework of grains and pores and a dominant triclinic crystalline phase upon annealing at 250$^{0}$C. Transmission electron microscopy and scanning electron microscopy images clearly reveal the annealing induced microstructural evolution for the film. Subsequent to lithium intercalation, the film annealed at 250$^{0}$C shows quasi-reversible structural changes, as ascertained by X-ray diffraction and Fourier transform infrared spectral data. Dynamic transmission modulation for film revealed a high optical modulation of 72 % ($\lambda$ = 650 nm) and a coloration efficiency maximum of 132 cm$^{2}$C$^{-1}$ at 800 nm

under a lithium intercalation level of x = 0.20. X-ray photoelectron spectroscopy of the W4f core levels demonstrated a progressive increase in the $W^{5+}$ content at the expense of $W^{6+}$ proportion as insertion coefficient was raised from 0 to 0.25, with 0.20 as the threshold value above which, the $W^{5+}$ content exceeds the $W^{6+}$ proportion and a new $W^{4+}$ state also appears which acts to lower the coloration efficiency for $x \geq 0.22$. Presence of charged oxygen interstitials in the vicinity of electrochemically active tungsten sites is also responsible for the coloration efficiency decline at high ion insertion levels.

**Nanostructured mesoporous tungsten oxide films with fast kinetics for electrochromic smart windows**

NPL has successfully fabricated a self-assembly of sodium dodecyl sulfate/ tungsten oxide aggregates at the electrolyte-electrode interface followed by template extraction and annealing by mesoporous thin films of electrochromic tungsten oxide ($WO_3$). Electron microscopy images revealed that the films are characterized by a hitherto unreported hybrid structure comprising nanoparticles and nanorods with a tetragonal crystalline phase of $WO_3$. In addition to pentagonal voids characteristic of the tetragonal $WO_3$ phase at the lattice scale, open channels and pores of 5 - 10 nm in diameter lie between the nanoparticles, which cumulatively promote rapid charge transport through the film. This ensued in coloration efficiency ($\eta_{max}$ ~ 90 $cm^2$ $C^{-1}$ at $\lambda$ = 900 nm) and switching kinetics (coloration time = 3 sec and bleaching time = 2 sec for a 50 % change in transmittance) higher and faster than previously reported values for mesoporous $WO_3$ films. Repetitive cycling between the clear and blue states has no deleterious effect on the electrochromic performance of the film, which is suggestive of its potential as cathode in practical electrochromic windows.



Mesoporous $WO_3$ films in blue and clear states

**Estimating radiative forcing due to aerosols***:*

NPL has reported that: surface fluxes of aerosols during pre-monsoon period, derived through measured spectral distribution of aerosol optical depth (AOD) and model calculated over Delhi indicate a typical urban and desert sources mixture, explaining also very low value of single scattering albedo. The average total radiative forcing efficiency experimentally observed at the surface in the broad wavelength band (280-2800 nm) was of the order of 13.6 ± 1.4 $Wm^{-2}$ comparable to that

estimated using the SBDART model. In an aerosol measurement campaign during winter from Delhi to Hyderabad and back in the month of February AOD reveals a latitudinal distribution with minimum at about 23.5º N, near central Indian forests. The results from first study of trace gases and aerosol transport by NPL over the seas surrounding India indicate that enhanced concentration of atmospheric $CH_4$ and $N_2O$ over Arabian Sea is due to emission from ocean, whereas the enhanced concentration of these gases over Bay of Bengal can be linked to biomass burning over East and South East Asia. Emission factors for OC and BC of a variety of fuelwood, dungcake, agricultural residue, charcoal and softcoke collected from rural users have been determined for the first time to estimate total emissions from the burning of traditional bio-fuel in the rural sector of the country as a whole.

**Technology Enabling Center for manufacturing natural fiber composites(R WOOD)**

RRL, Bhopal has developed a technology for making composites (R-wood) using industrial wastes, natural fiber and polymer. The salient features of the composites are high strength to weight ratio, termite and corrosion resistant, self-extinguishing, durable and environmental friendly. These composites can be used for various applications such as doors, tiles, partitions, ceilings, boards, panels, furniture, instant houses, electrical application etc., The door shutter with innovative technology was thoroughly tested by CPWD, BHEL and CBRI, Roorkee for their performance. After successful field trial CPWD approved the door shutters. For up scaling and customization of these products, a Technology Enabling Centre (TEC) is setup. This center will also facilitate the development / commercialization of composites materials and products from different industrial wastes like fly ash and natural fibre to be used in automobiles, railways, acoustics and noise barrier materials, light weight composites, insulating materials, asbestos substitute, leather composites, boat and instant houses for disaster victims.

Layout of the machineries in R-Wood Technology Enabling Centre

**Light weight composites for personal armour applications**

RRL-Bhopal has developed Aluminium (Al) alloy composites using liquid metallurgy technique for lightweight personal armour applications. The composite castings were

forged and then rolled into plates. The ballistic performance of Al composite plates confirms that a projectile of 7.62 mm moving at a velocity of 800m/s (range:100m) can stop after penetration of 25 mm.

**Conformable pipe system**

RRL Bhopal and BHEL (Bhopal-unit) have jointly modified the design of the existing steel pipe and its coupling system of hydro generator to improve the operation and for fixing/replacements. Apart from this the material specifications have been developed. Two size/dimension conformable pipes of desired size and dimensions are fabricated and these pipes are coupled with socket and are fixed in power plant

**Production of plasma spray grade powder by jet-wheel impact atomization**

RRL Bhubaneswar developed a new kind of spray dryer, called 'Jet-wheel impact atomization based spray dryer' of 26 kW capacity producing spheroidal alumina powder of plasma spray quality. The spray dryer has been designed by overcoming the demerits of pressure nozzle as well as centrifugal atomization and operates at low slurry pressure (< 5 bar) and low wheel speed (<12000 rpm). Alumina-water slurry (in the range 20-50 wt% alumina) mixed with appropriate binder, dispersant and plasticizer was spray dried in a drying chamber with 415-420$^0$C inlet air temperature and 95-110$^0$C outlet air temperature. The flowability of alumina powder thus produced was tested and found to be very good. The production capacity of the spray dryer is around 5kg/hr (alumina powder) with more than 80% efficiency.


**On-line Terafil water filter**

RRL, Bhubaneswar has developed an online Terafil water filter to supply clean drinking water to the household at a high flow rate. The filter comprises of 'Terafil' clay filter media in a food grade plastic container, which can be fixed in the kitchen with drinking water system. The filter provides clean water at a rate of 40 lt. per hour, which is free from turbidity, major pathogens and 90% soluble iron. The unit is affordable and has a long life, especially with respect to the filter candle.

Terafil water filter

### 1.13.3 Human Resource Development

**NML**

- Five undergraduate engineering students from BITS, Pilani underwent PS-1 training and completed their projects entitled - a) Estimation of uncertainty in thermocouple calibration and b) Beneficiation of Iron ore by Froth flotation.

**RRL-BHOPAL**

- CSIR Programme on Youth for leadership in Science (CPYLS) was organized for meritorious students from the states of MP and Chattishgarh to instill in them a love for taking up science and research as a career.
- The Second Sub Committee of the Parliamentary Committee on Official Language visited Bhopal for inspection of the status of implementation of Official Language policy of Govt. of India at RRL, Bhopal.
- An Interaction meet was organized on Sept 1, 2005 by RRL, Bhopal with MP Rural Livelihood Project to discuss the design and development of customized software for village selection in seven tribal districts of MP

### 1.13.4 Recognition & Awards

| | |
|---|---|
| SAIL Gold Medal | Dr. G. P. Sinha, CMERI |
| Best Corrosion Research Laboratory awarded by National Association of Corrosion Engineers, USA International India Section | NML |
| Mascot Award 2005 | Dr. D.D.N. Singh, NML |
| MRSI Medal for the year 2006 | Dr. S. Srikanth, NML |
| Distinguished Engineers' Award | Dr. P.N. Chaudhary, NML |

| | |
|---|---|
| Member of the Standing committee on Young Scientist in the 28th General Assembly of International Union of Radio Science (URSI) held at New Delhi in October 2005 | Dr. Vikram. Kumar, NPL |
| Technical Assessor, Hong Kong Accreditation Scheme (HKAS), Govt. of Hong Kong | Shri R.P. Singhal, NPL |
| Fellow: The Indian National Academy of Engineering (FNAE)<br>Member: International Advisory Committee, Asian Symposium on Precision Forging (ASPF), Taiwan, 2005 | Dr. A.K.Gupta, NPL |
| DAE Golden jubilee SSPS young scientist award | Dr. V.P.S. Awana, NPL |
| Reviewer of the IPCC 2006 Guidelines for National Greenhouse Gas Emission Inventories, Aug. 2005, under IPCC National GHG Inventories Programme, IGES, Japan | Dr. P.K. Gupta, NPL |
| National Award for R&D work related to use of Fly Ash for Building Components, Agriculture & Value added products | Regional Research Laboratory, Bhopal |
| National Design Award in Environmental Engineering –2005 | Shri B. Chakradhar, RRL-Bhopal |

# II

# CENTRAL MANAGEMENT ACTIVITIES

## 2.0 PREAMBLE

CSIR under its umbrella has a network of 38 laboratories and 39 field/extension centers, which are multi-disciplinary and multi-locational, manned by around 18000 committed staff. The R&D activities and affairs of CSIR are managed by the Director General with the assistance of a multifunctional and multi divisional CSIR Hqrs. under the guidance and direction of the Governing Body (GB) and the Advisory Board (AB). The policy directions are outlined by CSIR Society, which has Hon'ble Prime Minister as the President and Minister for Science & Technology & Ocean Development as Vice President. The Central Management Activities during the year are outlined as under:

## 2.1 CSIR SOCIETY

A meeting of the CSIR Society, presided over by the Prime Minister, was held on 25.05.05 at 7, Race Course Road, New Delhi. The following items were adopted by the Society:

- Confirmation of the Proceedings of the Meeting of CSIR Society held on 26 July, 2004,
- Consideration and adoption of the Annual Accounts of CSIR for the year 2003-2004; the audit report and CSIR's comments thereon,
- Adoption of CSIR Annual Report 2003-2004, and
- Amendment of rules 59 & 60 of CSIR By-Laws.

Hon'ble Minister Shri Kapil Sibal thanked the Hon'ble Prime Minister for the strong support that he has provided not only to CSIR but to the entire scientific fraternity. He said "*as the Vice-President of CSIR, it gives me immense pleasure to say that we had a great year*".

CSIR had recorded the highest number of basic research papers in peer reviewed science journals, the highest number of foreign patents as well as the highest earning last year, Shri Sibal informed the Society.

He also informed the launch of Sofcomp, a computer for the common man, with a price less than Rs. 10,000 a scientific breakthrough from CSIR reported in the prestigious journal 'Science' about tracking of the migration of population using modern molecular biological tools (by CCMB), TB molecule that will help the poor in India, an affordable medicine to treat psoriasis,

producing bacteria and virus free water by using unique polymeric membrane processes and the flight of the SARAS aircraft.

Shri Sibal further, said that CSIR has a huge potential, yet to be explored. He assured Hon'ble Prime Minister that CSIR will deliver to its full potential and that too in tune with the new exciting national agenda that he has set up. He said "*we want Bharat Nirman to be a reality*".

Dr. Mashelkar presented the overall achievements of CSIR during the year. He mentioned about upward growth in terms of the quality of science with the number of research papers published increasing to 2668 in peer reviewed journals (both national and international) at an Average Impact Factor per paper of 1.9 this year which is comparable to the figure of 2.2 of IISc. The scientific achievements included technology transfers of A-Acrylamido 2-Methyl-Propane Sulfuric (AMPS) to M/s Vinati Organics and THPE to M/s Excel Industries; chemical free (enzyme only) bioprocessing in Leather; low priced mobile desktop PCs (Rs. 10,000); new anti-leukemic compound isolated from Betel plant (Piper Betel) etc.

Hon'ble Prime Minister and President, CSIR Society complimented CSIR for the good work carried out during the year. He commended the active role being played by CSIR community in the field of providing pure drinking water particularly the breakthrough in ultra filtration technology where membrane can filter the virus along with other bacteria. He cited this as an excellent example of socially relevant research. He appreciated that several other technologies are available from CSIR labs that can ameliorate not only the drinking water problem but several other problems faced by our people on a daily basis. He emphasized upon an urgent need to focus our attention on robust delivery mechanism and wider dissemination of technologies. He invited CSIR to lend a hand through its technological prowess in the areas of irrigation, power, roads, drinking water, housing and communications under a massive 'Bharat Nirman' scheme with a total outlay of Rs. 1,74,000 crore to provide technological support for basic human needs of the people living in rural India. He reiterated the need to address the challenges at the apex of the knowledge pyramid and announced the formation of a National Science and Engineering Research Foundation- an autonomous body- to support basic science.

He dwelt upon the specific issue of protection of knowledge and mentioned about the new IPR regime in the wake of passing of the Third Patent (Amendment) Bill. He stated that CSIR has always been at the forefront in understanding the importance of generation, valuation, protection and valorisation of intellectual property. He quoted "*I am happy to see the CSIR's*

*initiative to launch a formal Intellectual Property Management Policy as early as 1996 has richly paid dividends".*

Recognizing the superb human capital that have been built in science, engineering and technology, he gave the responsibility to CSIR to flag not only country's prowess in high technology but also ability to make high technology work for the poor during South Summit meeting to be held in Doha in June 2005.

He concluded his speech by saying *"Our Science & Technology should continue to fly the Indian flag, higher and further. I will like to wish the entire CSIR family all the very best on its journey on this limitless ladder of excellence".* [The full text of the speech is at Annexure-VII]

## 2.2 GOVERNING BODY (GB)

The Governing Body of CSIR met twice during the year, i.e. on 13th September 2005 and 16th February 2006. The GB in its meetings deliberated on several crucial subjects and gave directions on these issues:

- On 13th September 2005 in its 165th meeting, the GB approved: CSIR – Advanced Institute of Science Training (AIST)- a deemed university; scheme for setting up Knowledge Alliance between CSIR constituent labs and private industry; recruitment rules for the post of Director; CSIR-technology Awards-2005; donating desalination plants to *tsunami* affected areas of India; modification of investment procedure of temporary surplus funds of Govt. grants in CSIR Hqs.; proposal for construction of polymer science & engineering lab building at NCL; construction of wind turbine lab at NAL; consideration and adoption of CSIR Annual report 2004-05.
- On 16th February 2006 in its 166th meeting, GB approved: setting up incubation centres in CSIR laboratories; mobility of scientists between industry and CSIR; acquisition/ in-licensing of early stage IP knowledge and sourcing of expertise from abroad to NMITLI projects; National facility for advanced Proteomic & Protein research for development of drugs and therapeutic proteins; extension of time of the proposal on consolidation of core competencies of CMRI & CFRI; proposal for upgradation of additional posts of Director in the pay scale of Rs. 22400-24500; CSIR award for S&T innovations for Rural development; award of 2005 Shanti Swarup Bhatnagar Prizes and CSIR young scientist awards.

## 2.3 DEPARTMENT RELATED PARLIAMENTARY COMMITTEE

The Department Related Parliamentary Committee on Science & Technology, Environment and Forests examines and recommends the demands of grants of the DSIR including CSIR. It also takes up specific topics/ subjects of

national S&T interest for deliberation from time to time. The Committee considered the Demand of grants for the year 2005-06. A background note was prepared highlighting activities, programmes and financial summary. The Committee has made certain observations/ suggestions. Significant ones are:

- appreciates that the CSIR is striving towards undertaking a wide gamut of research and developmental activities in the area of high technology, which would help in projecting India as a forerunner amongst scientifically advanced nations. The Committee, however, feels that emphasis of CSIR should be dissemination of new technologies from the laboratories for the benefit of the common man**.**
- commends the efforts of the Department to keep pace with the new technologies and to project the country as a technologically developed nation. The Committee feels that keeping in view the fact that the CSIR infrastructure was built or acquired more than thirty years ago, building of new infrastructure and renovation of the existing ones are of utmost importance and should be taken up in right earnest**.**
- commends the CSIR for achieving number one position in securing Patents in India and abroad and hopes that the CSIR would strive towards safeguarding the country's interests, specially keeping in view the efforts made by foreign organizations to encroach upon our traditional base.
- that a special cell may be set up to coordinate and pool the knowledge gained in the CSIR laboratories and the private sector companies and disseminate it through direct interactions with the industry or through the print and electronic media. Efforts may also be made to ensure that there is no duplication in the research work carried out in the CSIR laboratories and the private sector companies so that country's scarce resource is not wasted.
- that India needs the most advanced infrastructure and laboratories for carrying out cutting edge research in various fields. The infrastructure should be seen as a strategic national resource and funding should be given on a long-term basis so that the modernization becomes a continued process for effectiveness and improvement in our scientific growth. The Committee is also of the view that the laboratories at the graduate/post-graduate level should be upgraded so that interest can be generated among the young students for further research**.**

### 2.4 CSIR FOUNDATION DAY

TWENTY-SIXTH September is a very important day for the entire Council of Scientific & Industrial Research (CSIR); it was on this day in 1942 that CSIR

was established. The day is celebrated by the entire CSIR family of 38 labs with great pomp and gaiety. It is a day for introspection — to take stock of the past year's progress, and plan for the future. It is also a day for recognizing excellence through various awards.

The CSIR Foundation Day main function this year was held at the Hotel Ashok, New Delhi. It was attended by a host of dignitaries from different walks of life in addition to members of the CSIR family. It was an affirmation of CSIR's belief in progress through partnerships at all levels — local, national and global. Shri Somnath Chatterjee, Speaker, Lok Sabha, was the Chief Guest. Shri Kapil Sibal, Minister of Science & Technology and Ocean Development and Vice President, CSIR, presided over the function.


From R to L: Shri Kapil Sibal, Shri Somnath Chaterjee and Dr. R.A. Mashelkar

Dr Swati Piramal, Director, Strategic Alliances & Communications, Nicholas Piramal India Limited, delivered the CSIR Foundation Day Lecture, titled 'Kurukshetra, Science and Transformation: Two forces that reshape the world'. Dr R. A. Mashelkar, Director General, CSIR, extended a warm welcome to the distinguished invitees and guests.

Hon'ble Minister of S&T and OD during Foundation Day celebrations

The prestigious CSIR Young Scientist Awards and CSIR Technology Awards were presented, and names of winners of the CSIR Diamond Jubilee Invention Awards for School Children for 2005 were announced. A book on Materials Science by Dr. Lakshmi Kumar, National Physical Laboratory (NPL), New Delhi, was also released on the occasion.

**Address by Shri Somnath Chatterjee, Hon'ble Speaker, Lok Sabha**

*"Shri Kapil Sibal, Honourable Minister of State for Science & Technology and Ocean Development; Dr R.A. Mashelkar, Director- General, Council of Scientific and Industrial Research (CSIR); Members of the CSIR Family; Distinguished Scientists; and Ladies and Gentlemen: It is a matter of privilege and an honour for me to be here with you and to associate with the Foundation Day Celebrations of the Council of Scientific and Industrial Research (CSIR). Let me extend my best wishes to the entire CSIR fraternity on this happy and auspicious occasion. There is great appreciation in the country of the positive and pro-people work being done by the CSIR over the decades. In a developing country like ours, the scientific community has a very important role to play. Indeed the multifarious initiatives that the CSIR has taken to see that the fruits of science and technology are available for the benefit of the average Indian have been impressive. CSIR is known to be using advancements in science and technology to meet the basic human needs relating to food, health, water, energy, employment and shelter, amongst others. It has made commendable achievements in several fields, starting from agriculture to space research, and made a mark as an organization driven by pursuit of excellence and an urge to contribute to the process of nation-building. We must realise that our multifarious socio-economic problems can be effectively addressed only through scientific, technological and industrial progress. We all aspire for the transformation of India on modern scientific lines, extending the benefits of education and health-care to all. Pt. Jawaharlal Nehru always laid great emphasis on developing a scientific temper among Indians and underscored the importance of science and technology in the task of nation building and in establishing an egalitarian and rational society. Our scientists are exploring the heights of space and the depths of the oceans. India is now one of the leading nations in developing and using space technology for the benefit of humanity. Our Ocean scientists have been making enormous strides in harnessing gas hydrates, a vast energy resource in the ocean bed. The results of our R&D in the medical and pharmaceuticals fields are also attracting global attention. Indian companies are providing low-cost drugs to fight HIV/ AIDS in Africa. CSIR's successes in developing affordable drugs for the poor and for the treatment of tropical diseases such as Malaria, are particularly commendable. We are matching global standards of excellence in the frontier area of biotechnology. The spirit of innovation and excellence is now spreading to many new areas. Undoubtedly, India's most remarkable*

*success in recent years has been in the field of Information Technology. The success lies not only in the steadily rising software exports but also in the growing opportunities in outsourcing of services. Every area of India's socio-economic development today bears the signature of Indian science."*


Hon'ble Speaker of the Lok Sabha, Shri Somnath Chaterjee addressing the gathering

## 2.5 SHANTI SWARUP BHATNAGAR PRIZE PRESENTATION CEREMONY

The prestigious Shanti Swarup Bhatnagar Awards function was held on 28th September, 2005 at Vigyan Bhawan, New Delhi presided over by Honourable Prime Minister of India, Dr. Manmohan Singh who gave away the prizes to the winners of the awards for the years 2004 and 2005 and also addressed the gathering.

**Excerpt of Speech by Shri Kapil Sibal, Hon'ble Minister for Science & Technology and Ocean Development** [Full text of the speech is at Annexure VIII]

The Hon'ble Minister welcomed Hon'ble Prime Minister of India, Dr. Manmohan Singh and applauded his (PM's) support to the scientific community. He termed these celebrations to honour our achievers as triumph of science and quoted Nobel laureate and eminent English chemist, Sir Cyril Herman Hinshelwood who once said "Science is an imaginative adventure of the mind seeking truth in a word of mystery". It is these adventures in which all of us join these achievers.

He congratulated the Shanti Swarup Bhatnagar prize awardees and termed the prize as India's Nobel Prize. He also congratulated the winners of CSIR Diamond Jubilee Technology Award and winners of Diamond Jubilee Invention Award for school children. He stated the purpose of the award was to create awareness and arouse interest of school student in Intellectual Property.

He commended the work done by M/s Media Communication Technologies to connect the unconnected, which had fetched them the CSIR Diamond Jubilee technology award. He stressed upon the need to support indigenous technology at the earliest.

He expressed his happiness to see the Bhatnagar awardees in the function. He pointed out that meritocracy was not only necessary but essential. He mentioned the institution of Ramanujam Fellowships with an objective to bring the very best back to the country. Hon'ble Minister appreciated the release of India Science Report, of the Indian National Science Academy as it reveals the true state of science and technology in the country. Shri Sibal felt that it will not only quell many myths that are spread about Indian S&T, but at the same time shall also provide an occasion to think and analyse as to what needs to be done either by executive actions or remedial policy measures.

Shri Kapil Sibal delivering his address at Bhatnagar prize presentation ceremony

He mentioned about the events of significance that have happened during the year, viz. initiation of much higher levels of funding to basic scientific research, institution of fellowships to attract best talents from India and abroad, initiation of a process for creation of new institutes of science, education and research, evolving new policies and strategies for bio-technology, creating new public-private partnerships, facilitating `hassle-free' regulatory processes that could place Indian S&T on the world map, and enhanced funding in frontier areas, such as nano-technology. He was confident that with the unstinted patronage of Hon'ble Prime Minister of India support for new initiatives and safeguards for S&T infrastructure would always be available. He concluded by assuring that cause of science would always serve India well as long as the scientific community continues to get the support of extraordinary leaders of India like Hon'ble Prime Minister of India.

**Excerpt of Speech of Hon'ble Prime Minister, Dr. Manmohan Singh** [Full text of the speech is at Annexure IX]

The excerpts of his speech are provided in the following paragraphs:

Hon'ble Prime Minister expressed his delight to be in the company of scientists, creators of a new India, - an India free from shackles of ignorance, and felt very happy to recognize the role played by scientists & technologists

in Nation building and to honour the very best of Indian Science & Technology.

He complimented CSIR for the good work being done under the leadership of Dr. Mashelkar whose election as fellow of U.S. National Academy of Sciences was indeed a matter of pride. He applauded the Bhatnagar laureates and asked them to be ready to own many responsibilities such as to work for good science, to serve the best interests of mankind and of our natural inheritance. According to him the Bhatnagar Laureates had a role and responsibility to improve the quality of life and widen the span of knowledge in India. He was hopeful that each laureate would dedicate his/her life to the cause of science, to the welfare of country's people and to the development of the country.

Hon'ble Prime Minister Dr. Manmohan Singh addressing the gathering

He also congratulated the team of M/s Media communication Technologies on winning the CSIR Diamond Jubilee Technology Award. He applauded the technology which could reach the unreached and connect the unconnected and the role of leadership among developing countries. He hoped that the Technology Award would inspire others to develop similarly useful and potentially winning technologies.

He felt happiness in releasing the 'India Science Report' –published by Indian National Science Academy and based on an excellent survey taken up by National Council of Applied Economic Research. According to him, while the proportion of enrolled students in science going up from 28.0% in 1995-96 to 34.6% in 2003-04 is comforting, the fact that 20% of science graduates and 14% of Ph.Ds in science could not get gainful employment is a matter of concern. Further, the regional imbalance in terms of educational institutions in different states was also worrysome. He assured that the government would evolve policies to remedy these imbalances.

Bhatnagar Prize-winners (2004) with Dr. Manmohan singh, Shri Kapil Sibal and Dr. R.A. Mashelkar

He reaffirmed India's commitment to basic science, applied science and promotion of excellence and rebuilding the science base in universities. He, further recalled Government's determination to de-bureaucratise S&T institutions and to restructure S&T support systems.

He expressed his concern over the existence of only one Indian Institute of Science for the whole country. To address that problem, he announced the creation of two institutes dealing exclusively with science education and research. He assured that within next 5-6 years the number of Ph.Ds in India would be doubled.

Bhatnagar Prize-winners (2005) with Dr. Manmohan singh, Shri Kapil Sibal and Dr. R.A. Mashelkar

He also announced the approval of National Science & Research Foundation, an autonomous organisation, with funding of Rs. 150 crore per year. He felt pleased to announce the institution of Ramanujam Fellowship, J.C. Bose Fellowship and Fellowships for Scientists & Technologists of Indian Origin (STIO) to create exciting career opportunities for scientists to retain talent.

Hon'ble Prime Minister emphasized the importance of the knowledge and announced the formation of a Knowledge Commission. He also asserted that 21$^{st}$ century would belong to 'brain power' rather than to the military or economic power.

Dr. Singh set for the S&T community challenges of generating high technology, creating wealth & prestige for India and an assurance to improve

the lives of the poor. He complimented CSIR Society for some major breakthroughs such as high-tech membrane filter which could remove bacteria as well as viruses from water and provide drinking water at just 4 paisa per liter when fitted with hand-pump.

In his concluding remarks he desired the benefits of science to reach each & every corner of the country. He also stressed upon the need of improvement in the quality of text-books and teaching at school level and to make science an exciting discipline and an attractive career. He wished a great success in noble endeavours of CSIR as a whole.

# III

# HEADQUARTERS ACTIVITIES

The CSIR Headquarters is the hub of its 38 laboratories, whose prime activities include strategic planning; repository of organizational learning; policy guidelines; managing intellectual property; front face to the Planning Commission; gateway to international linkages and collaborations; business development; extramural human resource development; legal handling and advising on vigilance related matters. These are carried out through the technical and administrative divisions set up for the purpose. Some of the major activities carried out by the divisions during the year are summarized below:

## 3.1 R&D PLANNING DIVISION (RDPD)

R&D Planning Division is the nerve center of CSIR Hqrs. with intensive and vide ranging activities encompassing regular interactions with Government departments; Demand for grants; Annual Plan; Five Year Plan and related matters; Annual Report; Reports to Cabinet, Planning Commission etc.; Advisory Board; Performance Appraisal Board; Directors' Conference; Research Councils and matters pertaining to S&T plan projects/ proposal, databank of whole CSIR R&D activity, execution of New Idea Fund and implementation of CSIR-National Innovation Foundation Scheme.

With reference to the network and similar projects, the division has the responsibility to coordinate externally with Planning Commission, Finance Ministry, and other sector specific departments and internally with Finance division and laboratories. It also has the responsibility to provide technical support to Investment Sub Committee and GB.

### Annual Plan 2006-07

The year 2006-07 being the terminal year of TFYP, the Annual Plan 2006-07 was formulated accordingly. As a publicly funded organization, CSIR derives its finances from the three major sources, namely: budgetary support from the Government; funding from contract R&D, consulting activities and technical services (External Cash Flow); and internal receipts. The TFYP was formulated with an assumed annual GDP growth rate of the economy of 8 percent and the national R&D expenditure increasing to around 2 percent of GDP by the end of the Plan period. In the TFYP of CSIR, there are six schemes in total, of which five are continuing and one is a new scheme (two schemes of the Ninth Plan

period have been closed or merged with others). The emphasis on continuing schemes is on consolidation of ongoing activities and building on the existing investments and infrastructure to initiate new priority programmes. The division sought detailed information from the national laboratories/ institutes through a comprehensive proforma, wherein the progress of network programmes against the planned activities as envisaged and approved by the competent authority were ascertained along with the future targets vis-à-vis financial requirements. In addition, information on non-networked activities/ progress was also sought. The information was analyzed and keeping in view of the priorities through operational planning, the Annual Plan document 2006-07 was formulated and sent for the consideration of the Planning Commission. A plan investment of Rs. 940.00 crore for various schemes as projected with the Planning Commission was approved for CSIR.

**Network Projects**

The key feature of CSIR's programmes during the Tenth Plan is the creation of major and innovative knowledge networks across and beyond CSIR laboratories. These programmes which were categorized in 3 distinct philosophy of level of implementation were formulated through a detailed exercise. The focus of the programmes was to synergise the vast competencies developed in CSIR Laboratories and to implement the programmes/projects in network mode. Accordingly, categorisation of programmes under National Laboratories was carried out keeping in view the requirement at the national level, at CSIR level and at the laboratory level.

The Division had the responsibility to facilitate the implementation of the projects. The Division had participated in Monitoring Committee meetings of the network projects held periodically. The Committees evolved suitable and monitorable parameters for each network project, monitored the progress half yearly, assessed and advised the mid course changes in network composition and recommended additional fund release in some of the network projects.

The progress of the projects was reviewed by the DG-CSIR in meetings held at Lucknow, Pune and Delhi. The basic purpose of the review meetings was not only to assess the status of projects but to ensure that projects reach their logical conclusion. Officials from Planning Commission were also present in the meetings. The outcome of the review revealed, very noticeably that in the CSIR system resides strength and power not only to do things differently and synergistically, but the expertise from diverse sections have come together to address the different aspects of products/ processes. The meetings provided a

critical evaluation of each network project and provided an insight to plan strategy for implementing large scale network projects for the Eleventh Five Year Plan.

**Outcome budget**

Hon'ble Finance Minister in his Budget speech 2005-06 announced a new instrument of governance the outcome budget. Accordingly, the Government put in place a mechanism to measure the developmental outcome of all the major programmes during the current year. These are monitored at the highest level on half yearly basis now (earlier on quarterly basis). It was further categorically stated that Government would ensure that programmes and schemes were not allowed to continue indefinitely from one plan period to the next without an independent and in-depth evaluation. The Division has played a major role to ensure that the activities were completed with due envisaged outcomes, prepared and submitted the consolidated report to the Ministry of Finance. The report, later, became public document and has appeared on the website of the Finance Ministry.

**R&D Management Conference 2005**

CSIR (RDPD) has been organizing annual R&D Management Conference since 1999. The Conference has emerged as an unique platform for exchange of ideas/views, experience and knowledge on diverse issues related to R&D management amongst academicians, scientists, technocrats, senior corporate executives/ managers etc. All India Management Association (AIMA) and Confederation of Indian Industry (CII), the apex associations of Management & Industry, respectively, joined hands with CSIR to organize the Conference this year. The global competition is forcing organizations of all sectors, particularly the high performing ones, to look for means to become more innovative. Organizations are required to be continuously innovating, come up with newer initiatives rapidly to meet the ever-increasing challenges and stay ahead of competition. Keeping these points in mind, the theme of the conference was aptly chosen as 'Innovation: A route to competitiveness in global economy'. The focus of the conference was the role of innovation to gain competitive advantage. Dr. Vijay Kelkar, an eminent economist and Chairman, IDFC Private Equity Co. Ltd. Inaugurated the conference and gave the key note address. Another new feature of the conference this year was the invited talks from key industry leaders viz. M/s Satish Kaura, Chairman & MD, Samtel Colour Ltd.; Harsh Mariwala, Marico Industries Ltd.; V. Sumantran, former ED, Tata Motors Ltd.; V.L. Deshpande, Chairman & CEO, Encore Software Ltd. etc. The topics covered in this RDMC

were 'Creating and nurturing innovation culture', 'Innovative management of R&D', 'Managing innovative people', 'Innovations in marketing' and 'Innovative management of technology'. Technical papers were published in the proceedings brought out on the occasion. About 150 participants were attended the conference.

**Consolidation of core competencies of CMRI and CFRI**

CSIR in today's competitive and fast changing environment has embarked upon consolidating its core competencies spread across different laboratories. The consolidation of different core competencies with rich knowledge and background can be expected to herald a new dimension in CSIR and as well indicate a new trend worldwide to notice. The Performance Appraisal Boards (PABs) of CMRI and CFRI in their review report had suggested for the possibilities of consolidation of core competencies of these two laboratories keeping in view their resource endowments, programmes, activities and performance as both are located at Dhanbad. Based on the "suggested action" by the High Level Committee on consolidation of core competencies of CMRI and CFRI, the Vice President, CSIR had constituted a Review Committee for thorough reexamination of the charter of these laboratories and possibilities of consolidation of their core competencies. The Review Committee submitted its report on June 2005 and recommended for the consolidation of core competencies of CMRI and CFRI in to a new entity namely **"Central Institute of Mining and Fuel Research (CIMFR)".** The recommendations of the Review Committee were considered and approved by the GB of CSIR in its 165$^{th}$ meeting held on 13.09.2005. The Division has coordinated the meetings of Review Committee and its proceedings in submitting the report to VP, CSIR.

**CSIR-Advanced Institute of Science Training (AIST) - a deemed university.**

CSIR laboratories are making significant contributions to the national pool of high quality scientific manpower by producing Ph.Ds degree holders in diverse areas of science. CSIR as a whole contributes about 300 Ph.Ds and hosts over 2000 research scholars annually. Some of the CSIR laboratories have excelled in this endeavour and have strong student base carrying out Ph.D work. At present there are over 1800 students working in various CSIR laboratories but are registered for their Ph.D. degrees under different Universities with varying academic standards, a need was thus felt to establish a standardized Ph.D. programme. CSIR realizing the growing need for highly trained scientific manpower, especially in trans-disciplinary areas, and taking the advantage of the available excellent infrastructure and existing training culture and ethos at HRDC,

Ghaziabad, proposed to expand the scope of HRDC and register an autonomous society named **CSIR-Advanced Institute of Science Training (CSIR-AIST)** functioning from the HRDC premises. Accordingly, a proposal was made by CSIR to UGC on 17th February 2005 proposing establishment of an independent entity CSIR-AIST with a deemed university status for teaching and training for Ph.D. programme. The GB of CSIR in its 165th meeting held on 13.09.2005 considered and approved the CSIR proposal for seeking deemed university status to CSIR-AIST. The proposal is under the consideration of UGC. The Division steered the meetings of the Committee constituted by DG, CSIR for obtaining deemed university status to CSIR-AIST.

**National facility for Advanced Proteomic and Protein Research for development of drugs and therapeutic proteins at IICB, Kolkata.**

The proposal involves the creation of an integrated state-of-the-art infrastructure for advanced research on protein and proteomes encompassing the areas of; clinical proteomics, structural proteomics, functional proteomics, protein engineering, and bioinformatics. The proposal was initiated as one of the new facilities to be created under strengthening India's vast S&T infrastructure as contained in the S&T section of the Common Minimum Programme (CMP). The facility would be created by joint funding of CSIR and DST at a total cost of Rs. 2256.50 lakhs. The facility would offer an excellent opportunity to carryout world class research in the important area of drug development. The proposal was duly considered and approved by the GB in their 166th meeting held on 16th Feb.2006. The Division coordinated with IICB Kolkata in preparing the SFC proposal and with DST & Planning Commission for obtaining the necessary financial and administrative approvals.

**Prof. G.N. Ramachandran award for excellence in Biological Sciences & Technology**

CSIR had instituted a Gold Medal award from the year 2004 for excellence in Biological Sciences in the fond memory of Prof. G.N. Ramachandran, pioneer in protein chemistry research founding father of Structural Biology in India. The award is given each year at the annual meeting of Indian Science Congress for notable and outstanding contributions in biological science & technology. Prof. P. Balaram, Director, IISc, Bangalore, was honoured with the gold medal award for the year 2005. The Division steered & handled the whole proceedings of the Advisory Committee constituted by DG, CSIR for selection of a Scientist for the award.

**Programme on `Discovery, Development & Commercialization of New Bioactives and Traditional preparations'**

Programme on 'Discovery, Development & Commercialisation of New Bioactives and Traditional Preparations"' was initiated for discovering new leads from Indian biodiversity. The strategy evolved has been able to give many leads for various diseases in discovering single molecules and taking them to the stage where IND can be contemplated. The programme has been converted into a Task Force Networked Project of CSIR. The project has made a steady progress and sixty drug discovery groups formed which are *in-vitro* and *in-vivo* active.

Around 16000 samples (12000 plants and~ 4000 microbial) have been screened for various diseases. Presently there are 65 Discovery Groups on promising entities for 20 disease conditions. Out of 65 discovery groups 13 groups have reached advanced stages of single molecules (9 samples) and herbal preparations (4 samples). The four herbal formulations are for ulcer, dementia and cancer and nine single molecules are for cancer, dementia, hypertension, leishmania, hepatoprotective and immunostimulatory conditions.

## 3.2 INTELLECTUAL PROPERTY MANAGEMENT DIVISION (IPMD)

The Division strives for enhancing the value and volume of IP. The efforts have led CSIR to maintain its dominant position in IP arena by filing 570 foreign and 407 Indian Patent Applications during the year.

**Fourth CSIR Diamond jubilee invention award for school children-2005**

Four inventions were selected for 'Fourth CSIR Diamond Jubilee Invention Award for School Children-2005'. The selected inventions included, i) an improved low cost artificial limb for above –knee amputees, ii) improved design of Tri-cycle Rickshaw, iii) composition of litchi leaves and black pepper useful for lowering hyperglycemia, and iv) click herbal stick.

**Third CSIR Diamond jubilee invention award for school children**

The winners of the 2004 competition for Third CSIR Diamond Jubilee Invention Award for School children were given prizes on the 26$^{th}$ September, 2005, CSIR Foundation Day

**Licensing of IP Portfolio**

The Division has facilitated licensing of four US patents pertaining to anticancer drug molecules to M/s. Indus Pharmaceuticals Inc., USA.

**Best Patent Award**

US patent No. 6,800,622 for "Pyrene-linked pyrrolo(2,1-c)(1-4) benzodiazepine hybrids useful as anti-cancer agents" from IICT, Hyderabad, earned the 'Best Patent Award' for the year 2004-05 given by Indian Drug Manufacturers Association.

**Rejection of the opposition to the European patent granted to CSIR**

For the first time, a European patent granted to CSIR, India was opposed by Trifolio-MGmbH, Germany, a leading manufacturer of neem based products. The opposition was contested by CSIR using fingerprinting chromatography analysis (based on CSIR's another European patent) and generated the necessary evidence to convince the Opposition Board, EPO that CSIR's process was simple and economical and aimed at purifying and isolating better yield of azadirachtin as a powder with larger amount of salanin. Based on evidence provided by CSIR, the Opposition Board, EPO rejected the opposition.

**Workshop on "Negotiating Technology Licensing Agreements"**

A five-day CSIR-WIPO Workshop on "Negotiating Technology Licensing Agreements" was organized by WIPO jointly with CSIR (IPMD and NISCAIR) during July 4 to 8, 2005. Shri Kapil Sibal, Hon'ble Minister of Science and Technology and Ocean Development inaugurated the Workshop. The five day workshop covered wide range of topics including mining patent information; developing a patent strategy; establishing a marketing plan for technology commercialization; basic principles of technology licensing including licensing negotiations and preparing agreements; commercial and financial considerations in licensing; confidentiality issues and litigation. The faculties for the Workshop were drawn from EPO, WIPO, UOP, and Consulting firms from Australia and India.

## 3.3 TECHNOLOGY NETWORKING & BUSINESS DEVELOPMENT

Persuing activities under its assigned mandate, the Technology Networking and Business Development Division (TNBD) steered Govt. of India's unique programme, the New Millennium Indian Technology Leadership Initiative (NMITLI) on one hand and CSIR's overarching business development activities on the other. The TNBD Division also facilitates functioning of two CSIR units namely Unit for Research & Development of Information Products (URDIP) and Customer Satisfaction Evaluation Unit (CSEU). In addition, it also undertook various challenging tasks assigned time to time, and facilitated putting in place farsighted policy measures for better functioning of CSIR. Highlights of some of

the important activities undertaken and managed by the TNBD Division during the year are given hereunder:

In the Industry Originated Proposal (IOP) category, around 100 conceptual proposals were received during the year in response to open advertisement and letters from CSIR. The Screening Committee constituted to screen the proposals short listed 12 proposals for further consideration. Among the 8 proposals in the area of Biosciences and Drugs & Pharmaceuticals, 2 proposals were short listed by Area-wise Expert Group for projectization. One proposal on "Development of an integrated micro PCR system with in-situ identification" has been developed with the help of Domain Experts, which was put up to High Powered Committee (HPC) for further consideration.

The six projects under NMITLI, which were taken up earlier for necessary R&D have graduated to second phase for further development. These projects are: (i) Biotechnology for Leather: Towards Cleaner Processing Phase-II; (ii) Development of production system for tea polyphenols and their condensed products; (iii) A prospective study to correlate gene signatures with clinical outcome of astrocytomas and identification of potential therapeutic target(s); (iv) Development of DNA microchips for the detection of eye infections and Glaucoma; (v) Lactic acid and lactic acid based polymers- establishment of a 300 TPA Pilot plant for lactic acid production; and (vi) A cost effective Simple Office Computing (Sofcomp) platform to replace PC.

**Business development and marketing of knowledgebase**

In the domain of business development the Division has taken several new initiatives to put CSIR on a higher pedestal. These range from undertaking revision of the marketing guidelines (so as to align them with the changes in the external policy settings and making them more customer friendly) to exposing CSIR's knowledgebase in a strategic way to facilitate building up of a long term business relationships with Indian as well as international companies to putting in place enabling mechanism for enhancing pace of innovation led research and development in CSIR. The Division organized CSIR-Industry meet for enhancing and deepening public-private partnership and to create awareness as well as demand for CSIR's knowledgebase. The focus of this unique meet was on Life Sciences, Chemicals, Drugs & Pharmaceuticals and Materials & Nano Materials. Several industries have signed agreements with CSIR namely: Actavis Pharmaceuticals Ltd. (non disclosure agreement); Johnson & Johnson Consumer Company and Johnson & Johnson Vision Care Inc., Japan (non disclosure agreement); Colgate-Palmolive Company (confidential disclosure

agreement); Novakos LLC (confidentiality and non-disclosure agreement and master agreement); BP International Ltd. (letter of intent and confidentiality agreement); Indigene (umbrella agreement); and Procter & Gamble Company (MCA non-analysis agreement). Further, the Division continued to provide necessary assistance to laboratories for business development and marketing of knowledgebase. It also provided hands on training in the domain of business development to a scientist each from CDRI and NEERI.

**Global Research Alliance (GRA)**

With the objective of providing safer, faster and cheaper therapeutics in the long run, GRA has launched a new initiative with World Bank on Indigenous Knowledge (IK) for Health. CSIR India, supported by the World Bank and their associates, organized the 2nd Indigenous Knowledge Workshop in India in February 2006. Fifty delegates from 14 countries and 5 continents participated in the workshop. The forum was utilized to built on the learning from the 1st IK workshop and develop a plan to take this initiative forward.

Based on the feedback from visit of GRA team in August 2005, it has been agreed to take up the Tanga Project as a pilot project. CSIR- South Africa has offered to fund the first part of the first Phase of the project viz. report on the legal framework for this work. In the next part of the first phase an ethno-botanical study is to be conducted, which will be funded by the World Bank.

Contacts established with global funding bodies like the WB, USAID, ID, Melinda Gates and Rockefeller Foundations to enhance mutual understanding and to promote high-level dialogue. These efforts are enabling GRA to enter the mainstream for meaningful contributions to meeting the Millennium Development Goals (MDGs) and other large S&T for development challenges. These efforts are expected to translate into harnessing S&T and knowledge for development.

CSIR with NEERI in the lead has submitted an Expression of Interest on behalf of GRA for carrying out detailed EIA & SIA studies for the Kalpasar Project in Gujarat. The EOI has participation of NEERI, NIO & CSMCRI from Indian side and CSIR-SA and CSIRO & SMEC from Australia.

**Security and sensitivity clearance**

The R&D proposals involving foreign scientists/ agencies were examined and assessed in the division from security and sensitivity angle. The proposals covered basically contract R&D. During the year, about fifty-eight such proposals were processed. Some of the clientele covering these proposals included DuPont, Invista, ISIS Pharmaceuticals, Honeywell, Bayer, FAO, ESCOM,

Lanxess, Bell Helicopters, Procter and Gamble, Solvay, Schenetady Herdillia, GE, etc. The list also includes clients from France, Italy, Australia, Sri Lanka, Nepal, Malaysia, Kyrgyz Republic, Singapore, Dubai, South Korea, etc.

## CSIR Technology Awards 2005

Following the methodology in place, Division invited nominations for the CSIR Technology Awards for the year 2005. A total of 21 nominations were received. These nominations were processed for perusal and consideration of the Technology Awards Selection Committee constituted by DG, CSIR. Awardees were selected for three Technology Awards namely: Prize for Chemical Technology jointly to Indian Institute of Chemical Technology, Hyderabad for Enzymatic degumming of rice bran oil (50 tpd capacity) and to National Chemical Laboratory for Development of a complete process technology for manufacture of 2-Acrylamido-2-methyl-1-propane sulfonic acid (ATBS); Prize for Engineering Technology to National Aerospace Laboratories, Bangalore for the Development of advanced composite technologies for aerospace applications; and Prize for Biological Sciences to NBRI for the "Development of artificial promoters, novel δ-endotoxin coding genes and indigenous transgenic to cotton lines for resistance to insect pests".

### Customer Satisfaction Evaluation Unit

A new version of questionnaire was designed for Customer satisfaction activities for in-depth understanding based on the customer feedback for the year 2004-05. It was made available to all the CSIR laboratories for collecting customer Satisfaction feedbacks on projects. The Oracle database were also upgraded and updated based on the customer satisfaction feedback received. The software was developed to record CSI Report on compact disk to the layout design of Project Information. Customer Profile and Customer Satisfaction Feedback databases were changed to give relevant information in a particular format.

## 3.4 GENERAL ADMINISTRATION

General Administration is yet another important functionary of the Headquarters, which facilitates the general functioning of all CSIR laboratories. It has different arms to assist its day-to-day functioning. The following paragraphs present significant activities of the sections:

(i) Establishment-I (E-I): It is the cadre controlling section of all the common cadre officers (CCO) of CSIR dealing with their personnel matters including their appointment, verification of caste certificates, confirmation,

training, promotion, transfer, posting, deputation, disciplinary issues, apart from other service matter that may come up from time to time.

(ii) Establishment-II (E-II): The major functions of this section includes maintenance of personal file of Directors of CSIR laboratories, extension of service of Directors and of Group IV staff beyond superannuation, recognition of hospitals, counting of service, fixation of sanctioned strength of S&T staff, verification of character – from IB in case of candidates who had resided abroad, preparation of Agenda items of Governing Body of CSIR, policy matters related to assessment promotion of S&T staff, issues related to CCO (R&A) rules.

(iii) Establishment-III : Also known as Central Office, this section provides performance-driven administrative support. It maintains personal files, service books and Annual Confidential Report (ACR) folders of around 500 staff members. The section also initiates action to convene Department Promotion Committee (DPC) meetings for non-technical staff (except common cadre), S&T Staff (Group I, II, & II of MANAS) of Headquarters, timely action with respect to CCS (CCA) rules in cases of violation of conduct rules. The section also deals with allotment of staff quarters & scientist apartments, matters pertaining to estates, leaves for Headquarter staff, deputation/foreign services, pension, medical reimbursement etc.

**Parliament Cell**

It deals with Parliament Questions which involve collection of inputs from concerned sections/divisions of the CSIR Hqrs. and from CSIR Labs./Institutes and compiling replies for submission to the Parliament.

It also deals with other Parliamentary matters and the visits of the Parliamentary Standing Committee on Science & Technology to various CSIR Labs./Institutes.

**Committee Section**

The section deals with Agenda/Proceedings of Management Council meetings of CSIR Labs./ institutes. It collects comments from the concerned Sections/Divisions at CSIR Hqrs. and after compiling the same, the comments are sent to the Labs./institutes. It also convenes meetings of the Governing Body & Society, prepares agenda papers/minutes and takes follow up action on the recommendations of the GB/Society meetings.

**Raj Bhasha Unit**

Raj Bhasha unit deals with the implementation of Official Language Act at CSIR

Hqrs. & coordinates with the Labs./institutes of CSIR. Arrangements for visits of the Raj Bhasha Sansdiya Samitis are also made by this Unit.

**SC/ST Cell**

It deals with the grievances of SC/ST & Physically Handicapped employees and ensures implementation of instructions and provisions made for the welfare of SC/ST & Physically Handicapped employees and also coordinates with the concerned Departments/bodies.

## 3.5 HUMAN RESOURCE DEVELOPMENT GROUP (HRDG)

The Division has a mandate to develop and nurture S&T manpower at the national level. It also promotes, guides and co-ordinates scientific & industrial research through scientific projects. The activities include: Award of Shanti Swarup Bhatnagar Prizes (SSB) and CSIR Young Scientist Awards (YSA); Selection of Junior Research Fellows (JRF) through National Eligibility Test (NET); Selection of Senior Research Fellows (SRF), SRF Extended Research Associates (RA), Senior Research Associates (SRA) and Shyama Prasad Mukherjee Fellows (SPMF); Funding of Extra Mural Research (EMR) Schemes at universities/ R&D organizations; Visiting Associateship Scheme; Travel / Conference / Symposium grants; CSIR Programme on Youth for Leadership in Science (CPYLS).

**Shanti Swarup Bhatnagar Prize**

CSIR gives recognition to a scientist for doing outstanding research work in the country, in the form of prizes/awards. The Shanti Swarup Bhatnagar Prize (SSB) for Science & Technology is given every year to outstanding scientists in 7 disciplines of Science & Technology. The Shanti Swarup Bhatnagar Prizes for the year 2004 and 2005 were presented by Dr. Manmohan Singh, the Hon'ble Prime Minister of India & President, CSIR to twenty one outstanding scientists at a glittering function organized at Vigyan Bhawan on 28$^{th}$ September, 2005. Bhatnagar Laureates (2004) symposium was also organized in which Bhatnagar awardees of 2004 presented their award winning work.

**Young Scientist Award**

Young Scientist Award (YSA) is meant for scientists below the age of 35 years, working in CSIR laboratories, to recognize in-house excellence. YSA is given in 5 disciplines of Science & Technology. In the year 2005, only three scientists were selected for Young Scientists Awards, one each from Chemical Sciences; Engineering Sciences; Earth, Atmosphere, Ocean & Planetary Sciences. These Awards were presented by Shri Somnath Chatterjee, Hon'ble Speaker of Lok

Sabha at the CSIR Foundation Day function held at Convention Hall, Ashoka Hotel on 26 September, 2005. Dr. Swati Piramal of M/s Nicholas Piramal India Ltd. delivered the CSIR Foundation Day Lecture.

**Junior Research Fellowship (JRF)**

CSIR conducts National Eligibility Test (NET) for Junior Research Fellowship and Eligibility for Lectureship twice a year at 23 centres throughout the country.

The result of CSIR-UGC NET June 2005 examination was announced on 25th November 2005. A total number of 1134 candidates qualified for CSIR/UGC Junior Research Fellowship and lectureship and 1300 qualified for lectureship only.

The subject-wise split of the result is given below.

| | Chemistry | Earth Science | Life Science | Mathematics | Physics | Total |
|---|---|---|---|---|---|---|
| JRF Selected | 332 | 55 | 437 | 146 | 164 | 1134 |
| Lecture-ship | 383 | 71 | 587 | 109 | 150 | 1300 |

The CSIR-UGC NET December examination was held on 18th December 2005. A total of 79,416 candidates registered for the examination.

**Shyama Prasad Mukherjee Fellowship (SPMF)**

The SPM Fellowship Scheme was started in the year 2001 with the objective to nurture budding scientific talent towards pursuit of scientific research. The Scheme is open to top 20% CSIR-UGC JRF-NET scholars along with top 100 GATE qualified candidates with percentile 99 and above who have to qualify a specially designed written test followed by an interview to be eligible for the fellowship.

The examination for SPMF for the year 2005 was held on 10th July. Out of 545 candidates called for written examination, 350 appeared and 29 were selected for interview. Eight candidates finally qualified for SPM fellowship, two each from Chemistry, Life Sciences, Mathematics and Physics.

**Senior Research Fellowship (SRF), SRF Extended and Research Associateship (RA)**

A total of 2220 applications were received in 16 subject categories. The Selection Committees selected 355 candidates for SRF, 31 candidates for SRF (Ext) and 65 candidates for RA.

**Junior Research Fellowship for GATE qualified engineering graduates (JRF-GATE)**

CSIR has introduced a new research fellowship in 2002 for the GATE qualified candidates with B.E./ B. Tech. / B. Arch./ B. Pharm. degree to pursue research leading to Ph.D. This is known as the GATE qualified Junior Research Fellowship (JRF-GATE). JRFs selected under this scheme get excellent opportunity to work with the CSIR scientists with state-of-the-art R&D facility and obtain Ph.D. degree.

Around 155 JRF-GATE Fellows are at present working in different laboratories of CSIR.

**Senior Research Associateship (SRA)**

The Senior Research Associateship (SRA ship) is primarily meant to provide temporary placement to highly qualified Indian scientists, engineers, technologists, and medical personnel who are not in regular employment in the country, including those returning from foreign countries. 122 Senior Research Associates were selected and 84 joined during the year 2005-06.

| Year | No of SRA Selected | No. of SRA Joined | Total No. as on 31st March 2006 |
|---|---|---|---|
| 2005-2006 | 122 | 84 | 150 |

**Extra Mural Research Schemes and Special Support Programs**

CSIR provides financial assistance to promote research in the field of science and technology including Agriculture, Engineering and Medicine. It is given in the form of research grants to Professors/ Scientists in regular employment in Universities/ Academic Institutes/ IITs etc. The number of research schemes recommended during 2005-2006 is as given below:

| Schemes | Proposals considered | Proposal Recommended | Proposal Renewed |
|---|---|---|---|
| General | 539 | 208 | 514 |
| Emeritus Scientist | 86 | 24 | 101 |
| Sponsored | 23 | 6 | 41 |
| One Time Grant | 14 | 4 | - |

Under General schemes, financial assistance was provided to 208 schemes out of a total of 539 proposals considered and 514 renewals were made during the year 2005-06 whereas under the Emeritus Scientists Scheme, financial assistance was provided to 24 outstanding superannuated scientists out of a total of 86 proposals received, and 101 renewals were made during the year. In the Sponsored Scheme category, 9 schemes were sanctioned out of 23 proposals received, and 41 ongoing schemes were renewed. Under the one time grant category, out of 14 proposals received 4 were granted.

**Travel/Conference Grants**

Travel grant is provided by CSIR to young researchers for presenting research papers at International Conferences held abroad. The travel grant committee considered a total of 1043 applications and out of which 426 cases were recommended. The same committee considered 683 proposals from scientific societies/ institutes etc for organizing national / international conference/ symposium/ workshops, etc. and recommended 554 cases for organizing these events.

**CSIR Programme on Youth for Leadership in Science (CPYLS)**

The CPYLS scheme is a unique 'hand holding' program started for school children at secondary level. The scheme was started to attract the meritorious young school children towards science.

Till March 2006, most of the CSIR laboratories had organized 2 open days programme for the year 2005. The reports received from coordinators of these programmes show a very good response both in terms of participation and appreciation of the scheme.

**CSIR Diamond Jubilee Research Interns Award Scheme**

The CSIR Diamond Jubilee Research Interns Award Scheme is a preparative scheme through which young interns are trained in the tools and techniques of research under supervision of experienced CSIR scientists. Each CSIR laboratory can have a maximum number of 30 Interns at any time and the selection of interns is carried out by concerned laboratory itself.

**Technological Entrepreneurship Programme for Research Scholars**

The objective of this program is to broad base the perspective of the research scholars so that they can make linkages of their scientific and technical knowledge to the buoyant world of business and industry. The 3rd training program on technological entrepreneurship was organized from 20th Feb, 06 to 22nd March, 06 at CLRI. Fifty three participants from 21 CSIR Labs attended the programme.

**Faculty Training & Motivational Programme and adoption of Schools and Colleges by CSIR laboratories.**

The objective of this scheme is to organize training and motivational programmes for selected science teachers from schools and colleges around CSIR labs to upgrade their knowledge base in new and emerging areas of science thereby raising the standard of science education in selected schools & colleges. It also envisages to promote the interaction of science students with CSIR labs thereby motivating them to take up science as a career. The scheme is being implemented by almost all the CSIR laboratories.

**3.6 HUMAN RESOURCE DEVELOPMENT CENTRE**

Human Resource Development Centre (HRDC), Ghaziabad continued and intensified its human resource development activities for meeting multiple competency needs of CSIR personnel. The campus of the Centre has become functional and residential training programmes have commenced during the period.

The Centre, during the year 2005-06, conducted 23 customized training programmes for different categories of CSIR staff viz. scientific & technical, administrative, finance and purchase personnel. These programmes which included induction, refresher and skills development activities were meant to address the training requirements of the staff at different levels, both new inductees as well as in-service personnel. In continuation to the Centre's earlier initiatives to bring quality in value added R&D services offered by the laboratories, the Centre conducted training programmes in Laboratory

Accreditation under ISO 17025 standard (NABL). Some of the laboratories have taken initiatives for the ISO 17025 accreditation process as an outcome of these programmes.

With the coming in force of the Right to Information Act, the Centre took initiatives to conduct a series of awareness programmes on the same for better appreciation of diverse provisions of the Act & implementation thereof.

The Centre completed the training need analysis and using the inputs of this analysis, is developing modules for different training programmes for CSIR personnel.

The infrastructural development work was completed during the year and CSIR has now a modern training Centre with state-of-the-art facilities.

### 3.7 INTERNATIONAL S&T AFFAIRS DIRECTORATE

In order to achieve its mandate of identifying, facilitating, and promoting international cooperation in the emerging and frontier areas of science and technology, ISTAD's major activities during the current year include the following:-

## A. Bilateral cooperation

**CHINA: CSIR-NNSFC Co-operation**

**a) Working Programme for 2006-08 signed**

A new working programme for the years 2006-2008 for S&T cooperation between CSIR & National Natural Science Foundation of China (NNSFC) was signed during the visit of a CSIR delegation during 13-21 March 2006. Areas identified were materials research and technology, chemical sciences, food safety, biotechnology, drug design, discovery and development, oceanography and Earth sciences including natural disasters, S&T policy.

Both sides also agreed to organize four joint workshops/symposia in the following areas, two each in India and China, with a view to bring forth state-of-the-art in both the countries and to identify challenging areas of common interest for collaboration:

i) Designing Materials through Nano-technology (March 2007, China)

ii) Organic Chemistry & Chemical Biology: Bridging Bonds for 21st Century (March 2007, India)

iii) Global Change: Oceano-Atmosphere-Land Interactions driven by Asian Monsoon (December 2006, India)

iv) Modern Methods and Techniques of Research involving Laboratory Animals (October 2008, China).

**b) Joint Workshop on Genome - Informatics**

The 2nd CSIR-NSFC Workshop on Genome Informatics was organized at IGIB,New Delhi during 22-26 February, 2006 under the MoU signed between IGIB and Beijing Genomics Institute (BGI) China . The main aim of the Workshop was to initiate bilateral collaboration between China and India to harness the potential of genome sequencing efforts.The major topics identified for joint research in the area of genomics are cancer research, study of population diversity and genome informatics.

**c) Joint Workshop on Traditional Medicine**

The second joint workshop on Traditional Medicine under the CSIR-NSFC Cooperation was organized at Wuhan, China, in September, 2005. Five scientists from NBRI, RRL-Jammu & IICT participated from the Indian side. Major recommendations include:-

a. joint research programmers in selected diseases or metabolic disorders (diabetes) and neurodegenerative disorders;

b. establish digitized database and informatics in traditional medicine for IPR protection/management and prevent piracy;

c. share experience in identifying rare, endangered and endemic medicinal plants and preparing passport data of the species;

d. develop joint research ventures in discovering bioactive molecules from plants used in traditional medicine for diseases for which there is no cure available in modern medicine;

e. joint effort to make evidence based traditional remedies by integrating traditional medicine with modern scientific methods and tools and modern medicine in line with the Golden triangle in positioning traditional medicine as a global mainstream health care system.

f. identify institutions for initiating scientists exchange/training programmes;

g. identify medicinal plants found common in both the countries for developing GAP and GCP in line with WHO guidelines. Also consider a common pharmacopoeia in line with the European Union; and

h. To continue to joint workshop/conference at every alternate year for continuing the dialogue in traditional medicine between China and India.

**d) Joint workshop on MEMS Devices**

An Indo-Chinese workshop on MEMS Devices and related technologies from April 5-7, 2006 was organised at NPL under the collaboration between DST and NSFC with the participation of 12 Chinese Scientists and equal number of Indian Scientists.

NAL-CAE Co-operation

The 9th Joint Committee meeting of the NAL-CAE, was held at Beijing, China during 24-26 October, 2005. A project on structural health monitoring was approved.

**2. FRANCE**

**a) CSIR -CNRS Agreement signed**

First Joint Committee meeting of the Indo-French Programme for Weather & Climate was held in Paris, France during 16-18 May, 2005. The participating labs are C-MMACS and NIO from the Indian side and five labs from French Institut of Pierre-Simon-Lapac(IPSL). Under this umbrella, NIO is carrying out the following work: (i) Monsoons and the Tropical Intraseasonal – Interannual variations (MOTIV) and (ii) biological response of the Indian ocean (BRIO)

b) Symposium on Nanotechnology

Under the Inter-Governmental S&T collaboration between India and France, NIO organized an Indo-French Symposium on "Nanotechnology: Promising domain for young scientists" during 22-25 January, 2006 at NIO. The event discussed nanomaterial synthesis; nanostructured objects and devices; simulation and modelling in nano scale; and drug delivery and nanomedicine, biomedical nanotechnology, agriculture and environment cosmetics and textiles, industrial applications

The main objective of the conference was to develop few collaborative projects between the scientists of India and France.

c) Joint Projects

- A project entitled "Resource of Assessment and Quality of Ground Water in Hard Rock Environment (granito-gneiss)" submitted by Indo-French Centre for Groundwater Research with NGRI was approved for funding by DST and French Ministry for Foreign Affairs.

The following projects were approved for funding from Indo French Centre for the Promotion of Advanced Research (IFCPAR).

- "Preparation of nanoporous ceramic membranes over clay-alumina support for water treatment" submitted by Dr. S. Bandyopadhyay of CGCRI with Prof. Andre Larbot of CNRS, France;
- "Genomics and biotechnology of fruit quality" submitted by Dr.Pravendra Nath of NBRI with Dr. Jean-Claude PECH of France;
- "Mannolipids and Mannose Metabolism in Mycobacterium tuberculosis" submitted by Dr. K.Madhavan Nampoothiri, of RRL-Trivandrum with Dr. Jerome Negou of France;
- "Deciphering history of the Indo-Eurasia collision from detailed plate tectonics of the Indian Ocean" submitted by Dr.G.C.Bhattacharya of NIO for collaboration with Dr. Jerome Dyment of CNRS, France; and
- A project entitled "Palaeomagnetic study of Great Dyke and Vindhyan Supergroup rocks of India: A contribution to Precambrian geodynamics" submitted by NGRI.

**3. GERMANY**

a) Bilateral CSIR- FzJ Cooperative Science Programme

A Project on "Surface effect based on charge accumulation phenomenon in ferroelectric and antiferroelectric liquid crystal materials" between NPL & Institute of Physical Chemistry, TU Darmstadt was approved in the programme for a period from April 2005 – December 2007.

b) DST-DAAD PPP

A project entitled "Kinetic and Mechanistic Investigations of Oxo-Transfer Reactions catalysed by Ruhtenium Model Complexes of Cytochrome P-450 Mono-Oxygenase" of CMERI and University of Erlangen, Nuernberg was approved for implmentation during June 2005-June 2007.

c) CSIR-Humboldt Reciprocity Research Award

Two eminent German experts were granted the prestigious Research Award for the year 2005. Both the awardees have visited India and the visits have resulted in assured long-term research ties between their institutes and the Indian host institutions:-

- Prof. Juergen Kurths, Institute of Physics, Potsdam University, Potsdam, Germany on the invitation of IICB.
- Prof. Michael Hunger, University of Stuttgart, Instt. of Chemical Technology, Stuttgart, Germany on the invitation of IIP.

d) CSIR-DAAD Exchange Programme

Three scientists each from India and Germany exchanged visits under this programme.

Nominations of six scientists each from CSIR and German institutions were approved for visiting counterpart country under collaborative projects and in addition three nominations each of CSIR and German scientists were approved for stand-alone visits during 2006.

e) Inter-Agency Cooperation

NPL signed an MoU with Physikalisch-Technische Bundesanstalt (PTB), Germany for cooperation in the field of metrology.

## 4. JAPAN

a) Indo-Japanese Inter-Governmental S&T Cooperation

The 7th meeting of the Indo-Japanese Joint Committee for S&T was held on 3rd November 2005 at New Delhi.

b) NEERI-NIMS S&T Co-operation

Under the NEERI-NIMS collaboration in the field of "Development of Advanced Materials for Environmental Applications" three joint workshops have been organized, two at Nagpur and one at Tsukuba. The 4th workshop is in pipeline. A joint research project was considered for funding by the 7th joint Committee Meeting.

c) Asian Pacific S&T Seminars – JISTEC

The Japan International S&T Exchange Center (JISTEC) has been organizing a series of Science & Technology Management Seminars among the Asia-Pacific regions for the past ten years on various themes of Science Management. The 11th seminar, renamed as 1st Asian S&T Seminar (ASTS), entitled "Appropriate Intellectual Property Right Regime & Practical System for Utilization of IPR for Asia" was held at Bangkok (Thailand) during March 19-21, 2006.

d) Security/sensitivity clearance

The following projects were cleared from security/sensitivity angle**:-**

1. "Investigation of the Magneto-Superconductivity of Ruthenocuprates" submitted under Indian National Science Academy (INSA) New Delhi, India and the Japan Society for the Promotion of Science (JSPS), Japan between NPL, New Delhi and Advanced Materials Laboratory, National Institute for Materials Sciences, Japan.

2. “Asian ozone pollution in Eurasian perspective“ submitted by NPL, India under Asian-Pacific Netowork for Global Change (APN), Kobe, Japan. The collaboration is based on sharing of ozone and carbon monoxide data observed at Hanle, India. The collaborating Indian Institutes are (a) National Physical Laboratory (b) Physical Research Laboratory, and (c) Indian Institute of Astrophysics whereas the collaborating foreign institutes are (a) Frontier Research Centre for Global Change, Japan (b) Chinese Academy of Metrological Sciences, China (c) Departmental of Civil and Structural Engineering, Hong Kong, China & (d) Environmental Studies Division, Malaysian Meteorological Service, Malaysia.

## 5. NEPAL

a) Indo-Nepal intergovernmental S&T Co-operation

Three Nepalese Scientists from Royal Nepal Academy of Science & Technology (RONAST), Nepal were trained in the areas of medicinal plants at IHBT, RRL-Jammu & CIMAP.

b) CSIR-RONAST

A four member Nepalese delegation from RONAST led by their Vice Chancellor visited New Delhi during 12-18 February 2006 to learn about some facilities in testing Genetically Modified Foods/Organisms.

A project proposal entitled “Molecular Characterization and Bioprospecting of *Swertia* species of Napalese Himalayas” submitted by RONAST, Nepal for collaboration with IHBT has been approved by both the sides under this cooperation.

## 6. SOUTH KOREA

a) India – Korea Intergovernmental S&T Co-operation

The first India-Korea joint Committee on S&T was held in Seoul on 31$^{st}$ August, 2005. The salient features of mutual agreement were: exchange of S&T personnel also on complimentary basis; holding academic meeting in the form of workshops/seminars etc., exchange of personnel on complimentary basis at organizational costs by the host country; joint research projects as identified in academic meetings (two areas of work already agreed, biotechnology, nano-technology); joint funding of the order of US $30000 towards meeting costs of events above.

b) MoU between NML and KIGAM, Korea

NML and Korea Institute of Geoscience & Mineral Resources (KIGAM), Korea signed an MoU for undertaking a joint project on "Development of Technology for Recovering Heavy Minerals from Sea Sand by Flotation".

## 7. SWEDEN

Following joint projects were approved:

- "Sources and sinks of atmospheric aerosols in India" (IICT and International Meteorological Institute, Sweden);
- "Monitoring Network of aerosol and precipitation chemistry measurements in south Asia under Atmospheric Brown Cloud Project" (IICT and International Meteorological Institute, Sweden);
- "Physico-Chemical Characterization of Wet deposition"(NPL and Department of Meteorology, Stockholm University (MISU), Sweden); and
- "3rd phase continous long-term measurements to establish the trend of acidification both in dry and wet depositions". (RRL, Bhubaneswar and Department of Meteorology, Stockholm University).

## 8. TAIWAN

a) Visit of Taiwanese delegation to CSIR labs

- A six member Taiwanese delegation led by Prof. Ching Jyh Shieh, Deputy Minister from National Science Council of Taiwan visited IGIB, NPL & NAL. During the visit to NPL, they showed keen interest in the area of Bio-molecular electronics like DNA biosensors, cholesterol biosensors & glucose sensors etc.
- A six member delegation led by Dr. Hsin-Sheng Tsay, Dean, College of Science & Engineering visited CSIR to discuss the development of India's Biotechnology and Herbal Medicine sector. A brief overview of CSIR's capabilities & achievements in this area was presented to the delegation. The delegation also visited NBRI, CIMAP and NCL.

b) Joint Workshops on functional genomics

- An Indo Taiwanese joint Workshop on Functional Genomics under the Indo-Taiwanese inter-Governmental S&T Cooperation was organized at IGIB, New Delhi during 20-21 Oct 2005;

- The second Indo Taiwan Joint Workshop on Functional Genomics was organised at Taipei between 3-5 March 2006 under the DST's of Indo-Taiwanese Bilateral Co-operation. Bioinformatics was identified as one of the major areas for collaboration between the two sides;

c) MoU between IGIB and Vita-Genomics Inc, Taiwan

IGIB and Vita-Genomics Inc, Taiwan have signed a Memorandum of Understanding and are in the process of joint project formulation in the field of asthama pharmacogenomics. Also a liver proteomics project between Taiwan and India is in pipeline in which IGIB will be a major participant.

**9. VIETNAM**

Indo-Vietnam intergovernmental S&T Co-operation:

The sixth meeting of the Indo-Vietnam Joint Committee on S&T was held at New Delhi, during 19-20 May,2005. Areas agreed were:

- Biotechnological methods for improvement and production of high-yielding hybrid rice varieties for growing in Vietnam and India;
- Cultivation techniques in the drought and semi-arid regions;
- Bioinformatics for assessment and exploration of plant and animal genetic resources;
- Cultivation of grass and green plants suitable for feeding dairy and meat cattle in the northern provinces of Vietnam; and
- Renal and kidney function disorders.

The new PoC for the years 2005-2007 was also signed during the meeting.

**10. Poland**

A project proposal entitled "Studies on separation and removal of metals using solvent extraction and liquid membrane methods" to be undertaken by NML with Institute of Chemistry and Environment Protection, Poland under the Inter-Governmental Indo-Polish collaborative programme of DST was approved.

## 11. RUSSIA

ILTP Projects:

The following projects were approved for implementation under ILTP

- "Design of Highly Stable and Low Pd Containing for Hydrodechlorination and Methane Combustion: Structure, Reactivity and Reaction Modeling" (Dr. P.S. Sai Prasad, IICT and Prof. E.F. Stefalgo, Institute of Coal and Coal Chemistry, Russia; 3 years);
- "Catalytic Reforming of Coal for Value-added Chemicals" ( Dr. G.S. Salvapati and Prof. E.F. Stefalgo, Institute of Coal and Coal Chemistry, Russia);
- "Study and prediction of noble-metal Mineralization in non-traditional geological formations and developing methods for identification of such mineralization in East Russia and South India" (Dr V. Balaram, NGRI and Dr. Nikolay V. Berdnikov, Institute of Tectonics and Geophysics, Khabarovsk; 3 years);
- "Dense ceramic nano-composites by SHS process" ( Dr. S.K. Mishra and Dr. V.A. Shcherbakov, Institute of Structural Mackrokinetics and Materials Sciences (ISMAN) RAS, Chernogolovka, Moscow Region, Russia – 3 years); and
- "Oxidation of hydrocarbons by molecular oxygen and peroxides" (Dr. S.B. Halligudi and Dr. Georgiy B. Shul'pin, Semenov Institute of Chemical Physics, RAS, Moscow)

**12. SWITZERLAND**

A Project proposal entitled "Improving rust resistance in wheat suitable for marginal rain fed and semi arid zone of central and peninsular India through molecular markers" submitted by Dr.(Mrs.) V.S. Gupta, NCL for collaboration with Institute of Plant Biology, Zurich, Switzerland under the Indo-Swiss collaboration in Biotechnology with Switzerland was approved.

**B. Regional S&T cooperation**

## EUROPEAN UNION

The project entitled "Sustainable shrimp aquaculture" was approved for funding by EU with NIO as a partner.

CSIR co-hosted the following two meetings with UNESCO on 17$^{th}$ and 18$^{th}$ March, 2006 respectively:

- "Heritage at Risk: the forgotten victims of earthquakes, floods and the *tsunami* in South Asia; and

- Peer review meeting for the field manual on repair and retrofitting of the earthquake-damaged vernacular structures in the Kashmir region

Financial provision for the first year of this five-year project is Euro 90,600.

**C. Fellowships**

**CFTRI-UNU**

Under the CFTRI-UNU(United Nations University), Japan fellowship programme 5 foreign nationals from Bhutan, Ethiopia and Nigeria have been awarded 12-months fellowship enabling them to carryout advanced research at CFTRI in the area of Food Science and Technology.

**D. Human Resource Development**

During the year Division processed the deputation 129 CSIR Scientists. Of these 99 were deputed to attend international conferences, 6 for fellowships, 13 under bilateral S&T Programmes, 8 on leave, 2 for training & one for business development.

**E. Partial financial assistance (PFA) to non-CSIR scientist, R&D professionals**

229 applicants from academia and medical fraternity were awarded PFA to enable them to attend International Conferences/Workshops/Seminars.

**3.8 UNIT FOR SCIENCE DISSEMINATION**

The Unit for Science Dissemination is fully responsible for furthering favorable public image of CSIR as a whole. During the year several image-building activities were executed to achieve the overall objective.

**Image building through print media**

***Publicity efforts***

- Effective media relations helped in furthering result-oriented relationship with the key press persons covering science in their respective dailies. Appropriate logistics support was ensured to all of them to earn their confidence in this Unit; several features/ stories were published with the support of inputs provided by this Unit.
- Press coverage was successfully organized during important CSIR events, including: Bhatnagar Awards Function; Election of Dr. R. A. Mashelkar, DGSIR, as Foreign Associate of US National Academy of Sciences at its Annual General Meeting on 3$^{rd}$ May 2005; Release of SofComp products by Minister S&T and Ocean Development, Shri Kapil Sibal on 10$^{th}$ May 2005;

CSIR Society Meeting held on 25th May 2005; Declaration of Shanti Swarup Bhatnagar Prizes 2005; Presentation of Shanti Swarup Bhatnagar Prizes 2004 & 2005 by Hon'ble Prime Minister of India; Indo-US Symposium on Scientific approaches to quality, safety and efficacy assessment of ayurvedic & botanical products; seminar on bitumen emulsion & cold mix technologies, organized by CRRI, presentation of **Stars of Asia** award to Dr. R. A. Mashelkar, DG,CSIR, at Beijing; Launch of a campaign on the National Geographic Channel highlighting the innovative and path breaking trends in S&T in India by Shri Kapil Sibal, the Hon'ble Minister of Science & Technology and Ocean Development; Three-day Indigenous Knowledge Workshop in pursuance of a joint venture of the Global Research Alliance (GRA) and the World Bank in the area of Health; Press Announcement of the organisation of Fair-cum-Exhibition on Rural Technologies - Reaching Technology to Rural India: A step towards Rural Transformation.

This Unit successfully organized a Press Meet by DG, CSIR, in connection with 'India Science Report' of INSA, on the eve of its release by the Hon'ble Prime Minister of India, on 27th September 2005.

**Advertising Efforts**

Special advertisement campaigns were released exclusively on CSIR events that include: Diamond Jubilee Technology Awards; S S Bhatnagar Awards and CSIR Foundation Day; IPMD Innovation Awards; Exhibition-cum-fair on Rural Technologies - Reaching Technology to Rural India: A step towards Rural Transformation.

Advertisements were released in special issues of several publications.

**Image building through broadcast media**

Technical help was provided for the production of short films on CSIR achievements in various theme areas.

**Image building through interactive media (exhibitions, etc.)**

CSIR participates in the various national/ international exhibitions and other relayed events with two main objectives: (i) Creating awareness about CSIR and its achievements, and (ii) Supporting its business development efforts.

This important activity was consolidated and efforts were made to project, as far as possible, an integrated picture of CSIR's overall contribution to the theme areas of each event through extensive coordination with the participating CSIR labs. The Unit organized CSIR pavilion in the following events:

- Bio Bangalore 2005, 22-24 April, 2005, Bangalore;
- 3rd Infra Educa 2005, 17-19 June 2005, Jaipur;
- 3rd Infra Educa 2005, 24 – 26 June 2005, New Delhi;
- 3rd Infra Educa 2005, 2-3 June 2005, Chandigarh;
- Pharma 2005 & Chemtech 2005, 20-22 October 2005, Mumbai;
- Destination Uttaranchal-2005, 6 – 11 November 2005, Dehradun;
- India R&D 2005, 7 – 9 November 2005 at Vigyan Bhawan, New Delhi;
- Ninth Technology Trade Pavillion, 14 – 27 November 2005, India International Trade Fair, Pragati Maidan, New Delhi. It is worth mentioning here that CSIR Pavilion has been awarded Silver Prize for Excellence in Presentation of Special Display;
- Destination Uttaranchal-2005, 7 – 11 December 2005, Dehradun;
- Kisan 2005- Agricultural Trade Fair, 14-18 December 2005, Pune;
- PHARMAceutical Expo 2005, 2-4 December 2005, Hyderabad;
- 93rd Indian Science Congress, 3-7 January 2006, Hyderabad;
- EMEX (Engineering & Manufacturing Excellence) World Expo 2006 11-14 January 2006, Mumbai;
- Bio-Asia 2006, 9-11 February 2006, Hyderabad;
- AgriExpo 2006, 11-14 February 2006, Lucknow;
- Exhibition-cum-Fair on Rural Technologies - Reaching Technology to Rural India: A step towards Rural Transformation, 18-22 February 2006, Rai Bareilly.Shri Kapil Sibal, Union Minister of Science & Technology and Ocean Development inaugurated the exhibition. CSIR participated in the following international exhibitions

- India Trade Fair, 19-23 October 2005, Mauritius;
- "Made in India" show, 17-20 November, Johannesburg, South Africa; and
- EABEX 05, 10-14 December 2005, Kuala Lumpur (Malaysia).

**Other information dissemination services**

**Press clipping service**

The Unit provides press-clipping service to the office of the Minister of Science & Technology, DG, CSIR and other top management of CSIR after scanning about 25 papers and 14 magazines on a regular basis. This activity was consolidated to make more professional and timely.

**Publicity Campaign on National Geographic Channel**

CSIR coordinated the launch of a campaign on the National Geographic Channel (NGC). The campaign would revolve around a 45 minutes Science Safari Film and 15 short films covering different aspects of Indian S&T that would be produced and telecast on NGC.

## 3.9 RECRUITMENT & ASSESSMENT BOARD

The Division carried out following activities during the year:

**Recruitment**

Selection Committees were constituted for recruitment to about 275 posts of scientists in 28 CSIR laboratories. These positions were at entry as well as lateral levels.

**Assessment**

Eligibility screening and assessment interviews were carried out for the assessment promotion of around 300 scientists at the level `F' pertaining to the period 2002-2004. Assessment interviews of around 700 scientists at other levels were also organized for the year 2003-2004 in the areas of Engineering & Materials; Physical, Earth & Environmental Sciences and S&T Management & Policy Studies.

**Advisory Committee**

An Advisory Committee was constituted with a view to review from time to time the procedures adopted for recruitment & assessment and approve of its broad framework and any modification thereto besides providing necessary policy guidelines for RAB. The first meeting of the newly constituted Advisory Committee was held in May 2005 wherein quality of experts, backlog in assessments, transparency in the procedures, internal screening process, recruitment procedures, firming up of area of work of the candidate, etc. were discussed in details.

**Department Core Members**

The second meeting of the Department Core Members was organized in March 2006. Interactive sessions on the screening process, assessment procedures and firming up of procedures were organized and various meaningful suggestions arrived at. These members have been intimately associated with the recruitment and assessment process of RAB.

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| **April 2005** | |
| 1st | **IICT:** Prof S V Ley, University of Cambridge, UK delivered the 11th SS Bhatnagar memorial lecture on "Development of new tools and methods for organic synthesis" |
| 2nd | **IICB:** Prof. M.R.S. Rao, President, Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore, delivered the J.C. Ray Memorial Lecture on the occasion of Foundation day of IICB. |
| 3rd-4th | **NPL:** National Symposium on "Material science and progress on its applications" organized. |
| 1st –4th | **RRL-Bhubaneswar:** Four day Demonstration and Training Programme organised on Post-harvest Processing of Non-traditional Pulses. |
| 2nd | **IICB:** Foundation Day celebrated |
| 5th | **CCMB:** Visit of French delegation led by Mr. Bruno Mougin, Director, Human Genetics Department for possible collaboration in the area of infectious diseases and cancer. |
| 6th | **CSMCRI**: Platinum Jubilee of Dandi March organised. Half-day seminar on SALT held. |
| 7th | **NCL.:** Ninth Prof. Sukh Dev Endowment Lecture on "Engaging zwitterions in carbon-carbon bond forming reactions: a promising synthetic strategy" delivered by Dr. Vijay Nair, Emeritus Scientist, RRL-Triv. |
| 8th | **NEERI**: Foundation day celebrated. Dr. A.K. Sinha, Director, Maharashtra Remote Sensing Application Centre (MRSAC) delivered a Lecture entitled "Role of Geo-spatial data in Environment Management. |
| 10th | **CSMCRI:** 52nd Foundation day celebrated. Prof. V. Krishnan delivered the Foundation day lecture "Non-covalently Linked Molecular Assemblies" |
| 11th -13th | **CECRI**: CPYLS programme held. |
| 11th -15th | **CEERI:** Faculty Training and Motivation programme organised. |
| 12th –13th | **CFRI and CMRI:** International Seminar on "Coal Science and Technology: Emerging Global Dimensions (GLOBAL COAL-2005)" organised jointly. |
| 13th | **RRL-Bhubaneswar:** 41st Foundation day celebrated. Open day observed. Prof. S.N. Upadhyay, Director-Institute of Technology, Banaras Hindu University delivered the Foundation day lecture on "Biotechnology and environmental management". Prof. Upadhyay also released the Annual Report of the laboratory for the year 2004-05. |
| 15th –16th | **SERC:** Two day Annual Technical Symposium of Structures Panel of Aeronautics Research & Development Board (AR&DB) held. |
| 27th - 28th | **IGIB:** Indo–European Union Thematic Workshop on "Genomics & Biotechnology For Health" organised. |
| 30 April & 1 May 2005 | **CSMCRI:** Gujarat Gaurav Din Celebration organised. Hon'ble Minister of Industries and Mines, Government of Gujarat, Mr. Anilbhai Patel, inaugurated the industrial exhibition. |
| **May 2005** | |
| 5th | **CCMB:** Visit of Chinese delegation led by Mrs. Hu Miaohui – General Manager, Shandong Kexing Bioproducts Limited. |
| 5th-6th | **IIP:** CSIR Programme on Youth for Leadership in Science (CPYLS) organized. |
| 7th -8th | **IIP:** National Conference on "New Horizons in Applied Biosciences & Entrepreneurship Development" organised. |
| 10th | **CMRI:** 50th Foundation day celebrated Mr. B. Bhattacharjee, Director General, Directorate General of Mines Safety, Dhanbad delivered the |

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| | Foundation Day Lecture. |
| 11th | CSIR's constitutent laboratories celebrated National Technology Day:<br>**CFTRI**: National Technology Day Insignia license presented to the CFTRI Technologies during the year 2004-05. Dr. R.K. Gupta, Head IPMD, CSIR, delivered a lecture on "Intellectual Property Rights".<br>**CIMAP**: Dr Dinesh Patel, MD & CEO of Themis Medicare Ltd. Mumbai delivered lecture on "Biotechnology- Past, Present & Future"<br>**CSIO:** Open day observed. Dr. Anand Kumar, General Manager, BEL, Panchkula delivered a lecture on "Different Dimensions of Technology".<br>**IHBT:** Dr. V.P. Kamboj delivered the key note lecture on "Nutraceuticals: Opportunities for India".<br>**IIP:** Dr. Raghubir Gupta, Research Director of Centre for Energy Technology (CET) at Research Triangle Institute, North Carolina, USA delivered lecture on "Hydrogen as a future fuel".<br>**IMTECH:** Open day observed and Dr. P.K. Ghosh, President, Biocare, SBU, Cadilla Pharmaceuticals Ltd. Ahmedabad delivered lecture on "Planning by Indian Biotech R&D institutions: Post-2005 era"<br>**NEERI:** Mr. S. Bang, Executive Director, M/s Jubliant Organosys Ltd. delivered lecture on "Technological management for sustainable development"<br>**RRL-Jammu:** Prof. S. K. Joshi, Distinguished Scientist (CSIR) & Vikram Sarabhai Professor delivered lecture on "Physics and its Impact on Technology in the 20th Century".<br>**RRL-Triv.** Open House observed. The Chief Guest Dr. M. Radhakrishna Pillai, Director, Rajiv Gandhi Centre for Biotechnology, Trivandrum delivered the Technology Day Lecture.<br>**SERC:** Prof. V.N. Gupchup, Principal & Secretary, VJTI – Retd. & Chairman, RC, SERC, delivered the lecture entitled "Technology Creation – Need of the Nation". |
| 11th -12th | **RRL-Jorhat:** National Technology Day organised along with a two-day awareness programme for the small and marginal entrepreneurs of the state in collaboration with NESSIA, a local NGO. |
| 16th | **NCL:** Prof. Colin D. Bain, Department of Chemistry, Oxford University delivered the fifth Prof. J.W. McBain Memorial lecture on "Marangoni effects: where surface chemistry and fluid dynamics meet"<br>**NEERI:** Dr. A.P. Mitra, Chairman, Research Council, NEERI and Ex. Director General, CSIR inaugurated Updated NEERI Permanent Exhibition. |
| 16th May -24th June | **SERC:** Six-week training programme entitled "National Programme for Capacity Building of Engineers in Earthquake Risk Management (NPCBEERM)" organised |
| 17th –18th May | **NEERI:** National Workshop on "Assessment of Current & Futuristic Water Quality Standards in India". |
| 24th | **CCMB:** Swedish delegation led by Prof. Pam Fredman visited under the programme for exchange of students for Graduate and Ph. D. programmes. |
| 25th | **CSIR Society** meeting held at 7, Race Course Road, New Delhi under the Chairmanship of Hon'ble Prime Minister and President of CSIR Society, Dr. Manmohan Singh. |
| 24th –27th | **CFTRI:** CSIR Veterans' and Thacker Memorial Tennis Tournament conducted. Dr. B.L. Amla, former Director, CFTRI distributed prizes. |
| 28th | **CMERI:** Workshop on 'Dental Surgical Implants' organized. |

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| **June, 2005** | |
| 1st | **CCMB**: Visit of Iranian delegation comprising Dr. Naheed Mojgani – Head International Relations, Razi Vaccine & Serum Research Institute. |
| 2nd | **IHBT:** Third Lavender Day organised at Salooni Chamba to promote the lavender plantation in the region. |
| 3rd | **IIP:** Shri K P Nyati, Head, Environment Management Division, Confederation of Indian Industry (CII) New Delhi. delivered a lecture on "Sustainability: The Emerging Paradigm" as a part of World Environment day celebrations. |
| 5th | **RRL, Jammu:** LIV- 1 a herbal medicine for liver disorders launched. The product which has been licensed to M/s Medley Pharmaceuticals Pvt. Ltd., Mumbai was launched by Sh. Mangat Ram Sharma, Deputy Chief Minister, Govt. of J & K. |
| 7th | **IHBT:** Dr A.V. Rama Rao Former Director, IICT delivered the foundation day lecture on "Rediscovering Natural Products As Drugs" Annual Report 2004-05 was also released.<br>**NCL:** Fourth Prof. K. Venkataraman Memorial Lecture on "My life in drug research: and lessons learnt" was delivered by Dr. Nitya Anand, Former Director, CDRI, Lucknow. |
| 10th | **SERC:** Foundation day celebrated. Third Professor G.S. Ramaswamy Memorial Lecture delivered by Dr. C.S. Viswantha, Chief Consulting Engineer, Torsteel Research Foundation on "Sir M Visvesvaraya-A Legendary Figure".. |
| 11th | **NIO**: Dr. R.A. Mashelkar, DG-CSIR delivered a public lecture entitled, "Making high technology work for the poor". |
| 11th- 12th | **NCL:** Orientation programme for newly joined research students and staff members organised in four modules as: systems and procedures, good laboratory practices, information and communication and student academic affairs. |
| 13th –14th | **RRL-Bhubaneswar** jointly organised the International Conference on Emerging Trends in Mineral Processing and Extractive Metallurgy (ICME) – 2005 with Indian Institute of Metals, Bhubaneswar and Indian Institute of Mineral Engineers, Bhubaneswar. Hon'ble Chief Minister of Orissa Shri Naveen Patnaik, inaugurated the event. |
| 14th | **IIP:** Visit of Iranian delegation of M/s Beharan Oil Co. to explore the possibility of collaborative R&D projects. |
| 18th -21st | **NCL:** Indo-French workshop on "New solid state NMR methods and materials characterization" organised. |
| 20th June– 2nd July | **NAL:** A two week training programme organised for the customers of HANSA-3 aircraft, on Propulsion system (Rotax Engine 914F) and airframe. Certificates issued by Director, NAL to the participants who passed the examination conducted by DGCA |
| 26th | **RRL, Jorhat:** Workshop on popularizing organic farming in Arunachal Pradesh organised by RRL Branch, Itanagar |
| 27th | **RRL-Triv. :** A lab-industry meet on the theme "Diffusion of Technology on Multi-Functional Additives for Rubber Product manufacture" organised. |
| **July 2005** | |
| 1st – 8th | **NEERI:** Orientation Programm for 10 newly recruited Scientists Group IV(1) |
| 4th-8th | **CMERI:** Hands-on Training Programme for Entrepreneurs of Steel Based Bullock Carts organized. |

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| 5th | **RRL-Bhopal:** Hindi workshop on material science organised. |
| 5th – 6th | **CBRI:** Vocational training to 129 Science & Engineering students from 36 engineering colleges/institutes from May to July 2005. Interaction Meet of Rural Building Centres organised. |
| 6th | **CDRI**: 8th Dr. B Mukherji Memorial Lecture delivered by Prof. Samir Bhattacharya, Shantiniketan on "Free fatty acid induced insulin resistance and diabeted type2: Understanding of the underlying mechanism and need for new therapy." |
| 7th | **NAL:** Visit of team led by Dr. G. Madhavan Nair, Chairman, ISRO and held discussions, on present and possible interactions between ISRO and NAL. |
| 9th | **SERC:** Visit of Dr. R.A. Mashelkar, DG, CSIR, to the upcoming advanced Seismic Test Facility / Earthquake Engineering Laboratory of SERC. |
| 18th | **NEERI:** Dr. Ashok Juwarkar Memorial Lecture delivered by Dr. B.M. Khadi, Director, Central Institute of Cotton Research on "Agriculture & Environment". |
| 18th -19th | **IGIB:** Two days Indo-Brazil-South Africa Trilateral Workshop organised on "Functional Genomics, Life Science, GM Food and Agriculture". |
| 20th | **NAL:** Prof. R Narasimha, Chairman, Engineering Mechanics, Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore, delivered lecture entitled "Monsoon Ragas, Playing with wavelets on Rainfall Data". |
| 23rd | **NAL:** Foundation day lecture delivered by Shri. M. Natarajan, Scientific Adviser to Raksha Mantri, Secretary, Department of Defence Research, Ministry of Defence, New Delhi on "Opportunities and Challenges in Defence Programmes and projects" and released the NAL's Annual Report for 2004-05. Dr. A R Upadhya, Director, NAL launched the new web-site of Information Centre for Aerospace Science and Technology. |
| 24th | **CECRI:** Foundation Day celebrated. |
| 30th - 31st | **CMRI:** Two days national seminar on Policies, Statutes and Legislation in Mines [POSTALE 2005] organised with the theme to debate, deliberate and discuss on the mining related issues. Sri A. K. Singh, Secretary, Mining & Geology, Govt. of Jharkhand inaugurated the seminar. |
| 31st | **NAL** in association with the Kites Chapter of the Aeronautical Society of India, Bangalore Branch and Team Mangalore arranged a one-day workshop on kite building, flying and aeromodelling at the Jakkur Airfield for selected school children |
| **August 2005** | |
| 1st – 2nd | **NAL** conducted Indo-US workshop on Micro Air Vehicles with University of Maryland. 14 experts from various organizations participated in the workshop. |
| 2nd – 4th | **NPL:** Temperature & Humidity Standards Group peer reviewed by the International Technical Expert, Dr. J. Fischer from PTB, Germany |
| 5th | **NAL**: International Year of Physics was celebrated at NAL. Prof. N Mukunda, Indian Academy of Sciences, Bangalore delivered a lecture on "Einstein- Life and Legacy". |
| 7th | **CSMCRI:** Daimler-Chrysler (DC), India conducted a test drive with CSMCRI's jatropha biodiesel in Leh (Khardungla pass), which is 18360 feet, the highest motorable pass in the world. DC used C-class |

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| | Mercedes car and one Viano van and the tests drive was taken with neat biodiesel and no engine modification. The engine cranked at the first start and no difficulty was experienced at this altitude. |
| 8th | **CRRI:** Workshop on emerging ITS technologies organised. |
| 8th -9th | **CEERI:** Orientation programme for newly recruited staff organised. |
| 8th-10th | **IICT:** Workshop on CSIR e-journal consortium-user interface" organised. |
| 11th – 13th | **NAL:** 8th Annual CFD symposium organised by Aeronautical Society of India (AeSI). About 150 scientists from leading R&D Organisations and industry participated. |
| 12th | **CLRI:** Prof. P. Khanna Memorial Lecture entitled "A Vision of Missionary in Prof. Khanna for Leather" by Padmashri Dr. T. Ramasami, Director, CLRI. |
| 13th | **NEERI:** Visit of Hon'ble Minister of Science & Technology and Ocean Development and Vice President, CSIR Shri. Kapil Sibal. |
| 14th | **IIP:** Visit of H. E. Dr. A. P. J. Abdul Kalam. He addressed the scientific community of the Institute, giving a definite direction for future research and invited questions from the audience.<br>Hon'ble Minister of Petroleum and Natural Gas, Shri Mani Shankar Aiyyar was also present. |
| 16th – 18th | **SERC:** Three days Workshop on 'CSIR E-Journals Consortia – User Interface' was organised jointly with NISCAIR. |
| 18th | **CFTRI:** 500 MHz NMR Facility was inaugurated by Prof. R. Chidambaram, Principal Scientific Advisor, GOI. |
| 24th | **CRRI:** A workshop on 'Road Asset Management – Needs and Imperatives' organised |
| 25th | **CRRI**: Workshop on "Road Information System (RIS) and Computerized Project Information System (CPIS)' organised in association with NHAI and M/s. Consulting Engineering Services Pvt. Limited (CES) New Delhi. |
| **September 2005** | |
| 1st | **IGIB:** India's biggest Super Computer facility established with Cluster Platform 3000, Infiniband 4.7 Tera flop peak computational capability. This facility ranks 158th among the top 500 high performance computing facilities world-wide. |
| 10th | **NAL:** The first set of blades for 300 kW wind turbine, developed by NAL was commissioned at Sangeet Wind Farm, Kethanur near Coimbatore. |
| 13th | **165th Governing Body** of CSIR held. |
| 14th | **SERC**: Visit of Dr. Felek Jachimowicz, Vice President - R&D, W.R. Grace Co., USA alongwith Dr. Allan Jones, Director – R&D, and Dr. Lowell D'souza, Innovation Specialist, W.R. Grace Co., USA for Joint Research Partnership.<br>**IGIB**: Visit of High Power Committee from University Grants Commission with reference to CSIR-AIST Deemed to be University. |

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| 15th | **CCMB:** Visit of Dr. J. Claiborne Stephens, Senior Vice President, Motif Bio Sciences, Inc, New York along with Sri. Kevin Rakin, President and Chief Executive Officer of Genaissance Pharmaceuticals, New Haven, CT.<br>**NAL**: Visit/inspection by the Second Sub Committee of the Committee of the Parliament on Official Language (OL)<br>**NAL**: The First Karnataka Science Congress (KSC) jointly organised with Swadeshi Vijnana Andolana, Karnataka (SVAK). Over 250 delegates participated and 100 research papers were presented in 21 sessions. The "Sir M Vishveshvaraya Vijnana Puraskara" for the year 2005 conferred on 6 eminent scientists of the country. |
| 19th -20th | **CDRI:** Conference on 'Small and medium pharma enterprises in Uttar Pradesh: Challenges and prospects organized in collaboration with SIDBI. |
| 20th | **RRL-Jorhat**: Natural Hazards Awareness Programme organised in Nagaland. |
| 21st | **CEERI:** Foundation day celebrated |
| 23rd | **NEERI:** National Seminar on Safety, Health and Environment Management in Chemical Industry organised with Indian Institute of Chemical Engineers, Nagpur. |
| 25th | **CCMB:** Dr. R.A. Mashelkar, Director-General CSIR visited CCMB and inaugurated the Spectroscopy-I and Proteomics Facilities and addressed to the staff. |
| 26th | **CSIR Foundation Day :**<br>Shri Kapil Sibal, Hon'ble Minister of S&T and Ocean Development and Vice President, CSIR presented the 2005 CSIR Young Scientist Awards and CSIR technology Awards. Shri Somnath Chatterjee, Hon'ble Speaker, Lok Sabha was the Chief Guest. The foundation day lecture entitled 'Kurukshetra, Science and Transformation: Two forces that reshape the world' delivered by Dr. Swati Piramal, Director, Strategic Alliances & Communication, Nicholas Piramal India Ltd. A cultural Programme on 'The Dance of Life- A History of Man's Quest for Science' was presented by Ms. Mallika Sarabhai and her troupe.<br>Some important events in the laboratories were:<br>**CCMB:** Open Day was observed wherein more than 14,500 visitors including students visited.<br>**CDRI:** A roving exhibition on major achievements of Lucknow CSIR laboratories was organised at Science Convention Centre. Prof. Deepak Pental, Vice Chancellor, Delhi University delivered lecture on "Molecular Biology and Precision Breeding of Crops."<br>**CGCRI:** Fourth Atmaram Memorial Lecture delivered by Prof. P. Rama Rao, Former Secretary, Department of Science and Technology.<br>**CMRI:** Shri Partho S. Bhattacharyya, CMD, BCCL, Dhanbad delivered lecture on "Road Map for Revitalization of Jharia Coalfield".<br>**CSIO**: CPYLS organised. Prof. J.S. Sandhu, FNA, Former Director RRL, Jorhat, delivered the inaugural address. Students from Haryana participated in this two – day programme.<br>**CSMCRI:** Dr. A.K. Luke, MD Gujarat State Fertilizer and Chemicals Ltd. Vadodara delivered the foundation day lecture on "Corporate and Research Development"<br>**IHBT:** Dr. V. S. Chauhan delivered the Foundation Day lecture on "Possible Mechanism of Action of the Antimalarial Artemisinin".<br>**IICB:** Prof. K. Muniyappa, IISc, Bangalore delivered the Foundation |

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| | Day Lecture.<br>**IIP:** Prof. B R Arora, Director Wadia Institute of Himalayan Geology, Dehradun delivered lecture on "Probing the Seismic Hazard Potential of the Himalayas".<br>**IMTECH:** Dr. K.V.S. Rao, Head, Immunology, International Centre for Genetic Engineering and Biotechnology, New Delhi delivered lecture on "The dynamics of receptor-mediated signaling: elegance in chaos."<br>**NAL:** Prof. P. Balaram, Director, IISc, Bangalore delivered a lecture on "Measuring and Assessing Science". |
| | **NIO:** Padmabhushan Prof. Roddam Narasimha, FRS delivered lecture on "The Future of Indian Aerospace**".**<br>**RRL-Bhub:** The Chief Guest Shri Gorachand Das, Director-Proof and Experimental Establishment (PXE) DRDO delivered lecture on "Role of test and evaluation in defence armament research".<br>An Interactive Business Meet was also held.<br>**RRL-Jammu:** Dr. Radha K Maheshwari, Professor of Pathology and Coordinator, Indo-US Activities, Uniformed Services University of the Health Sciences, Bethesda, Maryland, USA delivered lecture on "Role of Angiogenesis in Enhancement of Wound Healing and Chemoprevention of Cancer by Novel Botanicals : Benefit of Global Alliances".<br>**RRL-Jorhat:** ISO 9001:2000 awarded.<br>**SERC:** Open day observed. Professor P. Ramachandra Rao, Director, Institute of Armament Technology, DRDO, Pune delivered a lecture on "Creativity as a Science". |
| $29^{th}$ –$30^{th}$ | **RRL Bhubaneswar:** National seminar on "Poly Metallic Nodules (PMN 2005)" organised |
| **October 2005** | |
| $3^{rd}$ –$5^{th}$ | **NIO:** Workshop on Isotope Ratio Mass Spectrometry (IRMS), organised. Co-sponsored by DST, GV Instruments UK Ltd., Manchester (UK) and Thermo Finnigan Corporation, Mumbai. |
| $5^{th}$ –$7^{th}$ | **NIO**: International Workshop on "IOGOOS/JCOMM Western Indian Ocean XBT training" organised. |
| $6^{th}$ –$7^{th}$ | **NIO:** National Conference on "Marine Archaeology of Indian Ocean Countries" organised**.** |
| $8^{th}$-$9^{th}$ | **RRL-Jammu:** National Symposium on "An Overview of Advances in Magnetic Resonance and its Applications" organised at Gulmarg (Srinagar) in collaboration with NMR Society of India. |
| $12^{th}$ | **IIP:** A high level Nigerian delegation led by Dr. Edmund Daukoru, Honb'le Minister of State for Petroleum Resources and Amb. Adamu Waziri, Honb'le Minister of Commerce Federal Government of Nigeria visited the Institute |
| $14^{th}$ | **CDRI:** Bioethics symposium on "Protecting human participants in clinical research" organized. |
| $17^{th}$ | **CCMB:** Visit of Dr. Alan Smith, Chief Scientific Officer and Dr. Dick Meijer, Vice President Genzyme Corporation, Germany. |
| $18^{th}$ -$19^{th}$ | **CRRI:** A seminar on "Bitumen Emulsions and Cold Mix Technologies for Maintenance of Roads" organised. |
| $18^{th}$ – $20^{th}$ | **NIO:** Visit of Greek delegation - Dr. Evangelos Papathanasiou, Director and Prof Anastasios Eleftheriou, Scientist, Institute of Oceanography, Hellenic Centre for Marine Research, Greece to identify common areas of interest for collaboration. |
| $19^{th}$ – $20^{th}$ | **NML**: Workshop on "Blast Furnace Modelling and Real-time |

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| | Simulation", jointly organised with Bokaro Steel Plant and RDCIS, Ranchi<br>**RRL-Jorhat:** Two-day National awareness programme on application of radiation technology organised. |
| 21st | **NIO:** Visit of South African delegation comprising Prof. Cheryl Merle De La Rey, Deputy Vice Chancellor, Dr. Arletta Maria Sienaert, Director of Research Office, University of Cape Town and Dr. Xolela L. Nofukuka, First Secretary, SA High Commission, New Delhi to discuss possible collaboration in the context of the S&T agreement between the two countries. |
| 21st – 22nd | **SERC:** A Two day Training Programme on Reservation In Service for DS/COA/US/AO/Section Officers organised. |
| 23rd-29th | **NPL:** 28th General Assembly of International Union of Radio Science (URSI GA-2005) organized. |
| 24th- 25th | **NEERI**: Workshop on "Indian Urban Quality – 2005" organised jointly with INSA. |
| 26th-27th | **IHBT:** CPYLS programme organised |
| 27th | **NIO:** Prof. M.K. Chandrashekaran, 6th recipient of prestigious Prof. Har Swarup Memorial Endowment Award, delivered a public lecture on "Biological clocks in bat, mice and human". |
| 30th | **CSIO:** Dr. B.R. Arora, Director, Wadia Institute of Himalayan Geology, delivered the Foundation day lecture. |
| **November 2005** | |
| 3rd | **ITRC**: 40th Foundation Day celebrated. 9th Prof. S.H. Zaidi oration was delivered by Prof. A.K. Tyagi, University of Delhi on "Mycobacterium tuberculosis: a pathogen that refuses to be tamed" |
| 7th-11th | **CDRI:** International symposium on 'Emerging trends in drug discovery" organised. |
| 9th-11th | **CMERI:** Short Term Training Course on 'Vibration Analysis of Rotating Equipment & Components' for practicing power plant engineers organized. |
| 10th –11th | **CSMCRI**: CPYLS organised.<br>**NIO:** Indo-Norwegian Workshop on Environmental Management in Coastal Aquaculture organised. |
| 11th | **CMRI:** National Seminar on the use of Fly Ash in Mining Sector organised in association with TIFAC, DST Ministry of Environment & Forests, Ministry of Power, Ministry of Coal, Ministry of Mines and Ministry of Labour.<br>**IIP:** National Seminar on "Vision 2010 : Analytical Techniques & Instruments for Industries, Research and Academics" organised |
| 14th | **ITRC:** International Conference on Toxicology, Environmental and Occupational health. |
| 17th-19th | **CEERI:** CPYLS organised |
| 17th – 20th | **NBRI:** National seminar on Nanobiotechnology – The Road Ahead & Satellite Seminar on Plant Physiology. Dr. S. Ahmad, a leading expert in Nanotechnology delivered the key-note address. |
| 21st | **RRL-Bhubaneswar**: An interactive meet with ferrochrome industries organised. |
| 22nd –23rd | **NISTADS:** A Dissemination Workshop on Agro-biodiversity Conservation for Sustainable Livelihood of Hill Communities in Uttaranchal Rudrapryag, Uttaranchal organised. |
| 24th | **IGIB**: A Strategic Research Partnership established with Genetics Department of University of Leicester, U.K. |

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| 26th | **CCMB:** Foundation day celebrated. Prof. Kai Simons, Germany delivered lecture on "Challenges in the post-genomic era".<br>**NML:** 55th Foundation day celebrated. |
| **December, 2005** | |
| 5th | **NAL** and North Carolina A&T State University USA entered into a Non Disclosure Agreement for undertaking projects of mutual interest<br>**RRL-Jammu**: Foundation Day lecture on "Balaglitazone, a New Partial PPAR-χ Agonist for Type-II Diabetes" delivered by Prof. Javed Iqbal, Distinguished Research Scientist and Global Head (Discovery Chemistry), Dr. Reddy's Laboratories Ltd., Hyderabad. |
| 5th-7th | **NIO:** National Workshop on "Applications of Informatics in Marine Biodiversity Conservation" organised |
| 7th | **RRL, Bhopal** bags the National Award for Fly Ash Utilization given jointly by Ministry of Power, Ministry of Environment & Forest, and Department of Science & Technology. |
| 8th-10th | **CGCRI:** International Workshop on "Emerging Areas of Fibre Optics and Future Applications" organized. |
| 9th –10th | **CFTRI:** Seventeenth Indian Convention of Food Scientists and Technologists (ICFOST 2005) organised in association with AFST(I), Mysore. |
| 10th –11th | **NBRI** Annual Chrysanthemum and Coleus show organised . |
| 12th | **CGCRI:** Workshop on dynamic behaviour of materials at high strain rates (DYMAT INDIA 2005) organised. |
| 13th | **NAL**: The Karnataka Rajyotsava function of the Kannada Sanskrutika Sangha celebrated. 31st issue of popular science journal "KANAADA" released by the Chief Guest, Dr. N Sheshagiri, former DG,NIC. |
| 13th-14th | **CIMAP:** CPYLS organized. |
| 13th-15th | **CMERI**: Fourth Asia Pacific Drying Conference (ADC 2005 organised. |
| 13th 17th | **NPL:** XIII International Workshop on the Physics of Semiconductor Devices (IWPSD-2005) held in collaboration with the Society for Semiconductor Devices. |
| 13th-20th | **IICB: '**FOGARTY' an International Training Workshop organised. |
| 15th | **CCMB:** South African delegation led by Dr N Msomi visited for exploration of bilateral co-operation in specific areas. |
| 15th -16th | **NAL:** 34th National Symposium on Acoustics of the Acoustical Society of India held. Prof. Roddam Narasimha delivered the inaugural lecture on "Aeroacoustics". |
| 17th | **CMERI:** CSIR – Automobile Industry Get-Together on Advanced Manufacturing Technologies organised jointly with SERC. Dr. R.A. Mashelkar, DG,CSIR released the Brochure on AMT and gave inaugural address. Dr. V. Sumantran, Formerly Executive Director, Tata Motors Ltd., Pune released the Book on AMT. |
| 20th –21st | **RRL-Bhopal, RRL,Bhubaneswar** and **RRL-Jammu:** CPYLS organised. |
| 22 -23rd | **IICB:** CPYLS organised |
| **January, 2006** | |
| 1st –2nd | **NIO**: Foundation day. lecture on "Smallest building block of matter" delivered by Prof. Gerard 't Hooft, University of Utrecht, Nobel Laureate. |
| 5th | **CCMB:** Visit of Ukranian delegation led by Dr. Oleh Semenets, Ambassador of Ukraine. |

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| 6th | **CCMB:** Visit of Pakistani delegation led by Prof. Khalid Mahmood Khan, Secretary General to India to explore the possibilities of cooperation. |
| 6th-7th | **CMERI:** National Symposium on "Investment Casting" organized. |
| 9th –21st | **CFTRI:** National Workshop and Symposium and Sensors and Instrumentation for food processing organised jointly with Biosensor Society (India). |
| 10th -11th | **NML:** Workshop on Electromagnetic Methods for Materials Characterisation (ENDEM) organised jointly with Indira Gandhi Centre for Atomic Research (IGCAR), Kalpakkam. |
| 12th –14th | **NBRI**: A National Symposium on 'Ethnobotany in the New Millenium' was organised. Dr. SK Jain, FNA, Former Director, Botanical Survey of India gave the key note lecture on, "Some thoughts on future directions in Indian Ethnobotany". |
| 16th-17th | **CMERI:** CPYLS programme celebrated. |
| 17th -20th | **ITRC:** XXIX All India Cell Biology Conference and Symposium on Gene to Genome organised. |
| 19th -20th | **NML:** CPYLS programme organised. |
| 20th | **CMRI:** workshop on `Strategies of environmental management in mining for sustainable development' organised. Jointly with Mysore Mineral Ltd. |
| 21st | **NGRI:** MoUs signed between DGH and NGRI for Marine Seismic and Magnetotelluric survey in Gulf of Kutch region; Magnetotelluric studies along two long transverses, Sihore to Akola and Indore to Jalgaon, Central India in Narmada-Tapti Basins; Analysis of Aerial Imagery/ Remote sensing data over Narmada Cambay / Deccan syneclise region in Central India. |
| 24th | **NPL:** Special lectures organised on Metrology in Chemistry by Prof. Paul De Bievre, Member, ISO Council on Reference Materials; Member, Consultative Committee on Amount of Substance and Editor-in-Chief, Journal Accreditation and Quality Assurance ("ACQUAL") |
| 25th | **IMTECH:** Foundation day lecture delivered by Dr. R. A. Mashelkar, DG-CSIR on "Making high technology work for poor" |
| 27th | **CRRI**: A workshop on "Accelerated Pavement Testing Facility Capabilities, Utilization and Benefits" organised. |
| 29th-30th | **IICB: "**TRendys in BIOCHEMISTRY–2005" organised. |
| 31st | **CIMAP:** "Harit-CIM-Utsav" with Kisan Mela organised. |
| 31st January-1st February | **CMERI:** National Workshop on "Microsystem manufacturing technologies" organised. |
| **February, 2006** | |
| 9th | **CDRI:** 9th Dr. B Mukherji Memorial Lecture delivered by Prof. K Muniappa, Chairman, Department of Biochemistry, IISc , on "Telomere length maintenance as a target for anticancer drug discovery". |
| 10th | **NPL:** XXXI K. S. Krishnan Memorial Lecture delivered by Prof. C.N.R. Rao |
| 13th | **CMRI:** Industry Meet on FLP Equipments organised. |
| 16th | **166th Governing Body** of CSIR held. |
| 17th | **CDRI:** On the occasion of Foundation day, 31st Mellanby Memorial Oration delivered by Prof. Asis Datta, Director, National Centre for Plant Genome Research, New Delhi on 'Winning of disease and |

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| | hunger: Chasing a dream' |
| 18th – 22nd | **SERC:** Participated as part of the CSIR common pavilion put up at the Exhibition at Amethi. |
| 19th | **CSIR Hqs.:** Shri N.R. Narayan Murthy, Chairman and Chief Mentor, INFOSYS, delivered the P.N. Haskar memorial Lecture on "A framework for urban planning for modern India". The lecture was jointly organised by the Society for Technology and National Development (STAND) and CSIR. |
| 23rd-24th | **NIO:** National Seminar on "Sustainability of Seafood Production" organised in association with Society for Indian Ocean Studies), New Delhi. |
| 24th –26th | **CDRI:** International Conference on "Drug discovery: Perspectives & Challenge" and International Satellite Symposium on "Medicinal plants functional foods in the management of diabetes, obesity and cardiovascular disease" organised. |
| 25th | **RRL-Bhubaneswar:** Orientation seminar on "Biotechnology – A New Frontier of Life Sciences" organised jointly with Trident Academy of Creative Technology (TACT), Bhubaneswar. |
| 28th | CSIR laboratories observed the National Science Day in commemoration of the outstanding discovery of Raman Effect by Nobel Laureate Sir (Prof.) C.V. Raman.<br><br>**CSIO**: Open Day was observed. Shri Naga Chenchaiah, CMD, Semi-Conductor Complex, Mohali, delivered lecture on "An Introduction to Remote Sensing Technology".<br><br>**IICB:** Prof. Shymal Chakrabarti, Department of Chemistry, Calcutta University delivered a lecture – "Bigyanar Ekal and Sekal"<br><br>**IIP:** Prof. S K Joshi, Ex. DG-CSIR delivered a lecture on the emerging science titled "Nanoscience and Nanotechnology : Endless Frontiers".<br><br>**NAL**: A lecture on "The Units of Darwinian Natural Selction - When should players sacrifice themselves for the sake of their team?" was delivered by Prof R Gadagkar, Chairman, Centre for Contemporary Studies and Professor, Centre for Ecological Sciences, IISc, Bangalore.<br><br>**SERC:** Dr. T.N. Gupta, former Executive Director, Building Materials & Technology Promotion Council, New Delhi delivered a lecture entitled "Natural Disasters: Vulnerability Reduction in Urban Areas" and Dr. Appa Rao, former Director, SERC, on "Current Trends in Development of Engineering Sciences". |
| **March, 2006** | |
| 7th-8th | **NIO:** Workshop on "Science-Policy Interactions on the River Basins and Coastal Zone Management" organised. |
| 8th -10th | **NML**: International seminar on "Mineral Processing Technologies" – MPT 2006 organised jointly with M/s Tata Steel. |
| 27th | **RRL-Jammu:** RRL, Jammu in collaboration with DST, New Delhi organised Regional workshop on "Technology Development, Transfer and Utilization" at Srinagar |
| 29th | **CDRI:** Symposium on "Current trends in management of cerebral stroke" organised |
| 31st | **CGCRI:** Visit of Shri Kapil Sibal, Hon'ble Minister for Science and Technology & Ocean Development and Vice President , CSIR Society |

# CSIR ESTABLISHMENTS

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| **CBRI** | Central Building Research Institute, Roorkee -247 667 |
| **CCMB** | Centre for Cellular and Molecular Biology, Hyderabad-500 007 |
| **CDRI** | Central Drug Research Institute, Lucknow -226 001, cdriindia.org |
| **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-570 020 |
| **CGCRI** | Central Glass and Ceramic Research Institute, Kolkata -700 032 |
| **CIMAP** | Central Institute of Medicinal & Aromatic Plants, Lucknow -226 015 |
| **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 -160 030, |
| **CSMCRI** | Central Salt & Marine Chemicals Research Institute, Bhavnagar -364 002, |
| **IGIB** | Institute of Genomics & Integrative Biology, Delhi -110 007 |
| **IHBT** | Institute of Himalayan Bioresource Technology, Palampur -176 061 (HP), |
| **IICB** | Indian Institute of Chemical Biology Jadavpur, 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 |
| **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 |
| **NISCAIR** | National Institute of Science Communication And Information Resources , New Delhi-110012 |
| **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-JAM** | Regional Research Laboratory, Jammu Tawi -180 001 |
| **RRL-JOR** | Regional Research Laboratory, Jorhat -785 006 |
| **RRL-TRI** | Regional Research Laboratory, Thiruvananthapuram -695 019 |
| **SERC** | Structural Engineering Research Centre, Chennai -600 113 |

# ANNEXURES

# OVERVIEW

# S&T CONTRIBUTIONS

# CENTRAL MANAGEMENT ACTIVITIES

# HEADQUARTERS ACTIVITIES

# DATELINE CSIR

## ANNEXURE-I

### INTELLECTUAL PROPERTY FROM CSIR DURING 2005-06

| | Patents | | | |
|---|---|---|---|---|
| | India | | Foreign | |
| **Lab** | **Filed** | **Granted** | **Filed** | **Granted** |
| CCMB | 2 | 1 | 3 | 2 |
| CDRI | 20 | 11 | 9 | 8 |
| CECRI | 5 | 7 | 2 | 2 |
| CEERI | 1 | 1 | 0 | 0 |
| CFRI | 0 | 3 | 43 | 5 |
| CFTRI | 52 | 47 | 54 | 10 |
| CGCRI | 9 | 10 | 9 | 4 |
| CIMAP | 12 | 16 | 39 | 10 |
| CLRI | 14 | 8 | 21 | 2 |
| CMERI | 9 | 0 | 0 | 0 |
| CMRI | 14 | 7 | 0 | 0 |
| CSIO | 5 | 0 | 13 | 5 |
| CSIR(SCH) | 4 | 6 | 9 | 7 |
| CSMCRI | 14 | 3 | 68 | 9 |
| IGIB | 11 | 3 | 30 | 10 |
| IHBT | 11 | 0 | 12 | 8 |
| IICB | 8 | 1 | 5 | 6 |
| IICT | 29 | 31 | 78 | 31 |
| IIP | 15 | 4 | 22 | 0 |
| IMT | 4 | 2 | 5 | 0 |
| ITRC | 1 | 0 | 0 | 0 |
| NAL | 5 | 1 | 2 | 0 |
| NBRI | 10 | 2 | 16 | 5 |
| NCL | 38 | 59 | 49 | 26 |
| NEERI | 17 | 0 | 0 | 1 |
| NGRI | 6 | 0 | 1 | 1 |
| NIMITLI | 3 | 0 | 0 | 0 |
| NIO | 6 | 2 | 20 | 7 |
| NML | 15 | 3 | 5 | 1 |
| NPL | 4 | 8 | 16 | 4 |
| RRL(BHU) | 19 | 5 | 3 | 1 |
| RRL(BP) | 8 | 3 | 0 | 0 |
| RRL(J) | 7 | 14 | 25 | 8 |
| RRL(JT) | 13 | 12 | 0 | 1 |
| RRL(T) | 16 | 6 | 11 | 5 |
| **TOTAL** | **407** | **276** | **570** | **179** |

| COPYRIGHTS APPLICATIONS FILED DURING 2005-2006 | |
|---|---|
| CIMAP | 1 |
| CLRI | 2 |
| CMERI | 5 |
| CMRI | 2 |
| IGIB | 6 |
| IMT | 2 |
| NAL | 1 |
| NML | 2 |
| NPL | 1 |
| **TOTAL** | **22** |

| TRADEMARKS APPLICATIONS FILED DURING 2005-2006 | |
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| IHBT | 1 |
| URDIP | 2 |
| IGIB | 1 |
| **TOTAL** | **4** |

## ANNEXURE-IA

## FOREIGN PATENTS GRANTED TO CSIR DURING 2005-06

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| **CCMB** | | |
| Preparation, characterization, esr and pas studies of CU0.5NBALP3O12 (CNP) and HNBALP3O12 (HNP) | M. Vithal, B. Srinivasulu, K. K. Rao, C. M. Rao | US 6942843 |
| Chimeric protein a BNAC crystallin with extraordinarily high chaperone-like activity and a method related to the use thereof | L. V. S.Kumar, C. M. Rao | US 6958224 |
| **CDRI** | | |
| Method of treating hyperlipidemic and hyperglycemic conditions in mammals using pregnadienols and pregnadienones | R. Pratap, R. C. Gupta, R. Chander, S. K. Khanna | US 6875758 |
| Method of treating a cognitive memory dysfunction using gugulipid | R. Pratap. R. Pal, S. Singh, G. Shankar, C. Nath, H. K. Singh, D. Raina, A. K. Srivastava | US 6896901 |
| N-aryloxypropanolyl-n'-phenethyl-urea | K. Bhandari, S. Srivastava, C. Nath | US 6962945 |
| Herbal medicaments for treatment of neurocerebrovascular disorders | M. Ray, R. Pal, S. Singh, N.M. Khanna | LT 5284 |
| Herbal medicaments for treatment of neurocerebrovascular disorders | M. Ray, R. Pal, S. Singh, N.M. Khanna | ZA 2004/4648 |
| Herbal medicaments for the treatment of neurocerebrovascular disorders | M. Ray, R. Pal, S. Singh, N. M. Khanna | US 6991814 |
| **CDRI+CIMAP** | | |
| Formulation of dihydroartemisinin for the control of wide spectrum of malaria | D.C. Jain, R.S. Bhakuni, R.R. Sharma, S. Kumar, G.P. Dutta | CN CN1197568 C |
| Formulation of dihydroartemisinin for the control of wide spectrum of malaria | D.C. Jain, R.S. Bhakuni, R.R. Sharma, S. Kumar, G.P. Dutta | JP 3686281 |
| **CECRI** | | |
| Solid state thermal synthesis of lithium cobaltate | C.R.M. Ariyanan, V.Thiagarajan, G. Ramaiyer | GB GB2390087 |
| Combustion process for the preparation of licovo4 | C. Srinivasan, K. Palanichamy, M. Thyagarajan | GB GB2390088 |
| **CFRI** | | |
| Process for the production of low ash fuel | P. N. Sinha, P. Sengupta, K. S. Bhattacharya | GB GB2377225 |
| Device for feeding pulverized coal to furnace | A. Mukherjee, S. Biswas, M. Kumar, S.G. Sahu, N.Choudhury, A. Choudhury, K. Sen | US 6928936 |
| Detergent-free scouring composition | R. Sen, U. Bhattacharjee, D.P. Choudhury, L. N. Nandi, S. Maitra | US 6969699 |
| A process for the production of plant growth stimulator from fly ash | S.R. Rao, S.K. Ghosh, G Singh, S.K. Hazra | NI 16270 |
| Process for the production of fly ash slurry | S.K. Rao, S.K. Ghosh, S.K. Basu, B.K. Mall, S.K. Verma, G. Singh, S. Mazumdar | KR 548738 |

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| **CFTRI** | | |
| Pharmaceutical composition for diabetic nephropathy | P. V. Salimath, S.Kari, C. D. Nandini | US 6884421 |
| Fermentation process for production of xylitol from pichia sp | A. E. Raj, M. K. Gowthaman, N..P. Ghildyal, M. C. Mishra, N.G. Karanth | US 6893849 |
| An improved process for the production of oryzanol enriched fraction from rice brain oil soapstock | T.N. Indira, A.V. Narayan, R.S. Baharte, K.S.M.S. Raghavarao, Sakina Khatoon, C. Gopal, A.G. Appu Rao and V. Prakash | US 6896911 |
| An improved process for the preparation of protein hydrolysate from legumes | V. Prakash, B. Swamylingappa, M.C.S. Sastry, K.S. Murthy, T.C. Sindhu Kanya and J Joseph | US 6896917 |
| An improved process for the preparation of soy protein concentrate with improved functional properties | B. Swamylingappa, A.G. Appu Rao and V. Prakash | SG 106843 |
| An improved process for the preparation of protein hydrolysate from legumes | V.Prakash, B. Swamylingappa, M.C.S Sastry, K.S. Murthy, T.C. Sindhu Kanya and Joseph | SG 99520 |
| One step process for preparing antibacterial and antioxidant fraction from seabuckthorn parts | A.S. Chauhan, P.S. Negi, R.S. Ramteke | US 6946154 |
| Process for preparation of protein-hydrolysate from milk protein | B. Swamylingappa, J. Joseph, K.S. Murthy, V. Prakash, C. Radha, M.C.S. Sastry and T.C. Sindhu Kanya | CN 233808 |
| An improved process for the preparation of protein hydrolysate from legumes | V.Prakash, B. Swamylingappa, M.C.S. Sastry, K.S. Murthy, T.C. Sindhu Kanya and J. Joseph | CN 1234288C |
| Shortening based emulsifying formulation for the preparation of cakes and its method | J. Rajiv, P. Prabhasankar, D. Indrani | SG 95536 |
| **CGCRI** | | |
| A process of making rare earth doped optical fibre | R. Sen, M. Chatterjee, M. K. Naskar, M.Pal, M. C. Paul, S. K. Bhadra, K. Da | US 6889528 |
| Process for making rare earth doped optical fiber | T. Bandyopadhyay, R. Sen, S.K .Bhadra, K. Dasgupta, M.C. Paul | GB GB 2388367 |
| A process of making rare earth doped optical fibre | R. Sen, Miss M. Chatterjee, Y.K Naskar, M.Pal, M. C. Paul, S.K.Bhadra, K. Da | EP 1441991 |
| A process for making porous ceramics for pressure filteration | S.N. Roy, S. Bandyopadhyay, B.P. Ghosh, H.S. Maiti | US 7014771 |
| **CIMAP** | | |
| Process for isolation of hepatoprotective agent “oleanolic acid” from lantana camera | S. K. Srivastava, M. Khan, S. P. S. Khanuja | US 6884908 |
| Protein profiling of hyper acidic plants and high protein extraction compositions thereof | R. S. Sangwan, N. S. Sangwan, B. R.Tyagi, A. K. Srivastava, U. Yadav | US 6893667 |

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| Process for isolation of anticancer agent camptothecin from Nothapodytes foetida | S. K. Srivastava, M. Khan, S. P. S. Khanuja | US 6893668 |
| Pharmaceutical composition containing cow urine distillate and an antibiotic | S.P. S. Khanuja, S.Kumar, A.K. Shasany, J. S. Arya, M. P. Darokar, M. Singh, P. Sinha, S. Awasthi, S. C. Gupta, V.K. Gupta, M. M. Gupta,R. Verma, S Aggarwal, S.B. Mansing | US 6896907 |
| Formulation useful as a nitrification and urease inhibitor and a method of producing the same | D. D. Patra, U. Kiran, M. Anwar, K. Chand, S. Kumar | AU 779660 |
| Anti-microbial composition and method for producing the same | S.P. S. Khanuja, S. Srivastava,T. S. Kumar, A. K. Shasany, A.C. Jain, M. Darokar, D. Saikia,S. Kumar | CN 217251 |
| Mosquito repellent composition and process for preparation of the same | D. Kumar, Y. N. Shukla, S. Tiwari, R. P. Bansal, S. Kumar | SL 12380 |
| Composition comprising pharmaceutical/nutraceutical agent and a bio-enhancer obtained from Glycyrrhiza glabra | S.P. S. Khanuja, S. Kumar, J.S.Arya, A. K. Shasany, M. Singh, S. Awasthi, S. C. Gupta, M. P.A. Darokar | US 6979471 |
| Pharmaceutical composition containing cow urine distillate and an antibiotic | S.P. S. Khanuja, S. Kumar, A. K. Shasany, J. S. Arya, M. P. Darokar, M. Singh, P. Sinha, S. Awasthi, S. C. Gupta, V. K. Gupta, M. M. Gupta, R. Verma, S. Agarwal, S.B. Mansing | CN 242766 |
| Use of phyllocladane diterpenoids for plant growth promotion and alleviation of growth retardant allelochemicals | A.K. Singh, G.D. Bagchi, S. Singh, P.D. Dwivedi, A.K. Gupta, S.P.S Khanuja | GB GB2411651 |
| **CLRI** | | |
| Device for leather processing | D. Lakshmanan, B. Thangaraj, S. Rishnan, N. Samivelu, P.G. Rao, T. Ramasami | US 6935144 |
| Dehairing and fiber opening process for complete elimination of lime and sodium sulfide | S. Saravanabhavan, P. Thanikaivelan, J. R. Rao, B. U. Nair, T. Ramasami | US 6957554 |
| **CSIO** | | |
| A ceramic mixture having negative temperature coefficient, a thermistor containing the ceramic mixture and the process for preparing thereof | M. L. Singla, B. Raj, V. R. Harchekar, R. P. Bajpai | US 6878311 |
| Fiber optic temperature switching immersion probe | N. Singh, S.C. Jain, A.K. Aggarwal | SG 106860 |
| Opto-electronic device for angle generation of ultrasonic probe | S. S. Ahluwalia | US 6946648 |
| Device useful for signal transfer from static surface to rotating surface and viceversa | S.S. Ahulwalia, S. Verma, S. R.Taneja | US 6950003 |
| Cu-Zn-Al (6%) shape memory alloy with low martensitic temperature and a process for its manufacture | V. R. Harchekar, M. Singla | US 6977017 |
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| **CSIR(SCH)** | | |
| Solid state thermal synthesis of lithium hexafluorophosphate | A. Subramanian, T. Vasudevan, R. Gangadharan | FR 2852945 |
| Process for the isolation of a major harmful oxidant from cigarette smoke | I.B. Chatterjee | US 6929012 |
| A process for the preparation of novel pharmacutical composition useful for extended release of drug | S. Garg; R.K. Verma; C.L. Kaul; | EP EP1469824B1 |
| Process for preparing cathode material for lithium batteries | C. Ramasamy, V. Thiagarajan, M. Ariyanan, G. Ramaiyer | US 6953566 |
| Preparation of lithium hexafluoro arsenate (liasf6) electrolyte by a novel method for lithium cells | A. Subramanian, T. Vasudevan, R. Gangadharan | EP 1487745 |
| Process for preparing quaternary ammonium tribromides | M.K. Chaudhuri, U. Bora, S.K. Dehury, D. Dey, S.S. Dhar, W. Kharmawphlang, B.M. Choudary, M.L. Kantam | US 7005548 |
| An anti-arrhythmic pharamaceutical composition and a process thereof | A. Gomes, A. Saha, A.K . Biswas, S.C. Dasgupta | US 7018659 |
| **CSMCRI** | | |
| Process for the preparation of a molecular sieve absorbent for the size/shape selective separation of air | R.V. Jasra, C.D. Chudasama, J. Sebastian | US 6878657 |
| Process for recovery of low sodium salt from bittern | R. N. Vohra, P. K. Ghosh, M. R. Gandhi, H. L. Joshi, H. H. Deriya, R. H. Dave, K. Halder | US 6890509 |
| Integrated method for production of carrageenan and liquid fertilizer from fresh seaweeds | K. Eswaran, P. K. Ghosh, A. K. Siddhanta, J. S. Patolia, C. Periyasamy, A. S. Mehta, K. Mody | US 6893479 |
| Preparation of nutrient salt of plant origin | P. K. Ghosh, M.P. Reddy, J.B. Pandya, J. Shambhubhai, S.M. Vaghela, M.R. Gandhi, R.J. Sanghvi, V.G.S. Kumar, M.T. Shan | US 6929809 |
| Preparation of nutrient rich salt of plant origin | P. K. Ghosh, M.P. Reddy, J.B. Pandya, J. Shambhubhai, S.M. Vaghela, M.R. Gandhi, R.J. Sanghvi, V.G.S. Kumar, M.T. Shan | AU 2002244907 |
| Process for the preparation of a molecular sieve adsorbent for selective adsorption of nitrogen and argon | J. Sebastian, R.V. Jasra | GB 2386889 |
| Preparation of nutrient rich salt of plant origin | P. K. Ghosh, M.P. Reddy, J.B. Pandya, J. Shambhubhai, S.M. Vaghela, M.R. Gandhi, R.J. Sanghvi, V.G.S. Kumar, M.T. Shan | IL 154973 |
| Improved process for simultaneous recovery of industrial grade pottasium chloride and edible salt enriched with KCl (low sodium salt) from bittern | R. N. Vohra, P. K. Ghosh, A. B. Kasundra, H. L. Joshi, R. Harshadr | US 7014832 |
| A process for the eco-friendly synthesis of bromobenzene | A. V. Bedekar; P. K. Ghosh; S.Adimurthy; G. Ramachandraiah | US 6,956,142 |
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| **IGIB** | | |
| Biological process for color reduction of pulp and paper effluent | R. Kumar, A. Kumar, D. Kachroo, K. Tiku | US 6896806 |
| Polypeptides useful for diagnosis of aspergillus fumigatus and a process of preparing the same | P. U. Sarma, T. Madan, P. Priyadarsiny, S. B. Katti, W. Haq | US 6902901 |
| Aerobic method of removing total dissolved solids (tds) from tannery wastewaters | R. Kumar, P. Ebase, D. Kachroo Tiku | US 6905863 |
| A computer based method for identifying conserved invariant peptide motifs | S. K. Brahmachari, E. Dash | CN 218305 |
| A rapid method for estimation of chemical oxygen demand(cod) | V.C. Kalia, V. Sonakya, N. Raizada, A.P. Joshi | GB 2373855 |
| Rapid method for enzyme-linked immunosorbent assay | P. Nahar,U. Bora, G. Lal Sharma | AU 2001218830 |
| Rapid method for estimation of chemical oxygen demand | V. C. Kalia, V. Sonakya, N. Raizada, A. P. Joshi | US 6967104 |
| Rapid method for enzyme-linked immunosorbent assay | P. Nahar, U. Bora, G.L. Sharma | EP 1309864 |
| A neural plasticity insect model | A. Sharma | US 7005297 |
| A novel process for biobleaching of kraft pulp using defined bacterial consortia | R. Kumar, A. Kumar | US 7018510 |
| **IHBT** | | |
| Method for producing chiral dihydrotagetone, and its conversion to chiral 5-isobutyl-3-methyl-4,5-dihydro-2(3h)-furanone | A.K. Sinha, B.P. Joshi, R. Dogra | FR 2822829 |
| Method for microproduction of tea plants from leaf explants | I. Sandal, A. Battacharya, M.Sharma, P. S. Ahuja | CN ZL 01109920.8 |
| Simple portable mini distillation apparatus for the production of essential oils and hydrosols | G. D. K. Babu, P. S. Ahuja, V. Kumar Kaul, V. Singh | US 6911119 |
| Species specific dna sequences and their utilization in identification of viola species and authentication of "banafsha" by polymerase chain reaction | M.Singh, C. Sharma, B. Lal | US 6924127 |
| Sterile laminar airflow device | R. Thakur, A. Sood, P. S. Ahuja | AU 782243 |
| Ddq mediated one step dimerization of ß-asarone or ß-asarone rich acorus calamus oil in the formation of novel neolignan | A. K. Sinha, B P. Joshi, R. Acharya | US 6969778 |
| Essential oil from cold desert plant for high value perfumery compounds | V. K. Kaul, U. Mahmood, P. S. Ahuja, B. Lal, H. R. Negi, V. Singh | ZA 2004/7701 |
| Microwave induced process for the preparation of substituted 4-vinylphenols | A. K. Sinha, B. P. Joshi, A. Sharma | US 6989467 |
| **IICB** | | |
| A process for the isolation of active principle from azadirachta indica useful for controlling gastric hyperacidity and gastric ulceration | U. Bandyopadhyay, R. Chatterjee, R. K. Bandyopadhyay | EP EP0787495 B1 |
| A herbal molecule as potential anti-leukemic drug | S. Bandyopadhyay, B. C. Pal, S. Battacharya | EP 1511475 |

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| Herbal-based composition for treating acute and chronic myeloid leukemia | S. Bandyopadhyay, K. C. Roy, M.Ray, G. Banerjee, B. C. Pal, T. Biswas, S. Bhattcharya | US 6967034 |
| Two gonadotropin releasing hormones and a method to isolate the same | A. Chatterjee, P. Ray, S. Dasgupta, S. Hattacharya, S. Pasha | US 6977242 |
| A process for the preparation of an extract from human placenta containing glycosphingolipids and endothelin-like constituent peptides useful for the treatment of vitiligo | R. Bhadra, P. Pal, R. Roy, A.K . Ata, | EP 839535 |
| **IICB+DST** | | |
| Method for enhancing cellobiase activity of termitomyces clypeatus using a glycosylation inhibitor | S. Khowala, S. Mukherjee | US 6946277 |
| **IICT** | | |
| Process for preparing diltiazem using a heterogeneous trifuntional catalyst | B. M. Choudary, N.S. Chowdari, S. Madhi, M.L. Kantam | US 6881839 |
| Non-cross linking pyrrolo (2,1-c[1,4] benzodia zepines process thereof | K. Ahmed, R. Gujjar, S. Olepu, R. Poddutoori | US 6884799 |
| Substituted Calix (4) pyrroles and process for the synthesis of Calix (4) pyrroles over molecular sieve catalysts | K. V. Raghavan, S. J. Kulkarni, M.i R. Kishan, N. Srinivas | GB GB 2383037 |
| Process for preparing 2,6-divinylpyridine and 2-methyl-6-vinylpyridine from 2,6-lutidine over modified zeolites | S. J. Kulkarni, M. Gangapuram, V. R. Kondapuram | US 6897320 |
| Process for the preparation of a polyaniline salt | P. Srinivasan | GB GB2379935 |
| A novel method for chromatographic finger printing and standardization of single medicines and formulations | V. K.Dadala, K. V. Raghavan | NZ 525007 |
| Process for the synthesis of n-substituted ß-amino nitriles through the ring opening of aziridines | B. M. Choudary, J. Kulandaivelu, P. R. Likhar, L. K. Mannepalli, S. Bojja, B. Kotamarthi | US 6906216 |
| Process for the preparation of a polyaniline salt | P. Srinivasan | CN 217275 |
| Process for the production of benzaldehyde by the catalytic liquid phase air oxidation of toluene | M. L. Kantam, B. M. Choudary, P. Sreekanth, K. Rao, K . Naik,T. P. Kumar, A. A. Khan | EP EP1088810 |
| An improved process for the preparation of ethyl 2,3-dihydrobenzo [1,4] dioxin –2-carboxylate | M. Pardhasaradhi, G. Kumaraswamy, A.K. Das, N. Jena, C.K.S. Nair | GB GB2399569 |
| Process for production of alkanesulfonic acid | B. M. Choudary, K. K. Rao, M. Koosam | US 6927305 |
| Process for synthesis of a porphyrin compound using a molecular sieve catalyst under microwave irradiation | S.K. Kulkarni, K.V. Raghavan, V.R.Kishan, N. Srinivas | EP 1373274 |
| New 4 beta –"-[2'-substituted benzoyl) anilino] podophyllotoxin analogues useful as anticancer agent | A. Kamal, Reddy PSMM Murali | GB 1377588 |
| Process for the synthesis of 2-deoxy-d-glucose | H. B. Mereyala, M. S. Kumar | US 6933382 |
| Process for the preparation of a polyaniline salt | S. Palaniappan | DE 10194816 |

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| Process for the preparation of polyaniline salt | S. Palaniappan, C. A. Amarnath | US 6942822 |
| A process for the preparation of inclusion complexes of rifampicin, an anti-tubercular drug,, with ß-cyclodextrin and 2-hydroxy propyl-ß – cyclodextrin | K.R. Rao, N. Bhanumathi, J.S. Yadav, N.S. Krishnaveni | CN ZL00812730.1 |
| Process for the isolation of glycolipids | S. R. Vali, P. P. Chakrabarti, N. B. K. Thengumpillil | US 6953849 |
| Process for the preparation of 2-nitrothiophene selectively from thiophene using metal exchanged clay catalysts | B.M. Choudary, M.L. Kantam, K.V. Ramprasad, K.V. S. Ranganath | EP 1346991 |
| Process for the preparation of a collidine and 2,3,5,6-tetramethyl pyridine | S J. Kulkarni, K V. Raghavan, S. Nagabandi, R.R. Vippagunta | CN ZL01816636.9 |
| Process for the preparation of nitrotoluenes | B.M. Choudary, M.L. Kantam, K.V. Ramprasad | EP EP1350787 |
| Process for the synthesis of highly active modified carbon supported palladium catalyst | J. K. Murthy, S. C. Shekar, K. S. Ramarao, B. D. Raju, K. V. Raghavan | US 6963016 |
| Pyrrolo[2,1-c][1,4]benzodiazepine-napthalimide conjugates linked through piperazine moiety and process for preparation thereof | A. Kamal, R. Rondla, G. Bhasker, R. Khanna, | US 6979684 |
| A process for the preparation of 1, 1, 1, 2-tetrafluoroethane | J. M. Rao, P. S. Rao, A. S. Prasad, N. Banda, K. Radhakrishnan, V. Vijayakumar | CN ZL00819402.5 |
| Process for preparation of cinnamates using polyaniline salts as catalysts | S. Palaniappan, M. Sairam | US 6982345 |
| Therapeutic/edible compositions comprising herbal ingredients and methods for treating hyperglycemia | A. S. Chauhan, K. B. Chalasani, S. Surapanini, S. K. Yandrapu, R. Kataram, G. M. Chary | US 6989160 |
| Compound iso-squamocin obtained from seeds of annona squamosa and composition containing the same | A. V. B. Shankaram, M. M. Murthy, D. M. Akkewar, M. Subramanyam, A. N. Rao | US 6991818 |
| A process for the preparation of inclusion and anti-tubercular drug, with beta – cyclodextrin or 2-hydroxypropyl betea-cyclodextrin and a process thereof | K. Ramarao, N. Bhanumathi, J.S. Yadav, N.S. L. Krishnaveni | US 7001893 |
| Novel non-natural c-linked carbo-ß-peptides with robust secondary structures | G.V.M. Harma, K.R. Reddy, A.C. Kunwar, A.R. Sankar, B. Jagannadh, P. Jayaprakash | US 7001982 |
| New pyrrolo (2,1-c) (1,4) benzodiazepines useful as antitumour agents | K. Ahmed, P. S. M.M. Reddy, D. R. Reddy | US 7015215 |
| A catalytic process for simultaneous furfural hydrogenation- cyclohexanol dehydrogenation in vapor phase | K.S.R. Rao; D.R. Burri; N. Sankarasubbier; M.N. Nagaraja, H.P. Aytam; S.V.Vasireddy; P. Shashikala, R. Seetharamulu, S.R.Reddy. | US 7015359 |
| **NBRI** | | |
| Custom made herbal health promotive formulation for females/expectant mothers | P. Pushpangadan, D.Prakash | US 6881425 |
| A process for preparation of herbal colours useful for cosmaceutical applications | P. Pushpangadan; S. Mehrotra; A. K. S. Rawat; K. Sayyada; G. Raghavan | FR 2822678 |

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| Fermented herbal health drink from plant andrographis | P. Pushpangadan, S. Mehrotra, A. K. S. Rawat, S. Khatoon, S.K. Srivastava, S. Rastogi, M. Chaubay, A. Agnihotri | AU 2002228290 |
| Synergistic composition for treating hyperilipdemia | P. Pushpangadan, S. Mehrotra, C. V. Rao, S. K. Ojha, G. Raghavan, G.M. M. Rao | US 6989165 |
| Herbal health protective and promotive nutraceuticals for diabetics | P. Pushpangadan, D. Prakash | US 7014872 |
| **NCL** | | |
| Process for the preparation of 1-[cyano(aryl)methyl] cyclohexanol | S.P. Chavan, S.K. Kamat, L. Sivadasan, K. Balakrishnan, D.A. Khobragade, T. Ravindranathan, M.K. Gurjar, U.R. Kalkote | EP 1238967 |
| Method for gas—solid contacting in a bubbling fluidized bed reactor | V. R. Choudhary, T. V.Choudhary | US 6894183 |
| Process for the preparation of arylamines | A. A. Kelkar, N. M. Patil, R. V. Chaudhari | US 6894191 |
| Process for preparation of conducting polyaniline | R. Subramaniam, S. D. Deshpande | US 6900286 |
| Process for the preparation of a polyesteramide | A. A. Kelkar, S. M. Kulkarni, R. V. Chaudhari | EP 1229065 |
| One pot method for preparation of 1-[2-dimethylamino -(4-methoxyphenyl) - ethyl] cyclohexanol | S.P. Chavan, S.K. Kamat, L. Sivadasan, K. Balakrishnan, D. R. T. Khobragade, M.K. Gurjar, U.R. Kalkote | EP 1238965 |
| Diol-functionalized antioxidant and process for preparation thereof | S. S. Solanky, S. M. Desai, R. P. Singh | US 6916960 |
| An improved process for the preparation of alkyl/aryl chloroformates | A.R. A. S. Deshmukh, V. K. Gumaste | US 6919471 |
| Process for the preparation of diemethyl cumenes | C. R. Patra, R. Kumar | US 6921843 |
| Process for preparation of cyclic carbonate | M. Palanichamy, S. Meenakshisundaram | US 6924379 |
| A novel catalytic formulation and its preparation | R. V.Chaudhari, A. N. Mahajan | EP GB2389324 |
| Process for epoxidation of a liquid olefinic organic compound using a supported nano-gold catalyst | V. R. Choudhary, N. S. Patil, B. S. Uphade, P. Jana | US 6933397 |
| Tinuvin p-hindred amine light stabilizer and derivatives thereof | S. A. M. Desai, R. P. Singh | US 6936717 |
| Process for the preparation of aqueous urethane dispersions | L. S. Ramanathan, K. G. Raut, S. R. Srinivasan, S. Sivaram | EP 982331 |
| Process for the preparation of adipic acid | D. Srinivas, S.A. Chavan, P. Ratnasamy | EP 1325901 |
| Oligomers containing n-acetyl glucosamine (nag) | M. G. Kulkarni, J. J. Khandare | US 6977285 |
| Catalytic process for the production of 3,3', 4,4'-tetraminobiphenyl | S. Bavikar, A. Maner, R. Kumar, S.Arumugam, S. Swaminathan | US 6979749 |
| Process for preparation of 2-phenyl ethanol | C. V. Rode, V. S. Kshirsagar, V. H. Rane, R. V. Chaudhari | US 6979753 |
| Process for preparing conducting or semi-conducting polymer with high piezo-sensitivity | R. Subramaniam, S. B. Kar | US 6984348 |

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| Acylation of aromatic compounds | V. R. Choudhary, R. Jha | US 6984760 |
| S-(-)-1-{4-[2-(allyloxy)-ethyl]phenoxy}-3-isopropylamino propan-2-ol, process for preparation thereof and process for preparation of s-(-)betaxolo | R. A. Joshi, M. Murugan, D. R. Garud, S. P. Borikar, M. K. Gurjar | US 6989465 |
| Process for preparing microporous crystalline titanium silicate | M. K. Dongare, P. T. Patil, K. M Malshe | US 6991678 |
| An process for preparation of semi-conducting polymer film containing beta crystalline phase of polyvinylidene fluoride | R. Subramaniam, S. Bikas Kar | US 6991759 |
| A polymer composition for the selective removal of cobalt, a process for the preparation thereof and the process for removal of cobalt | M. G. Kulkarni, R. N. Karmalkar | US 7001963 |
| An imprpved process for prepration of s-(-)-betaxolol hydrochloride | R. A. Joshi, M. M. Krishnan, D. R. Garud, S. P. Borikar, M.K. Gurjar | US 7019172 |
| **NCL+NIO** | | |
| Process for the treatment of industrial effluents using marine algae to produce potable wafer | P. P. Moghe, I. V. Panchanadikar, A. G. Untawale, V. K. Dhargalkar | US 6929942 |
| **NEERI** | | |
| Preparation of essential oil compositions for portable liquid disinfection | H.J. Purohit, M. Kulkarni | US 6929810 |
| **NGRI** | | |
| Smooth contouring software for generating geophysical data having less artifacts | R. Khanna, N. K. Thakur | US 6937960 |
| **NIO** | | |
| Pharmaceutical composition useful for inhibition of osteoclast formation and a process for the extraction of mussel hudrolysate from Indian green mussel | M. R. Wani, P. B. Parab, A.Chatterji | US 6905710 |
| Pressure housing for in-water pressure based systems | E. Desa, G. P. Naik, A. Joseph, E.A. Desa, P. Mehra, V. Kumar, S. P. Desai, S. A. Nagvekar | KR 501033 |
| Natural nontoxic multicolor fluorescent protein dye from a marine invertebrate, compositions containing the said dye and its uses | U. Goswami, A. Ganguly | US 6916492 |
| Pressure housing for in-water pressure based systems | E. Desa, G. P. Naik, A. Joseph, E.A. Desa, P. Mehra, V. Kumar, S. P. Desai, S.A. Nagvekar | AU 2002242937 |
| Simultaneous decolorization and detoxification of molasses spent wash using novel white rot-lignin-modifying fungus flavodon flavus | C. Raghukumar, M.S. Shailaja | US 6953685 |
| Multiple fluorescent natural dye compound from a marine organism | U. Goswami, A. Ganguly | US 6956122 |
| A novel compound and multiple fluorescent natural dye from a marine organism | G. Usha, G. Anutosh | US 7012093 |
| **NML** | | |
| Process for the production of zirconium boride powder | S. K. Mishra, S. Das, R. P. Goel, P. R. Rao | US 6908599 |

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| **NPL** | | |
| A sensitive, fast responsive thin film ethanol sensor and a process for the preparation of a sensitive, fast response thin film ethanol sensor and a process for the preparation of a precursor solution for ethanol sensor | A.K. Rastogi, K. Jain, H.P. Gupta, V. Kumar | US 6881582 |
| Simulated circuit layout for low voltage, low paper and high performance type II current conveyor | S. S. Rajput, S. S. Jamuar | US 6931605 |
| Method for determining the reflectance profile of materials | R. Nagarajan, S. P. Varma, D. Gupta | US 6963403 |
| Reusable heat pack, method of manufacture thereof, mixture for use in a reusable heatpack and process for the preparation thereof | C.P. Harma, R.K. Harma, C. Kant, A.K. Sarkar | RO 119342 B1 |
| **RRL(BHU)** | | |
| Process for cold briquetting and pelletization of ferrous or non-ferrous ores or mineral fines by iron bearing hydraulic mineral binder | Nayak; B. Mishra; N.Vibhuki. | US 6921427 |
| **RRL(J)** | | |
| Methods and compositions for in vitro germination and propagation of Polygonatum cirrhifolium royle | G. N. Qazi, S. K. Lattoo, A. K. Dhar, P. Purohit, R. K. Raina, R. S. Dhar | US 6905876 |
| Composition useful as hepatoprotectants comprising extract of plant Cryptolepis buchanani and a method thereof | G. N. Qazi, B.S. Jaggi, B.K. Chandan, K. A. Suri, N. K.Satti, R. Maurya, L. R. Manhas, A. Kumar | US 6913772 |
| Synergistic formulations of culture media for the in vitro release of epicotyl dormancy in Polygonatum cirrhifolium Royle | G. N. Qazi, S. K. Lattoo, A.Krishan Dhar, P. Purohit, R. K. Raina | ZA 2004/3703 |
| Synergistic composition of trans-tetracos-15-enoic acid and apocynin and method of treatment for hepatotoxicity | S. S. Handa, O. P. Suri, V. N. Gupta, K. A. Suri, N. K. Satti, V. Bhardwaj, B. Singh, B.K. Chandan | US 6949586 |
| Hepatoprotective activity of 2-p-hydroxybenzoylmussaenosidic acid | A.Prabhakar, B. D. Gupta, K. A. Suri, N. K. Satti, S. Malhotra, K. K. Gupta,V. K. Sharma, R. K. Johri, B. S. Jaggi, B. Chandan, S. La, K. L. Bedi, O. P. Suri, G. N. Qazi | ZA 2004/9049 |
| Process for isolation of eupalitin from Boerhavia diffusa | D. Mundkinajeddu, L. R. Manahas, R. Maurya, S. S. Handa | US 6977294 |
| Hepatoprotective agent of plant origin and a process thereof | G. N. Qazi, O. P. Suri, K. L. Bedi, K. A.Suri, B. D. Gupta, B. S. Jaggi, B. K. Kapahi, N. K. Satti | US 6989162 |
| Hepatocurative effect of Emblica officinalis against cyp 450 bioactivation heapato-toxicity of drugs | R.K. Johri, S.T. Abdullah, K. Singh, D. Gupta, B. Kapahi, D.M. Mondhe, S.M. Jain, O.P. Suri, K.L.Bedi, G.N. Qazi | US 7001619 |
| **RRL (Jorhat)** | | |
| 2-methylheptylisonicotinate and process for production thereof | G. N. Bordoloi, B. Kumari, N. Bordoloi, M. K. Roy, T. C. Bora | US 6998411 |
| **RRL(T)** | | |
| Liquid crystalline polymer films of polymers having azobenzene mesogenic groups in cross linked network structures, process for the preparation thereof, polymers and novel monomers having azobenzene mesogens | M. Saminathan, C. K.S. Pillai | US 6887632 |

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| Squarine based dyes modified with bromine, iodine and acridine, their preparation and use as sensitizers for photodynamic theraputical and industrial application. | R. Danaboyina, A. K. Thazhathveetil, S. Das | GB GB2370581 |
| Non-visualized permanent information recording substrate for use as a security label for authentication | S. Das, R. Davis | US 6951692 |
| Synthesis of ion imprinted polymer particles | K. Ramakrishnan, M. G. Joseph, T. P. Rao | US 6960645 |
| Viologen linked acridine based molecule and process for the preparation thereof | D. Ramaiah, N.V. Eldho, J. Joseph | GB GB2378440B |

# ANNEXURE-II

## TOP PAPERS PUBLISHED BY CSIR DURING 2005

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| 1. | RECONSTRUCTING THE ORIGIN OF ANDAMAN ISLANDERS : Thangaraj-K Chaubey-G Kivisild-T Reddy-AG Singh-VK Rasalkar-AA Singh-L | SCIENCE 2005, Vol 308, Iss 5724, pp 996-996 | 31.853 | CCMB |
| 2. | TRACING MODERN HUMAN ORIGINS - RESPONSE Thangaraj-K Chaubey-G Kivisild-T Reddy-AG Singh-VK Rasalkar-AA Singh-L | SCIENCE 2005, Vol 309, Iss 5743, pp 1996-1997 | 31.853 | CCMB |
| 3. | INDIA RESEARCH-AND-DEVELOPMENT - REACHING FOR THE TOP : Mashelkar-RA | SCIENCE 2005, Vol 307, Iss 5714, pp 1415-1417 | 31.853 | HQ |
| 4. | HEALTH INNOVATION NETWORKS TO HELP DEVELOPING-COUNTRIES ADDRESS NEGLECTED DISEASES : Morel-CM Acharya-T Broun-D Dang-AJ Elias-C Ganguly-NK Gardner-CA Gupta-RK Haycock-J Heher-AD Hotez-P | SCIENCE 2005, Vol 309, Iss 5733, pp 401-404 | 31.853 | HQ |
| 5. | ISSUES IN INDIAN SCIENCE – RESPONSE : Mashelkar-RA | SCIENCE 2005, Vol 309, Iss 5734, pp 557-558 | 31.853 | HQ |
| 6. | COMMENT ON THE GREAT SUMATRA-ANDAMAN EARTHQUAKE OF 26 DECEMBER 2004 : Neetu-S Suresh-I Shankar-R Shankar-D Shenoi-SSC Shetye-SR Sundar-D Nagarajan-B | SCIENCE 2005, Vol 310, Iss 5753, pp U1-U2 | 31.853 | NIO |
| 7. | BIOSCIENCE IN INDIA - TIMES ARE CHANGING : Dhawan-J Gokhale-RS Verma-IM | CELL 2005, Vol 123, Iss 5, pp 743-745 | 28.389 | CCMB |
| 8. | A CRITICAL ROLE FOR CYCLIN-E IN CELL FATE DETERMINATION IN THE CENTRAL-NERVOUS-SYSTEM OF DROSOPHILA-MELANOGASTER : Berger-C Pallavi-SK Prasad-M Shashidhara-LS Technau-GM | NATURE CELL BIOLOGY 2005, Vol 7, Iss 1, pp 56+ | 20.649 | CCMB |
| 9. | GLOBAL IMPAIRMENT OF THE UBIQUITIN-PROTEASOME SYSTEM BY NUCLEAR OR CYTOPLASMIC PROTEIN AGGREGATES PRECEDES INCLUSION-BODY FORMATION : Bennett-EJ Bence-NF Jayakumar-R Kopito-RR | MOLECULAR CELL 2005, Vol 17, Iss 3, pp 351-365 | 16.811 | CLRI |
| 10. | SYNERGISTIC RECOGNITION OF AN EPIGENETIC DNA ELEMENT BY PLEIOHOMEOTIC AND A POLYCOMB CORE COMPLEX : Mohd-Sarip, A., Cléard, F., Mishra, R.K., Karch, F., Verrijzer, C.P. | GENES & DEVELOPMENT 2005, 19 (15): 1755-1760. | 16.385 | CCMB |
| 11. | NEF-MEDIATED LIPID RAFT EXCLUSION OF UBC7 INHIBITS CBL ACTIVITY IN T CELLS TO POSITIVELY REGULATE SIGNALING : Alison Slimmons, Bevin | IMMUNITY 2005,23, 621-634, | 15.448 | IICT |

**ANNEXURE-III**

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    New Delhi – 110 067

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    Birla Group of Companies
    Prakash Deep, 10th floor
    7, Tolstoy Marg
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    Scientific Research
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| | Gangadharan, Asleigh Hodges, Kathrine Sharrocks,Sripadi Prabhakar, Angel Garc | | | |
| 12. | STEM CELLS IN POSTNATAL MYOGENESIS: MOLECULAR MECHANISMS OF SATELLITE CELL QUIESCENCE, ACTIVATION AND REPLENISHMENT : Dhawan J Thomas A. Rando | TRENDS IN CELL BIOLOGY 2005 Dec;15(12):666-73 | 14.327 | CCMB |
| 13. | DEVELOPMENT OF NANOPHOSPHORS - A REVIEW : Chander-H | MATERIALS SCIENCE & ENGINEERING R-REF 2005, Vol 49, Iss 5, pp 113-155 | 14.233 | NPL |
| 14. | CONFORMATIONALLY CONSTRAINED PNA ANALOGS - STRUCTURAL EVOLUTION TOWARD DNA/RNA BINDING SELECTIVITY : Kumar-VA Ganesh-KN | ACCOUNTS OF CHEMICAL RESEARCH 2005, Vol 38, Iss 5, pp 404-412 | 13.154 | NCL |
| 15. | CHEMISTRY OF SQUARAINE-DERIVED MATERIALS - NEAR-IR DYES, LOW-BAND-GAP SYSTEMS, AND CATION SENSORS : Ajayaghosh-A | ACCOUNTS OF CHEMICAL RESEARCH 2005, Vol 38, Iss 6, pp 449-459 | 13.154 | RRLTVM |
| 16. | A D-AMINO-ACID EDITING MODULE COUPLED TO THE TRANSLATIONAL APPARATUS IN ARCHAEA : Dwivedi-S Kruparani-SP Sankaranarayanan-R | NATURE STRUCTURAL & MOLECULAR BIOLO 2005, Vol 12, Iss 6, pp 556-557 | 12.000 | CCMB |
| 17. | PHOTOISOMERIZATION OF DIBENZOBARRELENES - A FACILE ROUTE TO POLYCYCLIC SYNTHONS : Ramaiah-D Sajimon-MC Joseph-J George-MV | CHEMICAL SOCIETY REVIEWS 2005, Vol 34, Iss 1, pp 48-57 | 10.836 | RRLTVM |
| 18. | GENETIC ASSOCIATION, POSTTRANSLATIONAL MODIFICATION, AND PROTEIN-PROTEIN INTERACTIONS IN TYPE-2 DIABETES-MELLITUS : Sharma-A Chavali-S Mahajan-A Tabassum-R Banerjee-V Tandon-N Bharadwaj-D | MOLECULAR & CELLULAR PROTEOMICS 2005, Vol 4, Iss 8, pp 1029-1037 | 9.624 | IGIB |
| 19. | ELECTROCHEMICAL ADDRESSING OF THE OPTICAL PROPERTIES OF A MONOLAYER ON A TRANSPARENT CONDUCTING SUBSTRATE : A. D. Shukla, A. Das, Milko E. van der Boom; | ANGEWANDTE CHEMIE-INTERNATIONAL EDI 2005,44[21] , 3237-3240. | 9.161 | CSMCRI |
| 20. | NUCLEOBASES IN MOLECULAR RECOGNITION: MOLECULAR ADDUCTS OF ADENINE AND CYTOSINE WITH COOH FUNCTIONAL GROUPS : Sathyanarayana Reddy Perumalla, E. Suresh, Venkateswara Rao Pedireddi; | ANGEWANDTE CHEMIE-INTERNATIONAL EDI 2005,44 [47] , 7752–7757 | 9.161 | CSMCRI |
| 21. | 17-BETA-ESTRADIOL-ASSOCIATED STEALTH-LIPOSOMAL DELIVERY OF ANTICANCER GENE TO BREAST-CANCER CELLS : Reddy-BS Banerjee-R | ANGEWANDTE CHEMIE-INTERNATIONAL EDI 2005, Vol 44, Iss 41, pp 6723-6727 | 9.161 | IICT |
| 22. | 9/11 MIXED HELICES IN | ANGEWANDTE CHEMIE-INTERNATIONAL EDI | 9.161 | IICT |

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| | ALPHA/BETA-PEPTIDES DERIVED FROM C-LINKED CARBO-BETA-AMINO ACID AND L-ALA REPEATS : Sharma-GVM Nagendar-P Jayaprakash-P Krishna-PR Ramakrishna-KVS Kunwar-AC | 2005, Vol 44, Iss 36, pp 5878-5882 | | |
| 23. | HYDROGEN PROCESSING BY FE-III-EXCHANGED MONTMORILLONITE - A UNIQUE GEOCHEMICAL PROTOCOL : Choudary-BM Kantam-ML Ranganath-KVS Rao-KK | ANGEWANDTE CHEMIE-INTERNATIONAL EDI 2005, Vol 44, Iss 2, pp 322-325 | 9.161 | IICT |
| 24. | SIMULTANEOUS CONVERSION OF METHANE AND METHANOL INTO GASOLINE OVER BIFUNCTIONAL GA-MODIFIED, ZN-MODIFIED, IN-MODIFIED, AND/OR MO-MODIFIED ZSM-5 ZEOLITES : Choudhary-VR Mondal-KC Mulla-SAR | ANGEWANDTE CHEMIE-INTERNATIONAL EDI 2005, Vol 44, Iss 28, pp 4381-4385 | 9.161 | NCL |
| 25. | NUCLEOBASES IN MOLECULAR RECOGNITION: MOLECULAR ADDUCTS OF ADENINE AND CYTOSINE WITH COOH FUNCTIONAL GROUPS : Perumalla, S.R.;Suresh, E.;Pedireddi, V.R. | ANGEWANDTE CHEMIE-INTERNATIONAL EDI 44(47), 7752(2005) | 9.161 | NCL |
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| 28. | FIGHTING TUBERCULOSIS - AN OLD DISEASE WITH NEW CHALLENGES Tripathi-RP Tewari-N Dwivedi-N Tiwari-VK | MEDICINAL RESEARCH REVIEWS 2005, Vol 25, Iss 1, pp 93-131 | 8.418 | CDRI |
| 29. | BIOLEACHING OF SAND BY THE FUNGUS FUSARIUM-OXYSPORUM AS A MEANS OF PRODUCING EXTRACELLULAR SILICA NANOPARTICLES : Bansal-V Sanyal-A Rautaray-D Ahmad-A Sastry-M | ADVANCED MATERIALS 2005, Vol 17, Iss 7, pp 889+ | 8.079 | NCL |
| 30. | RECENT ADVANCES ON TIO2-ZRO2 MIXED OXIDES AS CATALYSTS AND CATALYST SUPPORTS : Reddy-BM Khan-A | CATALYSIS REVIEWS-SCIENCE AND ENGINEI 2005, Vol 47, Iss 2, pp 257-296 | 8.000 | IICT |
| 31. | FURANOFLAVONOIDS - AN OVERVIEW : Maurya-R Yadav-PP | NATURAL PRODUCT REPORTS 2005, Vol 22, Iss 3, pp 400-424 | 7.890 | CDRI |
| 32. | ALTERED PRE-LAMIN-A PROCESSING IS A COMMON MECHANISM LEADING TO LIPODYSTROPHY : Capanni-C Mattioli-E Columbaro-M Lucarelli-E Parnaik-VK Novelli-G Wehnert-M Cenni-V Maraldi-NM Squar | HUMAN MOLECULAR GENETICS 2005, Vol 14, Iss 11, pp 1489-1502 | 7.801 | CCMB |
| 33. | SEQUESTRATION OF PRB BY | MOLECULAR BIOLOGY OF THE CELL | 7.517 | CCMB |

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| | CYCLIN-D3 CAUSES INTRANUCLEAR REORGANIZATION OF LAMIN-A/C DURING MUSCLE-CELL DIFFERENTIATION : Mariappan-I Parnaik-VK | 2005, Vol 16, Iss 4, pp 1948-1960 | | |
| 34. | MYCOBACTERIUM TUBERCULOSIS NAD+DEPENDENT DNA LIGASE IS SELECTIVELY INHIBITED BY GLYCOSYLAMINES COMPARED WITH HUMAN DNA LIGASE1 : Srivastava Sandeep Kumar, Dube Divya, Tewari N, Dwivedi N, Tripathi Rama Pati & Ramachandran Ravisha | NUCLEIC ACIDS RESEARCH 2005,33, 7090-101 | 7.260 | CDRI |
| 35. | KINETIC RESOLUTION OF BIMOLECULAR HYBRIDIZATION VERSUS INTRAMOLECULAR FOLDING IN NUCLEIC-ACIDS BY SURFACE-PLASMON RESONANCE - APPLICATION TO G-QUADRUPLEX/DUPLEX COMPETITION IN HUMAN C-MYC PROMOTER : Halder-K Chowdhury-S | NUCLEIC ACIDS RESEARCH 2005, Vol 33, Iss 14, pp 4466-4474 | 7.260 | IGIB |
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| 39. | CHARACTERIZATION OF THE DNA-BINDING DOMAIN AND IDENTIFICATION OF THE ACTIVE-SITE RESIDUE IN THE GYR-A HALF OF LEISHMANIA-DONOVANI TOPOISOMERASE-II : Sengupta-T Mukherjee-M Das-R Das-A Majumder-HK | NUCLEIC ACIDS RESEARCH 2005, Vol 33, Iss 8, pp 2364-2373 | 7.260 | IICB |
| 40. | GPCRSCLASS - A WEB TOOL FOR THE CLASSIFICATION OF AMINE TYPE OF G-PROTEIN-COUPLED RECEPTORS : Bhasin-M Raghava-GPS | NUCLEIC ACIDS RESEARCH 2005, Vol 33, pp W143-W147 | 7.260 | IMTECH |
| 41. | BHAIRPRED - PREDICTION OF BETA-HAIRPINS IN A PROTEIN FROM MULTIPLE ALIGNMENT INFORMATION USING ANN AND | NUCLEIC ACIDS RESEARCH 2005, Vol 33, pp W154-W159 | 7.260 | IMTECH |

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**ANNEXURE-IV**

# MEMBERS OF ADVISORY BOARD

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

2. Dr. H.S. Singhania
   President
   JK Organisation, Nehru House
   4, Bahadurshah Zafar Marg
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3. Dr. Raju D. Shroff
   Chairman and Managing Director
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6. Prof. P. Balaram
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8. Dr. M.K. Bhan
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9. Dr. Harsh K. Gupta
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   Mahasagar Bhavan, CGO Complex
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10. Shri K.K. Jaswal
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11. Dr. Jitendra Bajaj
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12. Dr. V. Prakash
    Director
    Central Food Technological Research Institute
    Mysore – 570 013

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

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

# ANNEXURE-V

**LIST OF NETWORKED PROJECTS WITH NODAL LABS**

1. Spearheading small civilian aircraft design, development & manufacture (NAL)
2. Exploration and exploitation of microbial wealth of India for novel compounds and biotransformation process (IMT)
3. Molecular biology of selected pathogens for developing drugs targets (CDRI )
4. Study of mesozoic sediments for hydrocarbon exploration (NGRI)
5. Pollution monitoring mitigation systems and devices (NEERI )
6. Asthmatic and allergic disorders mitigation mission (IICB)
7. Newer scientific herbal preparations for global positioning (RRL-JAMMU)
8. Special electron tube technologies for large scale applications (CEERI )
9. Environment friendly leather processing technology (CLRI )
10. Comprehensive traditional knowledge digital documentation library (NISCAIR )
11. Catering to specialised aerospace materials (NAL)
12. Developing cells & tissue engineering (CCMB)
13. Toxicogenomics of polymorphism in Indian population to industrial chemicals for development of biomarkers (ITRC)
14. Designing animals and plants as bio-reactors for proteins & other products (CIMAP)
15. Development of catalysis & catalysts (NCL)
16. Developing green technologies for organic chemicals (IICT)
17. Acquisition of oceanographic research vessel (ORV) (NIO)
18. Impact of anthropogenic perturbations oceanographic-atmospheric processes in and around India in the context of global change (NIO)
19. Development of key technologies for photonics and opto electronics (CGCRI)
20. Developing capabilities & facilities for microelectromechanical systems (MEMS) and sensors (CEERI)
21. Coal characterisation & resource quality assessment for end users (CFRI)
22. Developing new generation fuels & lubricants (IIP)
23. Positioning Indian nutraceuticals and neutrigenomics in a global platform (CFTRI)
24. Setting up a world class drug research institute (CDRI)

25. Predictive medicine using repeat and single nucleotide polymorphisms (IGIB)
26. Drug target development using in-silico biology (IGIB)
27. Animal models and animal substitute technologies (CDRI)
28. Developing new building construction materials and technologies(CBRI)
29. Mathematical modelling and computer simulation (C-MMACS)
30. Technologies for standardization of bioresources for and from leather (CLRI )
31. Custom tailored special materials (CGCRI)
32. Capacity building for coastal placer mineral mining (CMRI)
33. Upgradation of SI base units, national standards of measurements & apex calibration facilities (NPL)
34. Developing & sustaining High science & technology for national aerospace programmes (NAL)
35. Medicinal plant chemotypes for enhanced marker and value added compounds (CIMAP)
36. Globally competitive chemicals processes and products (IICT)
37. Development of novel polymeric materials (NCL)
38. Development of techniques and methodologies for exploration, assessment and management of ground water in hard rock areas (NGRI)
39. Tectonic and oceanic processes along Carlsberg-central Indian ridge system and back arc basins (NIO)
40. Electronics for societal purposes (CSIO)
41. Industrial waste minimization and clean up (NEERI)
42. Quality enhancement of coal for its efficient utilization (CFRI)
43. Natural, nature identical or similar biomolecules (CFTRI)
44. Infectious diseases handling storage and research facilities (CCMB)
45. Design analysis and health assessment of special structures including bridges (SERC)
46. New and improved road technologies (CRRI)
47. Establishing National science digital library (NISCAIR)
48. Consortium access to electronic journals (NISCAIR)
49. Establishing genetically modified foods referral facility (CFTRI)

50. Establishing advanced facility for safety evaluation of genetically modified/engineered drugs (CCMB)
51. Development of comprehensive technology for disaster prevention & management for Jharia coalfield (CMRI)
52. Biomineral processing for extraction of metal values from ores and concentrates (RRL-BHUB.)
53. Developing capabilities in advanced manufacturing technology (CMERI)
54. Technology for engineering critical assessment (NML)
55. Discovery, development and commercialization of new bioactives and traditional preparations (CSIRHQ.)

**ANNEXURE- VI**

# CAG Report

**Unfruitful expenditure on procurement of Liquid Nitrogen Plant:** Regional Research Laboratory (RRL), Thiruvanthaprum, a constituent laboratory of Council of Scientific and Industrial Research, placed a purchase order on a UK based firm in March 1998 for the supply of a Nitrogen Generator and a liquefier at a cost of UK Pound 28,600 (equivalent to Rs 20.84 lakh). The equipment, required for the production of liquid nitrogen, was received in August 1998. RRL paid Rs 21.29 lakh, for it including freight and bank charges in September 1998. The system that arrived at RRL was a water-cooling instead of the stipulated air-cooling system. RRL failed to get a replacement or install the existing system. The system was lying uninstalled and unused for more than five years with possible implication on the serviceability of the equipment. RRL had procured 10996 litres of liquid nitrogen during November 1998 to June 2003 at Rs 5.89 lakh which could have been avoided had the system been installed.

**(Para 10.1 of Report No. 5 of 2005)**
**Scientific Departments**

**Non-installation of Fermentation System:** The Regional Research Laboratory (RRL), Bhubaneshwar placed an order in March 1999 on a firm based at Kolkata, for supply of fermentation system comprising 50 litres capacity recycling fermentor and 100 litres capacity non-cycling batch type fermentor. The order was placed on the basis of quotation received in December 1998 from the firm. The firm has offered guarantee for a period of 14 months from the date of delivery/dispatch or 12 months from the date of commissioning/ demonstration whichever was earlier. While placing the order in March 1999, RRL incorporated a guarantee clause for a period of 24 months and also introduced a clause for performance bank guarantee of 10 per cent of the order value during the period of guarantee. As a result, the firm refused to complete the installation resulting in the system which was procured at a cost of Rs 13.08 lakh lying in disuse for more than four years.

**(Para 10.2 of Report No. 5 of 2005)**
**Scientific Departments**

## ANNEXURE-VII

**Full Text of Speech by Hon'ble Prime Minister of India and President, CSIR Society, Dr. Manmohan Singh during CSIR Society meeting held on 25th May, 2005 at 7, Race Course Road, New Delhi**

Shri Kapil Sibal, my cabinet colleagues Finance Minister Shri Chidambaram ji, Shri Kamal Nath ji and distinguished members of the CSIR society.

I am delighted to welcome you once again to the meeting of the CSIR Society. Since our meeting last July I have had the opportunity of meeting some of you at the Indian Science Congress and at the meeting of the Scientific Advisory Council to the Prime Minister. I would like to compliment CSIR for the good work it has been doing during this period and I have learnt with great pleasure about your achievements during the last one year for which I complement both Shri Kapil Sibal and Dr. Mashelkar. The honors that he has won make us truly proud of what he has done and I hope that, that will prove to be a pace setter of achievement in the years to come and that other younger scientists will emulate his example.

Last year I had drawn your attention to the priorities of our Government and had urged you to focus your attention on how science can work in the interests of the poor. We do need the best of modern science and technology to address such basic needs of our people as clean drinking water and I am very pleased that the CSIR community is very active in this field of providing pure drinking water. I would like to once again reiterate the importance of channeling the best brains in our country to solve some of the simplest but most crucial of the needs of our people. Science must serve the interests of society if it expects society to invest in it. There is, of course, the argument that one must invest in science for the sake of science, just as there is merit in the adage "art for art's sake". I do not minimize the importance of investing adequate amount in the development and adaptation of science and technology but our abilty to devote larger resources for science and technology development will get a lot more public support if science is seen to be in service of the common people in our country.

In a resource constrained developing economy like ours there are competing claims on the exchequer and elected Governments must respond to the needs of the people. Hence, there is merit in the view that making science and technology relevant to the needs of the people can in fact help raise more resources for science and technology. I therefore once again reiterate my plea that CSIR must justify its funding by addressing some of the most real needs of the people.

I must add, however, that I have been inspired by some recent examples of such people-oriented technology development that CSIR has sponsored. One such example is the breakthrough in ultra filtration technology. This membrane can filter the virus also along with other bacteria – which, I understand, has been achieved for the first time. For this our scientists deserve our heartiest congratulations. I understand that this has been achieved for the first time anywhere in the world. What I was happy to see from Dr. Mashelkar's presentation is that the device can work with a hand pump as well. It means it can work in a village without electricity. This is an example of socially relevant research. My colleague the Finance Minister, Shri Chidambaram, recently told me that in his constituency he is installing these pumps. This is something that I would urge all our MPs to look at. Perhaps the funds available under MPLADS can be used to finance this innovative project across the country.

Ladies and Gentlemen, I am aware of the fact that several other technologies are available from CSIR labs that can ameliorate not only the drinking water problem but several other problems faced by our people on a daily basis. There is, however, an urgent need to focus our attention on robust delivery mechanism and wider dissemination of technologies.

The Common Minimum Programme mandates us to focus our energies in several different areas concerning the rural population. It is imperative for CSIR to establish new linkages and partnerships by providing technological support for basic human needs of the people living in rural India. We have recently launched a massive 'Bharat Nirman' scheme with a total layout of Rs. 1,74,000 crore. Spread over four years, the projects under the scheme will focus on at least six critical areas of rural infrastructure development — irrigation, power, roads, drinking water, housing and communications. I would like CSIR to lend a hand through its technological prowess in these areas. The important thing here, however, is not outlays as much as it is outcomes. I do attach more importance to outcomes than to outlays.

Friends,

Even as this remains an important focus of our policy, I would not like you to divert your attention away from the pursuit of excellence in science and technology development. Even as we address the challenges at the base of our society, we must take on the challenges at the apex of the knowledge pyramid. India must regain its pre-eminent position in the fields of science and technology.

We have already taken a number of steps to ensure that Indian Science & Technology quickly moves into top gear. The Science Advisory Council to the Prime Minister that I had constituted under the chairmanship of Prof. C.N.R. Rao, has adopted a focused approach to its task. I have already given a go ahead for the formation of a National Science and Engineering Research

Foundation, which will be an autonomous body. It will support basic science just as NSF in USA does. After all, basic science of today is the technology of tomorrow. I am firmly convinced that without a strong base of basic science, we cannot build our technological enterprise.

People say that twenty first century will be the century of knowledge. If this is so, then our foundations on production, distribution, protection and utilisation of knowledge must be strengthened. Dominance of knowledge economy over the old 'brick & mortar' economy is visible all around the world. I am convinced that this is where India's advantage also lies. I would like to inform you that I will soon be constituting a National Knowledge Commission, with a view to improving the quality of our educational and research institutions. We must invest in excellence. We must make research an attractive career option for the young. We must liberate our research organizations from the stranglehold of bureaucracy and old mindsets so that they become once again the home of creativity and enterprise. I also want to revitalize public institutions in the knowledge sector like our libraries. Our libraries are in a terrible state of neglect in many parts of our country. We cannot build a knowledge society without active and growing libraries. I would like the Knowledge Commission to pay attention to such challenges in the field of science and technology development.

Coming to the specific issue of protection of our knowledge, in March 2005, we ushered in a new IPR regime by passing the Third Patent (Amendment) Bill. Against much speculation as to whether India would keep its commitment to modify its patent laws, we showed that we had the will to take up the challenge. This step gives us both a challenge as well as a great opportunity. Abraham Lincoln had once said 'the patent system added the fuel of interest to the fire of genius'. I am proud of the Indian genius. However, I am keen to see that our new patent regime will add the fuel of interest to this fire of genius! A time has come for our institutions and industry to move from 'imitation' to 'innovation'.

For this to happen, we must understand the importance of generation, valuation, protection and valorisation of intellectual property. In this context, I am happy to see that CSIR has always been at the forefront. CSIR's initiative to launch a formal Intellectual Property Management Policy as early as 1996 has richly paid dividends. I was happy to see from Dr. Mashelkar's presentation several fold increase in the last five years in the foreign patents granted to the CSIR. Since CSIR has taken a lead, I will like CSIR to help our IITs, Universities and industry in setting up similar IP management policies as well as help them in creating infrastructure to capture their full IP potential.

I would like to once again congratulate the CSIR family and Dr. Mashelkar, who has recently been conferred yet another honour, having been elected Foreign Associate of the US National Academy of Sciences, the eighth Indian to be so elected since 1863. The Indian scientific fraternity has done the nation truly proud. There is a buzz of excitement globally today about India. And it is not just because of our impressive economic growth and our markets and so on. It is because of the superb human capital that we have built in science, engineering and technology, a living tribute to the memory of India's first Prime Minister Jawahar Lal Nehru. That is why, in the second South Summit meeting to be held in Doha in June, we have decided to showcase Indian Science & Technology. I would like Dr. Mashelkar to flag not only our prowess in high technology but also our ability to make high technology work for the poor. Good work is being done in this regard but we cannot be satisfied with the status quo.

Our Science & Technology should continue to fly the Indian flag, higher and further. I will like to wish the entire CSIR family all the very best on its journey on this limitless ladder of excellence. Thank you.

## ANNEXURE-VIII

**Full Text of Speech by Minister of Science & Technology and Ocean Development during Shanti Swarup Bhatnagar Prize Award Ceremony held on 28th September, 2005 at Vigyan Bhawan, New Delhi**

1. It is indeed an honour for me this morning to welcome Dr. Manmohan Singh, Prime Minister of India to this CSIR Awards function. The scientific community is enthused by his un-flinching support and during the last one year has demonstrated that it is not only capable of producing world class science, but given the opportunities, can produce men of such scientific talent and excellence, who have the potential to be world leaders. The mere presence of the Hon'ble Prime Minister today is yet another example of his support for the scientific community. Today, we celebrate our achievers, our future Navratnas and in yet another sense celebrate the triumph of science. An English Chemist, Sir Cyril Herman Hinshelwood, who received the Nobel prize in 1956 once said "Science is an imaginative adventure of the mind seeking truth in a world of mystery". On this day of celebration, all of us are in some sense participating in that adventure. We thank you Sir, for being on this special day with us.

2. At the outset, my heartiest congratulations to the Bhatnagar Prize awardees. This is surely regarded as India's Nobel Prize. You all have joined the elite club of Bhatnagar Laureates today. This recognition imposes an onerous responsibility on you. You are expected to build on what you have achieved and be role models for our youth. Congratulations to Mr. Purohit, the winner of CSIR Diamond Jubilee Technology Award. I am sure in course of time this award will also come to command the same high prestige as Bhatnagar Prizes do today in science.

3. I commend CSIR for recognizing the best in Indian science and technology for decades now. We need to publicize these 'heros' on the national stage. This will inspire, motivate and attract some of our brightest youngsters to science.

4. I must applaud CSIR for not only recognizing achievements at the 'top of the ladder' but also in spotting and nurturing 'young bright minds' at the first rung too. Like the CSIR Diamond Jubilee Technology Award, CSIR has also instituted a CSIR Diamond Jubilee Invention Award for school children. The intention is to create awareness and arouse interest of school students in Intellectual Property – which I believe will in course of time be India's major asset and to encourage inventiveness and out-of-the-box thinking. Just two days ago, on CSIR Foundation Day on the 26th September, Dr. Mashelkar announced the winners of this year. I was pleasantly surprised to hear that the top two awardees, children from affluent schools, had inventions that reflected social sensitivity – one was an inexpensive lower limb

prosthesis – artificial leg and the other one was for a much improved cycle rickshaw to reduce the pedaling effort.

5. I was so impressed that I wanted to know more about the past awardees. Dr Mashelkar told me that the first awardee was Madhav Pathak, a Jabalpur school boy who developed an improved Braille slate to make writing and reading easier for the blind. This invention later received an international prize. This reassures me that our future is in the hands of youngsters who have a social conscience and are thinking of improving the quality of life of their unfortunate brethren.

6. We have seen the wonderful work that Media Communication Technologies has done to connect the unconnected. This has a huge significance for India. When you have to deal with large distances, a huge population and lack of resources, technology is the only tool through which this connectivity is possible. But I also heard stories on how tough they found it to get this technology accepted in India. Surprisingly this technology was first accepted abroad and then here. We need to learn from our past. When Cray denied us the supercomputer, Shri. Rajeev Gandhi took the initiative to create our own supercomputers. This 'denial driven' innovation drive finally helped us to join the select club of countries capable of manufacturing teraflop range supercomputers. The same Cray Company wanted to set up shop in India a few years ago. I therefore strongly believe that we need to support indigenous technology at the earliest and not wait for others to embrace it before we do.

7. I am happy to see 21 Bhatnagar awardees amongst us – they are our super stars – the very best that science has to offer in India. In turn, I assure you on behalf of my Ministry that you will get the very best we can give you to compete with the best in the world. Indeed the very best must be retained in India and return to India.

8. The other day, Dr. Mashelkar told me about how Mrs. Indira Gandhi sent Dr. Nayudamma, the then DG, CSIR abroad to pick up the very brightest and the best and offer them jobs on the spot. No formal interview, no application, no form filling. That is how Dr. Mashelkar was brought back. But he lamented the fact that what a Nayudamma could do to a 'Mashelkar', today a Mashelkar cannot do to another Mashelkar. Society has become so litigative. Appearing to be right appears to consume so much energy. I wish to assure you that in science, meritocracy is not only necessary, it is essential. I can assure you that we will leave no stone unturned to bring the very best back to the country. We have started this process by instituting Ramanujam Fellowships. But this is only the first step. We will do a lot more.

9. I am happy that our Prime Minister is releasing the India Science Report today. I am happy that Indian National Science Academy (INSA) took up this challenge. INSA, with its 750 distinguished Fellows, represent – the very elite – the most accomplished of Indian scientists. I find that in other countries government depends greatly upon the 'academies' for policy advice and other matters connected with science. I have heard that the US government's thinking is strongly influenced by the study and advice that it receives from the science academies. I believe we need to create a similar 'connect' in India too. To the distinguished fellows of INSA, that are present in this audience, I wish to assure that my Ministry will be most happy to create such a bridge.

10. The India Science Report, that will be released by the Hon'ble Prime Minister today, is truly revealing of the state of science and technology in the country – it will help quell the many myths that are spread about Indian S&T. At the same time, it has given us ample food for thought and analysis as to what needs to be done either by executive actions or remedial policy measures. May I suggest Sir that to begin with, if you consider it appropriate, remit the report to SAC-PM for their study and recommendations so that we could incorporate their findings in the Eleventh Five Year Plan. We need to act now, and act decisively.

11. I can assure you that much has happened during the last year to put Indian S&T on the world map. Initiation of much higher levels of funding to basic scientific research through the creation of an overarching NSF like structure, institution of Fellowships, not only to attract the very best talent from abroad but also to encourage talent within India, initiation of the process for creation of new institutes of science, education and research, evolving new policies and strategies for bio-technology, creating new public-private partnerships, facilitating 'hassle-free' regulatory processes, which will help the creation of enterprises in emerging technologies represents some of the path breaking decisions taken. We have stepped up funding in frontier areas, such as in nano-technology. I assure you that with the unstinted patronage of our Hon'ble Prime Minister for science and technology, we will not be found wanting in supporting any new initiatives to strengthen and safeguard our Science and Technology infrastructure.

12. Finally, next year we will celebrate the Awards function with yet another set of scientists. We will celebrate their achievements and the triumph of science. As long as the scientific community continues to get the support of extraordinary leaders like Dr. Manmohan Singh, the Prime Minister of India, the cause of science will always serve India well. I welcome all of you and thank you all for being with us today.

## ANNEXURE-IX

**Full Text of Speech by Hon'ble Prime Minister of India and President, CSIR Society, Dr. Manmohan Singh during Shanti Swarup Bhatnagar Prize Award Ceremony held on 28th September, 2005 at Vigyan Bhawan, New Delhi**

1. I am delighted to be here today as I find myself in the company of scientists. You are the creators of a new India; an India that is free from the shackles of ignorance. It is an India imbued with scientific temper and a liberal outlook. I am happy to recognize the very important role our scientists and technologists have played and will play in the ongoing task of Nation building. It is a pleasure to honour the very best of Indian science and technology today.
2. Several awards have been conferred today, but let me begin by complimenting CSIR for the good work being done under Dr Mashelkar's leadership. His recent election as a Fellow of the U.S. National Academy of Sciences—the seventh Indian to be so recognized since 1863-- adds one more feather in his distinguished cap.
3. I also congratulate the winners of our most coveted science prize—the Shanti Swarup Bhatnagar prize for 2004 and 2005. I am particularly happy that this prize is given to young scientists, who are in their prime. Becoming a Bhatnagar laureate gives you a status that you will undoubtedly enjoy. However, it comes with many responsibilities, such as the responsibility to engage in good science. You also have the responsibility to serve the best interests of mankind and our natural inheritance. Most importantly, you will also have the responsibility to improve the quality of life and widen the span of knowledge in India. My very best wishes to you on the exciting journey ahead. I hope it will be a never-ending journey of learning and creativity. I hope each one of you will dedicate your lives to the cause of science, to the welfare of our people and to the growth and development of our country.
4. Last but not the least, I congratulate the team of Media Communication Technologies, who have won the CSIR Diamond Jubilee Technology Award. I applaud this selection for two reasons.
5. First and foremost, these technologies can provide affordable solutions for connecting our rural population through internet and voice connectivity. I have often stressed the need for 'reaching the unreached' and 'connecting the unconnected' in India. I am glad that this technology can potentially fulfill this

goal. The telecom revolution and the development of road, air and rail linkages have shown that connectivity enhances output and productivity. Connectivity is therefore an important economic asset.

6. Secondly, I have always believed that India must assume a role of leadership among developing countries. Science and Technology can be a powerful tool to achieve this. Therefore, I am happy that these technologies have made inroads among larger developing countries. I hope this Technology Award will inspire others to develop similarly useful and potentially winning technologies.

7. Apart from the awards, I am also happy today to release the 'India Science Report'. I congratulate the Indian National Science Academy (INSA) for taking this important initiative. I also congratulate National Council of Applied Economic Research (NCAER) for their excellent work. In fact, I recall when Prof. M.S. Valiathan discussed this with me, I had suggested that INSA should approach NCAER for such a study. I had a chance to go through the report soon after it was printed. The findings of this report are truly revealing.

8. The Report shows that the proportion of enrolled students in science has gone up from 28.0 per cent in 1995-96 to 34.6 per cent in 2003-04. This is comforting. However, it also shows that while close to two-thirds of the students in class six to eight are satisfied with the quality of science teaching, this falls to 40% in class 11 and 12 ! This shows a shortage of good science teachers at higher levels. I would like our HRD Ministry and State Governments to take note of this and act upon it. We must lay increased emphasis on improving the quality of teaching in science and mathematics at all levels.

9. There are other causes for concern. The Report shows that 20 per cent of science graduates and 14 per cent of Ph.D.s in science do not find gainful employment. What is equally worrisome is the finding that many people employed in science-centered jobs are insufficiently qualified. There are lessons for us here. This Report also points to a grave regional imbalance in terms of educational institutions in different states. I am sure the facts and analysis presented here will help our policy planners. I trust our Government at the Centre, as well as State Governments, will take note of these findings and evolve policies to remedy these imbalances.

Ladies and gentlemen,

10. When I spoke here last year, I had reaffirmed India's commitment to basic science, applied science and the promotion of excellence. I had committed our Government to rebuilding the science base in the universities. I had also

made a commitment to de-bureaucratise our S&T institutions, to restructure our S&T support systems. I had committed our Government to create career opportunities to retain talent in the S&T sector. I am happy to say that we have made some progress on these counts.

11. Firstly, I have always felt that it is a pity that a country of a billion people has only one Indian Institute of Science. To rebuild our foundations in basic science, the Government is creating two institutes dealing exclusively with science education and research, one in Pune and another in Kolkata. We hope that these institutes will attain world class standard.

12. Second, the Ministry of Human Resource Development has already set up a Task Force on rejuvenation of scientific research in universities. The Task Force has set up a target of doubling the number of Ph.D.s coming out of India within the next 5 to 6 years. The necessary budgetary support for this has been promised.

13. Third, to strengthen our investment in basic science, as well as to improve our processes of funding, a new National Science & Engineering Research Foundation has been approved. It will receive generous funding and it will operate in an autonomous way.

14. Fourth, we have provided a fund of Rs. 150 crore per year for this specific purpose to Department of Science & Technology. I am keen on pushing forward many meaningful and productive public-private partnerships. Research in pharmaceuticals is particularly critical to us with the change of the patent regime that our Government has ushered in. Other initiatives will follow.

15. Finally, I had also stated that we would create exciting career opportunities for scientists to retain our talent at home. The recently announced Ramanujam Fellowship, J.C. Bose Fellowship and also Fellowships for Scientists and Technologists of Indian Origin (STIO) are part of our effort to fulfill this promise.

Ladies and gentlemen,

16. I realize that in a journey of a thousand miles, these are just the first few small steps. We need to do much more. We have, therefore, formed a Knowledge Commission under the chairmanship of Sam Pitroda, and with Dr P.M. Bhargava as deputy chairman. I do believe that if the 21st Century is going to be a 'Knowledge Century' then it is not military power or economic power but 'brain power' that will determine our place in it. We are expecting the

Knowledge Commission to come forward with bold initiatives to create excellence in research and teaching, especially in the frontier areas of mathematics, science and technology.

17. Those of us who are elected to public office in a democracy face the challenge of finding resources for basic human development and the resources for advanced research and technological development. We also face the challenge of addressing the demands of promoting equity and the requirements of encouraging excellence. I do sincerely believe that these need not become contradictory or contending objectives. I believe that at our stage of development we must learn to "walk on two legs" – fulfilling both these objectives.

18. The challenge before Indian S&T is, therefore, to generate high technology, creating wealth and prestige for India, while also ensuring that this technology improves the lives of the poor. I compliment CSIR Society for some of their recent breakthroughs in advanced scientific areas that have the potential to meet the basic needs of our people. The high-tech membrane filter, that can remove bacteria as well as viruses from water, has enabled CSIR to install in our villages hand pump based units that do not require electricity. At just 4 paise per liter, this technology makes safe drinking water affordable to all. I salute this effort to combine innovation with compassion.

19. Let me, in conclusion, pose a challenge before our S&T community. I urge you to join a race for reaching science and the benefits of science to every nook and corner of our vast Motherland. You must set targets that are ambitious but do-able to increase the quantity and quality of our scientific manpower. We must aim to improve the quality of text-books and teaching at the school level and to make science an exciting discipline and an attractive career. When people praise Indian science and technology, they invariably imply that some Indians are doing well. I would like to see a day, when people will say India is doing well. Our country needs each one of you to do well for us all to be able to do well.

20. I wish you great success in all your noble endeavours. May your path be blessed.

21. Thank you.