ANNUAL REPORT
2008-2009

Council of Scientific and Industrial Research
New Delhi

Legends for Coverpage

With compliments of

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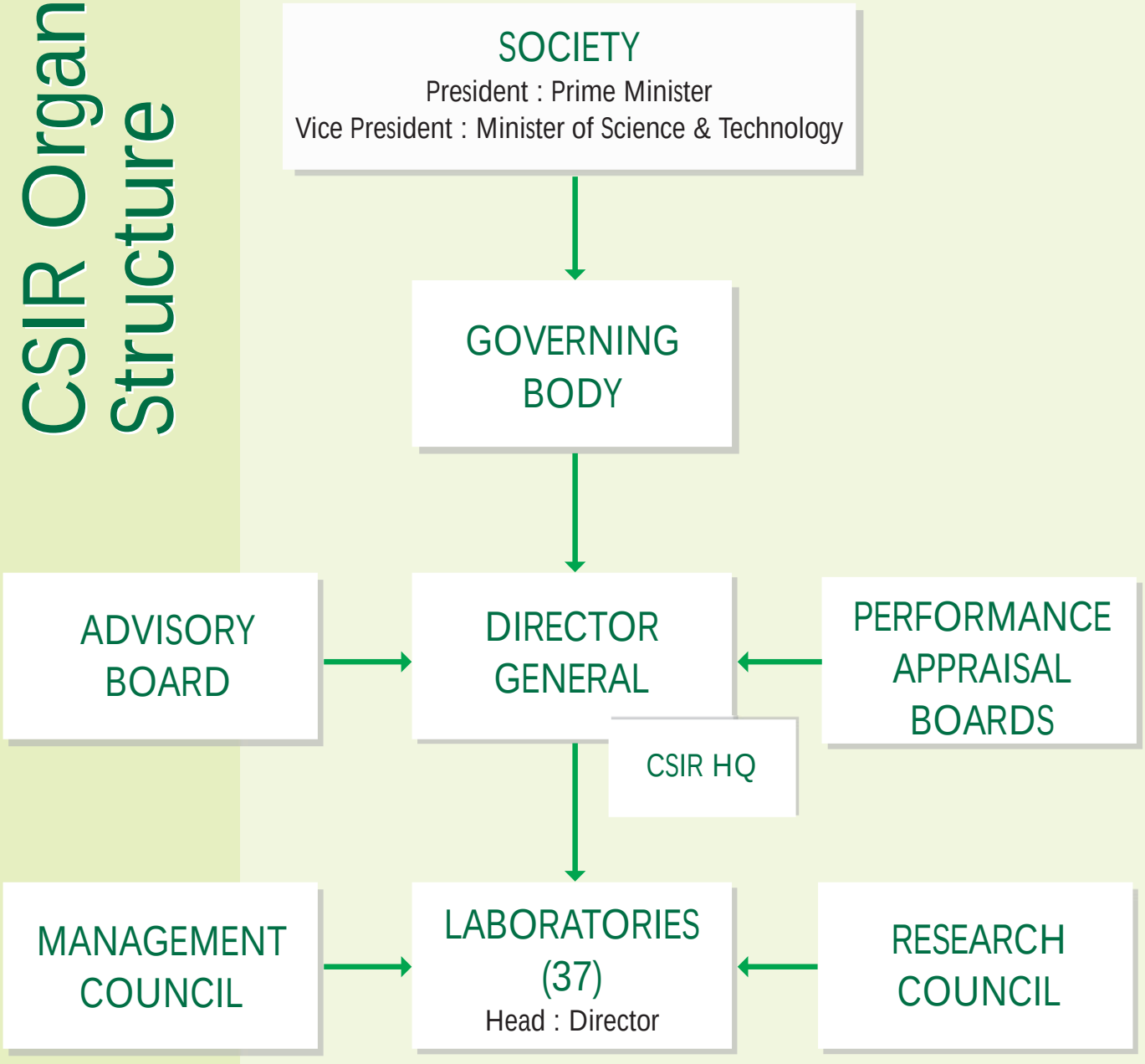
Director General
Council of Scientific
& Industrial Research
New Delhi

Legends for Coverpage

ANNUAL REPORT
2008-2009

Council of Scientific and Industrial Research
Anusandhan Bhawan, 2 Rafi Marg, New Delhi - 110 001
www.csir.res.in

CSIR Organisational Structure



Contents

Page No.

Executive Summary 1-4

Resource Base 5

Performance Indicators 5

1.0 S&T CONTRIBUTIONS

1.1	Aerospace Science & Technology	8
1.2	Biology & Biotechnology	10
1.3	Chemical Sciences & Technology	23
1.4	Earth & Physical Sciences	29
1.5	Ecology & Environment	33
1.6	Electronics & Instrumentation	36
1.7	Energy	38
1.8	Food & Food Processing	41
1.9	Health Care, Drugs & Pharmaceuticals	42
1.10	Housing & Construction	48
1.11	Information Dissemination & Products	52
1.12	Leather	55
1.13	Materials, Minerals, Metals & Manufacturing	56
1.14	CSIR-800	63

2.0 CENTRAL MANAGEMENT ACTIVITIES

2.1	CSIR Society	68
2.2	Governing Body	69
2.3	Shanti Swarup Bhatnagar Prize Presentation Ceremony	70
2.4	CSIR Foundation Day	73
2.5	Awardees of Shanti Swarup Bhatnagar Prize for the years 2007 & 2008	76
2.6	CSIR Young Scientist Award 2008	77

3.0 HEADQUARTERS ACTIVITIES

3.1	R&D Planning Division	80
3.2	Technology Networking & Business Development Division	84
3.3	Intellectual Property Management Division	87
3.4	Human Resource Development Group (HRDG)	87
3.5	International S&T Affairs Directorate	90
3.6	Information Technology Division	97
3.7	Unit for Science Dissemination	99
3.8	Human Resource Development Centre	101
3.9	Recruitment and Assessment Board	101

4.0 DATELINE CSIR 104

ANNEXURES

I	Awards / Recognition	A-2
II	Human Resource Development	A-7
III	Intellectual Property from CSIR	A-12
IIIA	CSIR Patents granted in foreign countries during 2008-2009	A-13
IV	Top Papers published by CSIR	A-42
V	Members of the CSIR Society (2006-2009)	A-54
VI	CAG Report	A-57
VII	List of Approved Projects in Eleventh Five Year Plan	A-58
VIII	Welcome address by Hon'ble Minister of S&T and ES and Vice President, CSIR	A-62
IX	Speech by Hon'ble PM at SSB Awards Presentation Ceremony	A-64

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Executive Summary


CSIR-INDIA

EXECUTIVE SUMMARY

The Annual Report for the year 2008-09 highlights the cumulative achievements of all the constituent units of Council of Scientific & Industrial Research (CSIR).

CSIR, with its 37 research laboratories and 39 extension centres, spans the length and breadth of India; with its laboratories operating from Jammu in the North to Jorhat in the East; and from Thiruvananthapuram in the South to Bhavnagar in the West. Established in 1942 as an autonomous, non-profit industrial research organization, CSIR's charter of functions includes promotion, guidance and co-ordination of scientific and industrial research, collection and dissemination of information on research and industry, setting up of laboratories to carry forward scientific and industrial research and utilization of the new knowledge so generated, for development of industry and society at large.

CSIR is also charged with other tasks such as rendering assistance to other institutions conducting research, awarding of fellowships and publishing of scientific journals. CSIR is making all-round efforts to achieve leadership in frontiers of cutting edge technologies in the field of aerospace; biological and chemical sciences & technology; healthcare; electronics; energy; materials for futuristic applications, improvement in quality life of underprivileged population through S&T interventions etc.

The Report covers significant scientific endeavours of all the constituent laboratories. It also lists awards and recognition conferred upon its scientists by various academies/ institutions. For human resource development, CSIR, through its laboratories, conducts activities, related to development of S&T manpower in the country, such as M.Sc. Courses in Food Technology, Leather Science, Chemical and Electrochemical Engineering, M. Tech in Mechatronics etc. About 2700 research scholars are working across the CSIR system, of which about 450 get Ph.D. degree every year.

The Governing Body of CSIR and the CSIR Society, the highest policy level bodies, continue to issue policy level directives from time to time for functioning of CSIR. This report, in its chapter on 'Central Management Activity', provides an account of the recommendations and suggestions given by the Governing Body through its three meetings held during the year. It also covers the proceedings of the CSIR Society meeting that was chaired by the Hon'ble Prime Minister of India and President, CSIR. To honour the significant scientific work done by scientists of the nation, CSIR awards 'Shanti Swarup Bhatnagar Prize', India's highest recognition to under-45 years of age scientists for their creative and innovative work across several science domains. Hon'ble Prime Minister gives away the prizes to the proud winners. The chapter covers the speeches of the Hon'ble Prime Minister and Hon'ble Minister of Science & Technology delivered during the award ceremony. It also highlights the celebration of CSIR Foundation Day at CSIR Headquarters.

Another significant chapter of the report is 'Headquarters activities' which captures the significant activities of the scientific divisions of CSIR Headquarters viz. R&D Planning Division, Technology Networking and Business Development Division, International S&T Affairs Directorate, Intellectual Property Management Division, Human Resource Development Group etc.

In addition to the above, the report also lists some significant events held during the year through a compendium 'Dateline', Intellectual Property filed/granted from CSIR, Top ranking research papers published by CSIR, amongst others.

S&T Achievements

CSIR's achievements cover a wide science spectrum from aerospace to healthcare to sustainable energy to environment to advanced materials to complex engineering design and civil structures. It also continues to make impact in global S&T arena through its cutting edge fundamental research covering both high science and innovation. Its recent programme, namely 'CSIR-800' presents a socialistic, yet commercially viable business model linked to the economic prosperity of a large section of the Indian population. Another programme, initiated and led by CSIR, the 'Open Source Drug Discovery' (OSDD), has a vision to develop low cost health solutions for the masses by involving volunteer researchers through a global platform. In this forum the best minds can collaborate and collectively endeavour to solve the complex problems associated with discovering novel therapies for neglected tropical diseases like Malaria, Tuberculosis, Leishmaniasis, etc.

Other significant contributions include:

Contribution to 'Chandrayaan': In October 2008 India launched Chandrayaan-1, India's first scientific mission to the Moon. As many as seven CSIR laboratories contributed in a significant way to this prestigious mission. It included space weather information/alerts, zinc oxide-based microelectromechanical systems acoustic sensor, acoustic testing, wind tunnel tests, designing of various civil structures etc.

In the area of Healthcare: One of the major initiatives is launching of OSDD. Modelled on the World Wide Web and 'Linux', this programme was launched on September 15, 2008 and more than 1300 registered participants were on the portal as on March, 2009. To begin with OSDD seeks to develop low cost molecules for the treatment of Tuberculosis. Another significant achievement in this sector is the commercialization of nano-size synthetic hydroxypatite bone graft for dental surgery which is available in the market under the name 'Sybograph'. CSIR has also developed a herbal formulation for treatment of prostate cancer and transferred it to a Kolkata-based company for commercialization. The product is available as 'Prostalyn'.

CSIR-800: The programme has a mission to increase per capita income of the economically disadvantaged target group by Rs 5000 annually, i.e. of the 800 million people of India living in the bottom half of the developmental pyramid. The focus areas are 'affordable health', 'sustainable energy', 'waste to wealth', 'potable water', 'low-cost housing', and 'empowering masses through Information and Communication Technologies' (ICT).

As the first of its new endeavours, CSIR launched 'Soleckshaw', an optimally designed, pedal operated-motor-assisted, low carbon emission, urban transport vehicle. It is expected to have four major societal effects, viz. conservation of natural petroleum resources; zero pollution (no exhaust fumes); increased self-employment for the urban and rural poor; enhancement of the dignity of human labour and cutting down of the drudgery and exhaustion of pulling/pedaling traditional rickshaws.

In the area of Sustainable Energy: Central Glass & Ceramic Research Institute (CGCRI) developed solid oxide fuel system towards its commitment to develop sources of sustainable energy. Augmenting its technology for conversion of jatropha to biodiesel, Central Salt and Marine Chemical Research Institute (CSMCRI) installed 1TPD plant in collaboration with Defence R&D Organization, Secundrabad. CSIR joined hands with Research Institute for Sustainable Energy, a section 25 company, to carry out collaborative research in the area of sustainable energy. Another significant achievement, by CGCRI, is development of a process for improvement in fuel efficiency by reducing kiln car mass in pottery industries.

In the area of Ecology & Environment: Institute of Minerals & Materials Technology (IMMT) made an assessment of the level of pollution in the Paradip Port area. In yet another significant achievement National Environmental Engineering Research Institute (NEERI) developed a portable kit for measurement of arsenic in fields. It has made an assessment of carbon sequestration in reclaimed manganese mine land sites. The fog forecast model developed by CSIR-Centre for Mathematical Modelling & Computer Simulation (C-MMACS) has been inducted into national weather service by Indian Meteorological Department beginning November, 2008.

In the area of Biology & Biotechnology: A traditionally strong area of research for CSIR, the laboratories working in this domain contribute through high quality of research output, including basic studies, industrial processes & products. Indian Institute of Chemical Biology (IICB) made a comparative biochemical analysis of purified protein which suggests that Leishmania actin is an unconventional form of actin that could serve as an alternative target for designing novel anti-leishmanial drugs. Central Drug Research Institute (CDRI) reported discovery of two spermicidal compounds (DSE-36 and DSE-37, disulphide esters of carbothioic acid) with extremely potent spermicidal action that killed 100% human sperm at just 4% of EC_{100} of N-9 while remaining practically inert to human cervical cells and Lactobacillus at spermicidal concentration. Another significant contribution is the development by Institute of Genomics and Integrative Biology (IGIB) of 'FishMap', a unified and centralized resource for storage, retrieval, and display of genomic information of zebrafish. A non-recombinant membrane antigen and diagnostic kit thereof was also developed by IICB for detection of Visceral Leishmaniasis and post Kala-azar dermal Leishmaniasis.

In the area of Chemical Technology: Indian Institute of Chemical Technology (IICT) was certified by Organization for the Prohibition of Chemical Weapons (OPCW) as a designated laboratory centre for the off-site analysis of chemical weapons and their degradation products. It also developed a highly economic process for the manufacture of Acethydroxamic acid by which it could produce this acid at Rs. 2500/Kg as compared to the imported price of Rs. 1.2 lakh/Kg. A process has also been developed for preparation of a nontoxic, biodegradable and biocompatible gel- 'chitam gel'. Likewise, a process for fabrication of superhydrophobic multiwalled carbon nanotube buckypaper has been developed at National Chemical Laboratory (NCL). Yet another achievement is development of an integrated process for the recovery of sulphate of potash i.e. sulphate rich bittern from CSMCRI. IMMT designed a pilot plant for beneficiation of iron ore tailings.

In the area of Physical and Earth Science: As a part of International space environment services, National Physical Laboratory (NPL) provides space weather information/alerts (solar flares, solar winds, radiations etc.) to the users like Indian Space Research Organization, Defence etc. For the last 15 years these data have been provided to the Indian Space Research Organization for their use in all its missions including the Chandrayaan-I Mission. NPL has become the full member of the Consultative Committee for Mass and Related Quantities. National Geophysical Research Institute (NGRI) carried out Global Positioning System measurements of post-seismic deformation of Andaman-Nicobar region following the great Sumatra-Andaman earthquake.

In the area of Engineering Design and Structure: Central Building Research Institute (CBRI) developed new bagasse-cement board and panels suitable for use in buildings as panelling material. It also came up with a solution to manufacture portable and cost effective standardized prefabricated housing components/units. During the year, Vulnerability assessment of buildings/structures along Rishikesh-Uttarkashi-Gangotri National Highway was conducted by CBRI scientists. Structural Engineering Research Centre (SERC) developed a Remote Health Monitoring scheme for civil structures which provides simultaneous monitoring of a number of structures.

In the area of Materials and Engineering: CGCRI developed a special variety of photonic crystal fiber having very high nonlinearity and demonstrated its operation in generating wide band supercontinuum source required for various applications, e.g. optical coherence tomography, spectroscopy, metrology etc. CMERI developed an improved cabinet dryer with high drying rate for drying ginger, turmeric and chilli. Yet another significant achievement fabrication of anti-reflecting titanium dioxide film was reported by IMMT.

In the area of Information Science: CSIR continued its efforts towards dissemination of science & technology information in the form of three well-circulated popular science magazines, Science Reporter (English monthly), Vigyan Pragati (Hindi monthly) and Science ki Duniya (Urdu quarterly), popular science books, and 16 scholarly science journals.

Intellectual Property: CSIR has positioned itself from being reactive to giving proactive IP protection by random patenting to planned patenting and designing patenting portfolios based on business plan with commercial and strategic considerations. It has filed 183 patents (unique inventions) in India and 404 patents abroad (multiple jurisdiction) during 2008-09. It now has a portfolio of 1910 patents in India and 2689 patents abroad. Besides, CSIR published 4114 research papers in SCI journals with Average Impact Factor per paper (AvIF) of 2.14.

Resource Base : 2008 -09

1. Infrastructure Resources	Number
• Laboratories/Institutes	37
• Outreach Centres	39
2. Human Resources (As on 1.1.2009)	
• Total Staff	16222
• Total S&T Staff	12065
✦ Scientists (Group IV)	4487
✦ Technical (Group III)	2780
✦ Technical (Group II + I)	4798
• Total Administrative & non-Technical (including isolated staff strength)	5157
3. Financial Resources	(` Crore)
• Government budgetary support	2355.20
✦ Government plan allocation	1154.00
✦ Government non-plan allocation	1201.20

Performance Indicators : 2008 -09

1. Science Output	Numbers	
• Research Papers published (SCI)		
✦ Number	4114	(3858)
✦ Average Impact Factor per paper	2.14	(2.047)
• Patents		
✦ Filed in India	183	(207)
✦ Filed abroad	404	(261)
✦ In force in India	1910	(1246)
✦ In force abroad	2689	(1770)
• Copyrights filed	42	(14)
2. National S&T Human Resource Development		
✦ Research Fellows/Associates Support	8091	(7022)
✦ Emeritus Scientists in position	122	(120)
✦ Pool Scientists (SRAs) in position	135	(148)
✦ Research Schemes supported	918	(829)

Figures in parenthesis correspond to the previous year 2007-08

CSIR-IND
Central Salt & Marine Chemicals Research Institute

S&T Contributions

1.1. Aerospace Science & Technology

CSIR has become an important player in the area of Aerospace research mainly through its constituent laboratories- NAL, CEERI, CSIO, SERC and others. It contributes not only to design and development of aircraft but also helps this strategic sector by way of development of new materials, acoustic sensors for satellites, and carbon composites etc. as under:

1.1.1. Scientific & Technological Achievements

Contribution to Chandrayaan

NAL has been providing extensive Wind Tunnel test support to the nation's space and defence programmes. During the year National Trisonic Aerodynamic Facility achieved its highest productivity; so far of nearly 1800 test runs. India's pride –Chandrayaan-1 satellite was tested at NAL along with the Eutelsat (Fig 1.1).

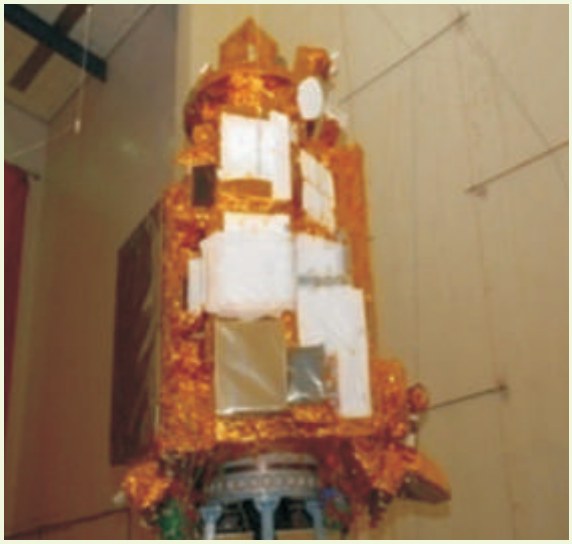


Fig:. 1.1. Chandrayaan-1 (fm)

MEMS acoustic sensor for ISRO PSLV flights

CEERI designed the process steps and fabrication procedure, for microelectro- mechanical sensors (MEMS) and supplied the chips, mounted on headers and wire bonded. These devices underwent 2-3 iterations before meeting the specifications.

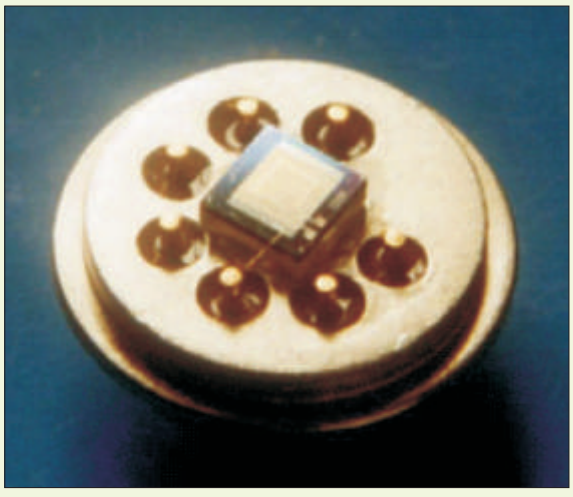


Fig 1.2: Packaged MEMS acoustic sensor used in PSLV Satelite

Zinc oxide layer, deposited by reactive sputtering, was sandwiched between a pair of aluminium electrodes and separated by a thin dielectric layer of 0.1micron deposited by Plasma Enhanced Chemical Vapour Deposition (PECVD) on silicon dioxide. A 25-micron thick silicon diaphragm with cavity was anodically bonded to Pyrex glass. The pressure developed inside the silicon cavity was released through the hole in glass and then a built-in acoustic tunnel was incorporated in the cavity. A patent has been filed on the method for fabricating acoustic tunnel to compensate acoustic pressure using bulk micromachining in MEMS acoustic sensor. The sensor chips were integrated with electronics and housed in a package for sound pressure measurement in launch vehicles of Vikram Sarabhai Space Centre (VSSC).

Technologies of Head-Up Display (HUD) for LCA and HJT-36 aircraft

Flight Trials on LCA – Tejas HUD

The Head Up Display (HUD) is one of the critical modules for Combat Aircraft which provides a comprehensive display of aircraft data superimposed on the world real view under all weather conditions. The technology involves an integrated design approach of electronics, optical and mechanical engineering of military grade standards. Few airworthy HUD units are in use for field trials with Light Combat Aircraft (LCA). Some advanced features like sun glare removal by use of multilayer coating on folding mirror,

Fig 1.3: LCA HUD Image during Flight

internally generated display to take care of display processor failure has also been incorporated. HUD is currently under use by Indian Air Force for fighter aircraft (LCA) and trainer aircraft (HJT-36) applications.

HUD proved its mettle with more than 1000 flights with various versions of LCA–Tejas without failure; field trials of LCA in harsh cold weather of Leh, weapon aiming (the air to air missiles R73 have been test fired successfully from LCA with weapon aiming using HUD), night flying etc., achieved using CSIO technology.

With the indigenous development of HUD technology for LCA, and its transfer to M/s Bharat Electronics Limited, (BEL) India became one of the top five nations having this technology. Technology denial has thus been eliminated and BEL got the production order of HUD for LCA from Aeronautical Development Agency, Bangalore.

HUD for HJT-36 Aircraft

HUD variant for Hindustan Jet Trainer (HJT-36) met all essential Safety of Flight (SOF) standards which cover various stringent tests like random vibration, sinusoidal vibration, mechanical shock, drop test, acceleration, low and high temperature operational & storage test, thermal shock, humidity, salt fog, high altitude & rapid decompression etc.

HANSA

NAL delivered two Hansa-3 aircrafts to the Director General of Civil Aviation (DGCA) during the year. The effort to obtain Civil Aviation Safety Authority of Australia (CASA) certification for Hansa-3 progressed further with completion of additional analysis, structural and flight tests as compliance requirements

Carbon Composite Airframe

NAL supplied Carbon Composite Airframe Components/Assemblies for eight Tejas (LCA) LSP Aircrafts to HAL. The laboratory successfully carried out in-situ hybrid

metal/composite repair of a large crack in the port side Main Landing Gear (MLG) Beam of a MiG - 23 trainer aircraft. After repair the aircraft was put back for operational use. Further, NAL successfully completed in-flight measurement of vibration and temperature on a MIG-29 aircraft for Indian Air Force which will help in generating standards for indigenous design of on-board equipment.

1.2. Biology & Biotechnology

CSIR established a distinct and mature presence in this area by reporting newer and creative R&D solutions by way of high science and product development on regular basis. Its constituent laboratories namely CCMB, CDRI, CIMAP, IGIB, IICB, IIIM, IHBT, IMTECH, NBRI cover a large cross-section of S&T areas from medicinal & aromatic plants to protein engineering to system biology to gene mapping to addressing the need for a cure for Leishmaniasis to transgenic banana plants to new cultivars. The following highlights some of the significant achievements:

1.2.1. Scientific & Technological Achievements

Differential dynamics and stability of lamin: a rod domain mutant

Mutations in the human lamin A gene give rise to highly debilitating diseases termed laminopathies. Laminopathic cells harboring certain mutations in lamin A display aberrant nuclear morphology due to abnormal lamina assembly. To understand the molecular mechanisms involved in these processes, CCMB scientists have studied the dynamics and stability of Green fluorescent protein (GFP)-tagged lamin A construct harboring disease-causing missense mutations in the rod and tail domains of the protein. Analysis of the mobilities of these proteins by fluorescence recovery after photobleaching (FRAP) and fluorescence loss in intensity after photobleaching (FLIP) techniques in live HeLa cells indicated that mutants that formed large aggregates, like E203G, G232E, Q294P and R386K were substantially more mobile than wild-type and mutant lamins H222P and R482L that assembled at the nuclear periphery. Nuclear extractions with detergent, nucleases and salt resulted in the dispersal of large aggregates into smaller foci throughout the nucleoplasm, whereas more stable lamins were retained at the nuclear periphery. The significant alterations in the dynamics and stability of certain rod domain mutants of lamin A are likely to have profound consequences for the organization of nuclear functions.

Functional characterization of mouse WDR-13 protein

Large number of Willson-Disease-Repeat (WDR) proteins are involved in a variety of functions, although only a few of them are characterized for their true physiological roles. As these proteins function in multi-protein complexes, it is rather difficult to individually express, purify, fold and functionally characterize these proteins. Evolutionary conservation of the protein sequence-structure and function is well known. Realizing that WDR13 is an unstable protein and expecting that protein instability could be an evolutionarily conserved property, CCMB scientists analysed a set of WD-repeat proteins for their Protein Instability Index and sequence motifs present in them, employing tool, and by using this information, predicted the physiological functions of WDR13.

Role of tyrosine kinase Ephb4 in the wnt pathway

Most colorectal cancers initiate with mutation in the wnt signalling pathway, which plays

a major role in controlling cell fate along the crypt-villus axis in the small intestine. This results in the upregulation of various intermediates in the pathway, especially Receptor Tyrosine Kinases (RTK's). Eph receptor (largest of the RTK's) activation leads to a number of downstream effects, which influence cell attachment, migration and interaction with ligand-expressing cells. Upregulation of EphB4 has been observed in various tumours by other researchers around the world as well as in CCMB's murine colon cancer models (wnt-upregulated). Upon wnt induction, β-catenin goes nuclear and causes the upregulation of downstream genes like c-myc etc. High level of expression of Ephb4 is also observed in HEK 293 cells upon wnt induction with LiCl and other wnt mutants. Also Ephb4 cDNA can induce wnt pathway its knockdown using RNA interference (siRNA/shRNA) technology helped in downregulating the pathway. Thus Ephb4 is proved to be a wnt inducer and regulator of the wnt pathway. The levels of EphB4 in various human colon cancer samples are being tried to develop this into an assay system for the early diagnosis of colon cancers.

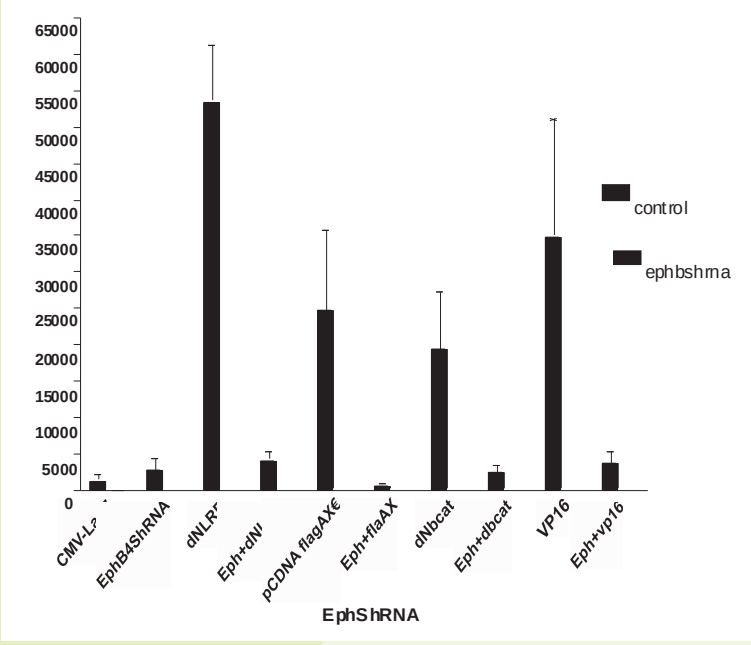


Fig:. 1.4 Upregulation of EphB4

Chemical conversion of the cytotoxic taxoid brevifoliol into its different derivatives and their cytotoxic activity

CIMAP synthesized several taxol-like analogues of brevifoliol by coupling brevifoliol and its oxidized derivatives with 2-monosubstituted-4-phenyl-1,3-oxazolidine carboxylic acid after removal of the protecting group with acid treatment. Brevifoliol and its synthesized analogues were tested for their cytotoxic activity against different cancer cell lines, oral (KB), breast (MCF-7), colon ($CaCO_2$) and liver (HepG-2) as determined by MTT assay. Brevifoliol has turned out to be almost three times more active than taxol against colon cancer cell lines. The C-13 oxidized brevifoliol retained significant activity as compared to brevifoliol. Out of the seven synthesized analogs, C-13 oxidized brevifoliol-5-[N-tert-butoxycarbonyl amino-(2'R, 3'S)-3'-phenyl isoserine] analog was interesting as it exhibited selective and potent cytotoxicity predominantly against liver cancer cell lines.

Anti Helicobacter pylori activity of artemisinin derivatives

Artemisinin, a sesquiterpene lactone endoperoxide derived from Artemisia annua, is an established antimalarial drug. It also has strong anti Helicobacter pylori activity. In an attempt to develop novel anti H. pylori agents, a series of artemisinin analogues, natural and also synthetically derived, were investigated for anti H. pylori activity in vitro. CIMAP has examined sixteen derivatives by disc diffusion sensitivity assay and values of minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC). The antibacterial spectrum has also been assessed against a panel of 10 H. pylori strains, 13 other bacterial strains and 8 fungal strains. The most active compound exhibited MIC ~0.5 μg/ml and MBC ~1 μg/ml against H. pylori while the MIC against other bacteria appeared more than 100 μg/ml. Among all the derivatives, GRB-1 appeared to be the best, and exhibited better potential than its -analogue. Time-kill kinetics of H. pylori strain ATCC 43504 revealed complete killing within 30 h at MIC

dose of GRB-1. The changes in bacterial morphology over time with treatment of GRB-1 indicated drastic damage to cell membranes, as investigated by transmission electron microscopy. Since H. pylori is strongly implicated in the manifestation of gastroduodenal disorders and also gastric cancers, the discovery of potent artemisinin analogues is therefore expected to contribute to current novel therapy for peptic ulcer diseases.

Gallic acid based podophyllotoxin and etoposide analogues as anticancer agents

Podophyllotoxins are lignan compounds possessing potent tubulin polymerization inhibition activity, but are toxic. On modification two of them i.e. etoposide and teniposide showed potent topoisomerase II inhibitors with reduced toxicities. Based on structure and activity relationship along with structure and toxicity relation, CIMAP studied the structural modification of podophyllotoxin by shifting lactone moiety from D-ring to C-ring and further to evaluate importance of ring A for cytotoxicity against human cancer cells and toxicity. Two of the analogues exhibited potent in vitro cytotoxicity against colon cancer cell lines, while five other analogues possessed higher level of cytotoxicity against other human cancer cells. The study revealed that rings A and D are not essentially required for inducing cytotoxicity. p-Demethylated E-ring analogues exhibited better potency than the corresponding methylated analogues. These analogues showed toxicity comparable to podophyllotoxin against human erythrocytes though at much higher concentrations (100 µg/ml). The study provides insights into their Specific Absorption Rate (SAR) which may help in the development of newer anticancer agents.

Antiproliferative and antioxidant activity of *Juglans regia* fruit extracts

CIMAP evaluated methanolic, aqueous methanolic and subsequent partitioned fractions of raw walnut *(Juglans regia L.)* for antiproliferative activity against various human cancer cell lines, i.e. MCF-7 (hormone dependent breast cancer), KB (oral), HepG2 (liver), CaCo-2 (Colon) and WRL68 (liver). These fractions have also been evaluated for their phenolic content, antioxidant and reducing power capacity. Chloroform and ethyl acetate fractions possessed very good antiproliferative activity. In both these fractions, the best activity was found against HepG-2, liver cancer cell line (IC50 = 9µg/mL and 15µg/mL respectively). The results revealed that the raw walnut contained potent antiproliferative activity. Having a rich phenolic content and high antioxidant activity, it may act as cancer protective agent too.

FishMap: a community resource for Zebrafish genomics

FishMap, a unified and centralized resource for storage, retrieval, and display of genomic information of zebrafish has been developed at IGIB. The data are organized into nine major sections, which include comparative genomics, mapping and sequencing, gene and gene predictions, expression and regulation, and variation and repeats. The datasets are linked to related data sources. FishMap is built on the Gbrowse, which is a part of the Generic Model Organism Database Consortium. The database is amenable to programmatic access through the Distributed Annotation System as well as BioMoby protocols, thus making it a central community resource that can be integrated with existing data mining and analysis workflows. Fig 1.5 shows the web page 'FishMap' and cover page of the journal 'Zebrafish' in which the research paper has appeared.

Mitochondrial structural changes and dysfunction are associated with experimental allergic asthma

An imbalance between Th1 and Th2 immune response is crucial for the development of pathophysiological features of asthma. A Th2-dominant response produces oxidative stress in the airways, and it is thought to be one of the crucial components of asthma

Fig: 1.5 Cover page of Web Page 'Fish Map' and Journal Zebrafish

pathogenesis. IGIB scientists demonstrated that Ovalbumin-induced experimental allergic asthma in BALB/c mice is associated with mitochondrial dysfunction. It also reported the association of mitochondrial structural changes and dysfunction with experimental allergic asthma. Studies suggest that mitochondrial structural changes and dysfunction are associated with allergic asthma. These findings may help in the development of novel drug molecules targeting mitochondria for the treatment of asthma. Fig. 1.6 shows the effect of IL-4 mAb or IFN_mAb on airway inflammation goblet cell metaplasia, and OVA specific IgE, IgG1 and IgG2a.

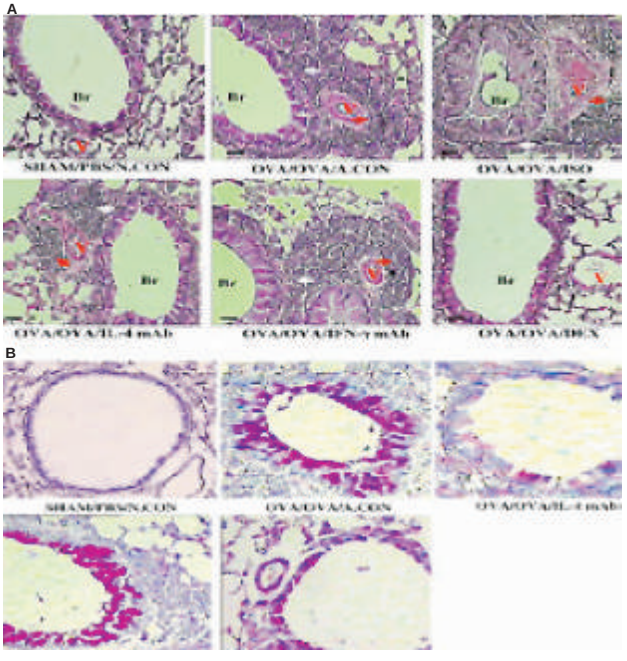


Fig.1.6: Effect of IL-4 mAb or IFN-_ mAb on airway inflammation, goblet cell metaplasia, and OVAspecific IgE, IgG1, and IgG2a levels. A, Representative photographs of H&E staining are shown. Br, bronchus;V, vessel; a, alveolus; red arrows indicate the perivascular inflammation; and white arrows indicate the peribronchial inflammation. OVA/OVA/ISO indicates OVA-sensitized and challenged mice administered isotypic control Ab. Bars, 50 _m. B, Representative photographs of periodic acid Schiff staining were shown. Black arrows indicate the goblet cell metaplasia. Bars, 50 _m. C, OVA-specific IgE (i), IgG1 (ii), and IgG2a

G-quadruplex DNA motifs as regulatory elements

IGIB reported for the first time a strategic approach to modulate quadruplex (G4) regulated gene expression (for example c-Myc expression) by Locked Nucleic Acid (LNA) modified complementary strand as a pharmacological agent utilizing the selectivity and specificity offered by Watson and Crick base pairing. LNA modifications have been found to confer increased thermodynamic stability to the duplex and thus favor predominance of the duplex population over that of the quadruplex structures. This finding has application for trapping quadruplex structures located in promoter regions of several oncogenes. Using a combination of in silico and experimental approaches, it was also concluded that the G-quadruplex, G4 motif has regulatory potential in transcription control.

A novel pressure-induced immunoassay procedure

IGIB invented a novel pressure-induced immunoassay (PIA) procedure. Detection and quantification of an antigen or antibody molecule in a test sample is conventionally carried out by Immunoassay technique. The present invention involves the

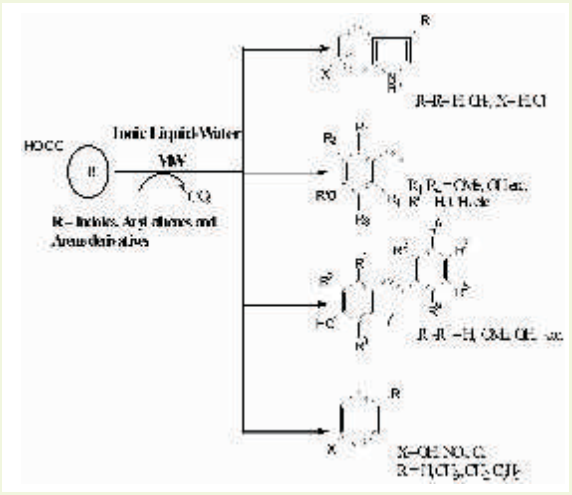


Fig:. 1.7: Schematic of metal-free decarboxylation of N-heteroaryl acids

immobilization of biomolecules onto a solid support by pressure energy followed by Enzyme-linked immunosorbent assay (ELISA) steps by controlled pressure energy. The developed PIA procedure is useful in agriculture, diagnostics, food technology, forensic applications, laboratory research and environmental monitoring. This method involves use of pressure energy to shorten the time of ELISA procedure without changing its ingredients but does not produce heat energy and has the potential for being automated.

Metal-free decarboxylation of N-heteroaryl an d aryl carboxylic acids

Ionic liquids have been introduced as clean catalysts and reaction medium for the metal-free decarboxylation of structurally diverse N-heteroaryland aryl carboxylic acids into pharmaceutically and industrially important indoles, styrenes, stilbenes and arene derivatives under microwave irradiation in aqueous conditions. The decarboxylation of indole and a-phenylcinnamic acids was successfully carried out by IHBT without addition of any metal catalyst in neat 1-hexyl-3 methylimidazolium bromide and 1-methylimidazolium p-toluenesulfonic acid, respectively, while addition of a mild base like aqueous sodium hydrogen carbonate ($NaHCO_3$) to 1-hexyl-3-methylimidazolium bromide further improved the decarboxylation of hydroxylated cinnamic and aromatic acid substrates.

Nucleopolyhedrovirus based biopesticides for management of *Helicoverpa armigera*

There has been great demand for development of eco-friendly biopesticides in view of the increasing concern for adverse health and environmental effects of pesticides used in agriculture. Entomopathogenic viruses constitute an important group of biopesticides. The polyphagus lepidopteron pest *Helicoverpa armigera* has shown resistance against almost all chemical pesticides. A highly efficacious local strain of nucleopolyhedrovirus (HaNPV) was isolated and tested against *H. armigera* by IHBT. The molecular characterization confirmed it as a new indigenous strain. The strain has shown higher efficacy than the market product. The biopesticide starts inducing larval mortality within a week after treatment with typical symptoms being larvae hanging by their abdominal legs. Various aspects of formulation development are being assessed for commercialization and prospect of transferring the technology to farmers through rural entrepreneurship.

Characterization of minor aroma components for Kangra Tea

Characterization of minor aroma components in orthodox black tea associated with uniqueness of quality in relation to geographical location is essential for bestowing 'Geographical Indication' to Kangra tea. IHBT has identified 138 aroma compounds from Kangra tea. The volatile components detected included geraniol, linalool, linalool oxides (both furanoid and pyranoid), trans-2-hexenal, phytol, β-ionone, 1-ethyl-2-formyl pyrrole, methyl salicylate and 3,7-dimethyl-1,5,7-octatrien-3-ol. Apart from these

components, 6,10,14-trimethyl-2-pentadecanone, nerolidol, methyl palmitate, cis-3-hexenyl hexanoate, geranic acid, palmitic acid, octanoic acid, isovaleric acid 2-ethyl-6-methyl pyrazine, 2-ethyl-3-methyl pyrazine, Z-2-hexenyl caproate and methyl pyrazine were identified as the important minor compounds. The minor components which appeared responsible for unique flavour included 2-amylfuran, 1-pentanol, epoxylinalool, cis-jasmone, 2-acetyl pyrrole, farnesyl acetone, cadinol. The volatile compounds α-irone, 2,7-epoxymegastigma-4,8-diene and 1,3-dioxalane have been identified for the first time in tea. The geographical indication in terms of distinctiveness of aroma components is value addition for commerce with respect to Kangra tea.

Caspase-independent algorithm of programmed cell death in Leishmania induced by baicalein: the role of LdEndoG, LdFEN-1 and LdTatD as a DNA 'degradesome'

In the post-genomic perspective, the quest of programmed cell death (PCD) mechanisms in kinetoplastid parasites lies in the identification and characterization of cell death executer proteins. IICB showed that baicalein (BLN), a potent topoisomerase IB inhibitor, generates an oxidative stress in the parasites leading to altered physiological and morphological parameters, which are characteristic of PCD. For the first time it has been elucidated that, caspase-independent activation of a novel effector molecule, endonuclease G (LdEndoG), mediates BLN-induced cell death. Functional characterization of LdEndoG identifies Flap endonuclease-1 (LdFEN-1) and LdTatD-like nuclease as other effector molecules. BLN treatment translocates LdEndoG from mitochondria to nucleus, where it forms separate complexes with LdFEN-1 and LdTatD to constitute a DNA 'degradesome' unique to these parasites. Conditional antisense knockdown of LdEndoG provides protection against PCD. This knowledge paves the path toward a better understanding of the PCD pathway in simpler systems, which could be exploited in anti-leishmanial chemotherapy.

Molecular signature of hypersaline adaptation: insights from genome and proteome composition of halophilic prokaryotes

Identification and analysis of distinct macromolecular characteristics of halophiles provide insight into the factors responsible for their adaptation to high-salt environments. IICB could present an extensive and systematic comparative analysis of genome and proteome composition of halophilic and non-halophilic microorganisms, with a view to identifying such macromolecular signatures of haloadaptation. Comparative analysis of the genomes and proteomes of halophiles and non-halophiles revealed some common trends in halophiles that transcend the boundary of phylogenetic relationship and the genomic Guanine-cytasine (GC)-content of the species. At the protein level, halophilic species were characterized by low hydrophobicity, over-representation of acidic residues, especially Asp, under-representation of Cys, lower propensities for helix formation and higher propensities for coil structure. At the DNA level, the dinucleotide abundance profiles of halophilic genomes bore some common characteristics, which are quite distinct from those of non-halophiles, and hence may be regarded as specific genomic signatures for salt-adaptation. The synonymous codon usage in halophiles also exhibits similar patterns regardless of their long-term evolutionary history.

Non-recombinant membrane antigen and diagnostic kit for detection of Visceral Leishmaniasis and PKDL

IICB invented a non-recombinant membrane antigen and diagnostic kit for detection of visceral Leishmaniasis. The kit provides a non-recombinant membrane antigen (LAg) obtained directly from promastigotes of *Leishmania donovani* strain AG83, wherein the said membrane antigen (LAg) being characterized by a complex of 25-35 polypeptides

having molecular mass in the range of 18 - 155KDa and having sensitivity and specificity in the range of 95 - 100% to anti-Leishmanial IgG antibodies is present in the serum of patient suffering from Visceral Leishmaniasis (VL) or post kala-azar dermal leishmaniasis (PKDL).

The kit also provides a process for the preparation of the said membrane antigen and the method of using it for the detection of anti-Leishmanial IgG antibodies present in the serum of patient suffering from visceral Leishmaniasis (VL) or post kala-azar dermal Leishmaniasis (PKDL).

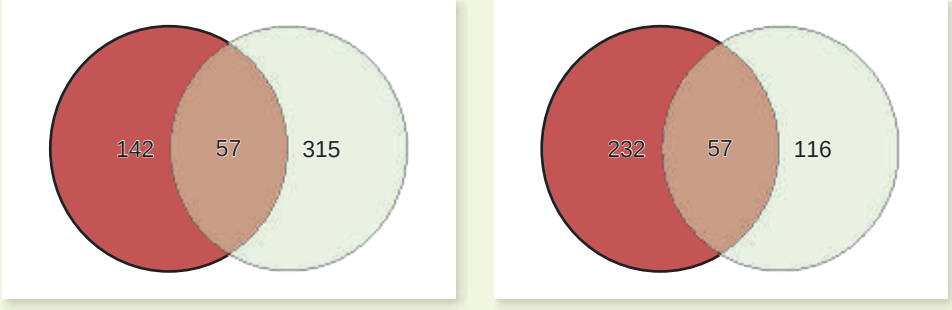
Biodiversity assessment, prospection and conservation of plant resources of India

NBRI collected, during the period, two-hundred accessions, representing 15 species of Berberis, along with location data from Himachal Pradesh, Uttarakhand, Madhya Pradesh and Tamil Nadu. High quality genomic DNA was isolated from these accessions. Six primer sets, belonging to three genes i.e. rpoB, rpoC1 and matK, were selected. Sequences of 48 samples using rpoC1-1, rpoC1-2 and 40 sequences of rpoB-1 and rpoB-2 from different Berberis species were analysed. However, there was no variation at sequence level among the samples. This indicates that both the regions may not be suitable for barcoding in Berberis. The reported matK primer failed to give any polymerase chain reaction (PCR) amplification. A modified matK primer was designed and named matK-nbri.
Data analysed, so far, indicate it as a superior barcoding marker for Berberis followed by trnH-psbA and matK, though none of these and other commonly used markers (rpoB, rpoC, rbcL) distinguish Berberis at species level.

High throughput marker assisted selection system for improvement of drought tolerance and fibre quality related traits in cotton

NBRI team selected JKC725 as a superior parent and JKC703 as an inferior parent for the detailed microarray studies. The microarray was carried out at six different stages of fibre development, viz. 0dpa, 6dpa, 9dpa, 12dpa, 19dpa and 25dpa. The microarray experiment for the fibre quality resulted in selection of 10 genes, each for fibre initiations, elongation and secondary cell wall thickening stage.

Detailed microarray of two contrasting parents at different developmental stages, viz. cotyledon, first leaf and flowering stage were generated. The microarray analysis resulted in several potential genes for the drought tolerance in cotton. Many of these genes are validated by real time analysis. Transcriptome sequencing from leaf and root of drought-treated three germplasms of cotton was performed. The sequencing data resulted in identification of 21,836 genes, out of which 14,000 were unique. Using microarray and transcriptome sequencing, 10 genes for leaf and 10 for root were selected for further validation. Fig. 1.8 shows upregulated and downregulated genes.



142 unique genes of Tolerant *315 unique genes of Sensitive*
Up regulated genes

323 unique genes of sensitive *116 unique genes of Tolerant*
Down regulated genes

Fig: 1.8

Transgenic banana plants

During the year NBRI developed transgenic banana plants using different constructs. These target plants were developed for fruit specific repression of the MaMADS, MaEXP1 and MaNAP genes by antisense expression and sense and antisense expression of the MaEXPA2 gene. All the genes were driven by acyl CoA oxidase (ACO) promoter for fruit specific expression. The constructs were introduced both in Rasthali (AAB genome, NR) and Robusta (AAA genome, R). In addition, transgenic banana plants were also raised for the study of the promoters of MaEXP1 gene and the MaIFR genes. In order to confirm the integration of transgene and promoters in these lines, DNA was isolated from a small portion of the leaves and PCR amplified using primers specific to the MaACO promoter (forward primer) and the NOS terminator (reverse primer) for those constructs that contained genes in sense and antisense orientation. For those constructs prepared for the study of promoters, amplification was carried out using the primers 101F and GusR. Fig 1.9 shows a representative amplification of MaMADS gene in putative transgenics.

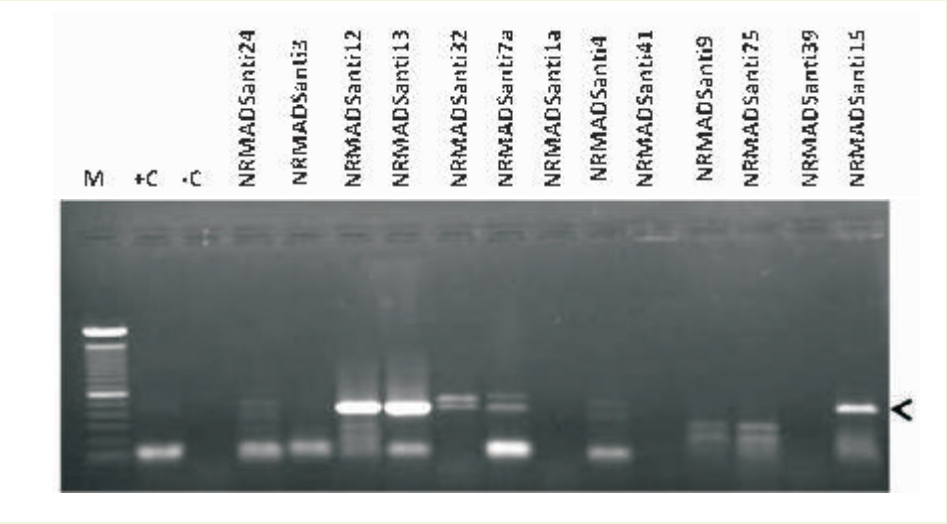


Fig.1.9: PCR analysis of banana transgenic plants with antisense MaMADS genes. M. 100 bp size marker, +C and -C are positive and negative controls respectively

Genetics and mechanism of induced male sterility in Andrographis paniculata

Andrographis paniculata is predisposed for selfing due to its floral architecture and overlap of male and female phases. On account of its obligate inbreeding nature, small flower size, intimate proximity of minute reproductive parts and their vulnerability to mechanical injuries during manual emasculation, it is extremely tedious and laborious to emasculate the flowers to harness the benefits of intervarietal hybridization. To obviate some of these bottlenecks, IIIM scientists explored the possibility of inducing male

Plant habit: Indeterminate shoot of Andrographis paniculata (a), pollen (P) clogged stigma (S) adpressed to transversely (TS) dehiscent anthers (A) provides for obligate autonomous selfing (Bar = 120 µm) (b). Fig 1.10

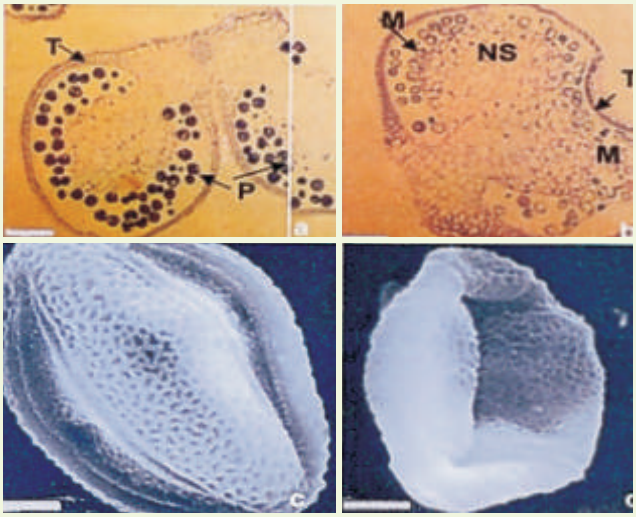


Fig 1.11 Semi-thin sections of bisporangiate fertile and sterile anthers: Stained viable pollen (P) and intact tapetum (T) of male fertile anther (BAR = 100µm) (a), unstained aborted microspores (M), hypertrophied non-sporogenous tissue (NS) invading the locule of male sterile anther (Bar = 100 µm (b), scanning electron micrographs of fertile pollen (Bar = 5 µm) (c) and of sterile pollen (Bar = 5 µm) (d)

sterility in order to emasculate the flowers genetically with the twin objective of optimizing its genetic amelioration, and also to enrich the germplasm resource base. A. paniculata was emasculated by induction of genic male sterility with ?-irradiation. Male sterility was conditioned by a single recessive genic mutation that acted upon the tapetal layer surrounding the pollen sac and was also manifested as hypertrophied non-sporogenous tissue, invading the anther locule. Female fertility remained unimpaired and fully intact. Inter-varietal hybridization resulted in positive heterosis in many yield attributes and metabolic pathway elaboration/intensification. Cross mating facilitated as a consequence of genetic emasculation of APJ 013 with male fertile APJ 020 as a pollen donor, yielded F1 progeny that exhibited positive heterosis in many yield attributes over both the parents. About 39 % increase in dry leaf biomass, 22 % higher seed output per unit leaf area, improved seed germinability (91.13 %) etc. are testimony to the immense breeding value of induced genic male sterility in A. paniculata. The progeny obtained was also quantitatively different from both the parents with regard to bioactive constituents. There was appreciable enhancement in the concentration of all the constituents and the overall increase (more than two fold) in the yield of total andrographolides (7.33 %) when compared with the mean value (3.215 %) of both the parents. Genic male sterility offers tremendous scope for qualitative and quantitative improvement of A. paniculata through intervarietal hybridization.

Versatile sexual mechanism ensures robust genetic and chemical polymorphism in Withania somnifera

Reproductive excellence holds the key to the sustenance, genetic improvement and evolution of any species. *Withania somnifera* presents a versatile sexual polymorphism of

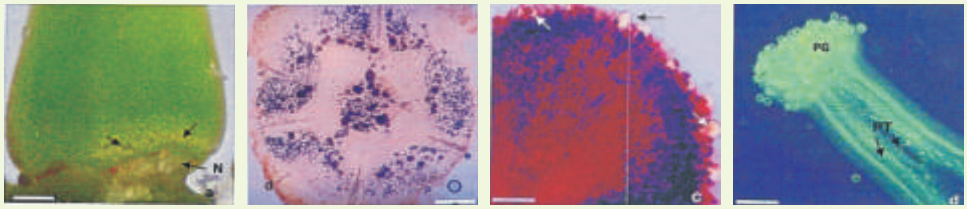


Fig 1.12 a: Nectariferous ovary base N showing nectar exudates (see, arrows) (Bar = 295 µm) (a), cross section of the nectariferous ovary base revealing nectar accumulation (dark spots) in parenchyma tissue (Bar = 286 µm) (b), stigmatic receptivity marked by lipiodal secretions all over (Bar = 105 µm) (c), fluorescence micrograph showing stigma clogged with germinating pollen grains PG and part of stylar region with fluorescing pollen tubes PT (Bar = 242 µm) (d).

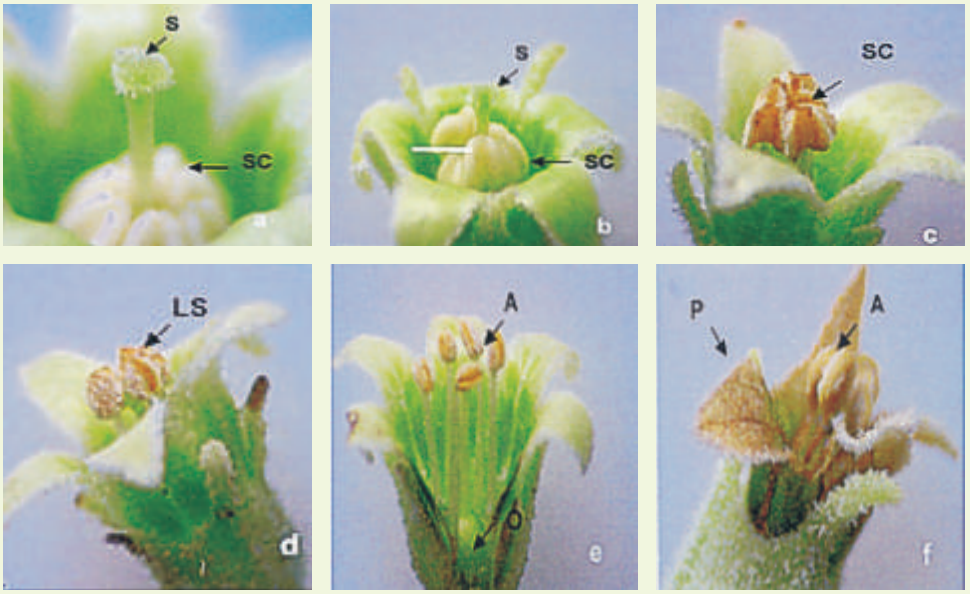


Fig: 1.12 b A flower of Withania somnifera just after anthesis showing papillate, globose, exserted stigma S beyond the staminal cone SC (a), relative position of receptive stigma S and staminal cone SC after two days of anthesis (b), staminal cone SC connivent about the receptive stigma after 3 days of anthesis (anther dehiscence stage) (c), arrow head showing pollen presentation through longitudinal slit LS on outer of the stigmatic side (d), ovary O after fertilization and reflexed-dehisced anthers A (e), abscising petals P and anthers A after 6-7 days of anthesis (f). Bars = 1 mm.

mixed mating. Experiments conducted by IIIM indicate that individual flowers exhibit partial temporal dichogamy of protogynous type, under which receptive stigma remains exserted beyond the undehisced staminal cone to receive cross pollen through insect vectors. In a probable situation of non-receipt of pollen through insect pollinators, autonomous fertilization is guaranteed by the upward staminal increase to form a cone connivent about the receptive stigma. Functional dimension and floral configuration suggests that crossing and autonomous selfing are mutually exclusive as the self-pollen arrives late during the floral ontogeny. Seed set efficiency and fruiting success are not influenced by pollen genotypes (self/cross) under different pollination treatments (autogamy, geitonogamy and xenogamy). Preemergent reproductive success (PERS) averages 37% with open pollination. Deoxyribonucleic acid (DNA) content (chromatin length 47.51 µm at somatic metaphase) is distributed asymmetrically among 24 chromosomes (2n = 48). Meiotic system reveals high recombination index (71.2). In accordance with the theoretical predictions for mixed mating, intermediate levels of heterozygosity are maintained. This was illustrated by the proportion of polymorphic loci calculated as Shannon index employing Random Amplification of polymorphic DNA (RAPD). High pollen-ovule ratio (631.77), pronounced protogyny, copious nectar production and insect visitation provide for strong out crossing. However, small flower size, high seed to ovule ratio (0.76) and moderate fruit to flower ratio (0.49) are in conformity with the prediction of 'reproductive assurance hypothesis'. Mixed mating and the efficient meiotic recombination system provide a reliable strategy that guarantees reproductive success and genetic polymorphism in 'with you' or 'without you' pollinator

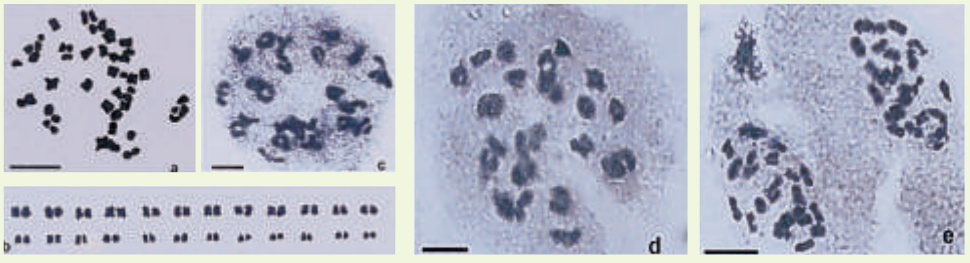


Fig:1.12 c Somatic metaphase spread showing 48 (a), the karyoidiogram thereof depicting 10 M + 9 SM + 5 ST chromosomes (b), diakinesis (c), meiotic metaphase-I presenting 24 (d), late anaphase-I showing normal 24:24 disjunction (e) Bars = 10µm.

environment. Both conceptually and empirically, manipulative hybridization has implications for breaking the metabolic blocks and production of novel bioactive molecules as the species displays an efficient genetic system.

Mechanism of liver toxicity of anti-tubercular drugs

Tuberculosis has become global menace particularly for developing countries. IIIM research work shows that anti-TB drugs remain targeted at hepatocytes and the endothelium of the bile ducts leading to altered serum profile. Mild hyperlipidemia, hypercholesterolemia, and hyperuricemia were the other pathologies observed. The results do not suggest any noticeable toxicity by rifampin and pyrazinamide individually, but the effect seems to aggravate in presence of isoniazid which seemed to be the major contributor in the overall toxicity profile. It has been suggested that the underlying mechanism of toxicity is related to: disruption of membrane integrity and function; imbalance in oxidant/antioxidant balance; bio-activation mediated by cytochrome P450 2E1; and abnormal rise in intracellular calcium.

This model has also been used to develop plant-based agents against anti-TB drugs induced liver toxicity. It is an attempt to access the biochemical, hematological, cellular and histological changes that occur due to daily administration of anti-TB drugs either alone or in combinations (i) rifampicin + isoniazid and (ii) rifampicin + isoniazid + pyrazinamide.

Insight into TNF-α inhibition through in silico approach

In order to understand the exact mechanism of reaction trimeric form tumor necrosis factor (TNF)-alpha inhibition, IIIM performed *in silico* studies on the target TNF-α involving docking studies on both forms of TNF-alpha, i.e the trimeric form as well as the dimeric form. In silico experiments were performed using Ligfit module of cerius2. In the present study, two natural products new to literature (NP-1, NP-2) and one known compound (rolipram), shown to supress TNF-α activity in the wet lab, were used to study the mode of inhibition of the selected target. The protein targets were downloaded from the Protein Data Bank viz., 1TNF and 2AZ5 (dimeric form) Analysis of the docking results and the molecular interactions revealed that the ligand NP-2 binds with the overall better affinity with TNF-α, when compared with NP-1 and rolipram. It is also observed that NP-2 is involved in three H-bond formation with chainA of the dimer and one of them being with Tyr151. It may be inferred here that this H-bond prevents the dimer to form the active trimer again This explains the first mode of inhibition, i.e the inhibitor functions actively by interacting with TNF-α trimer to promote the dissociation of a

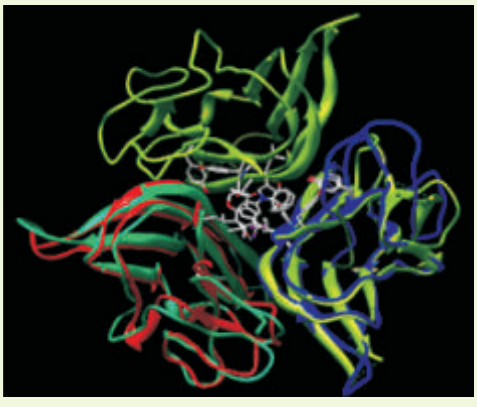


Fig: 1.13 a 3D-Structure of TNF-α and its bound ligand

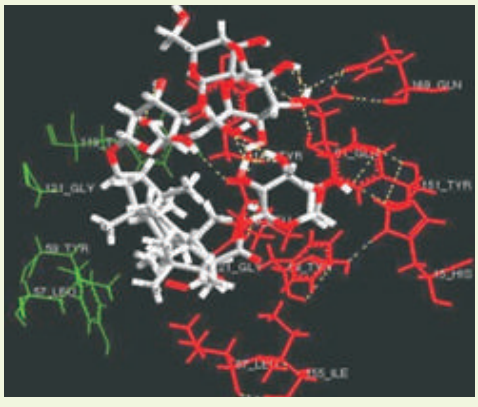


Fig: 1.13 b Interaction of SAP2 with the active site Residues of 2AZ5

subunit to form TNF-α dimer (pre-dissociation dependent) and once this dimer is formed, the ligand binds to it in such a fashion that it prevents the target from returning to its active (trimeric) form.

Caerulomycin A: an immuno-suppressive drug

IMTECH isolated a bipyridyl compound from a novel species of actinomycetes Actinoalloteichus spitiensis from the Himalayan region which inhibits the proliferation of activated lymphocytes, especially $CD4^+$ T cells (both Th1 and Th2) and B cells, which are the cornerstone of adaptive immunity. It also suppresses the production of cytokines. Further, it delays the onset of rejection of skin allografts in mice. The bioactive compound is identified and characterized as Caerulomycin A. The molecule is of immense interest because it exhibits better immunosuppression than the drugs that are currently in clinical use. The molecule, which has been licensed to a USA company, may have use in the survival of transplants and treatment of autoimmune diseases.

New cultivars registered

'Aruna': NBRI has developed a gamma ray mutant of 'Palekar' with drooping branching habit; leaves 6.8 x 3.8 cm, light green, margin curled inward; mature bracts - Azalia Pink (523/1), young bracts - Orange (12/1); recurrent bloomer; good for 'standard', cascade, hanging basket, mound and pot plant.

A canna cultivar 'Agnishikha' was registered as a new cultivar with National Bureau of Plant Genetic Resources, New Delhi and accorded accredition certificate.

Genomics of emerging geminiviruses by application of ϕ-29 DNA polymerase

Geminiviruses are one of the most important plant pathogens in the tropical world. Understanding the molecular biology of these viruses is a pre-requisite for management. IHBT has conducted surveys in solanaceous crops growing areas particularly, on tomato, potato and chilli. Initial detection was carried out by slot-blot hybridization and PCR based methods. Full genome amplification and characterization of important isolates were done using rolling circle amplification (RCA) method. A distinct bipartite Begomovirus species was found associated with severe leaf curl disease of tomato, whole genome of which was sequenced (GenBank Accession numbers AM884015 and AM992534) and a name 'Tomato leaf curl Palampur virus' was proposed. Whole genome cloning and sequencing of another distinct monopartite Begomovirus species and a satellite DNA-β infecting chilli plants was carried out through RCA. A name 'Chilli leaf curl India virus' was proposed for this species (GenBank Accession numbers FM877858 and FM877803). Whole genome of Tomato leaf curl New Delhi virus causing apical leaf curl disease was also cloned and sequenced through RCA (GenBank Accession numbers AM850115 and FN356024).

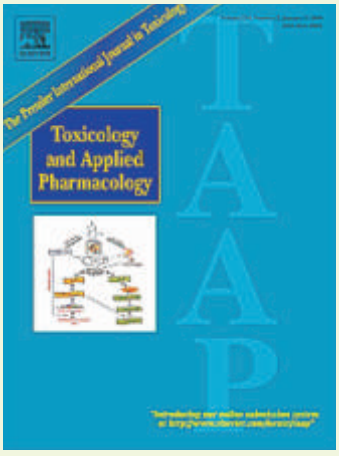
Genetic improvement in Jatropha

CSMCRI's continuous efforts in bioenergy domain led to the identification of superior genotypes of Jatropha for semi-arid conditions of Gujarat. In the absence of sufficient information regarding the suitable germplasm of Jatropha for specific areas, it is necessary to identify the genotypes for different type of wastelands before embarking upon its commercial plantations. The plants may survive and look green but may not be productive enough to translate into viable economics. A provenance trial was laid out in Randomized Block Design. The trial was conducted in a semiarid ecosystem where annual rain fall (400-700 mm) is 2-3 times less than evapo-transpiration. Observations were recorded on phenological and yield contributing characters in all the provenances

and observed ratio of male and female flowers fluctuated tremendously and did not significantly influence the yield. Fruit set percentage looked to be more important and was recorded in different provenances.

Patulin causes DNA damage leading to cell cycle arrest and apoptosis through modulation of Bax, p53 and p21/WAF1 proteins in skin of mice

Patulin (PAT), a mycotoxin found in apples, grapes, oranges, pear and peaches, is a potent genotoxic compound. World Health Organization has highlighted the need for the study of cutaneous toxicity of PAT as manual labour is employed during pre and post harvest stages, thereby causing direct exposure to skin. IITR has evaluated cutaneous toxicity of PAT following topical application to Swiss Albino mice. Dermal exposure of PAT to mice for 4 h resulted in a dose (40-160 µg/animal) and time (up to 6 h) dependent enhancement of ornithine decarboxylase (ODC), a marker enzyme of cell proliferation. The ODC activity was found to be normal after 12 and 24 h treatment of patulin. Topical application of PAT (160 µg/100 µl acetone) for 24-72 h caused (a) DNA damage in skin cells showing significant increase (34-63%) in olive tail moment, a parameter of Comet assay (b) significant G 1 and S-phase arrest along with induction of apoptosis (2.8-10 fold) as shown by annexin V and PI staining assay through flow cytometer. Moreover, PAT leads to over expression of p21/WAF1 (3.6-3.9 fold), pro apoptotic protein Bax (1.3-2.6) and tumor suppressor wild type p53 (2.8-3.9 fold) protein. These results suggest that PAT has a potential to induce DNA damage leading to p53 mediated cell cycle arrest along with intrinsic pathway mediated apoptosis that may also be correlated with enhanced polyamine production as evident by induction of ODC activity, which may have dermal toxicological implications.



1.14 Cover page of TAAP Journal showing the evaluated cutaneous toxicity of PAT

Responsiveness of cerebral and hepatic cytochrome P450s in rat offspring prenatally exposed to lindane

Prenatal exposure to low doses of lindane has been shown to affect the ontogeny of xenobiotic metabolizing cytochrome P450s (CYPs), involved in the metabolism and neurobehavioral toxicity of lindane. IITR investigated the responsiveness of CYPs in offspring prenatally exposed to lindane (0.25 mg/kg b. wt.: 1/350th of LD50: p. o. to mother) when challenged with 3-methylcholanthrene (MC) or phenobarbital (PB), inducers of CYP1A and 2B families or a sub-convulsant dose of lindane (30 mg/kg b. wt., p. o.) later in life. Prenatal exposure to lindane was found to produce an increase in the mRNA and protein expression of CYP1A1, 1A2, 2B1, 2B2 isoforms in brain and liver of the offspring at postnatal day 50. The increased expression of the CYPs in the offspring suggests the sensitivity of the CYPs during postnatal development, possibly, to low levels of lindane, which may partition into mother's milk. A higher increase in expression of CYP1A and 2B isoenzymes and their catalytic activity was observed in animals pretreated prenatally with lindane and challenged with MC (30 mg/kg, i.p.x5 days) or PB (80 mg/kg, i.p.x5 days) when young at age (approx. 7 weeks) compared to animals exposed to MC or PB alone. Further, challenging the animals of control group and prenatally exposed offspring with a single sub-convulsant dose of lindane resulted in an

earlier onset and increased incidence of convulsions in the offspring prenatally exposed to lindane indicating the sensitivity of the CYPs in the prenatally exposed offspring. These results assume significance as the subtle changes in the expression profiles of hepatic and cerebral CYPs in rat offspring during postnatal development could modify the adult response to a later exposure to xenobiotics.

Biocontrol potential of tortoise beetle *(Aspidomorpha miliaris)* on *Ipomoea carnea* in Assam, India

Ipomea carnea, a plant native of South America, a noxious aquatic weed with rapid vegetative growth and high invading powers has spread in all districts and threatens native flora and fauna of aquatic fresh water habitats in Assam. It can spread rapidly in crop lands and protected wildlife reserves, where it produces a huge biomass of 17.93 tons per hectare. Chemical pesticides are often recommended but found to contaminate water and are a threat to aquatic flora and fauna. Mechanical control method is too expensive. Therefore, biological control of this weed is the appropriate option for its management. NEIST studies found that A. Miliaris is a potential control agent for *Ipomea carnea* in India.

1.3. Chemical Sciences & Technology

This has traditionally been CSIR's strong area since its inception. CSIR is a major contributor for the growth and maturity of chemical industry in India. CSIR Laboratories namely IICT, CECRI, CSMCRI, IIP, NCL, and NIIST contribute significantly in the form of development of new products, economic and efficient processes etc., in the domain. All these also enjoy strong linkages with industries.

1.3.1. Scientific & Technological Achievements

A simple chemosensor for Hg^{2+} and Cu^{2+} that works as a molecular keypad lock

CSMCRI developed a simple chemosensor for biologically important ions such as Hg^{2+} and Cu^{2+} synthesized molecules. 1-Amino-8-Napthalene Sulphonic acid Ester (ANSE), together with certain ionic inputs in a specific sequence, could mimic the operation of an electronic keypad lock, e.g., a common security circuit. It can be used for numerous applications, in which access to an object or data is to be restricted to a limited number of persons. This lock is different from a simple molecular logic gate in that its output signals are dependent not only on the proper combination of the inputs but also on the appropriate sequence in which these inputs are introduced (Fig 1.15). Thus, one needs to know the exact sequence of inputs or passwords that opens this lock. This not only opens the way for a new class of molecular decision-making devices but also adds a new dimension of protection to existing defence technologies, such as cryptography and steganography.

Fig. 1.15 The fluoresence chemosensor : a basic molecular keypad lock

Syntheses of exfoliated hydrotalcites

CSMCRI synthesized exfoliated hydrotalcites CoAl-LDH (layered double hydroxide) in both aqueous and organic medium using different hydrolyzing agents such as urea or hexamine under different hybrid operative conditions like hydrothermal, aging, ultrasound and microwave. Preliminary results show that under optimized conditions, exfoliated hydrotalcites (HTs) could be successfully synthesized, although co-presence of crystalline form high temperature HT-like phase can not be completely avoided. Similar

Fig 1.16 Laser light passing through CoAl exfoliated sample

methodology is also extended for NiAl-LDH and exfoliated phase was successfully obtained under optimized synthesis conditions. Further, the exfoliated HTs did not settle upon standing even for days together (> 180 days). A pictorial representation of exfoliated HTs has been shown in fig 1.16. Such exfoliated HTs can be used for the selective removal of noxious anions in trace concentrations.

Nanocomposite polymer electrolyte membrane

CSMCRI developed a method for preparing sulphonated poly (ether-ether-ketone) (SPK)-zeolite-zirconium hydrogen phosphate (ZrP) nanocomposite polymer electrolyte membrane (PEM) by in situ infiltration and precipitation. This is the first report of the infiltration of zeolites in the pores/cavities created by water soluble surfactant in the polymer electrolyte, for accommodating proton conductor. Thermal, mechanical strength, oxidative and dimensional stabilities of SPK membrane were improved and water retention capacity was increased due to infiltration of zeolite and surface modification with ZrP, which are essential for PEM. These nanocomposite membranes showed slightly lower proton conductivity (2.91-3.35x10^{-2} S cm^{-1}) and markedly lower methanol permeability in comparison to Nafion 117 (N117) membrane. Although, developed SPK-zeolite-ZrP nanocomposite PEMs offered no significant advantages over SPK or N117 membrane at 30 °C, but at 70 °C they exhibited nearly same conductivity to N117 membrane. Also extremely low methanol permeability of these PEMs enhanced their selectivity parameter about three times at 70 °C in comparison to N117 membrane, and indicated suitability of these PEMs fuel cell applications at moderate temperature. Furthermore, these PEMs can be identified as potential candidate for providing new technological applications in high temperature electrochemical devices including ion separations, water electrolysis, and electro-chemical sensors. Fig. 1.17 shows

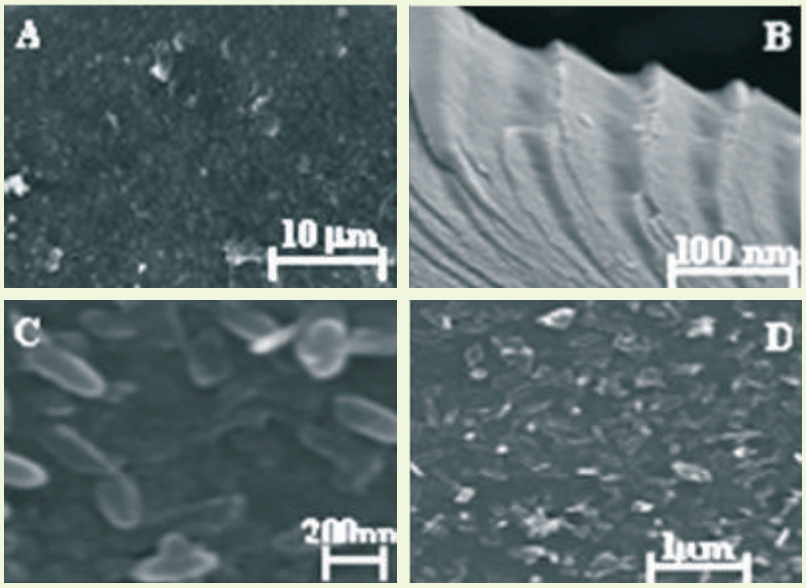


Fig. 1.17 SEM images for: (A) SPK membrane after leaching out CPC, (B) cross-section showing the pores formed due leaching out CPC, (C) SPK zeolite-2 membrane in high resolution, (D) SPK-zeolite membrane in low resolution

micrographs for SPK membrane at various stages of processing.

Sulphur reduction in the naphtha product obtained by fluid catalytic cracking

IIP developed an adsorption- based process for desulphurization of Fludized Catalytic Cracking (FCC) gasoline. A unique vapor phase adsorption process has also been developed, which can be integrated with a conventional naphtha hydrodesulphurization (HDS) process to produce ultra low sulphur gasoline. The process developed is expected to reduce the sulphur levels to below 30 ppm with minimum octane loss. A basic engineering process package has been prepared based on an actual naphtha HDS unit operating in an Indian refinery. Commercialisation of this technology in the refining sector will have enormous benefits, both economic as well as social, as it will make production of "clean fuel" cheaper and it will be a step towards better environment management with respect to emissions control for refineries.

IICT certified as OPCW designated Laboratory

IICT has been certified by Organization for the Prohibition of Chemical Weapons (OPCW) as a designated laboratory for the off-site analysis of chemical weapons and their degradation products. IICT is the only non-Defence lab which has been so designated. Chemical Weapons Convention (CWC) is an international treaty that prohibits production, storage and use of Chemical Warfare Agents (CWAs) through its verification programme. Verification involves on or off-site analysis of samples collected from suspected sites by the inspectors appointed by OPCW. There are 190 member countries and only 20 designated laboratories all over the world, and IICT is one of them. To achieve the status of designated laboratory, a laboratory must prove its analytical capability to analyze CWAs and related compounds (CRCs) in Official Proficiency Tests (OPTs) conducted by OPCW. This is a significant contribution of CSIR for the country on the disarmament of chemical weapons.

Process Technology for Acetohydroxamic Acid

Acetohydroxamic Acid (AHA) is used in partitioning of plutonium from the spent nuclear fuel. In view of nuclear agreement, it is mandatory for India to process the spent fuel. In this regard, AHA is an important chemical, which is not indigenously available.

IICT developed a techno-economic process for AHA as no adequate method was available to Indian industry. Through this process, AHA can be produced at the cost of Rs. 2500/- kg, which is much cheaper in comparison to the imported AHA. The optimised process for preparation of AHA gives good yields and high purity product. The process is unique in the sense that no aqueous effluents are formed and solvents used in the process are totally recovered and recycled.

Universal reagent for spectrophotometric estimation of polymer-supported functional groups

A new universal reagent, 2-O-[2-(4,4'-dimethoxytrityloxyethyl)]-hydroxy acetaldehyde (DEA), has been synthesized by IGIB which is used for the estimation of surface-bound aminoalkyl, aminooxyalkyl, hydrazinyl, and semicarbazide functions. The reaction completes in 10 minutes in the case of aminoalkylated supports and 30 minutes in hydrazinyl supports, whereas it takes approximately 60 minutes for both aminooxyalkylated and semicarbazide-modified polymer supports. DEA-treated supports, including glass slides and PP films on exposure to acid, liberates 4,4'-dimethoxytrityl cation, which was measured spectrophotometrically to estimate these functionalities. The method estimates accessible functional groups, useful for calculating the quantity of the ligands to be immobilized.

Solvent free synthesis of 1,4-dihydro pyridines

NEIST achieved a simple, green and cost-effective protocol for the solvent-free synthesis of 1,4-dihydropyridines [key intermediate for a cardiovascular drug] catalyzed by $AlCl_3.6H_2O$ as a mild and effective catalyst at 60 °C in high yields. 1,4-Dihydropyridines thus formed were aromatized to pyridines by in situ generation of HOCl employing $AlCl_3.6H_2O/H_2O_2/H_2O$/EtOH as an excellent reagent system under domestic microwave irradiation (MWI). Both the synthesis and oxidation steps were efficiently accomplished in one pot, four-component fashion following the same protocol. The reaction fulfills the requirement of green chemistry and the concept may be utilized /explored in developing green methods and technology.

Chitam gel

NIIST invented a process for the preparation of a colourless, crystal clear, nontoxic, biodegradable and biocompatible gel named 'Chitam gel'. It is prepared from xyloglucan and chitosan co-polymer in a definite ratio and both the ingredients are from renewable resources. The gel is made by modifying the xyloglucan to form dialdehyde of xyloglucan and making a co-polymer with chitosan to form a gel which is stable at temperature -20 to90 °C, UV radiation and pH from 3 to 7. This gel has a viscosity of 4100 centi Poises at 28 ±2 °C. 'Chitam gel', due to its beta linkage, is not digested by digestive enzymes in humans and does not contribute to calorie intake and hence can be used as a zero calorie food ingredient, and supplement for functional foods (nutritional care), also in jam, jellies, beverages, ice creams and other ready-to-eat products, as it is rheologically and texturally stable with food ingredients such as citric acid, sucrose, sodium chloride, aspartame, colours and flavours. Chitam gel also has applications in the area of cosmetic and personal care products, such as face wash, milky lotion, cream or foundation, as it has excellent elasticity and ageing stability, giving refreshing feeling, free from stickiness and has excellent usability, as a ultraviolet for protective agent or as a tissue adhesive, and in pharmaceutical preparations including haemostasis, wound sealing, tissue engineering or localised or oral drug delivery as patches, capsules & tablets.

Fig 1.18: Sample of Chitam gel

Gold nanorod chains as plasmonic waveguides

NIIST experimentally shown that the angle between the nanorods in noble metal waveguides has a significant influence on propagation properties. NIIST studied the plasmonic properties of gold nanorod dimers, where two nanorods were linked together through small linker molecules. Such nanorods can be synthesized through bottom-up techniques and stabilized in water. Their integration into the final device structure can then be guided, for example through electrostatic techniques. In order to study this dependency in detail, different linker molecules were used to bind the nanorods together. Rigid linker molecules tend to straighten the dimers, whereas more flexible linkers tend to lead to right angles between the nanorods.

For rigidly linked dimers, the plasmon coupling along the nanorods is strong and the plasmon resonance was determined to be at 840 nm. In flexibly linked dimers on the other hand, the plasmonic coupling across the nanorods is weak and the resonance

occurred at 732 nm. In the future, gold nanorod chains could be used as plasmonic waveguides where the transmission of light waves, in principle, can be controlled through the alignment of the nanorods. Fig 1.19 shows the micrographs of gold nanorod dimers.

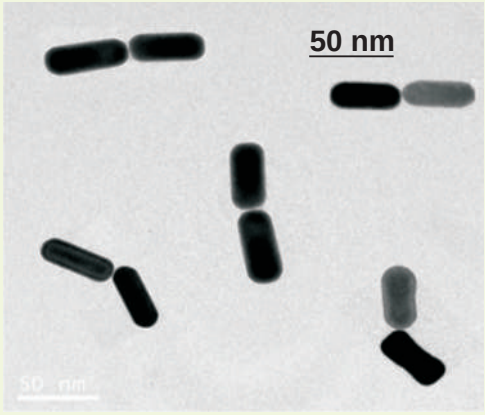


Fig. 1.19: Microscopy image of gold nanorod dimers

Clay-based inorganic-organic hybrid micro-vesicles: a potential candidate for guest-encapsulation applications

NIIST developed a facile process for synthesis of clay-based inorganic-organic hybrid Polystyrene-clay nano composite (PCN) which yields micro-vesicles (3-10 micrometer) by solvent-assisted self-assemblage properties and capable of encapsulating guest-compounds from their solutions by membrane diffusion or during vesicle formation. The vesicle is thermally stable over 250 °C, impermeable to water, permeable to alcohol and unstable in low-dielectric solvents. PCN vesicle can be a potential candidate for use as micro-storage system and may find micro-encapsulation/delivery applications in cosmetics, paints etc. Possibility exists for hydrophile modification of the vesicle so as to find pharmaceutical application also. Fig 1.20 shows micrographs of clay-based micro-vesicles.

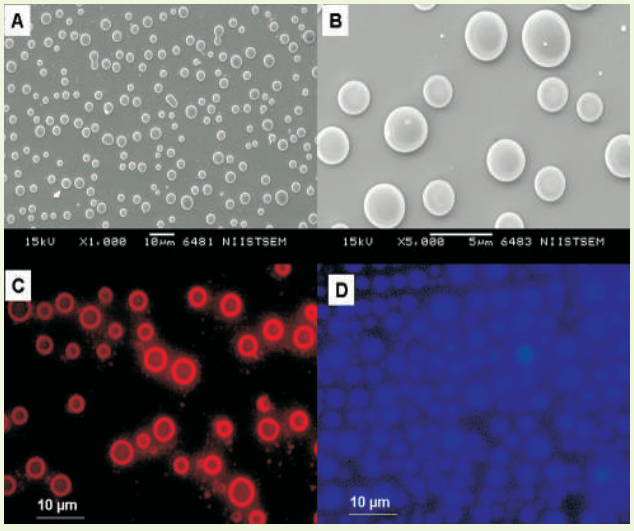


Fig. 1.20 SEM images of Clay-based inorganic-organic hybrid micro-vesicles and FMI image of Fluorescene encapsulated vesicles

Constant phase elements, depressed arcs and analytic continuation

The connection between the constant phase element and the depressed arcs often observed in the Nyquist plane was critically analyzed using the analytic continuation principle. CECRI pointed out a major inconsistency in a model presently used to explain these depressed arcs. A new model has been developed which removes this inconsistency and which also has a clear physical basis. A set of exact analytical results were reported, which may be used as diagnostic criteria for testing experimental impedance data against different models. Several Nyquist and Bode phase plots were generated as illustrations and the importance of this model for the characterization of coated metals highlighted. The results may be useful to corrosion scientists who develop suitable coating systems for metals as a tool to investigate the effectiveness of coatings.

Modified solid polymer electrolytes

CECRI developed a novel electrostatic method for preparing modified solid polymer electrolytes. Application of an electric field on an evaporating mixture of kynar, ethylene carbonate, propylene carbonate and $LiPF_6$ dissolved in tetra hydrofuran resulted in a solid polymer electrolyte whose charge transfer resistance was at least an order of

magnitude lower than that formed without the application of an electric field. Probably the observed enhancement is due to an electric field induced orientation of dipoles in the polymer chain. An effect of this kind has perhaps been observed for the first time. This innovation opens up a new direction in which properties of materials can be tuned by an applied electric field and will be of use for material scientists.

Hexaborides of Lanthanum

CECRI established a lab-scale process for the synthesis of LaB_6 by molten salt electrolysis. The process has been optimized on different electrolytic parameters such as current density, cell voltage and bath temperature. High purity crystals of LaB_6 have been synthesized by varying the reactants concentrations i.e., molar ratios of La:B and best of them have been identified. CECRI delivered about 300g of LaB_6 to Bhabha Atomic Research Centre. Further studies are in progress on the mechanistic aspects on the deposition of LaB_6 .

Alternate materials for functional components in SOFC

To reduce the operating temperature of the Solid Oxide Fuel Cell (SOFC) system, investigations on alternative materials such as partially substituted lanthanum gallates and partially substituted ceria were carried out by CECRI. Yttrium zirconium oxide ($Y_2Zr_2O_7$) (YZ), $Y_2Zr_{2-x}Co_xO_{7-\delta}$ (YZC) and $Y_2Zr_{2-x}Fe_xO_{7-\delta}$ (YZF) pyrochlore materials were prepared by self propagating hydrothermal glycine-nitrate combustion method. The crystal structure, particulate properties, sintering characteristics and electrical properties of YZ and $Y_2Zr_{2-x}M_xO_{7-\delta}$ (where M = Fe, Co; x = 0.025, 0.05, 0.075 and 0.10) were investigated. Pellets were fabricated under identical conditions and sintered in air at different temperature levels ranging from 1000 to 1400 ^{o}C. It is found that partial substitution of Co or Fe in the "Zr" sites improves the sintering characteristics of these oxides when compared with parent pyrochlore oxides. The substitution levels of Co or Fe (10.0 wt. %) resulted in increased conductivity when compared with parent yttrium zirconate. The experimentally measured data was analyzed in order to establish the importance of YZ, YZC and YZF ceramic materials as alternate electrolyte in SOFC.

Superhydrophobic multiwalled carbon nanotube bucky paper

NCL prepared a superhydrophobic multiwalled carbon nanotube bucky paper. This material shows fascinating wetting behavior as a result of an applied electric field, which could be remarkably tuned by changing key variables like ionic strength, nature of electrolyte, and pH of the droplet. More significantly, the droplet behavior can be reversibly switched between superhydrophobic Cassie-Baxter state, to hydrophilic Wenzel state depending on the manner in which the electric field is applied.

Autocatalysis in biological systems

Component unit processes in biology can be identified through the example of autocatalysis. An autocatalytic reaction occurs when a product catalyzes a reaction and aids in its own creation. Such processes are present in biological systems at all scales, from the single molecule to ecosystems. NCL unravelled modeling frameworks that are required for understanding these. Directions for further research, such as the stochastic and deterministic study of coupled autocatalytic loops at various length and time scales, and modeling of interlinked unit processes have been delineated.

This approach is potentially a better means for analyzing the fascinating dynamics exhibited by biological systems, and is a critical step in understanding existing normal and disease states (systems biology), as well as the new synthesis of biological networks (synthetic biology). A better understanding will also open up the possibility of using these

principles in designing robust chemical and biochemical processing operations. Fig.1.21 shows schematic for Autocatalysis in biological systems.

Fig. 1.21 Autocatalysis in Biological Systems

Novel integrated process for the manufacture for the recovery of sulphate of potash from sulphate-rich bittern

CSMCRI developed a novel integrated process for the recovery of sulphate of potash (SOP) from sulphate-rich bittern. The process requires bittern and lime as raw materials. Kainite type mixed salt is obtained by fractional crystallization of the bittern, and is converted to schoenite which is subsequently reacted with muriate of potash (MOP) for its conversion to SOP. End liquor from kainite to schoenite conversion (SEL) is desulphated and supplemented with $MgCl_2$ using end bittern generated in the process of making carnallite. Decomposed carnallite liquor produced is reacted with hydrated lime for preparing $CaCl_2$ solution and high purity $Mg(OH)_2$ having low boron content. It is shown that the liquid streams containing potash are recycled in the process, and the recovery of potash in the form of SOP is quantitative. The technology has been licensed to M/s Archean Group of Industries, Chennai.

Electrolytic reduction cell assembly for technology demonstration plant

Heavy Water Plant (HWP) Talcher, had taken up the development of a solvent extraction process for purification of merchant grade phosphoric acid, where reduction of ferric iron to ferrous form was necessary within the flow system. IMMT could provide a technology for this purpose where the ferric ion is successfully reduced electrochemically. HWP has implemented this technology in a demonstration plant (TDP) at Trombay, for which, the electrolytic reduction system has been designed by IMMT.

1.4. Earth & Physical Sciences

CSIR, through the National Physical Laboratory, is the keeper of Indian standards for mass, temperature, weight, time etc. It has also been providing space weather data for the last 15 years, which is very crucial to satellite launching, Indian Air Force etc. The sector covers scientific studies of ocean, earth mantle and lithosphere leading to development of many significant databases, processes, products etc. Apart from NPL, CSIR has three other major institutions viz. NGRI, NIO and NEIST which are active in this sector.

1.4.1. Scientific & Technological Achievements

Geodetic measurements in the Kutch region

The Global Position System (GPS) measurements carried out by NGRI campaigns over a period of six years following the 2001 Bhuj earthquake have thrown light on the unusually low viscous strength of the mantle below the earthquake epicentral region.

This may be the long -lasting result of thermal weakening by the late cretaceous Deccan Plume responsible for the unusually active interplate seismicity in the region. These studies throw light on the efficacy of GPS measurements in understanding earthquakes of the intraplate seismic regions.

Automatic gravity optimization of listric faults

NGRI developed a method for automatic gravity optimisation of listric faults using prescribed depth dependent density. The technique simultaneously estimates the parameters of listric faults having finite strike length as well as regional gravity background from a set of measured Bouguer gravity anomalies, wherein a parabolic density function simulates the decrease in density contrast of sedimentary rocks with depth within the structure. The novelty of this technique is that it automatically initiates both model parameters of a listric fault as well as regional gravity background from a set of measured Bouguer gravity anomalies and then improves them iteratively until the modeled gravity anomalies mimic, the observed ones. The automatic optimization technique has immense potential for application in both hydrocarbon and mineral explorations.

Post-seismic deformation in the Andaman & Nicobar islands after Sumatra earthquake

NGRI carried out Global Positioning System (GPS) measurements of post-seismic deformation from 22 campaign-mode, and one continuous, GPS sites in the Andaman-Nicobar region following the great Sumatra-Andaman earthquake of 26 December 2004. The measurements show that large horizontal displacements towards west to southwest, varying in magnitude from 10 to 40 cm, and with uplift reaching 16 cm, occurred in the region in the first year after the earthquake. The observed motion decreased logarithmically in the subsequent year. NGRI suggests that in the Andaman region, frictional afterslip occurred farther downdip of the co-seismic rupture, while in the Little Andaman and Nicobar regions, the co-seismic rupture and afterslip patch partly overlapped. The after-slip was mostly aseismic and did not contribute to the aftershocks. The aftershocks and post-seismic displacements appear to follow a similar relationship, although with different decay times. The temporal dependence of the two differs only by a term linear in time. Thus the temporal evolution of the afterslip seems to be consistent with a mechanism governed by frictional afterslip. Available rates of inter-seismic and post-seismic deformation and co-seismic static offsets allow us to approximately estimate a return period of about 400 years for great earthquakes in the Andaman region (Fig. 1.22).

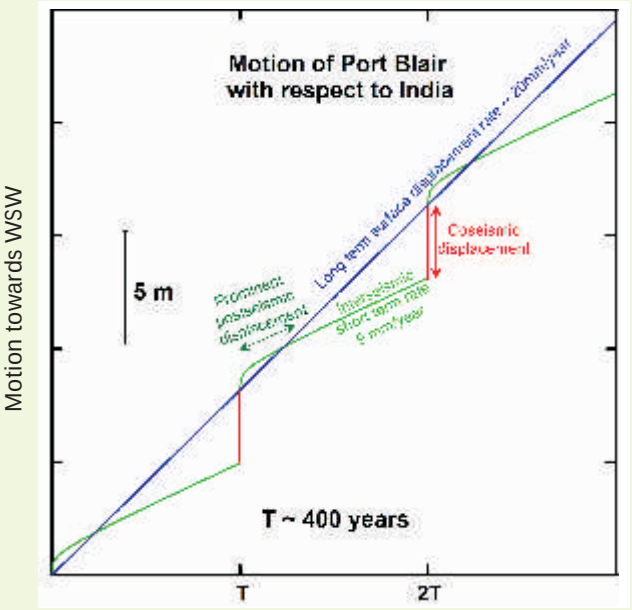


Fig. 1.22: Estimation of a return period of great earthquake

NPL becomes a full member of CCM/BIPM

The International Committee for Weights & Measures in its 97th meeting accepted NPL as a member of the Consultative Committee for Mass and Related Quantities (CCM/BIPM).

Ferrofluid based electric power generator

A ferrofluid bearing based portable electric power generating device has been developed by NPL using wind energy. The device is capable of generating a minimum of 1.2-watt electric power using transverse magnetic motion as driven by normal wind speed of 4m/s having fan blades with swept area 0.126 m^2. The device has the efficiency up to 24% at 4m/S. The torque required for rotation of magnets has been tremendously reduced by the use of ferrofluid bearings. The coefficient of friction has also been drastically reduced to 0.0008 between the rotating magnets and the stationary base plate to which the coils are connected. An alternating current has been produced and rectified using bridge circuit for providing continuous power source. The device has great potential for enhancement of power by increasing the number/size/field strength of permanent magnets or number/turns of coils or increasing the area swept by the rotating fan blades in case of availability of higher wind speeds. The unique property of magnet levitation by ferrofluid is used for making the power generator with improved output. The device is able to start functioning at very low wind speeds of even 2m/S as compared to other available wind turbines.

Regional Warning Centre: Space weather

As a part of the International Space Environment Services (ISES), NPL provides space weather information/alerts (solar flares, solar winds, radiations etc) to the users (ISRO, defence, air services etc) through its space weather Regional Warning Centres (RWC-India). The laboratory also predicts sunspots and sunspot cycle for satellite launch, satellite's tracking and applications before and during the launch of any space vehicles, such as Chandrayaan. Space weather informations are essential for determination of satellite's orbital parameters, and tracking, working of different electronic systems etc. All these are being provided daily to ISRO (MCF, Hasan & Istrac, Bangalore) for the last15 years.

Fig. 1.23: Auroras observed as a result of space weather over Indian Antarctic Ocean

Impact of tropical cyclone on biogeochemistry of the Central Arabian Sea

NIO combined remotely sensed data with shipboard measurements to investigate biogeochemical changes caused by a moderate tropical cyclone in the central Arabian Sea in December 1998. The sea surface temperature had decreased by approx. 4 C whereas surface nitrate and chlorophyll concentrations had increased by 5 µM and up to 4 mg m^{-3}, respectively, over a large area affected by the cyclone. Nutrient enrichment in the surface layer of the cyclone-affected zone was estimated to have supported a new production of approx. 4.2 Tg C, approximately 5% of the annual organic carbon export to the deep sea (beyond the continental margin) for the entire Arabian Sea. Entrainment of nitrous oxide from the thermocline led to more than doubling of its concentration in

the mixed layer. The cyclone had also resulted in an increase in nitrous oxide inventory within the oxygen minimum zone. The results imply that, should there be an increase in the frequency and intensity of tropical cyclones as a result of global warming, as projected in some recent reports, carbon production and respiration, and redox processes within the oxygen minimum zones, such as the production of nitrous oxide through nitrification/denitrification, and of molecular nitrogen through denitrification/anaerobic ammonium oxidation, may be significantly impacted.

Geophysical characteristics of the Ninetyeast Ridge-Andaman island arc/trench convergent zone

NIO exmined the convergence tectonics of the Ninetyeast Ridge (NER), upon the Andaman island arc trench system through an analysis of ETOPO2 bathymetry, satellite-derived free air gravity and seismic data. Oblique subduction and the buoyancy forces arising from subduction of the NER rendered the subduction processes near the Andaman arc highly complex. The bathymetric expression of the NER is visible up to Lat. 10 °N but seismic reflection data indicated that it extends up to about Latitude 17 °N. The gravity anomalies are strongly positive over the exposed segment of the ridge but are subdued over the buried portion. There is a prominent break in the continuity of the trench gravity low, where the NER seems to impinge upon the island arc. Further, a strong curvilinear belt of negative anomalies just behind and running parallel to the island arc, associated with the forearc basin, is a dominant feature of the gravity map. An offset in the continuity of this strong negative anomaly occurs at about the same latitude where the NER seems to be converging upon the island arc. Seismic reflection data indicate that the NER is very close to the trench. Flexural modeling of the gravity anomalies for the subducting Indian ocean, lithosphere, loaded by sediments and the NER, indicates that the NER is at the starting phase of its collision with the island arc and may not have started affecting the subduction process itself. It is inferred that the en-echelon block structure of the NER in the proximity of the convergent zone is a consequence of complex strike-slip and subduction-related tectonic forces.

Observational evidence for remote forcing of the west India coastal current

Circulation in the north Indian Ocean is influenced by both local and remote wind forcing. So far, however, determining the contribution of these two forcing mechanisms at any location has been possible only in numerical experiments. In a study, NIO could separate remote and local wind forcing in their observations. Using field measurements (current, sea level, and wind) for a month during March-April 2003 off Goa in the near-coast regime of the West India Coastal Current (WICC), it was shown that the current was driven by local winds only at periods approx. 10 days, with remote forcing contributing at longer periods. The high-passed (HP; period 10 days) component of the along-shore current was strongly correlated with the HP component of the along-shore wind, the current lagging the wind by half a day. The low-passed (LP) components of the wind and current were not correlated: the former was unidirectional, but the latter reversed during the period of observation. The relationship between the HP wind and current was used to estimate the locally forced LP current, permitting an estimate of the remote current, the LP residual. This separation of locally forced and remotely forced currents showed that remote forcing contributed as much as local forcing to the WICC. The local current behaved like a classical eastern boundary current forced by local winds. The reversal in the remote current was due to winds 700 km farther south along the coast; frictional damping had an impact only at periods less than 10 days, there being no remotely forced HP current.

1.5. Ecology & Environment

Environment-related issues are of paramount importance, not only to India, but also for the world. CSIR is conscious of its responsibilities and obligation to provide solutions for proper mitigation of this multi-faceted problem. The majority of the work is being carried out by NEERI, however other laboratories like CGCRI, IITR, IMMT, NBRI, and NML too offer solutions to some of the problems such as utilization of municipal solid waste, bioremediation of water and soil, developing methods for estimation soil of contaminants in fields etc.

1.5.1. Scientific & Technological Achievements

Delineation of bioremediation protocol for high phosphate bearing water bodies

High concentrations of nitrate, phosphate and fluoride in ground waters have been reported due to the increase in fertilizer application. Phosphorus additions to water-bodies, even in small amounts, can be of considerable concern and environmentally significant by producing accelerated growth of algae and aquatic vegetation, thereby causing eutrophication of the aqueous system like lakes and inland seas. To control eutrophication, phosphate removal from wastewater is often required before being discharged to the receiving water-bodies. NBRI has found *Pseudomonas putida* as a best phosphate accumulating bacteria among the screened bacteria species. Bacterial strains from phosphate contaminated sites were isolated and cluster analysis of Enterobacterial Repetitive Intergenic Consensus-Polymerase Chain Reaction (ERIC PCR) fingerprint of high phosphate accumulating *Pseudomonas* strains was developed to elucidate the microbial community structure.

Utilization of Wastes from the Steel Industry

During the production of Iron ore concentrates, the Plant at mines site also produces iron ore tailing as waste. Physically, iron ore tailing is an assemblage of particles of size less than 150 micron. Part of these particles are iron rich and the rest contains more of alumina and silica. Construction materials such as solid and hollow bricks, pavement blocks of diiferent designs and vitrified ceramic tiles etc., were developed by CGCRI from iron ore tailings. It is an energy-efficient process with low processing temperature and the products are having superior properties.

Likewise, Electric Arc furnace slag is generated as byproduct in Steel Plants. The slag when dumped at storage sites causes tremendous environmental pollution. The byproduct was utilized by CGCRI to produce commercial size tiles. The properties of these tiles were found to have superior to those conforming properties as compare to the Bureau of Indian Standards (BIS) specifications.

Pollution monitoring at Paradip port

IMMT assessed the level of pollution in the Paradip port area. Data on air, water, sediment, noise and biological environment were collected from the target area at planned intervals for study and interpretation. Studies indicated that average concentration of SO_2, NO_2 and NH_3 in the air was lower than that of the national ambient air quality standards. Higher level of Suspended Particulate Matter was observed due to dust and particulates from traffic, handling at tippler house, conveyer belt and emissions from vehicles bringing material to the site and from ships.

The harbour water was almost free of pollution. However, the concentration of chromium, lead and cadmium were high during loading and unloading operations, probably due to spillage of ores onto the harbour. Concentration of various elements in

the sediment samples exhibited wide variations both in bulk and fine fractions. Biological parameters studied in the phytoplankton population and species diversity indicated that about 18 species occurred in equilibrium with oligotrophic character and there was no eutrophication problem inside the harbour. Noise levels both within and outside the port area were within the prescribed limits. However, places like the general and multipurpose cargo berths, mechanical coal handling plant, and market complex showed relatively higher levels of noise.

Toxic potential of municipal solid waste leachates in transgenic *Drosophila melanogaster*

Municipal solid wastes (MSWs) are one of the major sources of environmental pollution, as leachates from these wastes may contaminate the water sources and affect quality of environment. IITR determined the possible toxic effects of leachates from MSW in transgenic *Drosophila melanogaster* (hsp70-lacZ). Third instar larvae exposed to 1.0-3.0% of these leachates at different time intervals were examined for hsp70 expression, oxidative stress enzyme activities, proteotoxicity, tissue damage along with effect on emergence and reproduction. Maximum hsp70 expression was observed in the larvae exposed to highly acidic leachates. Overwhelmingly high hsp70 expression in the exposed larvae caused a concomitant decline in total protein content and a significant elevation in oxidative stress enzymes and lipid peroxidation (LPO) product. The leachates caused a significant delay in emergence of flies and affected the reproductive performance of the flies at the tested concentrations. The study highlights the toxic potential of MSW leachates and the advantage of Drosophila as a model to evaluate the impact of leachates at organismal and cellular levels.

Amenability of electrochemical techniques for the treatment of wastewaters generated from aluminum industry

NML studied amenability of electroflotation for the removal of aluminum oxy-hydroxide precipitated from synthetic wastewater and water sample from Alcoa's Texas Alumina Refining Plant. The preliminary electroflotation tests conducted on synthetic effluent sample prepared from aluminum sulfate revealed that nearly 85% of Al could be removed from the wastewater using $IrO_2/RuO_2/TaO_2$ coated titanium within two minutes of electroflotation and over a pH range of 6.5-8.0. The recovery of Al by electroflotation was around 65% in the case of wastewater generated by Alcoa's Texas Alumina Refining Plant. The organics present in the wastewater (COD) was removed to the extent of 85% by electrooxidation using graphite material as anode. The process of electroflotation was found to be amenable for the removal of aluminum oxy-hydroxide precipitate. The plant wastewater could be reused after separating the pollutants.

Phytorid wastewater treatment

NEERI developed a know-how for Phytorid wastewater treatment which involves a constructed wetland exclusively designed for the treatment of municipal, urban, agricultural and industrial wastewater. The phytorid technology treatment is a subsurface flow type in which wastewater is applied to cell/system filled with porous media such as crushed bricks, gravel and stones. The hydraulics is maintained in such a manner that wastewater does not rise to the surface retaining a free board at the top of the filled media. The system is based on specific plants, such as Elephant grass *(Pennisetum purpurem)*, Cattails *(Typha sp.)*, Reeds *(Phragmites sp.)*, *Canna sp.* and Yellow flag iris *(Iris pseudocorus)*, normally found in natural wetlands with filtration and treatment capability. Furthermore, some ornamental as well as flowering plants species such as Golden Dhuranda, Bamboo, Nerium, etc., can be used for treatment as well as landscaping purposes.

The reduction in the treated effluent for the total suspended solids(TSS) varied from 70% to 80%, biochemical oxygen demand (BOD) from 78% to 84%, nitrogen from 70% to 75%, phosphorus from 52% to 64% and fecal coliform from 90 % to 97%. The treated effluent is useful for municipal gardens, fountains and irrigation. The demonstration plants were set up at Panvel to treat the sewage flow of 20 m^3/day for a period of two years and at Mumbai University Campus, Kalina with the capacity 25 m^3/day for one year which have given satisfactory results.

Portable digital kit for measurement of arsenic in fields

NEERI developed a low cost portable digital field kit for arsenic measurement suitable for Indian conditions. The prototype can measure arsenic concentration below the maximum permissible limit of 10ppb. The cost of production of the electronic instrument and reagents including glassware is significantly lower than the available quantitative field kits. The instrument is very easy to use; even by the layman. The instrument has latest microcontroller, sensor technology and is highly energy efficient, since a pair of cells can last for a year or so depending on usage.

Fig. 1.24: Prototype of the Digital Arsenic kit

Greenhouse gas measurement

NEERI measured Carbon dioxide and methane, the greenhouse gases (GHGs), released from the 42 sq. km area of Tehri reservoir. Gas samples were collected from forty nine locations near the periphery and across the reservoir. The gas trapping domes, fabricated by the institute were installed in the reservoir for a period of 24 hours. The accumulated gas in the domes were then transferred to Tedlar gas sampling bags and carried to Nagpur for Gas Chromatographic analysis. The data reveal that the emission levels of carbon dioxide and methane from the reservoir were 2800 and 29 mg/m^2/day respectively. The data trends were comparable with those of select tropical reservoirs, as reported from Brazil, Panama and French Guyana.

Purification and characterization of a novel plant-type carbonic anhydrase from *Bacillus subtilis*

Carbonic anhydrase enzyme are largely unexplored in prokaryotes when compared to its mammalian counterparts despite its ubiquity. NEERI purified the enzyme from Bacillus subtilis SA3 using sequential Sephadex G-75 chromatography, diethylaminoethyl-cellulose chromatography and sepharose-4B-L.tyrosine-sulphanilamide affinity chromatography and characterized to provide additional insights into its properties. The apparent molecular mass of carbonic anhydrase obtained by sodium dodecyl sulfate polyacryamide gel electrophoresis (SDS-PAGE) was found to be approximately 37 kDa. Isoelectric focusing of the purified enzyme revealed isoelectric point (pI) of around 6.1 when compared with marker. The presence of metal ions such as Zn^{2+}, Co^{2+}, Cu^{2+}, Fe^{3+}, Mg^{2+}, and anion SO_4^{2-} increased enzyme activity while strong inhibition was observed in the presence of Hg^{2+}, Cl^-, HCO_3^-, and metal chelator ethylenediaminetetraacetic acid (EDTA). The optimum pH and temperature for the enzyme

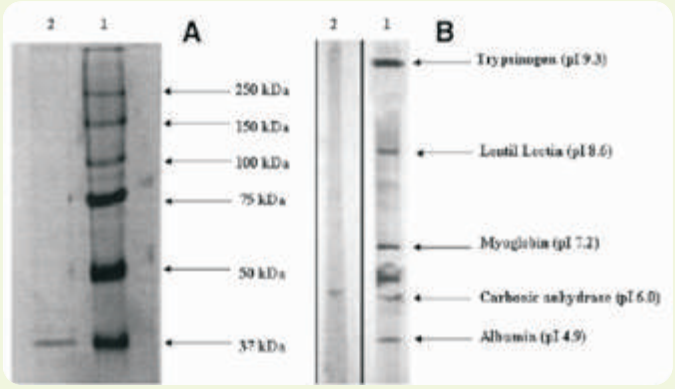


Fig. 1.25: (A) SDS-PAGE of purified BCA. A 12.5% gel was used for analysis. Lane 1, molecular markers; lane 2, purified Carbonic anhydrase. (B) Isoelectrofocusing of Carbonic anhydrase. Lane 1, protein markers (4.9~9.3); lane 2, affinity purified BCA.

were found to be 8.3 and 37 °C, respectively. The results from N-terminal amino acid sequencing imply that the purified protein is a putative beta-carbonic anhydrase with close similarities to catecholamines from plants and microorganisms.

A novel carbonic anhydrase was isolated, purified and characterized from B. subtilis SA3 obtained from environmental samples. The presence of CA enzyme has not yet been reported in B. subtilis. When compared to other plant CAs, which have molecular weights of 25~35 kDa, the enzyme has unique properties with a high molecular weight (37,000 Da) confirmed by both low and high range molecular weight markers to represent a monomeric polypeptide.

Fog forecast model

The fog forecast model developed by C-MMACS has been inducted into national weather service by Indian Meterological Department beginning November, 2008.

1.6. Electronics & Instrumentation

CSIR's strength in the area lies with its constituent laboratories, mainly CEERI, CSIO, and NPL which cater to the needs of the country's Space programme, Atomic Energy Mission, Railways and societal needs. Salient achievements are presented below:

1.6.1. Scientific & Technological Achievements

Direct nano-writing by self-assembly of 16-MHA on gold surface using dip-pen-nanolithography

Continued miniaturization of microelectronic devices and circuits has been the motivation for research and development of new materials, technology and manufacturing equipment. Dip-pen-nanolithography (DPN) is a soft-lithography tool for writing molecules onto substrates in the form of nano-structures, which are one-molecule thick. CEERI carried out experiments to write nano-dimensional patterns on gold surface. Ultra thin films of Cr/Au on silicon wafers were fabricated by sputtering. Commercial substrates were also used in the writing experiments. 16-Mercapto Hexadecanoic Acid (MHA) molecular ink compatible to Gold substrate was used.

Monoalkoxide species on the surface of palladium nanoparticles synthesized in ethylene glycol

Palladium nanoparticles consisting of metallic cores and encapsulating shells serve as an intriguing catalytic model system. CSIO investigated the surface structure of palladium nanoparticles by Fourier Transform Infrared Spectroscopy (FTIR) and thermogravimetric analysis (TGA). FTIR spectra showed the presence of monoalkoxide species with tilted geometry. TGA further confirmed the presence of these species along with some adsorbed byproducts formed during the reaction. Atomic force microscopy (AFM) shows the presence of diffused negatively charged coatings on the surface of the nearly

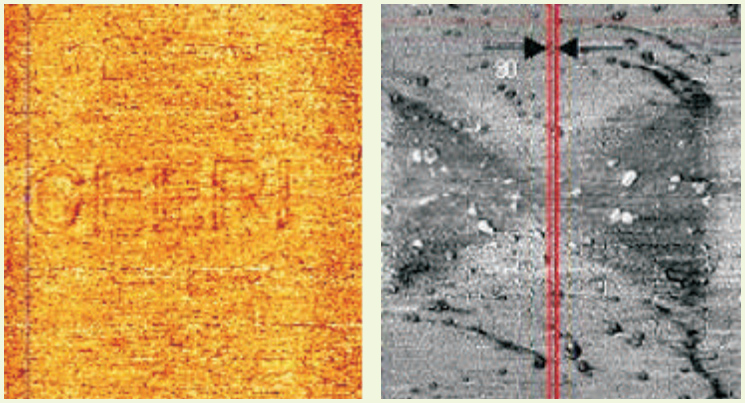


Fig. 1.26 (a) LFM image of word "CEERI" and nano-gap electrodes written using 16-MHA molecular ink on gold surface. (b) Measured minimum line-width (marked) ~30 nm and gap ~80 nm.

spherical nanoparticles. The important application areas include nano sensors and catalysis.

Embedded dual fiber Bragg Grating sensor for simultaneous measurement of temperature and load with enhanced sensitivity

CSIO demonstrated an embedded dual fiber Bragg Gratings sensor for simultaneous measurement of temperature and load (strain). Two nearly identical Gratings are mounted on opposite side of an arch-shaped steel strip. The Grating, in concave and convex position, experiences equal blue and red shift respectively due to bending of the strip which is exploited in temperature and load (strain) discrimination. The temperature and load (strain) sensitivity of the sensor improves to 28.5 pm/^{o}C and 2.8 pm/gm (2.6 pm/$\mu\varepsilon$). The sensor can measure temperature and load (strain) accurately with small error of $\pm 1^{o}$C and $\pm$1gm respectively.

FBG sensor technology

CSIO designed and fabricated different types of Fibre Bragg Gratings (FBGs) like Bragg reflectors, overlapped and chirped Gratings and uniform, chirped and concatenated Long Period Gratings (LPGs). Some of these Gratings have been supplied to various institutes for their research requirements and their performance has been found

Fig. 1.27 FBG Sensor for Structures

comparable with the imported ones. Developed FBG and LPG sensors have been investigated for structural health monitoring, petrol leak detection, and fuel adulteration measurement. Fig.1.29 shows a few packaged sensors for structural monitoring.

Surgical microscope for cataract surgery

CSIO developed a surgical microscope for cataract surgery. It enhances the Surgeon's view of microscopic structures (e.g. nerves, blood and lymphatic vessels, lesions) and provides variable object magnification. The opto-mechanical design of the microscope has been perceived specifically to meet the requirements of surgical applications of the

eye such as kerato-plasty, kerato-prosthetics and cataract operations. The main feature of the surgical microscope is the special motorized focusing control by foot paddle. Also to meet the need for high and safe illumination, a fiber optical system has been used with switch to change over in case of failure during the operation. The salient features of the microscope include: (i) sufficiently large working distance between operation field and microscope, (ii) true stereoscopic observation, (iii) good resolution with adequate contrast; (iv) brilliant and uniform illumination of the field of operation and (v) adequate, useful magnification range to guarantee a rapid change over from low power to high power.

Fig. 1.28 Surgical Microscope

The microscope has undergone thorough clinical trial at the Ophthalmology Department of Rajendra Hospital, Patiala, for three months and the reports have been quite encouraging. The instrument was used for three days during an eye camp organized by Shah Satnam Multi Speciality Hospital, Sirsa, where fortyeight eye cataract operations were performed successfully.

1.7. Energy

Energy issues are significantly affecting the whole world including India. Most of the current energy demand is met through extensive use of fossil fuel. Use of clean technology, alternate fuel and exploitation of renewable energy, particularly solar, geothermal, wind etc., have attracted the attention of researchers, policy makers, industrialists, and other stakeholders all across the globe. CSIR has taken a proactive step in this direction, particularly in the search of clean technology and renewable energy sources. It has intitiated a few programmes of immense technological interest however results will be visible only in the coming years. The following paragraphs capture a few of the most significant achievements during the year.

1.7.1. Scientific & Technological Achievements

Process for the conversion of waste plastics and low polymer wax into value added hydrocarbons

IIP has developed a unique two stage lab-scale process for the exclusive production of gasoline, or diesel or aromatics along with the liquefied petroleum gas (LPG) from catalytic conversion of waste polyolefins (low polymer wax). The process involves pyrolysis of polyolefins followed by catalytic reforming of hydrocarbons. The process is safe as it operates at atmospheric pressure; is environment friendly and also pollution free. The residue is less than 1% which results almost complete conversion of waste plastics into valuable hydrocarbons. This process is a truly sustainable solution for treating waste plastics, diverting from land fills, utilising the embodied organic and energy content of plastics and producing a highly useful commodity that, due to its clear burning characteristics in itself, is more environmental friendly than conventional distillates.

Silicon nanowires arrays-based solar cell

A simple method has been developed by NPL to prepare vertically aligned silicon nanowire (SiNW) array called "black silicon" on p-(100) silicon which has excellent light trapping properties and can be a potential candidate for the application as anti-reflection coating for silicon solar cells. Silicon solar cells (n^+pp^+ structure) can be made on such black silicon surface by conventional cell fabrication technology. The initial results show

marked improvement in solar cell performance compared to the control cell made using planner technology.

Novel electrode materials for high power lithium-ion battery technology

For applications in Electric Vehicles (EV), batteries must sustain a high rate current withdrawal and have good cycle life. CGCRI developed nanocrystalline $LiNi_{0.4}Mn_{1.6}O_{4-\delta}S_{\delta}$ which shows excellent rate performance and structural stability and hence will lead to high power batteries suitable for EV applications. Ni-doped lithium manganese oxysulfides with a nominal composition of $LiNi_{0.5}Mn_{1.5}O_{4-\delta}S_{\delta}$ ($0 \leq \delta \leq 0.1$) were synthesized by alanine assisted low temperature combustion process followed by calcination at 700°C in air. Quantitative X-ray phase analyses showed that the spinel structure of $LiMn_2O_4$ was retained for all compositions. A systematic change in microstructure was observed with increasing Ni content in the presence of S – the shape of the particles changes from spherical ($LiMn_2O_4$) to icosahedron ($LiNi_{0.2}Mn_{1.8}O_{4-\delta}S_{\delta}$) to octahedron ($LiNi_{0.5}Mn_{1.5}O_{4-\delta}S_{\delta}$).

Demonstration of planar anode-supported solid oxide fuel cell (SOFC) stack

CGCRI developed and demonstrated a working SOFC stack based on the planar anode-supported SOFC design. A large number of anode-supported single cells of dimension 10cmx10cmx1.5mm have been fabricated that show good power output at an operating temperature of 800°C (~1.0W/cm^2 at a cell voltage of 0.7V). At single cell level, it has been shown that its capability is even better than those available at international level. Similarly, glass-based sealants, an essential component for stack development, have also been developed indigenously. Using the developed 10x10 single cells, glass-based sealants, and ferritic steel-based metallic interconnect and gas manifolds several SOFC short stacks (3-cell, 6-cell and 10-cell) have been fabricated and demonstrated for the first time in India.

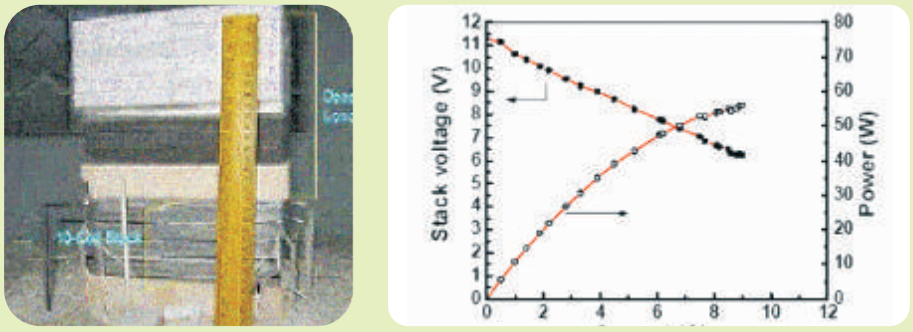


Fig: 1.29 A 10-cell SOFC stack assembly developed at CGCRI and its electrochemical performance

Improvement in fuel efficiency by reducing kiln car mass

CGCRI modified the present kiln cars in the tunnel and shuttle kilns used in pottery manufacturing in and around Khurja, which are expensive to operate due to inefficient combustion. Dead mass of the cars absorbs major part of the heat during firing. Designs of kiln cars with low mass materials were tried for reduction of fuel consumption. New designs were developed and reduction in the mass of the developed kiln cars was also calculated. The new low thermal mass kiln car designs showed that there would be a reduction in mass by 25-40% and this would assure fuel saving by at least 10-15% and enhance productivity by 5-10%.

CGCRI recognised as an Industrial testing and evaluation centre

CGCRI-Naroda centre has been approved by the international inspection agency "Intertek" and listed in their international directory for providing testing services for the ceramic raw material and product prior to export. Testing and evaluation has been one of the main activities of this centre which carries out physical and chemical analyses of ceramics, glass, refractory raw materials and allied products that are received from industry and government institutions. It has become an important service provider and has already established its position as a centre of excellence in testing activities.

Adsorption technology for the removal of CO_2 from power plant flue gas

IIP developed a novel three column, eight step Vacuum Swing Adsorption (VSA) cycle for CO_2 recovery from power plant flue gas. This cycle uses a strong adsorptive rinse in a co-current depressurization step and is able to enrich the CO_2 from 12 vol% to > 90 vol% at elevated temperatures and low adsorption pressures with recovery of around 80%. Adsorbent testing has been carried out in presence of 5 vol% moisture as typically present in flue gas and it was shown that with addition of a guard layer of commercial air drier adsorbent , the performance of the VSA system does not deteriorate and the system is able to consistently separate and recover CO_2 over repeated cycles.

Fatty acid methyl ester (biodiesel) from triglycerides oil through transesterification

CSMCRI developed an improved zero effluent process for preparation of biodiesel which enables production of biodiesel, meeting EN 14214 Spec. The biodiesel is being used/tested as neat fuel (B/100) in unmodified engines. Two plants, one each at Rajasthan State Mines and Minerals Ltd., Udaipur and Defence R&D Organization, Secunderabad, have been installed on turnkey basis, having 1000L/day capacity.

Fig. 1.30 Zero-effluent biodiesel plant installed at Military Farm, DRDO, Secunderabad

Pilot plant for removal of toxic contaminants from spent pot liners

IMMT designed and fabricated a 100 kg/batch pilot scale processing unit for decontamination and recovery of carbon value from the toxic, spent, pot lining materials generated at aluminium smelter plants. The column flotation unit required for removal of toxic contaminants has also been fabricated. The project is a scale-up effort towards commercialization of lab scale process technology.

A self-supported direct borohydride-hydrogen peroxide fuel cell system

CECRI developed, constructed and demonstrated a self-supported direct borohydride-

hydrogen peroxide fuel cell system operating under ambient conditions. The system delivers a peak power of 40 W with about 2 W to run the auxiliary control unit. Such a fuel cell system is ideally suited for submersible and aerospace applications where anaerobic conditions prevail.

1.8. Food & Food Processing

CSIR set up an early entry and now leads in this important sector through CFTRI, a champion in providing food-related process technologies and products and also a generator of trained manpower in the field. Some of the developments during the year are highlighted below:

1.8.1 Scientific & Technological Achievements

Natural flavourant from swallowroot

Swallowroot or Decalepis hamiltonii is a monotypic genus found in the Deccan (South) peninsula, mostly in the forest regions of Eastern and Western Ghats. The swallowroot has a strong aromatic odour and sweet taste, and is used in traditional Indian medicine as an appetizer and blood purifier. The chemical compound responsible for the aroma and taste of Decalepis hamiltonii is 2-hydroxy-4-methoxybenzaldehyde (HMB), which is an isomer of Vanillin. CFTRI developed a process for optimizing extraction and isolation of HMB from swallow roots. The extract is crystallized in a low polar solvent to get the final product. HMB from swallowroots finds application as a natural flavourant in beverages, dairy products and bakery products.

Ready-to-eat snack

CFTRI developed a process for expanded horse gram to give an acceptable expanded ready-to-eat snack. The product has 'reduced anti-nutritional factors' with improved protein digestibility. The product is crisp, crunchy and shelf stable. It can be used as such or as a snack after salting or spicing. It can also be added as an ingredient in cereal bar or chikki. The process is ready for commercialization.

Vanillin: Value added product from agricultural waste

NEIST developed a novel process for the synthesis of Vanillin (4-hydroxy-3-methoxy benzaldehyde). The preparation of Vanillin is achieved by a single-step oxidation of ferulate moiety of rice straw, an agricultural waste in the presence of hydrogen peroxide, manganese sulphate, cupric chloride, sodium acetate, sulphuric acid and water under reflux condition in 1-3 hours. The process does not involve any expensive or hazardous chemicals. Water and inorganic compound used in the process can be recycled.

Value addition to agri food products

Continuing with its mandate, CFTRI worked out the following:

Xylanases in functional foods: Xylanases (E.C. 3.2.1.8; 1,4 - beta-D-xylan xylohydrolases) are the major cell wall degrading enzymes induced during germination facilitating the mobilization of endosperm reserves. Xylanases, with molecular weight 29 kDa from malted finger millet have been purified by CFTRI to homogeneity by conventional protein purification methods. By the analysis of the products liberated from larchwood xylan the enzyme was identified as a "endo xylanase". The xylo-oligo saccharides liberated have prebiotic activity and find application in the development of functional foods.

Peroxidase enzyme for bakery products: Wheat dough formation is a complex process which involves interaction between many components like proteins, carbohydrates, and enzymes. The polymeric glutenin provides elasticity and gliadin provides viscosity to the

dough. Peroxidase is an enzyme which contributes to the cross linking of wheat proteins. The enzyme peroxidase was purified by CFTRI and its functional role in baking applications has been established.

Natural colours as food additives: The major colouring principles beta cyanin and beta xanthin present in beet root have been fractionated by CFTRI to homogeneity by aqueous two phase extraction. Curcumin a natural yellow colourant from turmeric has been rendered water soluable by preparation of amino acid derivatives. These amino acid derivatives with high anti oxidant and anti mutagenic activities, could find potential applications in food and pharma industries.

Cyclic peptides as proteinase inhibitors: Protein inhibitors for proteinases are widely distributed in plants, being particularly abundant in storage tissues such as seeds and tubers. The Bowman-Birk inhibitors (BBI) have been extensively studied and their use as chemopreventive agents is well established. CFTRI cloned and overexpressed the horse gram Bowman-Birk Inhibitor (HGI III). The over-expressed protein was purified to homogeneity by affinity chromatography. The expressed protein (pETHGI) was characterized and compared with the virgin seed inhibitor. Smaller cyclic peptides, designed based on the inhibitory loop structures of HGI-III the major isoinhibitor, was cloned using pTWIN-1 vector. The protein was expressed in *E. coli* B ER 2566 and purified by chitin bead affinity chromatography.

1.9. Health Care, Drugs & Pharmaceuticals

India has a huge disease burden of disease like Malaria, Tuberculosis, Asthma, Cancer etc., and the treatment of such diseases is expensive. A large percentage of the population is unable to afford the cost of treatment. On the other hand, drug development is also very expensive. CSIR, through its constituent laboratories, CCMB, CDRI, IICT, IGIB, IICB, IIIM, IMTECH and NCL, is addressing the problem using a two pronged approach. On one hand, it is trying to develop affordable drugs through open source and on the other through public-private partnership mode. Some of the pathbreaking developments are listed below:

1.9.1. Scientific & Technological Achievements

Genetic landscape of India: A canvas for disease gene population

In a study designed to understand the genetic diversity of selected sets of Indian population and to use the underlying results for predicting the propensity of studied population sets of certain genetic diseases, a consortium of CSIR laboratories has reported some startling results. "Indian Genome Variation Consortium" involves six CSIR laboratories namely IGIB, CCMB, IICB, CDRI, IITR, and IMTECH, alongwith Indian Statistical Institute, Anthropological Survey of India, The Centre for Genomic Applications, SilicoGene Informations Pvt. Ltd., etc. This study has its basis in the assumption that genetically isolated population is considered to be important in dissecting complex diseases and mapping underlying genes. Although the validation of results across populations has met with limited success, CSIR, through this consortium has made an attempt to assess the nature and extent of population stratification in contemporary endogamous populations especially in the context of established or candidate disease genes.

The consortium has reported the results of analyses of 405 Single-Nucleotide Polymorphism (SNP) from 75 such genes and a 5.2 Mb chromosome, 22 genomic region in 1871 individuals from 55 diverse endogamous Indian populations. These include 82 large (< 10 million individuals) and 23 isolated populations, representing a large fraction of the people of India. It has been observed that high levels of genetic divergence exist

between groups of populations that cluster largely on the basis of ethnicity and language. The study reveals that how Indian population is divided as far as the natural protection against Diabetes, genetic risk for hypertension, genetic protection agains HIV infection, susceptibility to *Plasmodium falciparum* are concerned. The results have implications in disease prediction in its sets of population studied and could be an important reference point for researchers and medical services in general.

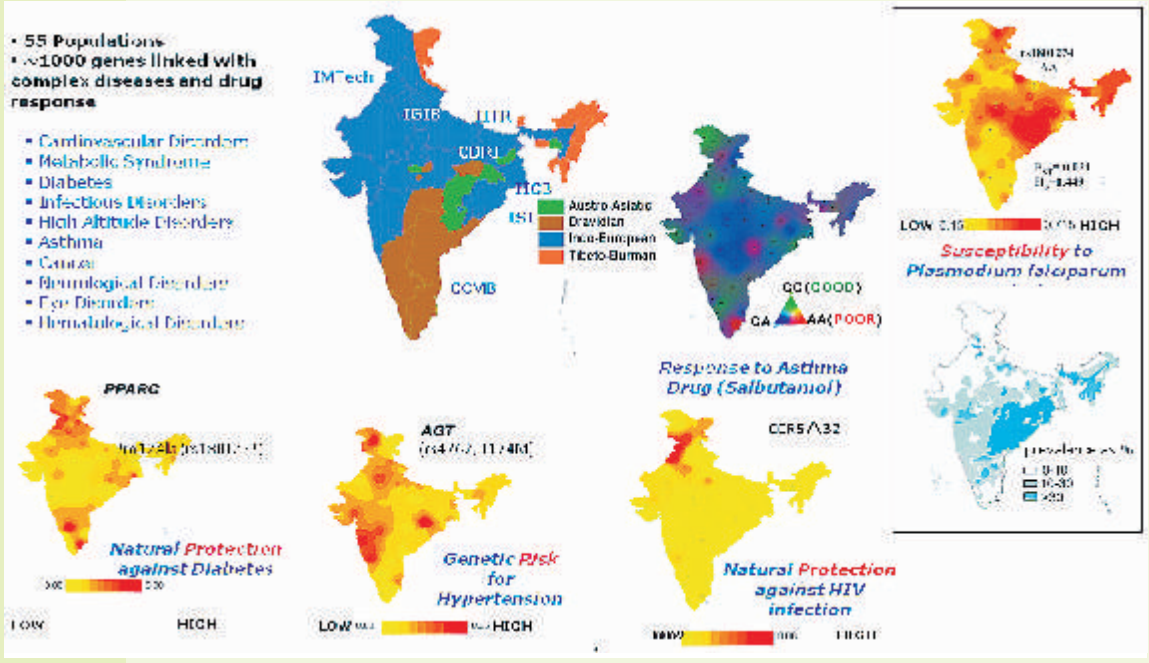


Fig. 1.31 The genetic landscape of India

DNA organization of the apicoplast genome of the malaria parasite

The Malaria parasite, *Plasmodium falciparum*, carries a non-photosynthetic plastid of secondary endosymbiotic origin called the apicoplast. The organelle is essential for parasite survival and is of interest for identification of novel drug targets for Malaria. The *P. falciparum* apicoplast contains a 35 kb, circular DNA genome with limited coding capacity that lacks genes encoding proteins for DNA organization and replication. The role of a *P. falciparum* nuclear-encoded bacterial histone-like protein (PfHU) in DNA compaction in the apicoplast has been revealed by CDRI. PfHU associates with apicoplast DNA and is expressed throughout the parasite's intra-erythrocytic cycle. The protein displays a preference for supercoiled DNA and is capable of condensing *E.coli* nucleoids *in vivo*. The unique 42 aa C-terminal extension of PfHU influences its DNA condensation properties. In contrast to bacterial HUs that bend DNA, PfHU promotes concatenation of linear DNA and inhibits DNA circularization. Atomic Force Microscopy of PfHU-DNA complexes shows protein concentration-dependent DNA stiffening, intermolecular bundling and formation of DNA bridges followed by assembly of

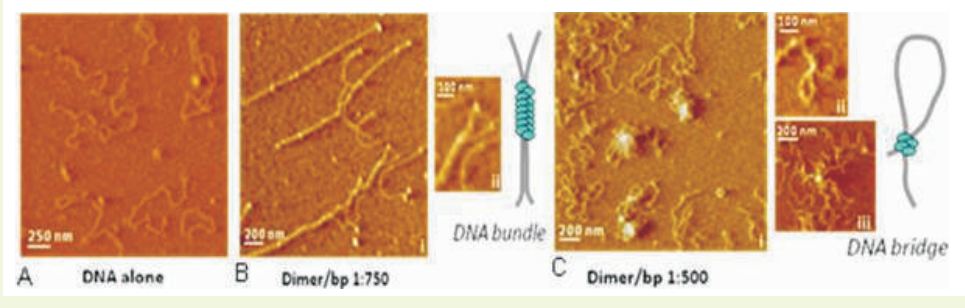


Fig: 1.32 AFM images of PfHUp- DNA complexes with increasing dimer/bp ratio. (A) DNA in the absence of protein. (B) Dimer/bp ratio of 1:750. Stiffened DNA strands (panel i) as well as DNA bundles (panel ii) are shown. (C) Dimer/bp ratio of 1:500. Formation of complexes with a small number of foci and extruding DNA loops (panel i), a DNA bridge resulting in DNA looping (panel ii) and a nucleoprotein complex with a single focus (panel iii) are seen.

condensed DNA networks (Fig. 1.32). These results have provided the first functional characterization of an apicomplexan HU protein and give additional evidence for red algal ancestry of the apicoplast.

Characterization of Rv3868, an essential hypothetical protein of the ESX-1 secretion system in Mycobacterium tuberculosis

Over 40% of the M. tuberculosis genome codes for proteins of unidentified functions. Rv3868, a conserved 63 kDa hypothetical protein of the ESAT-6 secretion system is essential for the secretion of at least four virulence factors. CDRI's studies show that it consists of two domains joined by a linker. The N-terminal domain is a compact, helical domain of approximately 30 kDa and apparently functions to regulate the ATPase activity of the C-terminal domain and oligomerization. The nucleotide-binding site is situated in the C-terminal domain, which exhibits ATP-dependent self-association. It is also the oligomerization domain. The N-terminal domain is proximal to the C-terminus in the apo protein and exhibits a specific movement upon ATP binding. *In silico* modeling of the domains suggests that Arg-429 of a neighboring subunit forms a part of the binding site upon oligomerization. Mutational analysis of binding site residues demonstrates that the Arg-429 functions as the important "sensor arginine" in AAA-ATPases. The studies also rule out a general chaperone-like function for Rv3868. and suggest that ATP-dependent "open-close" movements of the individual domains enable it to interact and transfer energy to co-proteins in the ESX-1 pathway.

A B C

Figure:1.33

(a) *In silico modeling and mutational analysis of Rv3868.*
(b) *Close-up of the ATP binding site in Rv3868*
(c) *Michaelis-Menten plots of ATP hydrolysis by CT-Rv3868 (?) and CT-Rv3868P336A (O), CT-Rv3868T338A (•), CT-Rv3868K340A (Δ), and CT-Rv3868R429A (*).*

First total synthesis of (+)-varitriol: an antitumor natural product from sea

CDRI has synthesized a highly stereoselective (+)-varitriol, an anti-tumor natural product, for the first time from commercially available methyl-α-D-mannopyranoside

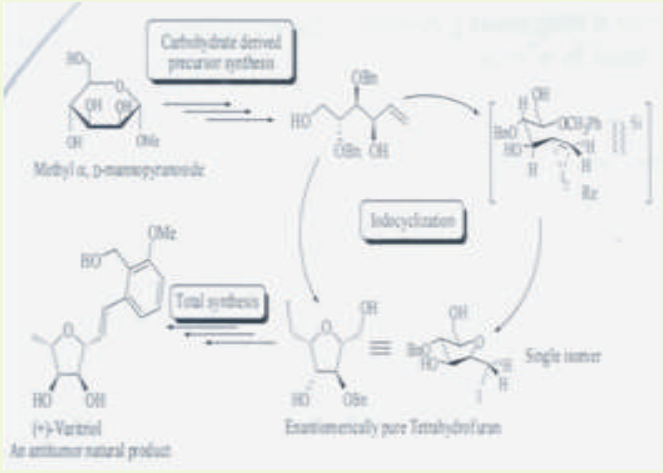


Fig:1.34 Synthesis of a highly stereoselective (+)-varitriol

and 2,6-dihydroxybenzoic acid. (+)-Varitriol isolated from marine strain (named M75-2) of the fungus *Emericella variecolor* exhibits potent cytotoxicity towards a variety of cancer cell lines most notably with selected renal, CNS and breast cancer tested within the 60 cell line panel of the National Cancer Institute, India. The furanoside part was synthesized from D-ribose suggesting synthesis of natural isomer could be possible from L-ribose which is highly expensive sugar. In contrast, CDRI scientists developed cost-effective first total synthesis of this active natural product (+)-varitriol starting from inexpensive methyl α,D-mannopyranoside and 2,6-dihydroxybenzoic acid utilizing highly diastereoselective iodocyclization strategy for the synthesis of furanoside unit of varitrol. This methodology can be applied for the construction of novel isomers and analogues of this natural product to evaluate their anticancer activity to obtain better biological activity profile.

Rationally designed spermicides for selectively targeting human sperm in vagina to ensure safe contraception

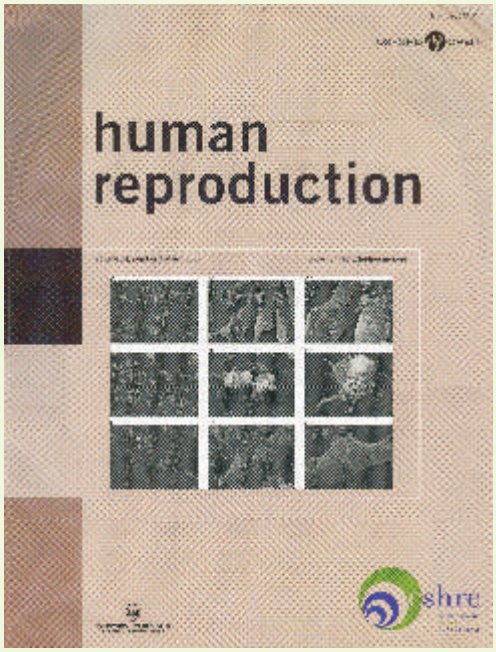


Fig. 1.35 The cover of Human Reproduction shows scanning electron micrographs of HeLa cells

Killing ejaculated spermatozoa outside the male body (*ex-vivo* condition) during their very brief stay in vagina offers a simple and safe method of contraception. Nonoxynol-9 (N-9) is a surfactant spermicide that forms the active ingredient in most of the vaginal contraceptives available in the market. Recent clinical trials have shown that regular use of N-9 based contraceptives increases susceptibility to sexually transmitted disease (STD) and human immune deficiency virus (HIV). World Health Organization has already issued a caution to that effect. CDRI's efforts to design, synthesize and evaluate novel molecules with a specific, mechanism-based action on sperm cells resulted in the discovery of two spermicidal compounds (disulphide esters of carbothioic acid: DSE-36 and DSE-37) with extremely potent spermicidal action that killed 100% human sperm at just 4% of EC100 of N-9 while remaining practically inert to human cervical cells and *Lactobacillus* at spermicidal concentration. The ability of these novel spermicides to kill sperm almost instantaneously at innocuously low concentration that spares cervico-vaginal cells and *Lactobacilli*, indicates their worth as improved active ingredients for vaginal contraceptive preparations as compared with N-9. The micrographs of HeLa cells have found place on the cover of the journal 'Human Reproduction' (Fig 1.35)

Caenorhabditis elegans functional genomics in toxicity testing and identification of novel drug targets

CDRI used model organism functional genomics for toxicity testing and identification of novel drug targets. Initial studies have led to creation of a novel *Caenorhabditis elegans* model for a specific viral protein-mediated pathogenesis. Using *E. coli mediated* transformation system the viral protein of interest was systemically delivered to the intact organism via a pET-28a vector. Experiments were carried out using age synchronized

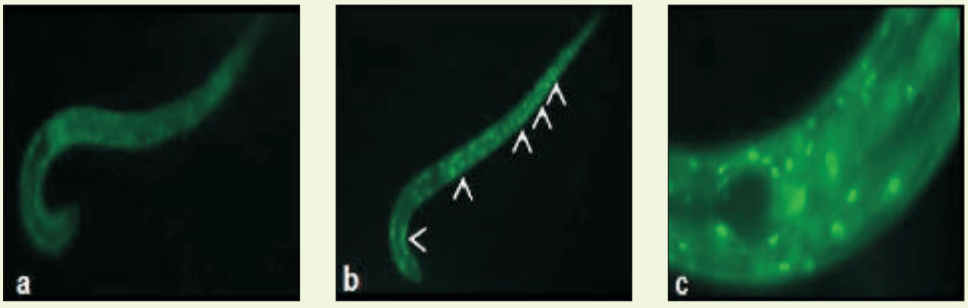


Fig:1.36 Expression of DAF-16 in a transgenic DAF-16::GFP starin (a) control, (b) viral protein treated © viral protein treated nematode at higher magnification.

nematodes, and the systemic absorption of the protein via the gut of nematodes was observed after carrying out immunohistochemistry of exposed nematodes v/s that of control. The synchronously raised population of nematodes was then observed for pathogenic effects caused as a result of protein expression.

Results indicate that the phenotype exhibited by the nematodes, might be in agreement with the pathogenic effects observed in case of humans. To further understand the epistatic correlation of the observed effects, CDRI carried out studies using a transgenic strain of C. elegans carrying an integrated green fluorescence protein (GFP) tagged to the FOXO transcription factor (DAF-16), which is a *C. elegans* homologue of mammalian forkhead transcription factor (FOXO). FOXO is known to play critical role in immune function. Further, a key pathway- the DAF-16/DAF-2 is conserved between humans and *C. elegans*. The studies in the transgenic strain led to the observation that DAF-16 is upregulated in the presence of viral protein under study.

Candidate drugs under clinical trials: CDRI's progress in the drug development

During the year several compounds have shown promising results such as:
Compound 80/574 (anti-hyperlipidemic) is being developed in collaboration with Cadila Pharmaceuticals Ltd., Ahmedabad. Data compilation of the Phase III clinical trials of 175 cases has been completed. Final report is awaited from M/s Cadila Pharmaceuticals Ltd.

Compound 97/78 (anti-malarial) is being developed in collaboration with IPCA Labs, Mumbai. Phase I clinical trial is in progress at PGIMER, Chandigarh. Thirteen male volunteers have completed the study so far.

CDR-134 D-123 (anti-hyperglycemic) is being developed in collaboration with TVC Sky Shop Ltd., Mumbai. It has been found safe in phase I single dose tolerance study in 32 healthy human volunteers. Multiple dose tolerance studies have been planned to be conducted at Seth GS Medical College, Mumbai.

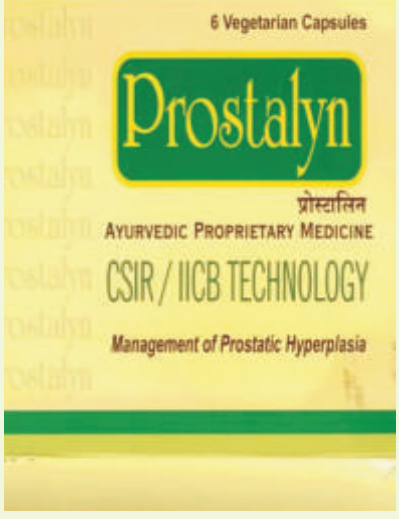


Fig. 1.37 Prostalyn Packaging

Prostalyn: ayurvedic cure for prostate cancer

IICB has developed a herbal formulation for the treatment and remedy of Prostate problem. The technology has been licensed to M/s. East India Pharmaceutical Works Ltd., Kolkata. Using IICB technology, the company has started marketing this drug under the name Prostalyn. Prostalyn inhibits abnormal proliferation within the prostate gland and relieves urinary symptoms associated with prostate megaly. This

leads to a decrease in its size, improved urinary flow rate, more complete emptying of the bladder, decreased urine retention and relief from the symptoms of prostatic hyperplasia.

Ayurgenomics: Links between ayurveda & modern science for predictive and personalized medicine

In a landmark study, the first of its kind in the world, it has been demonstrated by IGIB that normal individuals within the same ethnic population, clustered on the basis of clinical criteria described in Ayurveda, show variations in the basal levels of blood parameters used in routine for diagnostic purposes, as well as in basal levels of expression of genes. Links have been found between *Prakriti*, a fundamental principle of personalized medicine of Ayurveda, and modern genomics for development of predictive and personalized medicine. The study reveals that it is possible to identify groups within normal individuals of the populations, which could be predisposed to certain kind of diseases, and which also might respond differently to drugs. Such integration of the principles of Ayurveda with genomics, appropriately termed as Ayurgenomics, holds great potential and promise for future predictive and personalized medicine at an affordable cost.

Enzymatic membrane for the detection of cholesterol in serum

An enzymatic membrane has been prepared by IGIB through co-immobilization of cholesterol oxidase (COD) and cholesterol esterase (COE) onto a new immobilization support. The enzymes were co-immobilized on this membrane by entrapment method. The pH stability and thermal stability of the co-immobilized COE and COD were found to be higher as compared to the free enzymes. In addition, this enzyme membrane was used several times for estimation of cholesterol by colorimetric method without loss of enzyme activity. This enzyme membrane was further attached to the oxygen electrode and a linear relationship was observed between the oxygen consumption and cholesterol concentration. This enzyme membrane can be stored at room temperature for 30 days without any loss of activity.

Biphasic calcium phosphate nano-bioceramic for dental and orthopaedic applications

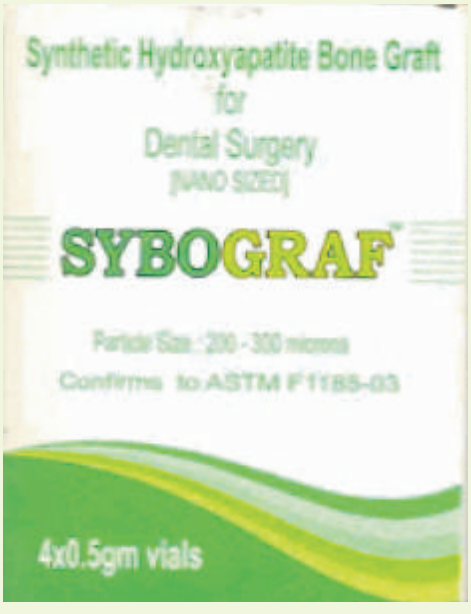


Fig. 1.38 'Sybograph' Packaging

NML developed technology for dental and orthopaedic applications. It deals with solid state transformation coupled biomimetic synthesis of biphasic calcium-phosphate bioceramic. This material is a two phase system comprising hydroxyapatite and tricalcium phosphate. Having a different chemistry, this material is not only biocompatible but bioactive also. The added bioactivity has made this material suitable for restorative tissue engineering. The technology has been transferred to M/s Eucare Pharmaceuticals Pvt Ltd. Chennai for commercialization. The product is being marketed as 'Sybograph'.

1.10. Housing & Construction

Structural engineering is one among the core operations of the engineering science laboratories of CSIR, namely CBRI and SERC. The laboratories provide solutions to structure-related issues being faced by dams, bridges, tall buildings, buildings of strategic importance like nulear power plant installations etc. Another constituent laboratory, AMPRI, provides solutions to housing for disaster victims by developing housing and construction materials utilizing waste materials like red mud, fly ash, natural plant fibres etc. Following paragraphs showcase some of the most significant developments during the year:

1.10.1. Scientific & Technical Achievements

Bagasse-cement board

A new bagasse-cement board and panels have been developed by CBRI scientists using sugar cane bagasse and cement. These panels and boards are suitable for use in buildings as paneling material and for making paneled door shutters. The product is cost effective and the technology can be adopted at any level for commercial production. Complete specifications have been filed for getting the patent. Typical prototypes of board and panel are shown in Fig. 1.39.

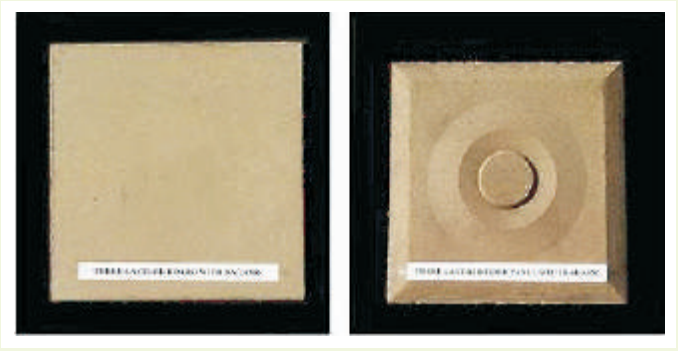


Fig. 1.39 Panel of bagasse-cement board

Thermo-acoustically efficient combined materials for conducive environment in building

CBRI identified and fabricated suitable single materials based on design standard and thermo-acoustic efficiency for achieving comfort in buildings.

Various materials like plastic board, particle board, wood wool board, coir board, non-asbestos board, cement-bonded particle board, plastic hollow board, gypsum board, polyurethane foam etc., were selected and analyzed for their thermal and acoustical behavior. Based on basic and insulating data of individual material, several combinations have been fabricated. The analysis of these combined materials is being studied for thermo-acoustical properties for achieving increasing efficiency of these materials. CBRI also conducted the measurement Sound Transmission Loss (STL) of single homogenous materials of partition wall in a reverberation chamber.

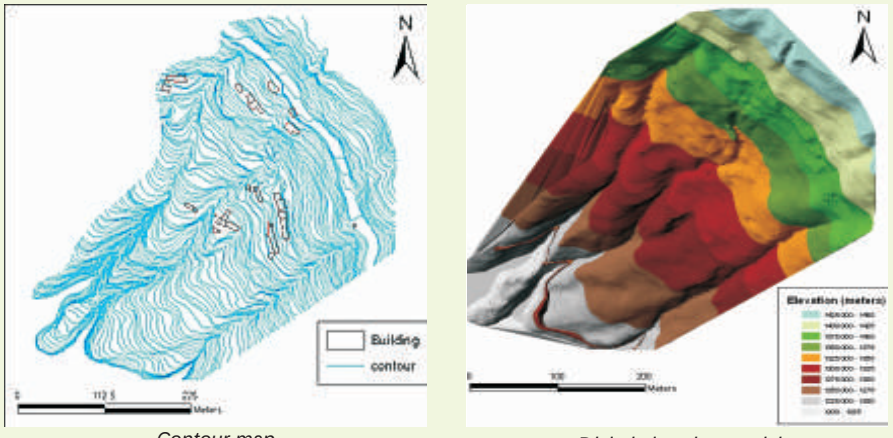
Vulnerability assessment of buildings & structures along Rishikesh-Uttarkashi-Gangotri national highway

The Rishikesh-Uttarkashi-Gangotri National Highway has many unstable slopes and landslides. These landslides always threat human lives and properties, which include buildings, bridges, power transmission line etc. One such unstable slope near Agrakhal on way to Uttarkashi is causing road subsidence and damage to several houses situated on down hill slopes. The slope has many houses which have shown distress. The building

Study area
Fig. 1.40 Road subsidence and damaged houses

of Garhwal Mandal Vikas Nigam Guest house has been considerably damaged. This unstable slope has been selected for detailed geological and geotechnical study.

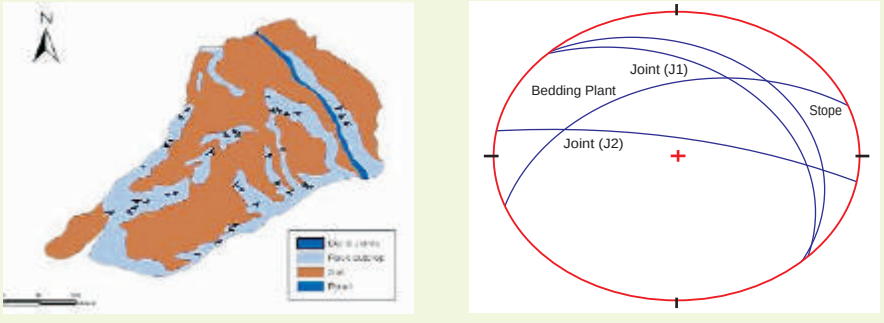
Topographic survey of the slope was carried out and a contour map was prepared on 1:1,000 scale with 2 meter contour interval. From the contour map, Digital Elevation Model (DEM) was generated in GIS. A slope map was also derived from the DEM.



Contour map *Digital elevation model*

Fig. 1.41

The geological data were collected to prepare the geological map of the area. Rocks present in the area are shale and phyllites, which are highly weathered, fractured and thinly bedded. The rock beds dip 50° towards North-west and there are two major joint sets, out of which one joint dipping towards North-east is outward dipping favouring slope instability. The soil cover on the slope is about 2-5 m thick. There are three major drains on the slope. The houses situated on either side of the central drain have shown sign of distress. From the field investigation it is inferred that continuous water flow in the central drain is contributing to slope instability in the area.



Geological map *Stereo plot of structural data*

Fig. 1.42

The study so far has shown that the slope is still in unstable state and analysis is being carried out to quantify the instability. The instability in the slope is mainly due to water

seepage through jointed and fractured shale beds. Rock joint analysis shows an outwardly dipping joint in relation to slope which is also favouring slope instability. Adequate remedial measures will be suggested after completion of the study.

Alpha plaster & cementitious binder from nontraditional materials for use in building bricks/blocks and composites

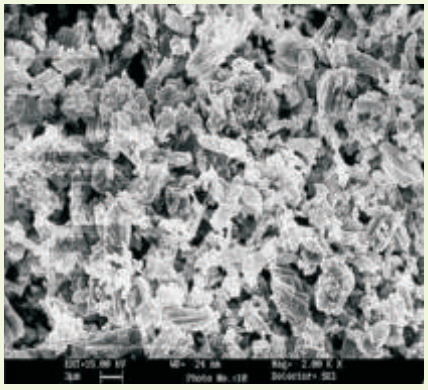


Fig. 1.43 Microstructure of alpha plaster produced in presence of sodium succinate (0.20%)

Gypsum is one of the important industrial minerals having multiple uses. CBRI developed a novel method of making α-hemihydrate to reduce calcination period and to get a product of considerable high strength. Crystal modifiers were introduced during the autoclaving of gypsum in this process. Phosphogypsum was autoclaved in slurry form at different steam pressures for different durations in presence of different chemical admixtures. It observed that with small quantity of chemical admixture, alpha plaster of high strength can be produced. The alpha plaster was characterized for properties like consistency, setting time, compressive strength and bulk density. The results show an increase in compressive strength and bulk density with all chemical admixtures. At 0.20% concentration of sodium succinate ($Na_2C_4H_4O_5.6H_2O$) alpha plaster gives maximum attainment of strength 27.0 MPa, setting time 8-10 minutes and bulk density 1.40-1.50 g/cc. Fig. 1.43 shows micrograph of α-plaster produced of sodium succinate.

Remote health monitoring scheme for civil engineering applications

SERC developed a Remote Health Monitoring Scheme (RHM) for civil engineering applications. It can be operated in any mode of communication, i.e., Radio Frequency/Public Switched Telephone Network/Global System for Mobile Communication (RF/PSTN/GSM) depending upon the availability of network at site. In a single platform, data can be acquired remotely from different types of sensors which are normally used for structural health monitoring. It can also acquire, both high speed dynamic data, and also slow speed static data and can send alarm messages to the user in case of any abnormal event and acquire data at a higher sampling rate automatically. This technology provides simultaneous monitoring from a single monitoring station of a number of structures, which are geographically located at different places. This technology can be implemented for efficient and economical monitoring of civil infrastructural systems.

Fig. 1.44 View of the Railway Bridge

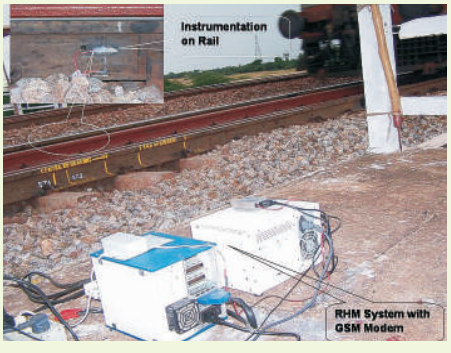


Fig.1.45 Real-Time Remote Health Monitoring of Railway Bridge

Analysis of RC structural components based on damage mechanics concepts

SERC has modelled the shell structure of a large cooling tower and analysed using ULTSTR module. The height and base radius of the tower are 150 m and 58.1 m, respectively. The base thickness of the shell is 750 mm. The shell is discretised using 650 layered shell elements. Each element is modelled as six plane stress concrete layers and two orthogonal steel layers on both faces. The response of the cooling tower is computed for wind loads specified by IS:875 and IS:11504 (both in terms of magnitude and distribution). In addition, self weight of the shell is also included in the analysis. Radial symmetry of the structure as well as loading has been exploited by modelling only one half of the structure. Appropriate boundary conditions are imposed at the plane of symmetry. The circumferential and meridional stress resultants per unit length of shell at a critical longitudinal section are plotted in Fig. 1. 46

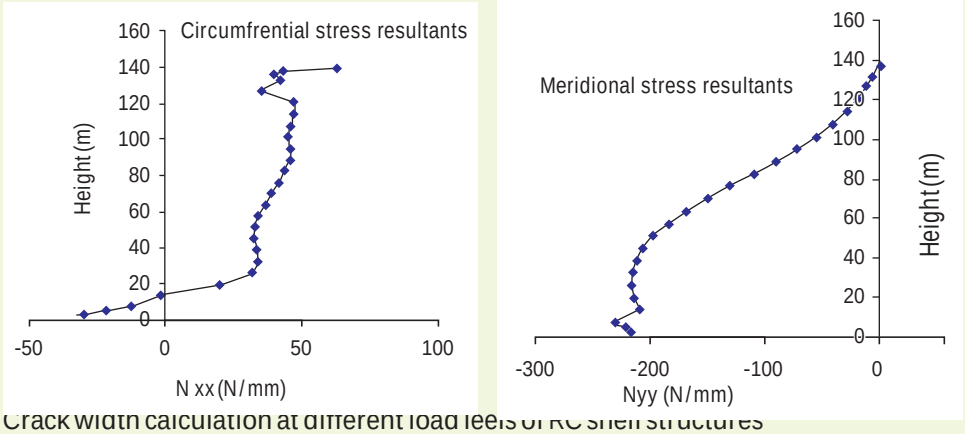


Fig. 1.46 Circumferential and meridional stress resultants

Crack width calculation at different load levels of RC shell structures

SERC formulated a methodology to calculate the crack width at different load levels of Reinforced Concrete (RC) shell structures. A bilinear tension softening model along with the results of direct tension test has been used. The expression has been implemented in program modules and integrated with ULTSTR module of FINEART program. The updated module has been validated by analyzing a RC beam which has been experimentally tested. Only one half of the beam has been modelled and analysed taking advantage of symmetry in geometry, support and loading conditions. The beam is discretised into 10 finite elements along the length while the cross section in represented by 6 concrete layers. Reinforcement at top and bottom are smeared into concrete layers at respective locations. Contribution of shear reinforcement is indirectly incorporated in the finite element model by enhancing the shear stiffness. The response obtained from numerical simulation is presented along with the experimental results in Fig. 1.47.

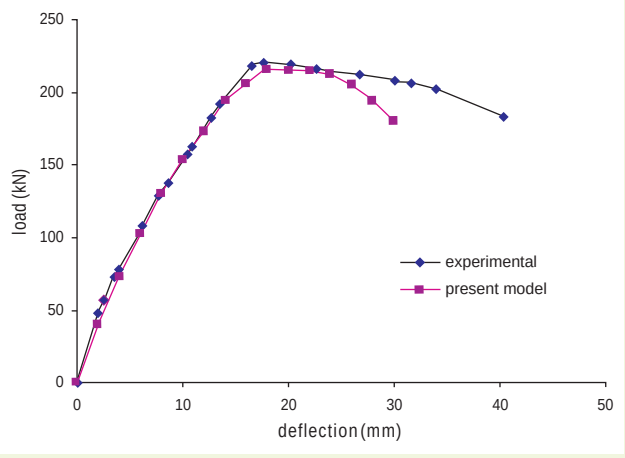


Fig. 1.47 Load vs deflection at centre of the beam

The excellent nonlinear response prediction capability of the present model can be seen

from the comparison. It is to be noted that the present model performs fairly well even in the immediate vicinity of post ultimate range. The ultimate load predicted by the model is 212kN whereas experimentally obtained ultimate load is 215kN. The model has also been used to predict the width of cracks present in all the elements.

Mathematical modeling of slip in a buried shear fault

Generation of realistic seismograms for time-history analysis of engineering structures require modelling of the source, taking into account the geological and geophysical data on the properties of nearby faults and the distribution of regional stresses. In this investigation, an attempt is made by SERC to model a slip in a buried shear fault as an equivalent single couple along with a single distributed force. Towards this, general solution of three-dimensional non-homogenous wave equation is derived. A rectangular volume of rock is assumed with fault plane as x-y plane at some level and direction of the slip is along x-axis. The body force equivalents of the fault slip are calculated and used in the general solution of the wave equation. A potential function is defined as the representative of the severity of the ground motion felt at the site and maximization of the potential function is carried out to define the convex model parameters. The displacement history at the center of the fault is then generated. It is noted that fault displacement time history is required to model the slip numerically. However, monitoring of fault displacement is rare in most cases, at least, in India. Therefore, it is assumed that fault displacement is likely to be constrained by Ellipsoidal-Fourier-Bound convex model and an attempt is made to account for the uncertainty in fault displacement by such convex modeling.

1.11. Information Dissemination & Products

Information generation, collation, dissemination and usage play a significant role in today's cutting edge science and technology development. CSIR, mainly through two of its constituent laboratories NISTADS and NISCAIR captures, analyzes and disseminates the relevant information leads/development. It also brings out policy papers on various current issues related to S&T. Followings are few achievements recorded during the year:

1.11.1. Scientific and Technological Achievements

Dissemination of information to S& T community

NISCAIR provides communication links to scientific community through the publication of 19 scholarly journals of international repute, covering all major disciplines of science and technology. These 19 journals include 17 research and two abstracting journals. The research journals are (Volumes corresponding to years 2008-2009): Journal of Scientific and Industrial Research (JSIR, monthly, Vol. 67-68), Indian Journal of Experimental Biology (IJEB, monthly, Vol. 46-47), Indian Journal of Biochemistry and Biophysics (IJBB, bimonthly, Vol. 45-46), Journal of Intellectual Property Rights (JIPR, bimonthly, Vol. 13-14), Natural Products Redieuce (NPR, bimonthly, Vol. 7-8), Indian Journal of Marine Sciences (IJMS, quarterly, Vol. 37 -38 , Indian Journal of Traditional Knowledge (IJTK, quarterly, Vol. 7-8), Indian Journal of Biotechnology (IJBT, quarterly, Vol. 7-8), Bharatiya Vaigyanik evam Audyogik Anusandhan Patrika (BVAAP, Hindi, half-yearly, Vol. 16-17), Indian Journal of Chemistry - Section A (IJC-A, monthly, Vol. 47-48), Indian Journal of Chemistry - Section B (IJC-B, monthly, Vol. 47-48), Indian Journal of Pure and Applied Physics (IJPAP, monthly,' Vol. 46-47), Indian Journal of Radio and Space Physics (IJRSP, bimonthly, Vol. 37-38), Indian Journal of Chemical Technology (IJCT, bimonthly, Vol. 15-16), Indian Journal of Engineering and Materials Sciences (IJEMS, bimonthly, Vol. 15-16), Indian Journal of Fibre and Textile Research (IJFTR, quarterly, Vol. 33-34), Annals of Library and Information Sciences (ALIS, quarterly, Vol. 55-56). The abstracting journals

are: Medicinal and Aromatic Plants Abstracts (MAPA, bimonthly, Vol. 30-31), and Indian Science Abstracts (ISA, fortnightly, Vol. 44-45). IJTK and MAPA are included in the list of 'Prior Art Journals' used by the International Search Authorities for prior art search while granting patent(s)

AII the NISCAIR journals follow international practices for scholarly communication, e.g. having editorial boards, peer reviewing, and timeliness, and are covered by the major abstracting, indexing and current awareness services in their respective fields. Many are also covered by SCI, e.g. IJC-A (2007, IF 0.685), IJEB (2007, IF 0.551), IJCT (2007, IF 0.429), IJBB (2007, IF 0.368) and IJC-B (2007, IF 0.368). All the journals have good subscriber base.

Special issues of the journals are brought out from time to time on important themes. The themes of special issues of the various journals brought out during 2008-09 are: Tsunami- 2004, other natural processes and anthropogenic impact on hydro biogeochemistry of coastal eco system (IJMS, Vol. 37 No.2, June 2008), Antarctic and southern ocean-geoscientific and biological studies (IJMS, Vol. 37 No.4, December 2008); TRIPS and the pharmaceutical industry (JIPR, Vol. 13, No.5, September 2008); Biofuels " (JSIR, Vol. 67 No. 11, November 2008); Recent Developments in Heterocyclic Chemistry (IJC, Sec. B, Vol. 47B, July 2008); Free radicals and anti-oxidants in human health (IJBB, Vol. 46 No.1, February 2009); Biophotones and alternative therapies (IJEB, Vol. 46 No.5, May 2008); Condensed Matter and Materials Physics (IJPAP, Vol. 46 No.6, June 2008), Ferroelectrics and dielectrics (IJEMS, Vol. 15, No.2, April 2008); Innovations in textile machinery and instrument (IJFTR, Vol. 33, No. 3, September 2008); Indigenous knowledge of the ethnic people of northeast India in bio- resources management (IJTK, Vol. 8 No.1, January 2009).

The special issue of IJMS on 'Antarctic and Southern Ocean - Geoscientific and biological studies' was released by Shri Somnath Chatterjee, the then Speaker of Lok Sabha, who also released a special issue of Science Reporter during the International Polar Year celebrations at NISCAIR on 4 February 2009.

Science popularization

NISCAIR endeavours to take science to the people, mainly students, through its three well-circulated popular science magazines: 'Science Reporter'(English monthly); 'Vigyan Pragati' (Hindi monthly); and 'Science Ki Duniya' (Urdu quarterly).

Science Reporter (Vol 45-46) 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 informative reading material such as amazing scientific facts, profiles of scientists, science projects, inventions and discoveries and much more. Five of the 12 issues brought during the year were focused issues: Agriculture (June 2008), Drugs & Diseases (August 2008), Wildlife (November 2008), Chandrayaan (January 2009), and International Polar Year (February 2009). Three new columns were started: Floral Records (featuring unique floral species), Amazing Adaptations (dealing with animals adapting to different environments), CSIR in the Service of the Nation (profiling CSIR labs and their contributions to the country). Two competitions - Science Fiction and Science Cartoons - were also organized and received overwhelming response.

Likewise, Vigyan Pragati (Vol. 57 -58) continued to provide information in an easy to understand mode on important current events/issues. Six special issues were brought out on:

Environment Day (June 2008); Wild Life Conservation (October 2008); Children's Day

(November 2008); Plant Kingdom (January 2009); National Science Day (February 2009); and Children's Science Congress (March 2009).

Similarly, Science Ki Duniya (Vol 34-35) continued to provide a package of interesting columns such as Science Quiz, Science Models, Science News, Science for Children and Science for Women apart from major articles covering a wide range of fields including agriculture, energy, environment, food, health care, oceanography, space and wildlife.

NISCAIR also brings out CSIR News (fortnightly, Vol 58-59 during the reporting period) the Council's newsletter that serves as a useful link among the various CSIR establishments and also communicates activities/accomplishments of the Council, particularly those pertaining to research and developments, to other R&D organizations, Universities, S&T agencies/ departments, industry and other users, mass media, etc. It also disseminates information regarding CSIR to other countries through Indian/foreign missions. Its Hindi version, CSIR Samachar (monthly) is also brought out. Full text of both the newsletters is regularly uploaded on the NISCAIR/CSIR websites.

"India S&T- 2008"

NISTADS brought out, during the year, "India S&T 2008" report which featured affairs of Indian S&T covering S&T policies, performance indicators and achievements. The report focussed on six theme viz. S&T human resources; Financing for S&T; Structures, infrastructures and public space in S&T; Indian industry and S&T; outputs of research publications and patents; and rural India and S&T. Each theme was further divided into several sections, and sub-sections.

This compilation provides important insights into multiple modes of the functioning of Indian S&T system. Inferences drawn in this report provide important comparative policies, effectiveness of respective instruments, the directions of S&T and the dynamics of S&T linkages with the Indian economy and society.

Energy research and CSIR: A policy document

India's economy stands at a crucial "take-off" stage of Rostov's model. The rapid growth brings its own set of problems, one of the most important being how to cater towards the increased energy demand. At present India imports almost 22% of its total energy requirements. The fluctuation in the global oil and natural gas prices risks our energy security considerably. CSIR could play a vital role in planning for the strategic energy research towards the sustainable development. Towards that NISTADS brought out a report which provides an input to the policy makers and technologists in the form of a strategic framework.

Women and science in India

NISTADS carried out study related to 'Women in Science' in India. The study highlights the issues on gender and science for a developing country like India. Feudal authoritarian values and hierarchy have characterized Indian society. Are these reflected in Indian science as well? Using the available data and facts, along with the findings of an empirical study, the study discussed Indian case in relation to global scenario. It examined the issues and importance of gender vis a vis other characteristics in determining scientists' research related values, research performance, academic rank and professional recognition in Indian context. An analysis of the data on about 500 scientists in the area of physical science reveals:

- The number of women scientists is marginal (women constitute only 18%);
- There are differences in the social-class background of men and women scientists; This implies that only girls from elite and urban areas were able to choose science as a career;

- Female and male scientists do not differ in terms of research-related attitudes; and
- The higher proportions of women at lower ranks are not a simple function of low research productivity. The female scientists do not differ significantly with male scientists in terms of research contributions.

1.12. Leather

CSIR, through CLRI, has a unique presence in leather sector. It is recognized as a trend-setter in leather products and also provides research backbone to industry, be it new processes for preserving the hides or treatment of effluents. CLRI's operations cover the entire domain of leather, as under:

1.12.1. Scientific and Technological Achievements

Bacterial wound infection mitigation

Bacterial wound infection in burn cases is a major problem, which hinders the normal healing process. CLRI prepared Collagen bilayer dressing with ciprofloxacin from succinylated type-I collagen. FT-IR spectroscopy, SEM analysis, in vitro drug release pattern, antimicrobial activity and *in vivo* efficacy of the dressing were studied. The results suggest that sustained release of ciprofloxacin from a collagen bilayer dressing eliminates bacteria at the site of infection, leaving a pathogen-free wound environment, and it can be used as a dressing for an on-site delivery system

Molecular self-assembly and host guest interactions

A new tool based on the work of adhesion has been developed by CLRI to quantify adsorption of proteins to solid surfaces. This tool may be used effectively in designing the surface coating using proteins and protein-composite films. Influence of shear viscosity in promoting fibrillar assemblies in these proteins has been analyzed and a first model for visco elasticity in protein self-assembly processes has been made.

Variety of copper (II) complexes have been synthesized as potential metallonulceases and demonstrated that redox chemistry of the metal ion is the most important factor that decides the efficiency of nuclease activity of the metal complex.

The physical and optical properties affected by Ultra Voilet (UV) irradiation on collagen stabilized using chromium (III) have shown that chromium (III) treated collagen has better stability against UV radiation than native collagen. It is found from the study that to form collagen like peptides minimum of five triplets (15 amino acids) required. These results are immensely useful to design new collagen like peptides from first principles.

Use of hydrogen bonding interaction in the design of self-assembled molecular nanostructures akin to that of carbon nanotubes and fullerene has been demonstrated. A unified criterion for the formation of nano-structures from a particular basic molecular building block has been formulated from the studies on bowls, balls and sheets of orthoboric acid, metaboric acid and cyanuric acid clusters.

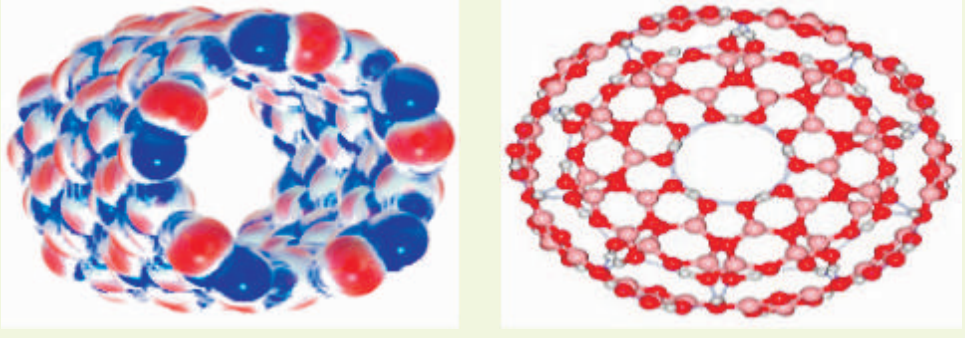


Fig. 1.48 Base building block of orthoboric acid

Evaluating and enhancing the atom economy, atom efficiency and energy efficiency of leather processing

Dehairing and fibre opening processes have been developed by CLRI using an enzyme and sodium metasilicate. The process exhibits significant reduction in Chemical Oxygen Demand (COD) and Total Solid (TS) loads by 55 and 24%, respectively. Twenty four natural shades were developed using combination of seven natural colorants such as Rhine, Rhine M, Indus, Pacific, Caspian, Henna and modified Logwood by mordanting with three metal ions. Developed colors have potential value in the global leather market in the context of environmentally benign leather processing.

Modified leather process (reverse process) by treating the delimed pelt with post-tanning chemicals first, followed by chrome tanning, has been developed. The modified process significantly reduces the usage of chemicals (41%), and water (62%) leading to the reduction in COD and TS loads. Oxidised dialdehyde sodium alginate (DSA) has been successfully shown to act as a potential tanning agent, which results in leathers that are easily biodegradable.

1.13. Materials, Minerals, Metals & Manufacturing

CSIR, through its constituent laboratories AMPRI, CGCRI, CMERI, IMMT, NEIST, and NML, have made a mark for itself in this domain. During the year, its contributions have been well received, as under:

1.13.1. Scientific & Technological Achievements

Helo dunking system through investment casting

CMERI fabricated the components of drive arms & support arms for helo dunking systems using rapid prototyping adopting Stereo Lithography Apparatus (SLA) process. The top domes have been prepared through quasi - hollow SLA quick cast patterns followed by ceramic sheeling and Investment casting of 356-Al Alloy.

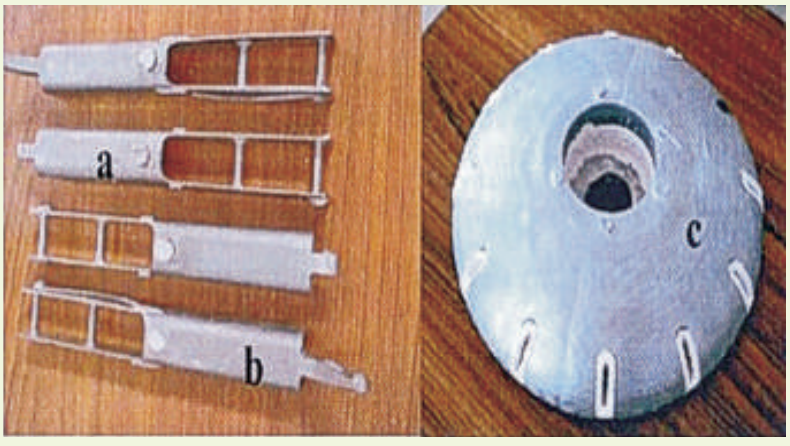


Fig. 1.49 Investment cast (a) support arm (b) drive arm and (c) Top dome components

It is an important step for manufacturing of intricate geometry as well as thin section cast component and weight reduction of Helo Dunking System through RP Integrated Investment Casting. It has strategic defense applications for suitable transducer housing in naval application under sea depth of 300-500 m. Fig. 1.49 shows the support arm, drive arm and top dome components.

Improved cabinet dryer for ginger and turmeric

CMERI developed an improved Cabinet Dryer with higher drying rate. Ginger, turmeric and chilli are the major cash crops of Mizoram and other North-Eastern states of India. The quality of the products is very good in terms of aroma content and the pungency. But

at present there is no proper post harvest processing technology of such good quality ginger. Open sun drying is generally being practiced although the availability of sun light is often uncertain. In such condition, this development is very important.

Photonic crystal fibers

CGCRI developed for the first time in India, a special variety of photonic crystal fiber (PCF) having very high nonlinearity and demonstrated its operation in generating wide band supercontinuum (SC) source required for various applications e.g. optical coherence tomography, spectroscopy, metrology etc. In a SC situation, the fibre can change a brief pulse of light (pico or femtosecond) with a narrow range of wavelengths into a spectrum hundreds of times broader and ranging from visible light to the infra-red. SC is one of the most exciting areas of applied physics today and the ability to create it easily will have a significant effect on technology.

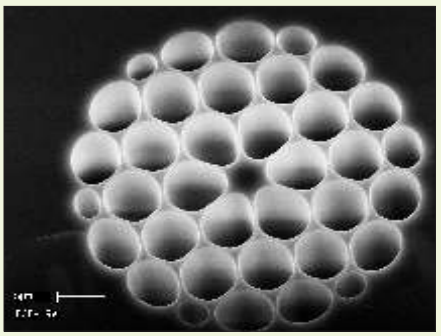


Fig. 1.50 (a)SEM picture of a non-Linear PCF

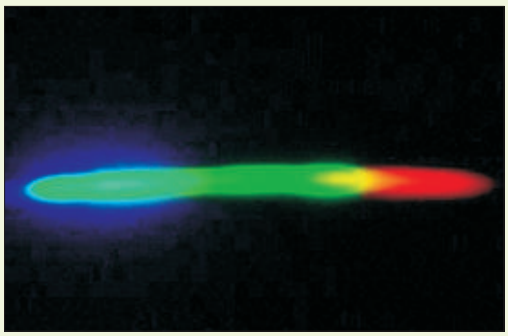


Fig. 1.50 (b) Visible spectrum generated from the PCF through femtosecond pulse pumping

Patterning of inorganic (sol-gel) thin films by soft lithography and self organization

CGCRI used soft lithography technique to pattern sol-gel films of various types (silica, titania, mixed sol etc.). A gel film, in the liquid state is imprinted with a soft stamp (Sylgard 184). Due to capillary action, the liquid rises along the walls of the confining stamp, resulting in a perfect negative replica of the stamp pattern. Atomic force microscopy scan in Fig. 1.51a shows morphology of the imprinted silica gel film created by Capillary Force Lithography. The figure displays line width of ~400nm and periodicity of ~800nm. These structures will be used by CGCRI for the fabrication of planar waveguide based optical sensors.

A novel combination of self organization and soft lithography was also utilized to create ordered 2-D patterns using a simple 1-D (stripe) patterned stamp. A stripe patterned polycarbonate substrate was used to coat the film, which was subsequently imprinted with another stripe patterned stamp, where the direction of the stripes on the stamp

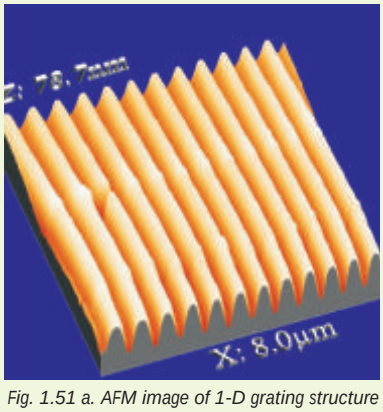
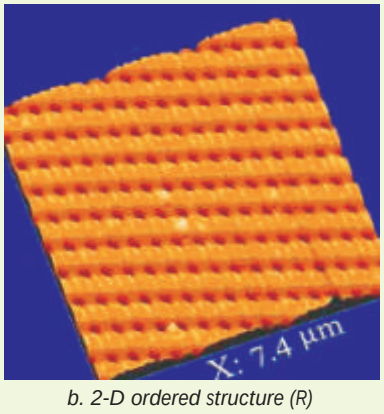


Fig. 1.51 a. AFM image of 1-D grating structure



b. 2-D ordered structure (R)

were perpendicular to those of the stripes on the substrate. The topographic contrast in the initial morphology of the film due to the substrate pattern, in combination with the capillarity driven self organization of the soft gel film results in ordered 2-D structures (fig.1.51b).

Stabilization of Au^{o}-nanoparticles by phosphine based ligands and their characterization

The synthesis and characterization of metal nanoparticles have attracted great attention due to their potential applications in the field of electronics, opto-electronics, biosciences and catalysis. Organic ligands are considered as one of the best supports for the synthesis of metal nanoparticles, particularly for noble metals. NEIST studied the elucidation of structural suitability and ligand donor site environment for stabilization of Au^{o}-nanoparticles. In this context, a series of mono [Ph_3P, P_1]-, di [$CH_2(PPh_2)_2$, P_2]- and tri [$CH_3C(CH_2PPh_2)_3$, P_3]- dentate phosphines & their corresponding chalcogen i.e. S functionalized ligands such as mono [Ph_3PS, P_1S_1]-, di [$CH_2(P(S)Ph_2)_2$, P_2S_2]- and tri [$CH_3C(CH_2P(S)Ph_2)_3$, P_3S_3]- systems are used to synthesize Au^{o}-nanoparticles. The synthesis of Au^{o}-nanoparticles was accomplished by using a room temperature, two phases, one-pot reaction involving the reduction of $HAuCl_4$ precursor by $NaBH_4$ in presence of various ligands.

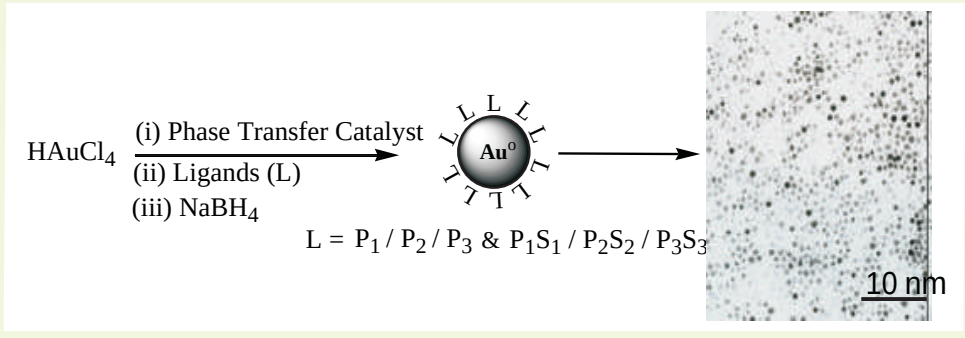


Fig:1.52 TEM Image of Auo nano particle

All these ligands are found to be excellent stabilizers for Au^{o}-nanoparticles having small core diameter and narrow size distributions. The phosphine ligands form smaller Au^{o}-nanoparticles than their corresponding functionalized phosphines, which may be due to the stronger interaction of Au^{o} (Soft) with P (Soft) than Au^{o} (Soft) with S (less Softer than P).

Green technologies for iron ore processing

IMMT jointly with NML, NEIST and CEERI developed three processes viz. (i) Process flow sheet to beneficiate Banded Hematite Quartzite (BHQ) with 38-40% Fe to produce pellet grade concentrate with 64% Fe by recovering 40% of yield; (ii) Process to recover most of the iron values in the form of super grade fines with more than 65% Fe from the existing washing plant tailings with 58-60% Fe with high alumina and silica; (iii) Process technology to beneficiate low grade fines (-10.0 mm) available in Orissa for effective utilization as pellet feed.

Microbial processes for recovery of nickel and cobalt

IMMT studied bioleaching of chromite overburden of Sukinda mines. The studies reveal about 35% nickel could be extracted using acidophilic microorganisms in one ton column and about 25% extraction could be achieved in ten ton heap in about nine months duration.

Leaching of cobalt was observed to be 40% and 31% in 1 ton and 10 ton respectively. The

percentage of metal extraction showed an increasing trend even after 9 months of leaching. The leach liquor was processed through solvent extraction and electro winning route to get highly pure nickel.

Activation of chromite overburden in Rotary Kiln

Ten ton Bioleaching Plant of Lateritic nickel ore

Fig 1.53

Preparation of Anti-reflecting titanium dioxide films

IMMT prepared anti-reflective, nanometric anatase grade titanium dioxide films employing pulse laser ablation based deposition method. The films have been characterized by physical techniques. Decrease in transmittance of TiO_2 films with increased reflectance has been observed with increase in annealing temperature. Films, with as low as 10% reflectance, have been made which are suitable for anti-reflection coating applications. Contact angle measurement of typical films shows that the films are of hydrophobic nature.

Cast titanium dioxide products used in the process

SEM micrographs of the titania films showing rod like structure

Fig 1.54

Silver nanoparticles

IMMT prepared silver nanoparticles by using two types of silver salt and silver complexes. Ultra Violet/Visible spectrophotometric studies have been carried out for the absorbance study of the silver nano sol at different time intervals. The particles show absorbance in the range of 420 - 450nm. A red shift was observed with increase in the time.

Attempts were also made to prepare silver nanoparticles in dry powder form. Characterization of the products by Small-angle X-ray Scattering (SAXS) shows that the particles are spheroidal and bipyramidal in nature and size varies between 2-39 nm. Antibacterial properties of these powders tested against some typical water pathogens indicated that these powders have affinity towards antibactreial action for gram negative bacteria. Based on this, attempts are being made to use the same to develop the water

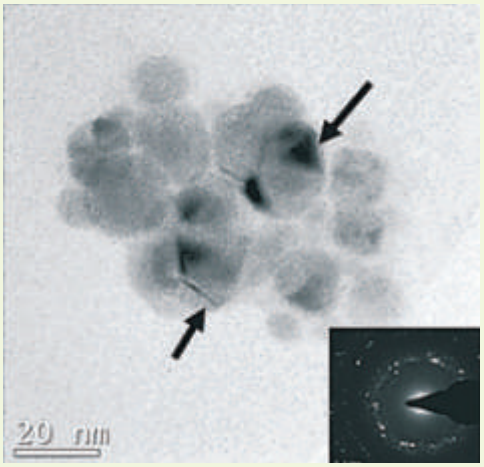


Fig 1.55 TEM micrograph

filters. Fig 1.55 is Transmission electron microscopy (TEM) figure showing spheroidal and bipyramidal shaped silver nano particles with single and multiple twin structures. Inset picture shows SAED pattern of the same, showing nano particles orientation in (110) direction

Aluminium alloys for aero-space applications

IMMT prepared aluminium alloys with Magnesium, Zinc and Copper by metal mould casting method followed by forging and heat-treatment. The effect of Ce addition in Al-Zn-Mg-Cu alloy has been rigorously investigated through optical and transmission electron microscopy and the mechanical properties have been evaluated through tensile and nano-indentation tests. The effectiveness of minor addition of Ce in refining the dendritic cast structure has been demonstrated. In TEM study it was observed that the matrix consists of closely spaced Guinier-Preston zone and fine grain boundary precipitates. The shape of the precipitates changed from spherical to needle like. Size increased from 5-50nm with increase of Cerium from 0.1-0.4%. Around 10% improvement in tensile strength was noted with 0.3% Ce addition, which was saturated with further Ce addition.

Unit for production of fabric dyes

IMMT standardized and patented processes for obtaining stable fabric dye material from a variety of plant materials. The stability of the colour on various fabrics has also been tested in association with the small scale fabric manufacturers. A 50 kg/batch dye extraction unit has been designed and developed to supplement IMMT's process technologies for the production of these natural fabric colourants. The machine has been installed and tested for leakage and cooling performance. Looking into the market potential for natural fabric dyes, it is expected that the machine will have wide commercial acceptability.

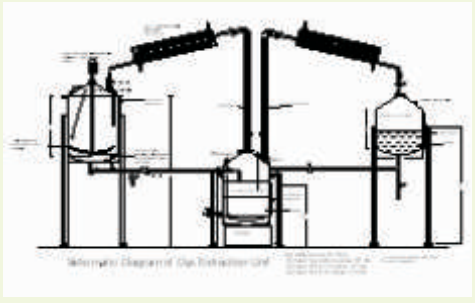


Fig 1.56 Schematic and actual photograph of Plant

Pilot plant for beneficiation of iron ore tailings at Essar-Kirandul

M/s Essar Steel Ltd. erected a 0.6m diameter flotation column of 8 meter height in the premises of its iron ore beneficiation Plant at Kirandul on the basis of design furnished by IMMT. The fabrication and erection job was done under the supervision of IMMT. Test run of the Plant was carried out by using the tailings generated from the existing beneficiation plant. The tailing slurry containing 30-40% solids was conditioned with

required dosages of reagents in the primary conditioner and then transferred to a secondary conditioner by gravity process. The slurry was diluted with additional waste to achieve a pulp density of 1.2. The unit, with a solid feed rate of about 2 tph, was satisfactorily run for about six hours. Continuous operation has also been streamlined.

Product output at the top of the column

Conditioner and agitator with feed pump

Pilot Plant - 0.6 m dia flotation column

Fig. 1.57

Setting up chromite ore beneficiation plant at Sukinda

IMMT had developed the flow sheet for recovery of chromite values from the chromite ore beneficiation (COB) Plant waste. A detail project report was furnished to M/s Jindal Stainless Limited for setting up a 500 tpd chromite recovery beneficiation Plant from the tailings of the existing COB plant at Sukinda. IMMT is currently rendering consultancy service to JSL in setting up the Plant. Assistance is also provided to JSL in the operation of 20 tph chromite beneficiation Plant. This plant treats tailing having a feed of 18-20% Cr_2O_3 to obtain the desired beneficiated concentrates.

Fig. 1.58 Sukinda Plant

Cost effective mine water reclamation technology for providing safe drinking water

NML developed a simple process for treating the coal mine water to make it suitable for drinking. The special feature of the process is the use of a metal hydroxide suspension, for lowering the Total Dissolved Solids, especially the dissolved cations and anions. A pilot plant prototype has been designed and installed. Expression of interest was sought from interested vendors for installing 50000 litres/day Pilot Plant based on the developed process at one of the BCCL collieries in Dhanbad.

Cast *in-situ* composites

Incorporation of second phase particles to the matrix through conventional synthesis technique has some limitations. However, these limitations could be overcome by in-situ generation of the second phases during melting or other processes. AMPRI developed an improved reinforcement and better bond strength between the matrix and second phases using the in-situ melting process. In addition, the surface is free of contaminations such as gas absorption and oxidation. AMPRI synthesized Cu/(Cu-Al) based metal matrix composites containing 50wt% $TiC_{0.7}$ by *in-situ* self-propagating high temperature synthesis (SHS) process using casting route. SHS is an attractive process for synthesizing engineering materials such as ceramics, composites and intermetallics as compared to

conventional synthesizing techniques. The master composites have been diluted to contain 10% TiC by alloying technique. C/Ti ratio of 0.7 has been maintained in this work to facilitate wetting and uniform dispersion of TiC in Copper matrix. The results indicate that aluminium addition improves the wetability of the dispersoid phase with the matrix and leads to more uniform distribution of the TiC dispersoid in the matrix along with micro structural refinement and superior mechanical and tribological properties. XRD results confirmed the presence of TiC particles in the Cu matrix.

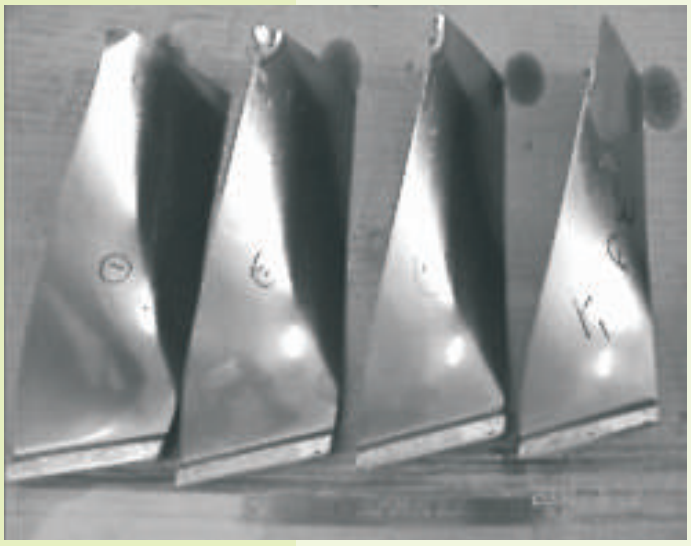
FRP V-Block

V-blocks are used in hydro generator to support field coil to avoid distortion and collapse and to remain at their position against very high loads generated during their rotation due to the centrifugal force. Existing V-blocks are made of aluminum alloy. AMPRI developed light weight, non-conducting, high strength Fibre Reinforced Plastics (FRP) glass fibre reinforced composite material. V-block has been redesigned and is made by reinforcing of stainless steel in FRP material using unique molding technique. Reinforcing of steel into FRP was decided based on the FEM analysis carried out on V-block. Modification in design of FRP V-block was carried out jointly by AMPRI and M/s Bharat Heavy Electrical Limited (BHEL) Bhopal. The blocks were installed successfully by M/s BHEL, Bhopal and are functional in hydro generators.

FOD characterisation of the damaged compressor blades of MIG-29 KB-3111

NML invstigated the low pressure compressor blades of MIG-29 KB3111 aircraft which were found damaged probably due to hit by foreign object. The impact of foreign object leads to different kind of damages like tearing, bending, nick formation and dent marks at the leading edge. It was found that the affected blades were made off different type of materials like Ti-base, Fe-base, Ni-base and Al-base alloys. From the location of damage over the blade surface it is evident that, the foreign object damages (FODs) followed the projectile path of reducing radius in between the successive collision.

The foreign object debris was impregnated at the impact sites and primarily consists of Si, Al, K, Ca, Fe, S and Cl. Their elemental concentration varies within different stages as well as within an impact site. The FODs originated from a rock source which is a complex combination of different mineral phases of varying stoichiometry. The gas generator blade, made of steel, is impacted by rock particles as well as Ti-alloy particles derived from the fractured pieces from forward stages.



Tip damage of fan rotor blade (FRB-1)

Compressor blades with damaged tip of FRB-2, GGRB-1, GGB-4, GGB-8 and GGB-9

Fig. 1.59

1.14. CSIR 800

As per the World Bank book (Dancing with the Giants: China, India, and the Global Economy, 2007), in India, more than 800 million people earn less than 2 US$ (~ ` 90.00) per day. CSIR launched a very ambitious programme, 'CSIR-800', with a mission to improve the living standards of the people by increasing per captia income by `15 per day through S&T interventions. The target areas include affordable healthcare, potable water, sustainable energy, low-cost housing, waste-to-wealth and ICT for empowering masses. It is expected to achieve these through involvement of all the constituent laboratories of CSIR. Some of the significant developments are discussed below:

1.14.1. Scientific & Technological Achievements

Solar powered dual-mode rickshaw

Fig: 1.60 Soleckshaw

CMERI developed solar powered, dual-mode three-wheeled vehicle, 'SOLEKSHAW'. It is aimed for use as a means of transport carrying two passengers and a driver. This vehicle can be driven either by pedaling or by electric motor or by a combination of both. This vehicle is deemed fit for transporting people over small distances, especially in the busy streets of the cities.

Novelty of the present invention lies in the use of Brushless Direct Current (BLDC) hub motor instead of Permanent Magnet Direct Current (PMDC) motor. Use of BLDC motor has eliminated torque enhancing devices and additional mounting structures, which are required for PMDC motor. This system has also eliminated use of many mechanical devices like clutch, spring loaded frictional plate and couplings.

Utilization of certain wild and cultivated plant species available in North Eastern Region for extraction of fibres

Assam and the other states of North Eastern Region of India are rich in bio-diversity. There are many varieties of wild and cultivated plants available in this region which possesses good quality fibre. NEIST collected some of the cultivated fibre bearing plants viz *Hibiscus cannabinus*, *H. sabderiffa*, and *H. esculentus* from Jorhat, Assam. The fibres were extracted by chemical and biochemical process. These fibres after giving certain mechanical and chemical treatment were found suitable for making cordages and yarns. The quality of the fibres were tested and found to possess adequate physical strength for making twines, threads and yarns for making fabrics. These fibres can also be utilized for making decorative handicraft items.

Cultivation of medicinal and aromatic plants

Cultivation and processing of aromatic and medicinal plants, including mushrooms have opened new opportunities for income generation in rural sector. IIIM has developed and standardized cultivation and processing technologies in case of lavender, lavendin, rose, clarysage, rosemary, rose geranium and tagetes. These high value plants have excellent cash benefit ratio.

A new variety of true lavender *(Lavendula angustifolia)* has been evolved through vigorous selection having high content of lavender oil (>1.6 %) and high content of linalool (>25%) and linalyl acetate (> 48%) content. Linalool and linalyl acetate are the

Fig. 1.61 Training and demonstration of lavender cultivation in open fields and fruit orchards

Cultivation of lavender in open fields and fruit orchards

two markers and criteria for its quality parameters. Value added products of lavender like lavender water were also standardized. Lavender oil and its value added products developed by the institute have been accepted well by the user industry both at national and international markets.

IIIM at its branch laboratory Srinagar under Public Private partnership mode has involved a few progressive farmers to cultivate these essential oil bearing plants over a large area of land. 100 hectare was brought under cultivation of rose and lavender.

These aromatic plants have been selected on the basis of harvesting periods under temperate climate conditions so that 6-7 essential oils, and their value added products, can be produced in one distillation plant. Thus this bio business is better protected from market fluctuations at national and international levels.

Nodal agency for quality control on honey export

India exports nearly 12000-15000 metric tonnes of honey valued at about ` 1000 crores annually. Due to the presence of metal and pesticides residues many a times the consignment gets rejected. In view of the excellent quality control and quality assurance facilities at IIIM, Agriculture and Processed Food Products Export Development

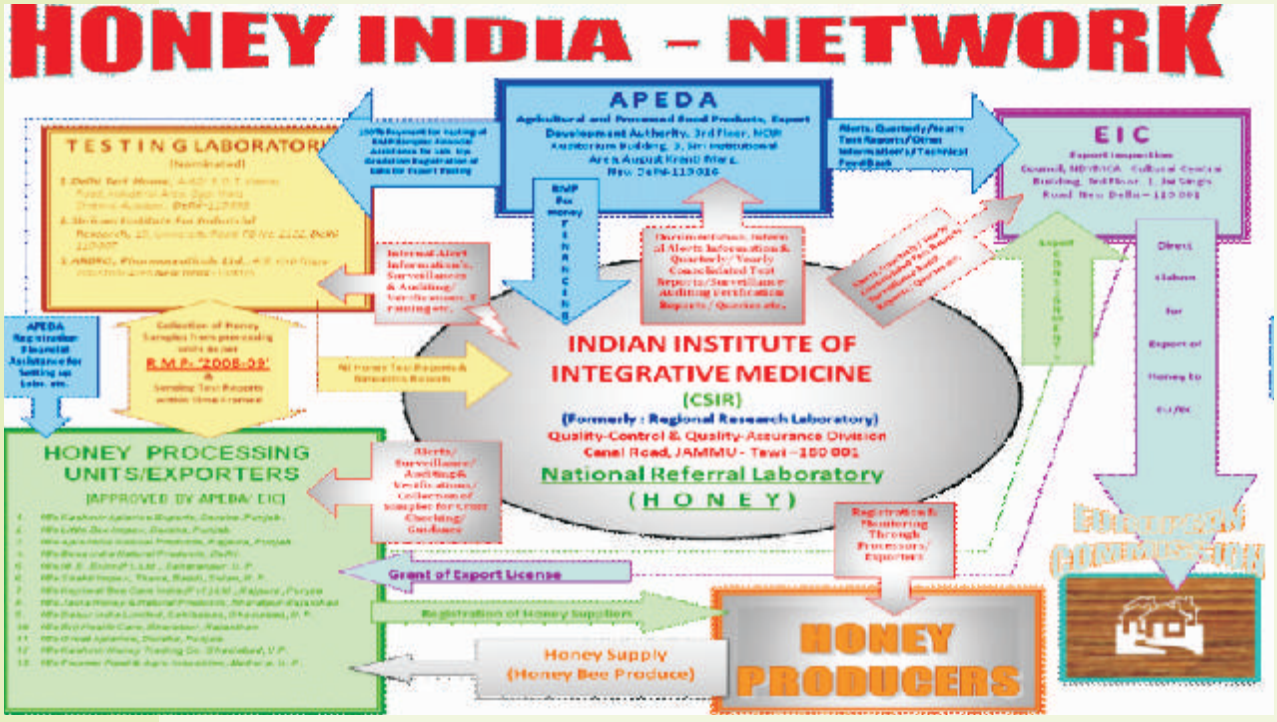


Fig. 1.62

Authority, APEDA (Ministry of Commerce, Govt. of India), has designated IIIM as national referral laboratory for the export of honey to European and other countries. IIIM picks up samples from other testing houses to keep a check on the quality control for exporting the honey.

So far there has been no international alert or failure in the export of honey from India due to the strict quality control of IIIM, which was reflected in the report given by European Commission, Health & Consumer Protection Directorate General.

Aroma Biovillage touches a new height

CIMAP's Aroma Biovillage concept on "Economic enabling of salt affected belt and agricultural lands in Sultanpur and Raibareli districts of Uttar Pradesh by establishing Aroma Biovillages through technology intervention", completed one successful year.

Suckers of menthol mint *(Mentha arvensis)* were distributed to farmers. Some farmers adopted sucker planting and the others raised nursery of mint and planted 35-40 day old seedlings after preparation of the field occupied by winter grain crop and vegetables. About 32 quintal of suckers (cv. Kosi and Kushal) were distributed to 130 farmers covering an area of 54 ha. During this period six field distillation units were installed in nodal clusters of the two districts and trainings imparted on planting, crop management, distillation, oil collection, vermicomposting of the distillation waste etc. Vermicompost pits have also been constructed in all the biovillages. Linkages have also been made for marketing of produce.

Seeds of palmarosa *(Cymbopogon martinii)*, and basil *(Ocimum basillicum)* and slips of lemongrass and vetivers were also provided to the farmers having salt-affected problem soils.

Cultivation of lavender, rose and safforn

Promotion of high value crop in the region is one of the important activities of IHBT. During the year several training programmes were organized at the institute and at farmers' fields to popularize cultivation of medicinal and economically important crops in Himachal Pradesh and Sikkim.

The demonstration plots on commercial cultivation of aromatic plants (damask rose and lavender) were established in a tribal village for the first time. Selected sites were brought under cultivation with the aim to apprise the farmers of the region regarding its cultivation techniques and to motivate them towards crop diversification for higher income generation.

Promotion of commercially important lilium at Lahaul-Spiti (H.P.)

Fig. 1.63 Demonstration plot of Asiatic hybrid lily at Lahaul-Spiti

Agro-technology on the production of cut flower and planting materials of Asiatic hybrid lily was transferred to farmers through training and field demonstration. In Lahaul-Spiti, for the first time, a demonstration plot of cut flower crop (Asiatic hybrid lily) was established by IHBT. The impact of this transfer of technology was realized by a farmer through the sale of cut flower worth

`27000/per 100 m^2 area at Delhi flower market.The income gained was approximately ten times more than the presently cultivated crops like potato and pea in Lahaul-Spiti. Encouraged by the high returns new growers of this area are now taking up interest in initiating cultivation of Lilium for higher income.

Cultivation of *Kappaphycus alvarezii* seaweed

CSMCRI developed a process related to a tissue culture method for cultivation of marine algae. The method comprises the steps of (i) establishing axenic viable algal material by sequential treatment thereof in sterile sea water supplemented with domestic liquid detergent, incubating the treated material, (ii) culturing the axenic explants on agarified medium for induction of callus; (iii) excising and sub-culturing the calli from the axenic explants on fresh agar plates to obtain differentiated densely pigmented oval or spherical shaped micro-propagules (iv) sub-culturing the pigmented calli in agarified medium to achieve enhanced somatic embryogenesis and micro-propagule formation in pigmented filamentous callus, (v) transferring the filamentous calli with somatic embryos for morphogenesis and development of young plantlets; and (vi) cultivating algal biomass on a large scale by growing the young plantlets in enclosed perforated polythene bags.

Fig. 1.64 Cultivation of Kappaphycus alvarezii on raft in sea

Improved *Gur Bhatti*

IIP has developed an improved *bhatti* (open air stove) that is based on the popular design normally found in the states of Uttar Pradesh and Uttarakhand. The improvement focuses mainly towards the better design of furnace and chimney which would improve the combustion performance of bagasse, resulting in about 10% reduction in bagasse consumption and lesser smoke through chimney. By using fire bricks in the furnace, its life has been increased considerably. In addition to it, about 20% increase in *gur (jaggery)* production, of better quality, has been observed. With all these improvements, the profit of gur bhatti owner has increased. Cost of the improved bhatti is higher but due to additional profit, the gur bhatti owner can recover the extra cost incurred, within 2 to 3 gur production seasons.

Fig. 1.65 Improved gur bhatti (furnace and chimney)

Central Management Activities

2.0. CENTRAL MANAGEMENT ACTIVITIES

2.1 CSIR Society

CSIR Society met on 6th August, 2008 under the Chairmanship of Dr. Manmohan Singh, Hon'ble Prime Minister of India and President, CSIR. In his welcome note, Shri Kapil Sibal, Hon'ble Minister of Science & Technology and Earth Science and Vice President of CSIR, thanked the Hon'ble Prime Minister for his unstinted support to CSIR as was evident in an almost 3-fold increase in the plan budgetary support to CSIR from Tenth Plan to Eleventh Plan. He also mentioned that CSIR has got a good science leader in Prof. Samir K. Brahmachari, as DG,CSIR. He said that Prof. Brahmachari's path-breaking programme like Open Source Drug Discovery was a pointer to his incisive thinking and futuristic vision. He lauded the significance of an exhaustive study towards profiling India's genetic diversity. He stressed upon that CSIR had to reinvent itself and work not only at the high end of science but also have progrmames which impact common man.

Prof. Brahmachari, DG,CSIR presented briefly his vision, the road map and also the encapsulated achievements of the previous year.

The Society approved the following items:

- Confirmation of the proceedings of the CSIR Society meeting held on 10th January 2007.
- Annual Accounts of CSIR for the years 2005-06 and 2006-07, the Audit Reports and CSIR's comments thereon.
- CSIR Annual Reports for the years 2005-06 and 2006-07.

President, CSIR and Hon'ble Prime Minister of India, Dr. Manmohan Singh felt that in this type of meeting, one can not discuss on micro scale but has to address the issues at macro level. He was confident that the issues raised by the members of the Society are solvable as two of his very talented ministers, Shri Kapil Sibal and Shri P. Chidambaram, being members of the CSIR Society, can solve the problems which scientific institutions like CSIR are facing. He expressed his concern on how to make career in science more attractive. He was hopeful of arriving at proper, long-lasting solutions to these issues; and felt that the sixth pay recommendations may help the matter.

Hon'ble Prime Minister felt that the issue of ensuring a judicious combination of reward with performance also needs to be discussed. He commended the success of Public-Private participation in science and stressed that this should be made more robust and expand. He also desired that, like science education, scientific and industrial research must be made a part of initial training of the students.

He further felt that institutions in the country are not able to attract philanthropic donations as in case of institutions abroad, particularly in developed nations. He requested the Finance Minister to give a liberal treatment to those who extend charity through research institutions and suggested that an incentive package can be evolved for such cases.

In his concluding remarks, the Hon'ble Prime Minister deeply appreciated CSIR and the new dynamism which Prof. Brahmachari, Director General has brought in. He also expressed his satisfaction that country's science establishments are in the hands of a talented minister like Shri Kapil Sibal.

Shri Kapil Sibal, Hon'ble Minister of Science & Technology and Earth Sciences and Vice President thanked the Hon'ble Prime Minister for setting up an agenda for CSIR and also his insightful thinking on matters related to research institutions.

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2.2 Governing Body

During the year, the Governing Body (GB) of CSIR met on three occasions, i.e. on 10th June 2008, 7th November 2008, and 6th February 2009. Some of the significant decisions taken during these meetings are highlighted below:

171st meeting held on 10th June, 2008

Prof. Samir K. Brahmachari informed GB about some of the significant administrative developments that happened since the last meeting of GB. It included:

- Long pending issue of framing Recruitment Rules for appointment of Directors of CSIR Laboratories/Institutes was done with;
- Approval of 102 Scientist positions at 'H' grade through open selection;
- Overdue assessments of Scientists 'F' to 'G' pending since 2004-05 completed upto March 2007; and
- Issue for granting one more chance to 68 scientists who were stagnating at respective positions for 10 to 12 years.

The Governing Body made the following recommendations:

- Implementation of additional Eleventh Five Year Plan projects at a cost of ` 162.39 crores;
- Revised cost estimates of the projects "High value products from Agro-forest Resources from the Himalayan Region and improving productivity and quality of product development including facility for nutraceutical/value added products" of IHBT, Palampur from ` 13.07 crore to ` 19.27 crore; and
- Increase in age limit for superannuated receipents of Shanti Swarup Bhatnagar Award, Fellows of Indian National Science Academy (INSA), Indian Academy of Sciences (IAS), National Academy of Sciences (NAS) and Indian National Academies of Engineering (INAE).

172nd meeting held on 7th November, 2008

The Governing Body made the following significant recommendations:

- Continuation of 'Unit for Research and Development of Information Products (URDIP)' on a permanent basis with support under 'R&D Management Support Scheme of CSIR';
- Enhancement of stipend under CSIR Diamond Jubilee Research Interns Award Scheme;
- Approval of Recruitment Rules, 2008 for the post of Scientist 'H'/Outstanding Scientists and Scientists/Technologists of Indian Origin;
- Approval of Operation of Distinguished Scientists positions in CSIR in scale of ` 75500-80000 HAG by upgradation of 30 existing posts of Group (IV) scientists;
- Adoption of revised CSIR Purchase Rules-2008; and
- Approval of new 'CSIR Nehru Science Post-doctoral Research Fellowship' Scheme.

173rd meeting held on 6th February, 2009

Some of the significant approvals/recommendations are highlighted below:

- Recommendation of Annual Accounts for the year 2007-08;
- Recommendation for CSIR Annual Report for the year 2007-08;
- Modernization of Indo-Swiss Training Centre (ISTC) at CSIO; and

- Eleventh Plan Project Proposals on "Nanostructured Advanced Materials", 'Setting up of state-of-art Multi-Tera flop High Performance Computing (HPC) facility at CMMACS", and 'Integrated Analysis for Impact, Mitigation and Sustainability: Regional Climate Modeling at Decade Scale'.

2.3 Shanti Swarup Bhatnagar Prize Presentation Ceremony

CSIR awards Shanti Swarup Bhatnagar Prize every year to scientists working in India for their outstanding contributions to science and technology. The Award has been named after the founder Director of the Scientific & Industrial Research, the late Dr. (Sir) Shanti Swarup Bhatnagar. The prize was presented to the awardees for the years 2007 and 2008 at a specially organized function on 20th December, 2008.

During the ceremony the following awards were also presented:

CSIR Diamond Jubilee Technology Award for the year 2007 to M/s Mahindra and Mahindra Limited for development and commercialization of Scorpio, which represents a new era where Indian Technology will dominate the Global market.

Hon'ble Prime Minister giving away CSIR Diamond Jubilee Technology Award for the year 2007 to M/s Mahindra and Mahindra Limited

CSIR Awards for S&T Innovations for Rural Developments for the year 2007 awarded jointly to 'National Research Centre on Yak (NRC-Yak), Dirang' for "Improvement of Sustainable Yak Husbandry Practices in Himalayan Region" and 'Nimbkar Agricultural Research Institute (NARI), Phaltan' alongwith National Chemical Laboratory (NCL), Pune', for "Use of the FecB (Booroola) gene in Deccani breed of sheep, to increase lamb production and thereby the income of Shepherds".

CSIR Award for S&T Innovations for Rural Development (CAIRD) for the year 2008 jointly to Central Salt & Marine Chemicals Research Institute (CSMCRI), Bhavnagar, for 'Innovations in the area of Salt for Rural Development' and Central Institute of Medicinal and Aromatic Plants (CIMAP), Lucknow, for 'Biovillage strategy for Agri-business of Medicinal and Aromatic Plants.'

Hon'ble Prime Minister giving away CAIRD to CSMCRI

Excerpts from the speech by Shri Kapil Sibal, Vice President, CSIR and Hon'ble Minister for Science & Technology and Earth Sciences (Full speech is placed at Annexure-VIII)

The Vice President, CSIR and Hon'ble Minister of Science & Technology and Earth Sciences, Shri Kapil Sibal, welcomed the Hon'ble Prime Minister of India and President, CSIR, Dr. Manmohan Singh to the CSIR Awards function. He also welcomed all the awardees, their family members accompanying them and members of CSIR family.

Shri Kapil Sibal presenting memento to Hon'ble Prime Minister and President, CSIR

During his welcome speech, Shri Sibal, in his inimitable style raised a question as to whether Nobel Prize winning discoveries, commonly understood to be associated with fundamental knowledge, like Raman Effect, are outside the realm of patents. He remarked that there would definitely be intermediate findings, big or small, which may be inventive and novel in themselves to qualify for grant of patents and they may also have commercial value in their own way. One has to be alert to seek intellectual property

rights for those, he cautioned. This, he said, required institutional mechanism and innovation. He announced that Bill for Protection and Utilisation of Public Intellectual Property had been introduced in the Parliament. The Bill has provisions for scientists and researchers to have incentives and means to protect their inventions and also enable them to have a share in the monies realized by the transfer and commercialization of their researches.

He, however, expressed his concern that despite the remarkable progress in science and technology, the asymmetry in the distribution of wealth, health, comfort and safety has in fact increased globally as well as in India. He felt that a new social contract of science with society, especially in India is called for, with the intent and determination to address and solve these problems. He requested scientists to develop more community-based research projects which allow the direct users/beneficiaries to influence the choice of problems and technology. This collaborative effort would lead to better cost-benefit analysis, so necessary for, on the ground decision making and acceptance and ownership of the research outputs, he hoped. He was also optimistic that science and technology would be able to directly help common mass to live their life with greater dignity and comfort.

Excerpts from the Speech of the Hon'ble Prime Minister of India and President, CSIR Dr. Manmohan Singh (Full speech is placed at Annexure-IX)

The Hon'ble Prime Minister opened his speech by stating, *"I am very pleased to be here in your midst today to give away the Shanti Swarup Bhatnagar Prizes for the years 2007 & 2008. I congratulate each one of the award winners. And I shall also like to congratulate their spouses because this creative pursuit is a joint enterprise which is not often recognized."*

He stated that the awards recognize not only past work but are also an inspiration for the winners to achieve even greater successes in the years to come. He mentioned that Shanti Swarup Bhatnagar award is named after one of scientific pioneers and institution builders of the country. Shanti Swarup Bhatnagar, along with Homi Bhaba, P.C. Mahalanobis and Vikram Sarabhai among others who created the scientific infrastructure of country. He called Shanti Swarup Bhatnagar, a visionary who laid the foundation of the great institution, the Council of Scientific and Industrial Research, a pride of India. He quoted Pandit Jawaharlal Nehru who once said about Shanti Swarup Bhatnagar: *"Dr. Bhatnagar was a special combination of many things, added to which was a tremendous energy with an enthusiasm to achieve things. The result was he left a record of achievement which was truly remarkable. I can truly say that but for Dr. Bhatnagar you could not have seen today the chain of national*

Hon'ble Prime Minister addressing the gathering

laboratories."

He commended the energy and enthusiasm of scientists that is being celebrated each year. He also lauded the creativity and innovation of scientists which is a matter of great national pride.

He commended CSIR for undertaking a number of important initiatives over the past few years, like mapping of the entire genetic diversity of its population and path breaking scientific discovery of mass propagation of asexually produced seeds.

He asked scientists to connect science to the daily lives of millions of people. He assured that the government would create a favourable enabling environment for this to take place. Public-private partnerships should be used to commercialize the technologies emerging from R&D programmes being funded by various science departments, he commented.

He felt that the role of technology in supporting counter terrorism and internal security efforts was not adequate particularly when compared with other countries' efforts which use modern science and technology in security structures with great effect. He indicated some of the areas where greater efforts were required, for example surveillance systems, cryptography, near real time search and identification from distributed large data bases and computer simulation exercises to enhance crisis tactics and responses. Scientific interventions are needed to neutralize weapons of terror and mass destruction, he advised.

He emphasized that this is also a time when the world is confronted with potentially devastating climatic changes along with a growing economic recession. He was confident that the ingenuity and inventiveness of science could find ways to 'leapfrog' to future technologies, which are affordable and also sustainable. He suggested utilizing some part of the public investment, in these new technologies that would help build sustainable pathways to development.

He further stated that government has worked hard for the rejuvenation of the S&T establishments in the country. He declared it as a national priority. He also stressed that scientific institutions of higher learning and research laboratories require high quality manpower particularly at entry level in order to flourish. He mentioned that the government has made strenuous efforts in this regard which would be visible in the years to come. He also suggested that we should not become a back office for providing Research & Development solutions for multinational companies.

The Hon'ble Prime Minister finished his address by congratulating the award winners once again.

Prof. Samir K. Brahmachari, Director General, CSIR, while extending vote of thanks, felt proud in representing CSIR and to honour those whose contribution to science has made the nation proud.

2.4 CSIR Foundation Day

CSIR celebrated its 67th Foundation Day on 26th September, 2008 at a glittering function, presided over by Shri Kapil Sibal, Hon'ble Minister of Science and Technology and Earth Sciences and Vice President, CSIR, Shri Sibal addressed the august gathering of scientists and technologists and gave away various awards. Prof. Bartha Maria Knoppers, Faculte de Droit, University of Montreal and Senior Researcher at the Centre de Recherche en Droit Public (CRDP), Canada delivered the foundation day lecture entitled "Investments in Health Research and International Interoperability". A workshop on 'Know Your Genome' was also organized at NPL for the high school and junior college students.

Seen on the dais during the CSIR Foundation Day Function at NPL, New Delhi (from right): Prof. Samir K. Brahmachari, Shri Kapil Sibal, Prof.Bartha Maria Knoppers and Dr. Vikram Kumar

Prof. Samir K. Brahmachari, in his welcome address introduced the speakers and their scientific contributions. He referred Shri Sibal as a Champion of Science not only in CSIR but also of the entire nation. He, in particular, lauded the efforts of young innovators by calling them 'especial'. Prof. Brahmachari also mentioned that the workshop on "Know Your Genome" was aimed to light a spark of intellectual curiosity in young minds.

Prof. Brahmachari delivering the welcome address

Prof. Brahmachari was emphatic in his statement that 'CSIR' stands not only for the 'Council of Scientific and Industrial Research' but also for 'Council of Scientific and Innovative Research' with 'Corporate Social Indian Responsibility'.

Foundation Day Lecture by Prof. Bartha Maria Knoppers

Prof. Bartha Maria Knoppers, in her foundation day lecture, spoke about the concept of "common heritage of mankind". She mentioned that it was recognized quite early that some things are common to all mankind and cannot be reduced to the property of an individual. Her talk highlighted that there are privately owned and state owned property but then there are also those property that fall in public domain. The public domain is a range of abstract materials commonly referred to as intellectual property which are not owned or controlled by anyone. She advocated the concept of 'Open Source' mechanism for data sharing.

Prof. Knoppers delivering Foundation Day lecture

Prof. Knoppers further elaborated on the Public Population Project (P^3G), which is a non-profit international consortium to promote collaboration between researchers in the field of population genomics. It was launched to provide the international population genomics community with the resources, tools and know-how to facilitate data management for improved methods of knowledge transfer and sharing. Its main objective is to create an open, publicly accessible knowledge data base.

It was clear from her talk that collaboration and cooperation were the only productive ways forward as far as the scientific community was concerned. This was the way, the fruits of science could be delivered to the common man at an affordable cost.

Address by Chief Guest, Shri Kapil Sibal, Vice President, CSIR and Hon'ble Minister of Science & Technology and Earth Sciences

Shri Kapil Sibal opened his address by congratulating the award winners and highlighted the advances in scientific R&D and also focused on the new trend that is Open Source; a collaborative way of making progress. He was excited by the pace at which science and research moving forward and by the perceptible change in thought. He appreciated the sharp change in the way science is being done. The trend is "towards sharing of knowledge". He expressed his delight at Prof. Knoppers' speech and emphasized that genetic make-up is the heritage of mankind. *"If 21st century healthcare problems are to be resolved, we have to change the existing R&D healthcare model"*, he stressed.

Hon'ble Minister of S&T & ES addressing the gathering

Shri Sibal congratulated Prof. Brahmachari, DG, CSIR for launching Open Source Drug Discovery (OSDD) targeting Tuberculosis. He said, that there is a wealth of knowledge dispersed around the world on Cancer, on TB, on Autism, on Alzeimer's, etc, but there is no platform to share this knowledge. He praised the OSDD platform and commented on the importance of such Open Source platforms that allow scientists to share. However, he cautioned about addressing huge ethical issues. He also pointed out the need to develop stronger linkages with industry. He said that while science developed well in CSIR, the linkages with industry needs strengthening.

He also praised the Soleckshaw - solar operated rickshaw, designed by CSIR, as an example of a "solution for the people".

He exhorted CSIR to address to the needs of the people by creating a roadmap for solutions for the 800 million poverty-stricken Indians. Shri Sibal said, *"Science is for the people. It is not meant to sit in labs. There is no point if you do not have solutions for the people. CSIR must have solutions for the people".*

2.5 Awardees of Shanti Swarup Bhatnagar Prize for the years 2007 & 2008

Year 2007

Biological Sciences: Dr. Narayanaswamy Srinivasan, Indian Institute of Science, Bangalore, and

Dr. Upinder Singh Bhalla, Tata Institute of Fundamental Research, Bangalore

Chemical Sciences: Dr. Amalendu Chandra, Indian Institute of Technology, Kanpur, and Dr. A. Ajayaghosh, National Institute for Interdisciplinary Science and Technology, Thiruvananthapuram

Earth, Atmosphere, Ocean and Planetary Sciences: Dr. Anil Bhardwaj, Vikram Sarabhai Space Centre, Thiruvananthapuram

Engineering Sciences: Dr. Rama Govindarajan, Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore, and Dr. Budaraju Srinivasa Murty, Indian Institute of Technology, Chennai

SSB award winners for the year 2007 with dignitaries

Mathematical Sciences: Dr. B V Rajarama Bhat, Indian Statistical Institute, Bangalore

Medical Sciences: Dr. Pundi Narasimhan Rangarajan, Indian Institute of Science, Bangalore

Physical Sciences: Dr. Yashwant Gupta, Tata Institute of Fundamental Research, Pune, and Dr. Pinaki Majumdar, Harish-Chandra Research Institute, Allahabad

SSB award winners of 2008 with dignitaries

Year 2008

Biological Sciences: Dr. Gajendra Pal Singh Raghava, Institute of Micobial Technology, Chandigarh and Dr. L S Shashidhara, Centre for Cellular & Molecular Biology, Hyderabad

Chemical Sciences: Dr. Pradeep Thalappil, Indian Institute of Technology, Chennai and Dr. Jarugu Narasimha Moorthy, Indian Institute of Technology, Kanpur.

Earth, Atmosphere, Ocean and Planetary Sciences: Dr. P N Vinayachandran, Indian Institute of Science, Bangalore

Engineering Sciences: Dr. Ranjan Kumar Malik, Indian Institute of Technology, Delhi

Mathematical Sciences: Dr. Jaikumar Radhakrishnan, Tata Institute of Fundamental Research, Mumbai

Medical Sciences: Dr. Ravinder Goswami, All India Institute of Medical Sciences, New Delhi

Physical Sciences: Dr Raghunathan Srianand, Inter-University Centre for Astronomy & Astrophysics, Pune and Dr. Srikanth Sastry, Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore

2.6 CSIR Young Scientist Award 2008

In order to promote excellence in various fields of science and technology, a scheme of awards for young scientists in the CSIR system was introduced in 1987. Normally, 5 awards, one in each of the following fields, are given annually:

- Biological Sciences
- Chemical Sciences
- Earth, Atmosphere, Ocean and Planetary Sciences

- Engineering Sciences
- Physical Sciences (including instrumentation)

Following scientists have bagged the CSIR Young Scientist Award for the year 2008.

Biological Sciences: Dr. Beena Pillai, Institute of Genomics & Integrative Biology, Delhi

Chemical Sciences: Dr. Subhash Ghosh, Indian Institute of Chemical Technology, Hyderabad and Dr. Melepurath Deepa, National Physical Laboratory, New Delhi

Engineering Sciences: Dr. Satyajit Vishnu Shukla, National Institute for Interdisciplinary Science and Technology Thiruvananthapuram and Dr. Ranjan K Sahu, National Metallurgical Laboratory, Jamshedpur

Earth, Atmosphere, Ocean & Planetary Sciences: Dr. Lidita Khandeparker, National Institute of Oceanography, Goa and Dr. Simanchal Padhy, National Geophysical Research Institute, Hyderabad

Physical Sciences: Dr. Pankaj Poddar, National Chemical Laboratory, Pune

CSIR Young Scientist Award-winners with Hon'ble Minister Shri Kapil Sibal, Prof. Samir K. Brahmachari, Prof. Bartha Maria Knoppers and Dr. Vikram Kumar

Headquarters Activities

3.0. HEADQUARTERS ACTIVITIES

CSIR Headquarters is pivotal to the working of all its 37 constituent laboratories, and its responsibilities include policy framework, plan process, management of intellectual property, dissemination of its achievements to public and stake-holders, serving as window to international linkages, interfacing with various government departments including the Parliament, Ministries, Planning Commission etc, extramural human resource development and many more. CSIR Headquarters has many domain-specific divisions which work in tandem to accomplish their respective tasks through a battery of dedicated workforce including Scientists, Technical Officers, Personnel from Finance, Purchase, General Administration etc.

Some significant achievements/contributions from various divisions of Hqrs. during the year are:

3.1 R&D Planning Division

The R&D Planning Division is focal point of the Headquarters, which is mandated to carry out activities ranging from regular interactions with Government agencies, conceptualizing and preparing Five Year Plans and Annual Plans, Demands for Grants and related matters, bringing out CSIR Annual Report and various submissions to statutory bodies, etc.

It also carries out activities related to organizing Directors' Conference, Research Councils of the labs, matters pertaining to S&T plan projects, data bank of pan CSIR R&D activities, implementation of CSIR-National Innovation Foundation Scheme, execution of CSIR Innovation Scheme, support to programmes like Golden Triangle Project, and providing assistance to Minister of S&T, etc.

3.1.1 Demands for Grants for the Year 2008-09

The Division prepared Demands for Grants for the year 2008-09 and submitted to the Department-related Parliamentary Standing Committee for its consideration. While considering Demands, the Committee had raised certain queries which were duly replied to the Committee. The Committee approved the demands for the year 2008-09. The Department-related Parliamentary Standing Committee made certain observations and recommendations. Some of the significant ones are reproduced below:

One Hundred Eighty Sixth Action Taken Report

- *Token hike in the allocation is basically no hike if the growth rate is of 9 percent and the inflation is of 5 percent, which may be taken into consideration;*
- *Mechanism to monitor and review the ongoing schemes for effective implementation of its programmes;*
- *The benefit of scientific research is yet to percolate down to the society as treatment of some of the diseases like Malaria, Polio, Diabetes, TB, Cancer etc. are still beyond the reach of common man;*
- *Urgent need to develop an economically viable and environment friendly technology for conversion and utilization of biomass to fuels;*
- *Take a lead role in galvanizing and dovetailing its activities and resources to find viable solutions to provide relief to the nation and the world from the most formidable challenges of Global Warming and Climate Change of the 21st Century. The Committee is happy to note that CSIR is contemplating initiation of mega R&D programme on climate change covering various dimensions such as assessment, adaptation, mitigation, alternate energy sources,*

etc. Since this has to be addressed on an urgent and immediate basis, the Committee is of the opinion that the Department should start working on this at the earliest in a time bound manner, efficacy of which may be reviewed annually. Progress made in this regard may be brought in the form of a white paper to know how real and formidable is the threat posed by global warming and climate change. The Committee also feels that separate budgetary provisions for this purpose could be made;

- *Prepare concrete proposals to trap, harness and retain human resource in the field of science by earmarking sufficient fund for the purpose;*
- *To improve awareness about patents in the country, especially among the scientist and other innovators so that the valuable intellectual property earned by them is commercially protected; and*
- *(NMITLI) has created a brand image and is viewed today as a benchmark of Public-Private Partnership (PPP) schemes which is being emulated by various other government Departments. The Committee is of the view that the public-private partnership is the kind of research model that can successfully work in today's world where commercial viability of research and its self-sustaining nature is as important as the research itself.*

The Division prepared suitable responses to the observations and recommendations and submitted it to the Committee.

One Hundred Ninety Seventh Action Taken Report

Based on the reply submitted by the Division, the Committee made further observations and recommendations: excerpts of some of the significant observations and recommendations are reproduced below:

- *The Committee is of the view that the future of the country depends upon its technological prowess and the research & development projects of the Department play an important role in this regard. Any unjustified decrease in funds allocation would slow the country's progress. Hence the Committee reiterates that the Department should pursue its demand for higher allocation with the Planning Commission more vigorously at R.E. stage.*
- *Find a complete solution to common man's diseases viz. Malaria, Polio, Tuberculosis, etc., though a lot of funds and effort has been invested for the purpose. The Committee therefore, recommends that research and development efforts should be intensified to find medication for these diseases at the earliest.*
- *Research & Development on commercially viable bio-fuel should be given top priority due to shortage of biofuel in the country and huge outgo of financial resources due to their import.*
- *'Human Resource Development Scheme' would not remain a scheme merely on paper, but would be implemented in letter and spirit to bridge the acute shortfall in the requirement of scientific manpower.*
- *NMITLI projects would be taken up with the various governments in the right earnest, so that all the states may benefit by this programme.*
- *Satisfy the aspirations of the country as regards growth of scientific research and development, providing scientific manpower and other associated responsibilities.*

Minister's Statement

As per the statutory requirement, the Hon'ble Minister of Science & Technology is required to make a statement in the Parliament to inform the esteemed House about the status of implementation of the actions taken by the Government on Reports on the consideration of the Demands for Grants of Department of Scientific & Industrial Research (DSIR) including CSIR. The Division prepared the statement on the status of implementation of recommendations contained in 186th and 197th Report of the Committee.

3.1.2 Outcome Budget

Ministry of Finance has made it mandatory to submit Outcome Budget for all Ministries/ Departments. The Outcome Budget, is basically, a mechanism to measure the development outcomes of all major programmes run by Ministries. It is envisaged to improve the quality of implementation of developmental programmes. In short, the 'outcome budget' is a pre-expenditure instrument to help realize the Department's vision through clearly defined outputs/outcomes, as a supplement to the current system built around post-expenditure scrutiny. Keeping the above philosophy in focus, the Division prepared the material pertaining to CSIR and provided it to DSIR for further integration with the DSIR component.

The document covers mandate, goals and objectives of CSIR as a whole, policy reforms and its major achievements during the year. The scheme-wise, project-wise achievements of the 2008-09, targets for 2009-10 have also been prepared, on the basis of inputs received from laboratories.

3.1.3 Annual Report

The Division also prepares CSIR's Annual Report every year. The document has been prepared on the basis of inputs received from all its constituent laboratories. The inputs are analysed, significant achievements selected, edited and got printed. The Report is put up to various committees for approval such as CSIR Governing Body, CSIR Society and the Parliament.

3.1.4 Annual Plan 2009-10

Annual Plan of CSIR is one of the major activities of the Division. It is prepared every year and submitted to the Planning Commission. The Document is prepared on the basis of inputs received from all the constituent laboratories and various divisions of CSIR Headquarters. The Annual Plan document for the year 2009-2010 consists of overall achievements of CSIR during the preceding year, details of the various schemes and projects being executed during the eleventh Plan period, and projected budgetary support for the year 2008-2009. The details of the scheme / project covers objectives / goals, deliverables / outcomes, progress /achievements, anticipated achievements during 2008-2009 and targeted deliverables for 2009-2010. A chapter is dedicated to the financial requirement which covers project-wise, scheme-wise, and consolidated financial requirement of CSIR.

3.1.5 Golden Triangle Project

The Golden Triangle Project (GTP) has been launched as an innovative scheme with Department of AYUSH, ICMR and CSIR as three equal partners to study identified Ayurvedic formulations/medicines using modern tools and technologies for the Indian and global markets. The project is being coordinated by the Division in a network mode involving CSIR labs namely: IIIM, NBRI, CIMAP, IICT, IITR, NIIST, NEIST, IMMT, CDRI, and NCL.

Out of 88 plants used in identified formulations, 84 have been standardized based on their microscopic examination, pharmacognosic studies, microbial contamination, heavy metals and pesticide residue content, aflotoxin and chemical analysis based on markers.

Physico chemical characterization and acute toxicity studies of eight herbo-minerals have been completed and report has been submitted to the Department of AYUSH. 90 days Chronic toxicity studies of sevel herbo-minerals namely Arogya Vardhini Vati, Kajjali Yoga, Makara Dhawaja, Ras Sindoor, Ras Manikya, Maha Laxmi Vilasras, Vasant Kusumakar ras have been completed and the report has been submitted to the Department of AYUSH.

3.1.6 Discovery and preclinical studies of new bioactive molecules (natural and semi-synthetic) and traditional preparations.

The Division is co-ordinating the above mentioned network project at the cost of `11.71 crore. Some of the significant achievements are:

- About 800 plant extracts have been bio-evaluated for pharmacological activities and pesticide activity. 119 Herbarium sheets, 45 seed samples, 184 plant samples and 691 extracts were submitted to NBRI, CIMAP, IIIM and CLRI, respectively for storage.
- 306 Bacterial and 667 fungal cultures were preserved at IMTECH which also supplied 54 bacterial and 42 fungal cultures for preparation of extracts. A new protocol was developed for preparation of microbial extracts.

Following ten leads showing consistently promising results have been identified for Fast Track Development.

Lead Code	Disease Condition	Nature of Lead
AP-20-15am, and 16am	Dementia	Single molecules
RJM/0035/P10/A001/F003/K002	Anti-hypertensive	Single molecule
RJM/0024/P10/A001/F003/K002	Immunostimulatory	Single molecule
Ap9cd	Anti-cancer	Mixture of three molecule
ICB-014-P04-A002	Anti-ulcer	Herbal formulation with potential of single molecule
RJM1195P08 A001	Immunosuppressive	Herbal formulation with potential of single molecules
MAP-1597 P03/A001	Anti-psychotic	Herbal formulation with potential of single molecules
WG 76P	Anti-ulcer	Herbal formulation
RJM0035 P05A003 F009	Hepato protective	Herbal formulation

- Out of five leads, four leads, i.e. AP-20 (16), RJM/0035/P10/A001/F003/K002, MAP 1597 P03/A001, ICB-014-P04-A002 and RJM0035 P05A003 F009 have been identified for commercial exploitation with the help of industry.
- WG 76P an anti-ulcer herbal formulation has been handed over to Arya Vaidyasala for making it available to patients through their own hospital chain in the country.

3.1.7 CSIR-National Innovation Foundation Scheme

CSIR had entered into a Memorandum of Understanding with National Innovation Foundation (NIF) in 2003 having objectives of empowering grass root innovators who

have demonstrated creativity and innovation by blending formal science with informal creativity and innovation. The division has the responsibility of execution of this MoU. Under the scheme following projects have been approved during the year:

(i) Development of screening procedures for the validation of folklore medicines (IGIB)

(ii) Development of joint database on medicinal plants used at grass-root level (CIMAP)

(iii) Short term validation of traditional herbal knowledge (NBRI)

(iv) Standardization and value enhancement of selected agro-based innovations (CMERI)

3.1.8 Open access to science publications

CSIR organized a one day conference on "Open Access to Science Publications: Policy Perspective, Opportunities and Challenges", in New Delhi on 24th March, 2009.

All over the world, there is a growing perception now that S&T/Research information should be shared among the S&T workers in a more open manner. This would lead to performing research on a wider canvas, more collaborations, better research, culminating into development of better technologies. However, there are issues regarding Intellectual Property Rights (IPR) - patents, copyright, trademark etc. that inhibit this free flow of Knowledge. Nonetheless, keeping these factors in view, many organizations across the world have put some S&T / Research information, research papers etc. in Institutional Repositories in Open Access mode.

The Conference was held for creating awareness on Open Access, to sensitize policy makers and senior scientists of the country on what is happening in the world in the field of Open Access and how it could be beneficial to Indian Science & Technology.

Inaugural address was delivered by Dr. Gangan Prathap, Director, NISCAIR & Former VC, Cochin University of Science & Technology. The Keynote addresses were delivered by Prof. John Willinsky, Stanford University, USA on "Global and Local Support for Making Research and Scholarship Publicly Available", and by Prof. Leslie Chan, University of Toronto, Canada, on "From Institutional Repositories to a Global Knowledge Commons".

3.2 Technology Networking and Business Development Division

Technology Networking and Business Development (TNBD) Division steers Govt. of India's programme, the New Millennium Indian Technology Leadership Initiative (NMITLI) on one hand and CSIR's overarching business development activities on the other. It also facilitates the functioning of the Unit for Research & Development of Information Products (URDIP). Highlights of some of the important activities undertaken and managed by the TNBD Division during the year are given hereunder:

3.2.1 NMITLI

The New Millennium Indian Technology Leadership Initiative (NMITLI) is the largest public-private-partnership effort within the industrial R&D domain in the country. It looks beyond today's technology and thus seeks to build, capture and retain for India a leadership position by synergising the best competencies of publicly funded R&D institutions, academia and private industry. It is based on the premise of consciously and deliberately, identifying, selecting and supporting potential winners. So far 57 network projects in diverse areas viz. Agriculture & Plant Biotechnology, General Biotechnology, Bioinformatics, Drugs and Pharmaceuticals, Chemicals, Materials, Information and

Communication Technology and Energy, have been formulated under NMITLI. These projects involve 80 industry partners and 270 R&D groups from different institutions. Approximately 1700 researchers are engaged in these projects. These 57 projects cumulatively have an outlay of approximately ` 500 crore.

Keeping in view the objectives, NMITLI evolves both 'push' and 'pull' type of projects, which are appropriately named as (i) Nationally Evolved Projects (NEP); and (ii) Industry Originated Projects (IOP). Besides, few projects are evolved based on the 'proof of concept' obtained from the earlier/ongoing NMITLI projects.

Under the industry originated category, CSIR received 101 conceptual proposals in response to open advertisement and invitation from CSIR. After various level of screening, shortlisting one concept has been developed into a project proposal i.e. 'Validation of the handheld diagnostic platform for HBV detection'.

Further, three projects have emerged from the ongoing NMITLI projects. Two projects are in the field of drugs and pharmaceuticals and are being proposed for further studies. One project on 'Conversion of cellulose and hemicellulose into sugars and ethanol' has been evolved to expand the knowledgebase for enhancing the chance of success. The other projects are: 'Development of nanoparticle based formulation for oral delivery of insulin', 'Pharmacological and Genomic Investigations on Ashwagandha plant' and 'Conversion of cellulose and hemicellulose into sugars and ethanol-expansion'.

Two projects 'Biofuel from Marine Microalgae' and 'Design & Development of Advanced Batteries' have been developed under Nationally Evolved Project category. Thus, in all 6 project proposals have been developed under the scheme in the year. These will be placed before High Powered Committee for consideration and thereafter to GB, CSIR for approval.

NMITLI supported R&D efforts have led to: Lysostaphin entering Phase-II Clinical Trial; Anti-TB molecule entering Phase-II Clinical Trial; Development and demonstration of 4 Fuel Cell Prototypes based on different technologies (viz: 1.00 kW based on the Polymer Electrolyte Membrane Fuel Cell Stack, 50W 10-Cells Direct Methanol Fuel Cells Stack, 40W 5-Cells Direct Borohydride Fuel Cells Stack and a 10-Cells Planar Anode-Supported Solid Oxide Fuel Cell Stack); Isolation and evaluation of Promoter probe fungal expression vector and novel promoters using alkaline xylanase as a reporter gene and five novel methanol tolerant species *(Candida hyderabadensis, Rhodotorula himalayensis, Blastobotrys serpentis, Pichia garciniae* and *Pichia cecembensis)*; and development of three types of electrically suitable lead free glass powders and pastes for plasma display panel technology.

3.2.2. Business development and marketing of knowledgebase

The Division maintained interaction with Indian as well as international institutions and companies. The division negotiated Umbrella Agreement for Research and Development Collaboration with PepsiCo Inc. The Division has been instrumental in signing up of MoUs with:

- Berkeley Center for Synthetic Biology, University of California, Berkeley, USA;
- Department of Pharmaceutical Research, Ministry of Chemicals & Fertilizers for setting up of NIPERs;
- National Research Development Corporation to designate it as its consultant to market CSIR technologies; and
- Consortium agreement and Grant agreement with Europa Media for EUNIC project.

- During the period it examined and facilitated for approval over 100 agreements received from CSIR laboratories. TNBD continued to maintain organic linkage with national level industry associations and other stakeholders.

3.2.3. Annual Business Meeting & Workshop on CSIR Research and Technology Ensemble (CReaTE) held at CECRI

TNBD organized Annual Business Meeting (ABM) - 2008 from 29th - 31st August, 2008. It provided a platform for Heads of Business Development groups in CSIR laboratories to interact with each other and discuss the emerging issues. The keynote address was delivered by Prof. Samir K. Brahmachari, DG, CSIR & Secretary, DSIR. The meet discussed the utilization of R&D Knowledgebase and Business Development in CSIR System.

3.2.4. 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, 62 such proposals were processed. Some of the clientele covering these proposals included Deutsche Forschungsgeme, Germany; Bombardier Aerospace Inc., Canada; Global Petroleum Ltd., Jordan;/ Alcoa, UNIDA;/ Vienna; /WHO; /Texas A&M University System Health, USA; /SINTEF, Norway;/ Philips Mouisre, USA;/ Ethio Agri-CEFT, Ethiopia;/ BHP Billiton Innovation Pty Ltd., Australia;/ Cover Technology Inc., USA;/ Reckitt Benckiser, UK; / Procter and Gamble, USA; / Colgate-Palmolive, USA;/ UNIDO, Vienna;/ Corus Technology BV, Netherland; Boeing Aircraft Corp., USA; / Nostrum Pharma, USA; / Reckitt Benckiser, UK etc. Some other clients are from Saudi Arabia, Canada, Thailand, Russia, Belgium, Spain, Kuwait etc.

3.2.5. CSIR Technology Awards 2008

Instituted in 1990, 'CSIR Technology Awards' seek to foster and encourage multi-disciplinary in-house team efforts and external interaction for technology development, transfer and commercialization.

CSIR received 29 nominations for the year 2008. Technology Award Selection Committee recommended awards in the three categories namely (a) Technology Award in Life Sciences to CCMB for the "Development of novel universal technique to establish the identity of enormous number of animal species for forensic applications"; (b) Technology Award for Innovation to CDRI for "Discovery of guggulsterone and development of analogues with novel mechanism of action as hypolipidemic agents"; and (c) Technology Award for Business Development & Technology Marketing to URDIP for the niche created in the knowledge based service sector.

Hon'ble Minister, S&T and Earth Sciences, Shri Kapil Sibal presented CSIR Technology Awards - 2008 to the winners on CSIR Foundation Day.

3.2.6. CSIR Award for S&T Innovation for Rural Development - 2008

CSIR had instituted a national award 'CSIR Award for S&T Innovations for Rural Development (CAIRD)' in the year 2006 to recognize and honour those S&T innovations that have made a visible impact and helped in transforming life in Indian villages. The award carries a cash prize of ` 10 lakh, a citation and a shield.

The award for the year 2008 was jointly awarded to CIMAP for "Biovillage strategy for agri-business of Medicinal and Aromatic Plants" and CSMCRI for "Innovations in the area of salt for rural development".

3.2.7. CSIR Diamond Jubilee Technology Award (CDJTA) 2008

CSIR had received 35 nominations for the CSIR Diamond Jubilee Technology Award (CDJTA) 2008. The criteria for selection of the award is very stringent, therefore, no proposal for the 'CSIR Diamond Jubilee Technology Award 2008' was found suitable for the award.

3.3 Intellectual Property Management Division

CSIR carries its IP-related activities through IPMD. On behalf of all the constituent laboratories of CSIR, the Division files and maintains patents both in India and abroad. CSIR has positioned itself from being reactive to proactive IP protection by random patenting to planned patenting and designing patenting portfolios based on commercial and strategic considerations. It filed 183 patents in India and 404 patents abroad during 2008-09. By the end of the year CSIR had a portfolio of 1910 patents in India and 2689 patents abroad.

To encourage the spirit of innovation and creativity in young, CSIR gives away invention awards to school children as under:

3.3.1 Seventh CSIR Diamond Jubilee Invention Award for School Children-2008

Five inventions were selected for 'Seventh CSIR Diamond Jubilee Invention Award for School Children-2008'. The selected inventions included, i) A novel writing aid (LIPI-Letting the Infirm Pen their Ideas), ii) A novel finger detecting composition based on the food dye tartrazine, iii) A novel low cost automatic warning system for high speed winds, iv) Manual battery charging device, and v) Anti algal/fungal and anti-bacterial materials.

3.3.2 Presentation of Sixth CSIR Diamond Jubilee Invention Award for School Children

The winners of the 2007 competition for Sixth CSIR Diamond Jubilee Invention Award for School children were given prizes by the Vice President of CSIR and Hon'ble Minister of Science & Technology & Earth Sciences Shri Kapil Sibal on CSIR Foundation Day 26th September, 2008.The presentation includes cash prize and certificates to the winners.

3.4 Human Resource Development Group (HRDG)

The Human Resource Development Group 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 extramural research grants to Scientists/Professors working in Universities / R&D institutes. The activities of the HRD Group 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). Significant achievements of HRD Group during 2008-09 are highlighted below:

3.4.1 National S&T Manpower Development

3.4.1.1 Junior Research Fellowship(NET)

CSIR conducts CSIR-UGC National Eligibility Test (NET) twice a year. During the year, 4352 students were selected for Junior Research Fellowship and 2899 were selected for lecturership.

3.4.1.2 Shyama Prasad Mukherji Fellowship (SPMF)

The SPMF Scheme was started in the year 2001 with the objective to channel budding scientific talent towards the pursuit of scientific research. The scheme is open to certain top rankers of CSIR-UGC JRF-NET scholars along with top 100 GATE qualified candidates with percentile 99 and above. Out of 463 candidates called for interview 251 appeared and finally 11 candidates qualified for SPM fellowship - One from Earth Sciences, Two each from Chemical & Life Sciences & three each from Mathematical and Physical Sciences.

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

The Expert committees for the selections of SRFs, SRF(Extended) and RAs in 16 different disciplines met twice during 2008-09. Of the total 1,886 candidates called for interview, the numbers of SRF, SRF(ext) and RA selected were 838, 113 and 139 respectively.

3.4.1.4 Senior Research Associateship (SRA) / Scientist's Pool Scheme

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. During the year, 99 Senior Research Associates were selected and their total number as, on 31st March 2009, was 135.

3.4.1.5 Junior Research Fellowship for GATE qualified engineering and pharmacy graduates (JRF-GATE)

CSIR introduced a new research fellowship in 2002 for the GATE qualified candidates with BE/ BTech/ BArch/ BPharm degree to pursue research leading to Ph.D., known as the GATE qualified Junior Research Fellowship (JRF-GATE). JRFs selected under this scheme get the opportunity to work with CSIR scientists. 120 JRF-GATE Fellows are at present working in different laboratories of CSIR.

3.4.2 Promotion and Recognition of Excellence

3.4.2.1 Shanti Swarup Bhatnagar Prize (SSB)

The Shanti Swarup Bhatnagar Prizes for Science & Technology are given every year to Indian Scientists below 45 years of age for their notable & outstanding contributions, applied or fundamental, in 7 disciplines of Science & Technology. The SSB Prizes for the years 2007 & 2008 were presented by Dr. Manmohan Singh, the Hon'ble Prime Minister of India & President, CSIR to twenty one (21) outstanding scientists at a function organized at DRDO Bhawan, New Delhi on 20th December 2008.

3.4.2.2 CSIR Young Scientist Award (YSA)

The Young Scientist Awards are given to scientists below the age of 35 years, in 5 disciplines of S&T, to recognize in-house excellence. In the year 2008, eight scientists were selected for Young Scientists Awards, two each from Chemical Sciences; Engineering Sciences; Earth, Atmosphere, Ocean & Planetary Sciences; and one each from Biological & Physical Sciences. These Awards were presented by Shri Kapil Sibal, Hon'ble Minister of Science & Technology and Earth Sciences and Vice President, CSIR at the CSIR Foundation Day Function held at NPL auditorium on 26th September 2008.

3.4.2.3 Funding of Extra Mural Research Schemes to promote R&D

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/IIT's etc. 222 research schemes and 39 Emeritus Scientist Schemes were recommended for support.

3.4.2.4 Travel / Conference Grants

Travel grant is provided by CSIR to young researchers for presenting research papers at International Conferences abroad. The travel grant committee considered a total of 1235 applications and recommended 906 cases. The committee also considered 831 proposals from universities/institutes/scientific societies etc for organizing national/international conferences/ symposia/ workshops etc. and recommended 724 cases.

3.4.2.5 CSIR Programme on Youth Leadership in Science (CPYLS)

The CPYLS scheme is a unique 'hand holding' programme started for school children at secondary level. The scheme was started to promote interest in science among the meritorious young school children.

During the year, most of the CSIR laboratories organized 2 open days program. About 1000 students from all over the country participated in this programme at the laboratory near their place. The reports received from some of the coordinators of these programmes show a very good response, both in terms of participation, and appreciation of the scheme.

3.4.2.6 CSIR Diamond Jubilee Research Interns Award Scheme

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 scientists in CSIR. The Selection Committee at its meeting held on 20th June 2008 recommended 18 interns for various divisions of CSIR Hqrs on the basis of Walk-in-Interview.

3.4.3 New Initiatives and Modifications in Existing Schemes

CSIR Nehru Science Postdoctoral Research Fellowship Scheme has been instituted to harness scientific talent of fresh Ph.Ds. gainfully in R&D pursuits. CSIR will offer 100 "CSIR Nehru Science Postdoctoral Research Fellowships" every year to promising Ph.D. holders for working in CSIR laboratories in niche, interface areas of basic science, Engineering, Medical and Agriculture at emoluments comparable with respect to purchase power parity to those available in west and provide them career guidance & intellectual environment for pursuing their research initiatives. Fresh Ph.D. within one year of doing Ph.D. and those who have submitted Ph.D. are eligible for CSIR Nehru Science Postdoctoral Research Fellowship. The amount of fellowship and contingency grant is ` 35,000/-per month plus HRA, as admissible, and ` 3.0 lakhs per annum respectively

SSB Prize money has been enhanced from the existing ` 2.00 lakhs to ` 5.00 lakhs per awardee, from the year 2008 onwards. Also, special honorarium of ` 15,000/-p.m would be given to all SSB awardees currently serving in public funded organizations, with effect from 1st January, 2008.

Research Grant given to the recipients of CSIR Young Scientist Awards has been enhanced from the existing ` 2 lakhs to ` 5 lakhs per annum from the year 2008 onwards.

The age-limit for superannuated SSB Awardees, Fellows of Indian National Science

Academy (INSA), Indian Academy of Sciences(IAS), National Academy of Sciences (NAS), and Indian National Academy of Engineering (INAE) availing the Emeritus Scientist-Scheme has been raised to 70 years.

The fellowships of JRF, SRF, SRF(ext) & RA have been increased from ` 8,000, ` 9,000, ` 10,000 and ` 11000-11,500-12,000 to ` 12,000/p.m., ` 14,000/p.m., `15000/p.m. and `16,000-17,000-18,000 respectively. Contingency in case of SPMF has been raised from ` 50,000 to ` 70,000.

Stipend for Research interns has also been increased from ` 7,500/p.m. to ` 11,500/p.m.

3.5 International S&T Affairs Directorate

During the period CSIR launched major efforts towards international benchmarking and global recognition through mutually beneficial S&T partnership models. Over 600 CSIR Scientists were deputed abroad for various international events and to project CSIR globally. New initiatives like Distinguished Foreign Scientist Fellowship (DFS) scheme, International benchmarking through conference participation support and Networks for International Cooperation in Cutting Edge Areas are emerging as major drivers facilitating international linkages with global centres of excellence.

Recognizing that project based cooperation creates a win-win situation with sharing of costs, resources, manpower and IP, 179 bilateral projects with partners from scientifically advanced countries including Germany, Japan, Australia, France, USA, China were continued, out of which 65 projects got initiated during the year.

Highlights of the significant achievements during 2008-09 are given below.

3.5.1 Bilateral Cooperation

United Kingdom (UK)

CSIR-Royal Society Joint Projects Scheme: Four joint projects were taken up as a part of the scheme on (a) Ceramic Hollow Fibre Membrane for Natural Gas Purification: CGCRI and Imperial College, London (b) Inhalable Microparticles for Chemotherapy of Tuberculosis: CDRI and Institute of Pharmaceuticals Innovation, Bradford (c) Electrode Materials for Lithium Rechargable Batteries: CECRI and University of Glasgow and (d) Photonic Crystal Fibre Laser Sources: CGCRI and Heriot Watt University, Edinburgh. The Projects have already made considerable progress through exchange of 15 Scientists with several joint research publications in the pipeline

UK-India Education & Research Initiative (UKIERI): CSIR Institutes have emerged as major players in UKIERI initiative and were awarded six (6) major projects with an investment of about ` 5.00 crores.

Project Title	UK Organization	CSIR Institute
Novel nano-materials for therapeutics	University of Bradford	ITRC
Nano-particles as sensitizer for Photo dynamic therapy - using light to treat cancer	University of Sheffield	CSMCRI
Biodiesel from non-edible oilseeds by extraction	New Castle University	IIP
Nano-materials for use in engine oil formulations for better fuel efficiency	Huddersfield University	IIP
Risk assessment modeling for groundwater arsenic mitigation	University of Manchester	IICB
Nano-valdium phosphate as oxidation catalysts	Cardiff University	IMMT

Australia

A five-member CSIR team visited Australia during 8-13 March 2009 at the invitation of CSIRO to experience "R&D Commercialization and IP Management Practices" in CSIRO for possible implementation in CSIR, India.

CSIR - CSIRO Strategic Partnership Programme: Two out of three identified joint projects on "Apomixis" (CCMB) and "Hydrogen Separation" (CGCRI) made substantial progress with exchange of Scientists and finalizing the detailed work plan.

Fig.3.1: Signing of CSIR-CSIRO Exchange Programme by DG, CSIR and Dr. Geoff Garett, CEO, CSIRO, on 7th July 2008

Australia - India Strategic Research Fund (AISRF): AISRF opened up networking channels with commitments of funds from both governments. CSIR bagged seven major projects in the fields of Climate Change, Geophysics, Nanomaterials and Biotech (Stem Cell and Genomics).

Project Title	Australian Organization	CSIR Institute
System-evolution of the Krishna-Godavari Basin for enhancing offshore hydrocarbon exploration success.	University of Melbourne	NGRI
Thermal evolution of peninsular India: behavior & future potential.	University of Adelaide	NGRI
Developing biodegradable magnesium alloys for implant materials.	Deakin University	CCMB
Re-establish trace gas monitoring of climate-forcing gases at Cape Rama, India.	CSIRO Marine and Atmospheric Research	NIO
Hybrid magneto electric nanostructures: optimizing interface coupling for enhanced functionality.	University of New South Wales	NCL
Endogenous adult cardiac stem cells: genome wide analysis of multipotency/differentiation in homeostasis & regeneration.	Victor Chang Cardiac Research Institute	CCMB
Identification of molecular markers closely linked with stem rust resistance genes inn wheat.	University of Sydney	NCL

Germany

CSIR-BMBF Cooperation Programme: Under this arrangement, CSIR Institutes continued their active participation in joint research projects with German counterparts (Max Planck, Helmholz, Universities) on Water purification, Liquid Crystal materials, Seismic resistant design and management of concrete structures, Density distribution and dynamics of Lithosphere and crustal evolution with over 25 exchange visits from/to CEERI, NPL, SERC and NGRI. These projects are immensely benefiting the major research programmes of CSIR under Network or Supra Institutional projects.

Indo-German Energy Workshop at Karlsruhe: Under Network of International Cooperation in cutting edge research in Energy, an Indo-German Workshop on "Fuel Cells & Hydrogen Energy" was organized at University of Karlsruhe on 16-20 March'2009 involving all major CSIR Institutes (CGCRI, CECRI, NCL, IICT, NPL, NAL, IICT and CSIR HQs) in partnership with Research Centre, Juelich, RWTH, Aachen and German Industry. The workshop discussed and defined major research efforts in solid oxide fuel cell (SOFC), polymer electrolyte membrane fuel cell (PEMFC), direct methanol fuel cell (DMFC) and hydrogen production & storage as a part of major energy initiative of CSIR.

CSIR (NPL) and PTB, Germany joined hands to take up a major Indo-German project on "Strengthening Quality Infrastructure in Environmental Analysis" with an aim towards supporting International traceability and quality assurance in environmental measurements for air and water. The project received generous funding of 700,000 Euro (~ ` 455 lakhs) from German Ministry for Economic Cooperation & Development (BMZ).

France

Indo-French Centre on Groundwater (IFCGR) set up at NGRI, Hyderabad jointly with French Geological Survey (BRGM) carried out extensive joint research work on hard rock aquifers including artificial recharge/ hydrodynamics. With the presence of French scientists at NGRI on long term basis, a decision support tool for ground water resource management in hard rock aquifers got developed and is being field tested.

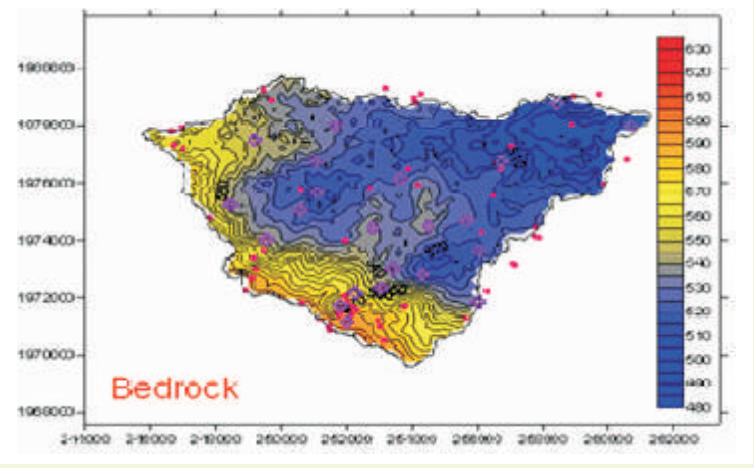

Fig.3.2: Map of the hard rock aquifer bottom, Gajwel watershed, Andhra Pradesh

CSIR actively got involved in the activities of Indo-French Centre for Promotion of Advanced Research (IFCPAR/CEFIPRA) and took up three major programmes with its French partners.

- "Mechanism based lead generation in Cancer chemotherapy from natural products" between IICT and University of Rennes;

- "Hydrology and Water resources from space over the Indian Continent" between NGRI and LEGOS-CNES, Observatorie Midi- Pyrenees; and
- "Synthesis and characterization of semiconducting nanostructures" between NPL and Laboratoire de Microscopies, University de Reims.

CSIR - CNRS Joint Lab on Green Chemistry: To implement the decision to set up a joint centre on Sustainable Chemistry at IICT, Hyderabad, CSIR and CNRS signed an MoU in the presence of Science Ministers of the two countries in January 2008. CNRS team led by Prof. Catherine Brechignac, President, CNRS visited CSIR in September 2008 to carry forward the dialogue of partnership including implementation of the joint centre which is to focus research partnership in Green Chemistry targeting therapeutic agents for Cancer and neuro disorders and protein interactions for targeting alternative drugs/biological systems. CNRS Laboratory for Molecular Chemistry and University of Rennes will be partnering with IICT in this endeavor.

Fig. 3.3: Signing of the CSIR-CNRS MoU in the presence of Science Ministers of both Countries

Russia

The following projects got approved for implementation under DST-Russian Foundation for Basic Research (RFBR) Cooperation Programme:

- "Intra-pore molecular compounds in micro porous silicates as indicators of P - T - fluid conditions of mineral and rock formation" between NGRI and Institute of Geology and Mineralogy of the Siberian Division of RAS, Novosibirsk;
- "Synthesis and study of ionic liquids possessing complexing cations or anions: Towards novel task-specific extractants for metal ions and organic compounds" between NCL and Lomonosov Moscow State University, Moscow; and
- "Development of scientific bases of technologies for recovery of nonferrous and rare metals from techno-generous raw materials by using binary reagents" between NML and Institute of General and Inorganic Chemistry of RAS.

China

CSIR-NSFC S&T Agreement: An Indo-China Workshop on 'Nanomaterials and their applications' was organized at CGCRI, Kolkata in March 2009 as a part of the workshop focused on Synthesis and characterization of Nanomaterials, Nano-photonics, Hybrid Composites, Biomaterials, Energy Materials, Functional Materials and Nano Carbon.

Fig. 3.4: Participants of CSIR?NSFC Workshop on Nanomaterials held at CGCRI during 24th-27th March, 2009

CSIR-CAS Cooperation: At the invitation of the President, Chinese Academy of Sciences (CAS), DG, CSIR visited China on 12th-15th November, 2008 to deliver a plenary lecture at the Global Forum "Academy, Research Institution & Innovation System". Both leaders held a bilateral meeting which paved the way for a collaborative model for research partnership.

Czech Republic

CSIR and Academy of Sciences of the Czech Republic (ASCR) reviewed their ongoing partnership and finalized the new Working Programme for 2009-2011. President, ASCR led a high level delegation for the Joint Committee meeting and signed the Working Programme on 9th February, 2009 approving 10 well defined research projects.

- "Nano-structured, catalytic & photocatalytic materials for environmental applications" (NEERI)
- "Preparation and application of immobilized esterases for industry and biosensors" (NIIST)
- "Fractal based correlation of material microstructures and their fracture characteristics" (NML)
- Assessment of stress-state and stability of shafts for deep underground caverns/mines by back analysis through numerical modeling" (CIMFR)
- "Assessment of micro cracks in rocks using acoustic emission and ultrasonic techniques" (CIMFR)
- "Plastic waste disposal and generation of synthetic natural gas" (CMERI)
- "Study on mechanism of neuropathogenesis in japanese encephalitis virus and tick borne encephalitis virus infection" (CCMB)
- "Rock mechanics investigations to meet challenges of strata control of deep underground coal mining" (CIMFR)
- "Bio-based polymers for food packaging applications" (CFTRI)
- "Ni Ti shape memory wires to realize high frequency actuators" (NAL)

Fig. 3.5: Signing of CSIR-ASCR Working Programme on 9th February, 2009 at CSIR HQs.

Sector-specific Partnership

CSIR and its institutes shook hands with their partners abroad for cooperation in specific areas by signing MoUs / LoIs.

- MoU between CSIR and Berkeley Centre for Synthetic Biology, University of California, Berkeley supporting cooperation in the area of 'Synthetic Biology' and for setting up Synthetic Biology Centre in Berkeley and in India (SynBInd) signed at CSIR on 25th September, 2008.
- MoU between CSIR and Systems Biology Institute, Japan, to cooperate in the area of Systems Biology signed on 29th March, 2009 at Kolkata.
- LOI between NML and Institute of High Technology LTD, JSC "NAC "KAZATOMPROM", Kazakhstan, for cooperation in the areas of Mineral Processing, Extractive Metallurgy, Materials Development, signed on 31st March, 2009 at NML.
- MoU between CECRI and Monash University, Australia, to collaborate in the area of corrosion and protection of magnesium alloys.
- MoU between NIO and Proudman Oceanographic Laboratory, Liverpool, United Kingdom, in the area of Marine Sciences and Technology

3.5.2 Multilateral Cooperation

European Union's research initiative including global partnership moved from Framework Programme 6 (FP6) to FP7 with India as a strategic partner. Three CSIR Institutes (IICB, CDRI and NIO) were involved in four major EC projects on Drug Development, Aquaculture and Leishmaniasis.

- "Targeting protein synthesis in the apicoplast and cytoplasm of Plasmodium (acronym: MEPHITIS)" between CDRI and other Indian and European Institutes;
- The International Research Staff Exchange Project entitled "Partnerships for Sustainable Shrimp Aquaculture (PASSA)" under the Marie Curie Exchange Programme between NIO and European Institutes;
- "New tools for monitoring drug resistance and treatment response in visceral Leishmaniasis in the Indian sub continent" between IICB and European institutes; and
- "Development of DNA vaccine for Visceral Leishmaniasis" between IICB and European partners.

CSIR joined a consortium of European research funding organizations to launch a major EC project under European Research Area Network (ERANET) of FP7 - New INDIGO (Initiative for the development and integration of Indian and European Research) with CNRS, France and CSIR, India as coordinators. The project envisages EC funding to the tune of about ` 20 crores with CSIR's share of about ` 2 crores. The project is aimed at mapping and analyzing bilateral S&T models, development of database for research hotspots in India and Europe including launching of Networking Pilot Programme as a new model for multilateral partnership. New INDIGO consortium includes CSIR India; CNRS, France; BMBF, Germany; FCT, Portugal; NWO, Netherlands; GAIA, Spain; and TUBITAK, Turkey.

3.5.3 Promoting Partnerships - Awards & Fellowships to Foreign Researchers

CSIR Humboldt Reciprocity Research Awards to German scientists

- Professor Dr. Ales Svatos, Max Planck Institute for Chemical Ecology, Germany visited NCL to work on "Development of method for identification of Helicoverpa armigera Midgut glycoproteins by Mass Spectroscopy".
- Professor Dr. Rainer Kind, GeoForschungs Zentrum, Potsdam, Germany visited NGRI to work on "Seismic structure & seismogenesis of Indian Lithosphere".
- Prof. Wolfgang Bleck, RWTH Aachen visited NML to work on 'Hydrogen embrittlement and delayed fracture of advanced multiphase high-strength steels'.

CSIR Distinguished Foreign Scientists Award for Research Stay in CSIR

- Prof. Martin Karplus, Theodore William Richards Professor of Chemistry at the Department of Chemistry and Chemical Biology, Harvard University, USA visited CCMB, IICB and IGIB.
- Prof. Mauizio Fedi, University Federico II of Naples, Italy visited NGRI
- Prof. Derecke Palmer, Senior Visiting Fellow, School of Biological, Earth and Environmental Sciences, University of New South Wales, Australia visited NGRI.
- Prof. David S. Chapman, University of Utah, Salt Lake City, USA visited NGRI.
- Prof. Yosi Ogata, Dean, School of Multidisciplinary Sciences, the Graduate University for Advanced Studies (SOKEN-DAI), Japan visited NGRI.
- Dr. Joy. Roy, University of Minnesota, USA visited NBRI to work on Plant Pathology.

TWAS Fellowships: Six researchers from Nigeria, Kenya and Cameroon were offered CSIR-TWAS Fellowship for the PhD / postdoctoral research stay at CSIR Institutes.

Research Trainees from developed world also found CSIR Institutes an appropriate place to undergo research training as a part of their sabbatical or summer training programme - sowing seeds for future linkages. Two researchers underwent training at CLRI and NEERI.

3.5.4 Building Human Capacity - Awards & Fellowships to Indian Researchers

For CSIR Scientists only

To expose CSIR scientists to the global Centres of excellence as part of HR initiatives, ISTAD made new policy guidelines and introduced various provisions like Sabbatical leave, prestigious fellowship, study leave opportunities etc.

35 CSIR Scientists availed fellowship opportunities to carryout long-term research (6 - 12 months) with highly acclaimed research groups in USA, Germany, Japan, Korea, France, UK and Australia.

Raman Research Fellowship: Nine scientists one each from IICB, CECRI, CSMCRI, CSIO, NGRI, NEERI, CGCRI, NML and SERC were selected for grant of Raman Research Fellowship for the year 2009-2010.

CSIR-DAAD Exchange Programme: CSIR in association with DAAD, Germany enabled exchange visits of CSIR Scientists to carry out pre-identified joint research at reputed German Technical Universities, Research Centres at Karlsruhe and Juelich, as well as, at the Max Planck Institutes.

Partial Financial Assistance to Indian (Non-CSIR) Researchers

As a part of its extra-mural activities, ISTAD was instrumental in supporting 583 scientists/ researchers from academia and medical fraternity from all over the country to present their research papers at major International Conferences/Workshops abroad during the current year with an investment of about ` 1.0 Crore.

3.5.4 International Conferences / Workshops

17 international events at NAL, NIIST, NPL, IICT, CECRI, NBRI, NML, IICB, CDRI and NISTADS in thrust areas of CSIR were facilitated. Some of the major events include 13th Human Genome Meeting 2008 (HGM 2008) held at Hyderabad during 27th September - 3rd October, 2008; "Mineral processing Technology 2008 (MPT2008) at Trivandrum during 22nd - 24th April, 2008 and "International Conference on Aerospace Science and Technology (INCAST)" at Bangalore during 26th - 28th June, 2008.

3.6 Information Technology Division

3.6.1 Video Conferencing

CSIR wide - Video Conferencing (VC) facility was established successfully for 37 CSIR labs/institutes as well as for CSIR Hq. including DG's Office, SSB Hall and CSIR Units such as HRDG-CSIR Complex, HRDC Ghaziabad, RAB etc.

Currently a total 46 VC sites have been made operational. This VC facilities provide point to point and point to multipoint facility using State-of-the-art Multi control Unit (MCU) commissioned at CSIR Hq. VC sites can be connected using IP and/or ISDN link. It is envisaged that by using National Knowledge Network (NKN) connectivity this facility may be extended to more sites.

Besides the peer to peer interactive communication, in particular between DG and Directors of the Lab/eminent scientists, this facility provided an enabling environment to meet the functional requirement of Scientists, who are working in collaborative research mode, in particular on the networked projects, such as OSDD.

3.6.2 National Knowledge Network (NKN)

CSIR is one of the major partner for establishment of Nation-wide multi Gigabits per second - National Knowledge Network. CSIR is also member of HLC of National Knowledge network. CSIR Hq. has been included in zero phase of Implementation and all the CSIR laboratories would be connected in phase-1 while field stations would be connected in phase 2 of the NKN implementation.

NKN will facilitate the high speed connectivity between CSIR laboratories and provides an enabling environment for making CSIR as a virtual organization.

3.6.4 Comprehensive Traditional Knowledge Digital Library (CTKDL)

During the year there have been significant developments in the CTKDL project. One of the major achievements has been the signing of the Access agreement with European Patent Office (EPO) for providing access to the TKDL database for search and examination purposes. This will enable the prevention of grant of wrong patents on the traditional medicine knowledge existing in India at the EPO. Some of achievements in the project are given below:

3.6.4.1 Current status of project

Traditional Knowledge Digital Laboratory (TKDL) has been created for over 2.03 lakh traditional medicinal formulations (Ayurveda: 81,500 formulation, Unani: 1,09,000 formulations, Siddha: 12,500 formulations) from 140 traditional texts existing in local languages such as Sanskrit, Hindi, Urdu, Arabic, Persian and Tamil, in patent application format in English, French, German, Spanish and Japanese. TKDL database contains 34 million A4 size pages. Under TKDL Yoga, approx. 900 Yoga postures have been transcribed.

3.6.4.2 Acess of the TKDL database to International Patent Offices

Access to the TKDL database has been given to European Patent Office (EPO), one of the International Search Authorities, after it signed in February, 2009 the Access Agreement for getting access to the TKDL database. EPO is a regional office with 35 member states such as UK, France, Germany, Italy, Poland, Norway, etc. Hence protection against misappropriation will be applicable even to the regional offices under the ambit of EPO. This is the first time that the such an agreement has been signed, which will defensively protect the traditional medicine knowledge of a country. EPO after using the TKDL has defined it as a unique encyclopaedia, a powerful tool, and a precise database and capable of establishing prior art.

3.6.4.3 Value addition to the database of medicinal plants

With respect to Value Addition work on Medicinal Plants used in Traditional Medicine systems, over 1,000 records on descriptive parameters related to morphological attributes have been collected in designed datasheet formats and entered in the software. Data Collection and scientific validation of over 2,000 species including nomenclatural edition (accepted names, synonyms, orthographic variants, misapplied names, vernacular names, status, geographical distribution) have been completed. Herbarium specimen database has been created for about 79,400 accessions and scanning of images have been completed for 40,000 specimens. Phytochemical data on 600 plant species having 3,363 chemical constituents has been compiled and entered into the database. With respect to the toxic constituents, data for 500 species has been entered into the software. Cytological information data on 1,251 plant species have been collected and data for 900 species uploaded in the software. Pharmacological parameters which include plant part, drug form test mode, dosage, administration, action mode, drug description, etc, have been added in the software. Pharmacognostical data include macroscopic and microscopic features, details of the powder, histo-chemical details, drug description, organoleptic and chemical components and fingerprinting details along with images including the sectional details. Data on pharmacognosy has been collected for 1000 medicinal plants and 500 have been entered into the database. With respect to utilization, data on 1,200 species have been entered into the software.

3.6.4.4 Database on oral traditional knowledge

For collecting the primary data on oral Traditional Knowledge field surveys were conducted in Eastern Ghat region of Orissa, Himachal Pradesh, Uttrakhand and Jammu & Kashmir, and data collected from 28 tribal communities. 1,400 data sheets have been prepared from the primary knowledge holders. With respect to secondary data on oral traditional knowledge 18,800 data sheets have been prepared.

3.6.4.5 Database on traditional foods

With respect to Traditional Foods over 1440 diverse cuisines have been entered into the database. Short digital movies have been prepared on selected traditional pareparations such as Chakuli, Jolada Roti etc.

3.7 Unit for Science Dissemination

The Unit for Science Dissemination is responsible for furthering favorable public image of CSIR. During the period, several image-building activities were executed to achieve the overall objective through `Team USD'.

3.7.1 Image building through print media

Publicity Efforts

- Effective media relations helped in furthering 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; several features/ stories were published with the support of inputs provided by this Unit.
- Press coverage was successfully organized during important CSIR events, including
  - Genetic Landscape of the People of India: An Indian Genome Variation Consortium Spearheaded by CSIR (2003-2007) - A record coverage
  - Bhatnagar Awards Function
  - CSIR Foundation Day celebrations
- Press releases were prepared and disseminated on several occasions and their coverage monitored for effectiveness.

Advertising efforts

- Released special advertisement campaigns exclusively on CSIR events including Industry originated Projects under NIMITLI; Technology Day; CSIR Diamond Jubilee Technology Awards 2008; Launch of Soleckshaw; Release of Shanti Swarup Bhatnagar Prizes; OSDD; National Science Day; CSIR Award for S&T Innovations for Rural Development (CAIRD) - 2008.
- Released advertisements for the recruitment of:

Directors of various CSIR Laboratories; Scientists; Outstanding Scientists; Section Officers and Executive Asstts.

- Released advertisement in special issues of several publications.

3.7.2 Image building through broadcast media

Two new projects were approved for coordination by this Unit:

- Audio-Visual Campaign by ANI on CSIR success stories in 13 episodes (English & Hindi) and their distribution on traditional and new media including telecast on Doordarshan.

- Radio Serial 'Nai Subah' in 11 languages as 13 episodes of 30 minutes each and their broadcast on 40 Vividh Bharti stations of AIR.

3.7.3 Image building through interactive media (Exhibitions, etc.)

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

- Efforts were made to project, an integrated picture of CSIR's overall contribution to the theme areas of each event through extensive coordination with the participating CSIR laboratories, on one side,. and the organizer of the event on the other. During the year, the Unit organized in CSIR pavilion in the following events:

Bangalore Bio 2008, Bangalore; Infra Educa 2008, Gwalior; Infra Educa 2008, Jaipur, and New Delhi; BIO (Biotechnology Industry Organisation, USA) 2008, San Diego, USA; Exhibition cum Conference and Fair on Multidimensional Development and Technology (Rural), Mewat, Faridabad; Ganga Festival 2008, Kolkata; 12th National Expo, Kolkata; HUGO's 13th International Human Genomics Meeting, Hyderabad; 2nd Destination Uttarakhand - 2008, Dehradun; Pharmaceutical Expo 2008, New Delhi; IISc Centenary Conference, Bangalore; KISAN-2008, Indian Agriculture Trade Fair, Pune; 96th Indian Science Congress, Shillong; Chemtech + Pharma World Expo 2009, Mumbai; ITM Expo 2009, Mumbai and Vision Haryana 2009, Hissar.

- The Unit also coordinated CSIR participation in ABLE India Pavilion at BIO 2008, San Diego, Boston, USA.

3.7.4 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 it more professional and timely.

As a value-addition to the regular Newspaper Clipping Service of this Unit,

- Special compilations were brought on the coverage by media (of important CSIR events) (both national and international) for perusal of DG,CSIR.
- Special supplements were also brought out covering the latest developments in S&T and other areas of interest to CSIR as reported in national and international online sources for the perusal of DG,CSIR.

Handling information queries

- A large number of information queries pertaining to CSIR activities were attended either in person or by way of post/e-mail to the satisfaction of the users.

Technical service to the office of DG,CSIR

- A large number of messages were drafted on behalf of DG,CSIR, for release in the souvenirs brought out by various organizations.

Publicity Campaign on National Geographic Channel

As desired by the office of the Hon'ble Minister of State (Independent Charge), for Science & Technology and Earth Sciene, CSIR coordinated the successful completion of

a campaign on the National Geographic Channel. This project is a joint effort of different Departments under the Ministry of Science and Technology, viz., Department of Science & Technology, Department of Bio-technology, CSIR and Ministry of Earth Sciences.

Production & Telecast of a Serial UTTHAN-a 13 episode serial on Rural Empowerment through S&T

As desired by the Hon'ble Minister of S&T and ES, a 13-episode Fiction Serial, UTTHAN has been approved for production and telecast on Doordarshan National. This serial aims at making the rural people aware about the various products and technologies developed by the DST & CSIR in a very subtle manner that would help to solve the problems of the rural people at the grass root level in the village itself.

3.8 Human Resource Development Centre

The year 2008-09 at HRDC was marked with several new initiatives and activities, the foremost amongst which was, the Centre taking its training activities outside the country. In association with Asian Pacific Centre for Transfer of Technology (APCTT), New Delhi, it organized a three-day training programme on "Valorization of R&D" for the Scientists and Research Managers of Mongolian Academy of Sciences (MAS), during 6-8 October, 2008 in Ullaanbaatar, Mongolia. The training organized at the request of MAS is a recognition of HRDC's domain expertise.

The CSIR Leadership Development Programme launched in 2007 by the Centre continued as a major activity during the year bringing in more scientists and officers in the training. The format of the programme is such that it induces competition amongst the participants to draw out the best in the participants and at the same time provides them with structured learning. So far 255 scientists & senior officers from administration, purchase & finance have been imparted training in leadership. The programme aims at building a strong future leadership pipeline in CSIR.

To help communicate the results of research effectively, the Centre has been organizing series of training programmes on S&T Communication. The programme has become increasingly popular amongst scientists, young researchers, students etc, and laboratories are reqesting HRDC to organize exclusive training programme for their staff.

The Centre continued with its endeavour to build synergistic linkages with other' human resource development organizations and entered into MoUs with an IT training organization namely NIIT Ltd, New Delhi and the Administrative Staff College of India (ASCI), Hyderabad, during the year.

In all, 44 programmes were conducted by HRDC during the year, including some new and divergent subject training programmes such as on 'Knowledge Management', 'Mentoring as a Management Tool', 'Self Effectiveness at the Workplace' and 'Work Life Balance for Women Scientists' for the first time.

3.9 Recruitment and Assessment Board

CSIR has been pioneer in introducing progressive career advancement policies and schemes for its staff. In accordance with this perspective, CSIR introduced "CSIR Scientists Recruitment & Assessment Promotion Rule, 2001" for Group IV scientists generally following the pattern of DRDO. In 2002 CSIR set up full-fledged and defined structure of the CSIR Recruitment and Assessment Board (RAB). RAB organizes the assessment and recruitment for Group IV scientists centrally to bring in uniformity across the laboratories and subject cluster.

Assessment of scientists

Assessment interviews of scientists at the level B up to EII for the period due during 2006-07 were conducted in two phases during July-August 2008 for Physical Sciences, Engineering & Materials and October-December 2008 covering Biosciences, Chemical Sciences & Management areas. A total of 751 candidates were considered for assessment out of which 586 were 'found fit' for promotion to their respective next level with 78% result including 31 who were granted one year early assessment promotion.

The centralized assessment of 497 candidates at the level of Scientists 'F' through the peer review process for the periods 2004-05, 2005-06 and 2006-07 was successfully completed.

Eligibility screening for the assessment of Scientists 'F' for 2007-08 was completed centrally at RAB in November 2008 and also in February 2009. Out of 369 cases processed for screening, 282 candidates were found eligible for assessment.

Recruitment of scientists

Selection committees were constituted for recruitment requests received from 21 laboratories for selection to 103 positions each of scientist B and C, 30 positions of Scientist EI, 9 positions of Scientist EII and 2 positions of Scientist F.

Consultancy project

A consultancy project on recruitment of eight Examiners of Patents and Designs was carried out by RAB for the Department of Industrial Policy & Promotion (DIPP) during March-May 2008.

RAB Web site

RAB has developed and launched a web site for speedier and wider dissemination of its announcements and results of assessments.

ISO 9001

RAB has completed the documentation stage in acquisition of ISO 9001.

Dateline CSIR

Date	Major Events
April, 2008	
1st	IGIB: Visit of Prof. Jay D. Keasling, Berkeley Centre for Synthetic Biology, University of California, USA and Dr. William A. Haseltine, Chairman and CEO, Haseltine Associates Ltd. USA for scientific discussion and technical lecture.
7th	CGCRI: Mrs. Subulakshmi Jagdeesan, Hon'ble Minister of State for Justice & Empowerment, Govt. of India inaugurated the Training programme on Glass Beads & Beaded Jewelry Making.
24th	CBRI: Course on 'Seismic Resistant Design and Rehabilitation of Structures' jointly organized with the Institution of Engineers, Roorkee.
22nd -24th	NIIST: International Seminar on Mineral Processing Technology.
May, 2008	
12th May - 7th June	NIO: Hydrography training course for the naval officers of National Hydrographic School, conducted.
19th	NIO: Lecture on "Future of Information and Communication Technology" by Dr Vijay Bhatkar.
June 2008	
17th	CSIR Hqrs.: Public lecture on "Assumptions: Guessing the Future of Science and Technology" by Prof. George M. Whiteside, The Woodford L. & Ann A. Flowers University Professor and Professor of Chemistry at Harvard University, USA
24th	IMMT: Seminar on "Technology Mission on Coconut" jointly organized with Coconut Development Board, Kochi.
26th	NAL: Three day International Conference organized on Aerospace Science and Technology 2008 (INCAST-2008) in Bangalore. Dr. A. P. J. Abdul Kalam, Former President of India, was the Chief Guest. CEERI: Scientific Meet on Gyro-devices (SMG-2008) organized.
July, 2008	
8th	CSIR Hqrs.: Public lecture on "Innovation: A People Game" by Dr. Geoff Garrett, CSIRO, Australia organized.
11th	IHBT: Science Popularization Programme in association JNCASR Bangalore. Prof. C.N. Rao, Linus Pauling Professor at JNCASR and National Research Professor delivered the lecture on "Learning Science". Around 300 children attended the programme.
21st	IICT: One day symposium organized as a part of scientific cooperation programme between CNRS,

	France and CSIR, India on "The Joint Indo-French Conference on Sustainable Chemistry at Interfaces".
August, 2008	
1st	CSIO: 43rd Convocation of Indo-Swiss Training Centre, held.
25th	CEERI: National Workshop on Electron Tube Technology (ETT-08), organized.
26th	IGIB: Visit of delegation from CSIRO, Australia led by Dr. (Mrs.) Joanne Daly, Group Executive for Australia's flagship programmes in Prevention Health, Food Futures, and CSIRO Entomology.
September, 2008	
6th	IICT: National Seminar on "Green Polymers from renewable resources Emerging Technologies", organized. Dr. S. Sivaram, Director, NCL, delivered the 6th K.T.Achaya Memorial Award Lecture.
10th - 12th	IITR: A three day 14th "Alexander Hollaender Workshop on Genetic Toxicology", organized.
18th - 20th	CECRI: Fourteenth National Congress on Corrosion Control, organized.
25th	IGIB: Lecture on "Do You Really Want to Know Your Whole Genome Sequence" by Dr. Charles Cantor, Chief Scientific Officer, SEQUENOM Inc.
25th - 26th	IICB: HUGO satellite meetings organized in association with research institutes of Kolkata (i.e. Indian Statistical Institute, Chittaranjan National Cancer Institute & Saha Institute of Nuclear Physics). Organized a symposium on "Complex Diseases: Approaches to Gene Identification and Therapeutic Mangement".
26th	CSIR Hqrs.: CSIR Foundation Day celebrated at all the CSIR laboratories. At Headquarters the function was held at NPL. Hon'ble Minister of S&T and Earth Sciences and VP, CSIR addressed the gathering. Prof. Bartha Maria Knopper, University of Montreal, Canada delivered the Foundation day lecture on The concept of common heritage of mankind". NPL: An exhibition on Human Genome, held. IGIB: HGM2008 Workshop on "Know Your Genome" organized on the occasion of CSIR Foundation Day
27th -30th	CCMB: Organized 13th Human Genome Meeting of HUGO with a large presence of international participants.
30th	CGCRI: Visit of Parliamentary Standing Committee on Science & Technology, Environment & Forests led by Chairman Dr. V. Maitreyan, Member of Parliament.

October, 2008	
15th -18th	NAL: India's first ever civil aviation exhibition and conference held. The exhibition was opened by Hon'ble Minister of Civil Aviation, Shri Praful Patel.
30th	CSIO:. A workshop on "Avionics Display & Optical Metrology (ADOM-2008) organized. Shri Kapil Sibal, Hon'ble Minister of Science & Technology and Earth Sciences, and Vice President, CSIR was the Chief Guest
November, 2008	
3rd -6th	IICT: International Conference on "Asian Symposium on Medicinal Plants, Spices and other Natural Products (ASOMPS-XIII)", organized.
9th - 14th	NCL: EMBO World Lecture Course on Recent Development in Macromolecular Crystallography, organized. About eighty students, with at least two-third from Indian universities and twenty faculty members from India and abroad attended the course.
14th	CGCRI: One day Seminar on Recent Trends in Sensor Technology, organized.
19th -21st	IMMT: Jointly with State Council of Science Technology and Environment, Govt. of Meghalaya organized a Workshop on "Demonstration and Transfer of Technology for Rural Development of North Eastern States".
19th -22nd	IICT: Jointly with NEIST, organized a Workshop/ Training Programme on "Sericulture for the Production of Better Cocoon Crop".
19th -23rd	CBRI: Participated in "Construction & Building Expo (CBX-2008)" at Pune organized by Builders Association of India.
27th -29th	NBRI: International symposium on "Perspectives in Pteridophytes, organized.
December, 2008	
1st	NIO: Workshop on DNA bar-coding for marine life under the auspices of Indian Ocean Census of Marine Life (IO-CoML) and NIO with 24 participants from National and International Organizations, organized.
11th -12th	CDRI: Two day symposium on 'Recent Advances in Female Reproductive Health Research', organized.
16th	IMMT: National Interactive Workshop on Recent Trends in Iron Ore Processing (IOP-2008), organized. Over 100 delegates from various industries attended the workshop.
18th - 20th	SERC: The 6th Structural Engineering Convention (SEC-2008) organized along with IIT Madras and Anna University, Chennai.
January, 2009	
4th - 6th	CEERI: 6th International Conference on "Trends in

	Industrial Measurements and Automation (TIMA 2009)" organized. The conference was preceded by two tutorials on "Advanced Process Control" and "Wireless Sensor Networks".
18th - 21st	NCL: 19th National Symposium on Catalysis (CATSYMP-19): Catalysis for Sustainable Energy and Chemicals
22nd	NCL: Indo-Russian workshop on 'Catalysis for biomass conversion and environmental engineering' sponsored by DST, New Delhi. The Russian team of six participants was lead by Prof. V.I. Bukhtyarov, Deputy Director, Boreskov Institute of Catalysis (BIC), Novosibirsk, Russia. About eighty participants from academia and research institutes attended the workshop.
22nd -24th	CCMB: National Symposium on "Celullar and Molecular Biophysics" organized wherein 325 persons participated.
31st	CIMAP: CIM-Utsav: Kisan Mela-2009 organized.
February, 2009	
2nd -4th	NGRI: National Seminar on "Climate change and the role of geoscientists to counter its impact" organized with over 200 participants. Dr.R.K.Pachauri, DG, TERI, New Delhi, gave the Keynote address on climate change and Dr.Shailesh Nayak, Secy, MoES, Govt. of India inaugurated the seminar.
3rd -7th	CDRI: 4th World Congress on 'Leishmaniasis (WorldLeish 4)' organized in collaboration with Turkish Society for Parasitology.
5th	NCL: 3rd CRSI-RSC Symposium & 11th CRSI National Symposium in Chemistry (NSC-11)
11th -12th	CBRI: Conference on Trends and Challenges in Structural Engineering and Construction Technologies, organized.
11th -15th	NAL: Participated in AERO-INDIA 2009 at Bangalore and showcased achievements.
19th -20th	CEERI: National Science Seminar in Hindi on CSIR Network Projects under the Eleventh Five Year Plan, organized.
20th -22nd	NGRI: 40th SSBM Tournament (Indoor) Finals in Badminton, Chess, Table Tennis, Carrom and Bridge organized. Mrs. Gutta Jwala, renowned National Badminton player was the Chief Guest for the Inaugural function. About 180 participants from 26 labs took part in the events. Prof. (Mrs.) Vani Brahmachari presented the prizes during the Valedictory function.
23rd -24th	CCMB: International Symposium on "Epigenetic modifications of the genome: mechanisms and implications", organized. 275 persons participated in the Symposium.

25th -26th	CDRI: 'National Symposium on Animal Models in Biomedical Research: Ethical and Welfare Issues' in collaboration with Committee for the Purpose of Control and Supervision of Experiments on Animals (CPCSEA), National Institute of Animal Science Association of India (LASAI), organized.
26th	NCL: Prof. N. Kumar, Homi Bhabha Distinguished Professor, Raman Research Institute, Bangalore delivered a lecture on "Viewing Raman Through His Effects" on the occasion of the National Science Day.
March, 2009	
2nd -5th	IMTECH: International Conference on "Protein- DNA Transitions". More than 150 Participants from India and abroad participated.
3rd	IMMT: Jointly with Centre for Fly Ash Research & Management (C-FARM), New Delhi, organized a one day National Seminar on "Technology to Manufacture High Fly Ash Content Bricks/Blocks & Measures for Quality Assurance". More than 90 delegates attended from all over India.
4th - 5th	NCL: Joint Indo-German Workshop on Micro reaction Technology, organized. More than 110 participants attended.
6th	CSIO: A Conference on "Impact of Technical Education" on Manufacturing Sector - Need for Quality Education" organized by Indo-Swiss Training Centre, CSIO.
13th	IICT: Seminar on "Monitoring of Multistage Mixer-Settlers using online Analysis System", organized.
22nd -26th	IMTECH: International Conference on "Open Source for Computer -aided Drug Discovery". More than 200 Participants from within India and abroad took part.
24th	CSIR Hqrs.: Conference on "Open Access to Science Publications: Policy perspective, Opportunities and Challenges" organized. Around 120 delegates participated in the Conference.
25th -26th	CDRI: 'Symposium on Medicinal Chemistry and Pharmaceutical Sciences' organized jointly with NIPER, Rae Bareli.
	CGCRI: Workshop on "Nanomaterials and their Applications" organized in collaboration with National Science Foundation, China under CSIR-NSF agreement.
27th - 29th	IICB: A two day mini-symposium on "Systems Biology and Proteomics in Biomedical sciences" organized at Kolkata to discuss the scope of this emerging areas and possible area of cooperation between CSIR, India and Systems Biology Institute (SBI), Japan. Prof. Samir K. Brahmachari, DG, CSIR and Prof.Hiroaki Kitano, President, SBI were present.

Annexures

ANNEXURE I

Awards/Recognition

Awards/Recognition	Name	Lab/Instt.
Shanti Swarup Bhatnagar Memorial Award and Gold Medal The Jagadish Chandra Bose Medal, 2007 Distinguished Alumni, Indian Institute of Science, Bangalore Shri Om Prakash Bhasin Award for S&T (Biotechnology) 2008 6th Biospectrum Person of the year, 2008 Prof. MV Pylee Lifetime Achievement Award 2005 VASVIK Award for Biological S&T D.Sc. (Honoris causa) from Vidyasagar University, West Bengal	Prof. Samir K. Brahmachari	DG, CSIR
Shanti Swarup Bhatnagar Prize, 2008 for Biological Sciences	Dr. L S Shashidhara	CCMB
	Dr. G P S Raghava	IMTECH
INSA Medal for Young Scientist, 2008	Dr. Ram Rup Sarkar	CCMB
Fellow of Indian National Science Academy	Dr. Ramesh V Sonti	CCMB
	Dr. Anil Kumar	NCL
	Dr. S S Rai	NGRI
Fellow of Indian Academy of Science	Dr. K George Thomas	NIIST
	Dr. G P S Raghava	IMTECH
	Dr. K P Mohanakumar	IICB
	Dr. Uday Bandopadhyay	IICB
Fellow of Indian National Academy of Engineering	Dr. Vikram Kumar	NPL
Fellow of National Academy of Sciences	Dr. P V Subba Rao	CSMCRI
	Dr. Sanjay Kumar	IHBT
	Dr. M Lakshmi Kantam	IICT
Fellow of Third World Academy of Sciences (TWAS)	Dr. V P Dimri	NGRI
	Dr. S W A Naqvi	NIO
CSIR award for S&T innovations for Rural Development (CAIRD 2008)	Team	CSMCRI
	Team	CIMAP
CSIR Technology Award-2008 for innovation and discovery of guggulsterones and development of analogues with novel mechanism of action as hypolipidemic agent	Team	CDRI
CSIR Technology Award in Life Sciences	Team	CCMB
CSIR Technology Award for Business Development & Technology Marketing	Team	URDIP

CSIR Young Scientist Award, 2008	Dr. Beena Pillai for Biological Sciences	IGIB
	Dr. Subhash Ghosh for Chemical Sciences	IICT
	Dr. M Deepa for Chemical Sciences	NPL
	Dr. Satyajit Shukla for Engineering Sciences	NIIST
	Dr. Ranjan K Sahu for Engineering Sciences	NML
	Dr. Pankaj Poddar for Physical Sciences	NCL
	Dr. Simanchal Padhy for Earth, atmosphere, Ocean & Planetary Sciences	NGRI
	Dr. Lidita Khandeparker for Earth, atmosphere, Ocean & Planetary Sciences	NIO
	Dr. Muhammed Shahid Anwar	CECRI
President, Society for Information Science	Dr. Naresh Kumar	CSIR Hqs
VASVIK Award	Dr. P S Ahuja	IHBT
	Dr. P P Barve	NCL
Ranbaxy Research Award, 2007	Dr. Arabinda Chaudhuri	IICT
Fellow of The Royal Society of Chemistry, London	Dr. V Jayathirtha Rao	IICT
	Dr. P V Diwan	IICT
J C Bose Fellowship	Dr. T K Chakraborty	IICT
	Dr. Sourav Pal	NCL
	Prof. Siddhartha Roy	IICB
MRSI Medal	Dr. R K Kotnala, 2008	NPL
	Dr. S K Bhaumik, 2009	NAL
	Dr. Absar Ahmad	NCL
	Dr. T Premkumar	CECRI
MRSI-ICSC Superconductivity & Materials Science Annual Prize from Materials Research Society of India, 2009	Dr. H S Maiti	CGCRI
National Mineral Award, 2007	Dr. S S Rai	NGRI
	Dr. Prantik Mandal	NGRI
	Dr. V M Tiwari	NGRI
	Prof. B K Mishra	IMMT
	Dr. K A Kamesh Raju	NIO
Raman Research Fellowship	Dr. S Mayilarj	IMTECH
	Shri J Rajasankar	SERC
	Dr. Sib Sankar Roy	IICB

Fellow of the National Academy of Agricultural Sciences	Dr. Ramesh K Aggarwal	CCMB
Fellow of the National Academy of Biological Sciences (NABS), Chennai	Dr. Swaranjit Singh	IMTECH
Tata Innovation Award, Department of Biotechnology, Govt of India	Prof. Siddhartha Roy	IICB
Tata Innovative Fellowship, 2008-2009, Department of Biotechnology	Dr. A Gnanamani	CLRI
Young Scientist Award of Indian Science Congress Association	Dr. (Ms) Nimisha Vedanti	NGRI
	Dr. B K Jena	IMMT
World Certificate of Merit from WIPO and NRDC - 2007	Dr. M Kanthimathi	CLRI
World Certificate of Merit from WIPO and NRDC - 2008	Dr. P Thanikaivelan	CLRI
19th IETE-Hari Ramji Toshniwal Gold Medal Award, 2008	Shri S K Mittal	CSIO
Fellow of West Bengal Academy of Science and Technology	Dr. R N Basu	CGCRI
	Dr. Goutam De	
Genomic Pioneer Award, 2008	Dr. S K Rath	CDRI
Indira Gandhi Pariyavaran Puraskar by Ministry of Environment & Forest, New Delhi	Dr. J Raghava Rao	CLRI
Vigyan Ratna Award by the UP State Council of Science and Technology	Prof. A K Shukla	CECRI
Fellow of American Society of Microbiology, USA	Dr. Jagmohan Singh	IMTECH
Fellow of Indian Society of Oil Seeds Research & Development	Dr. R B N Prasad	IICT
Fellow of Indian Virological Society, 2008	Dr. A A Zaidi	IHBT
Fellow of the Institution of Engineers	Shri G N Dayananada	NAL
Fellow, International Organization for Biotechnology and Bioengineering (FIOBB), 2008	Prof. Ashok Pandey	NIIST
Fellowship of the Academy of Science, Engineering and Technology, (F-ASET)	Dr. Zakir Ali Ansari	NIO
Elected President (Agricultural and Forestry Science Section), Indian Science Congress Association, Kolkata	Dr. D D Patra	CIMAP
Fellow of Andhra Pradesh Akademi of Science	Dr. R K Chadha	NGRI
Decennial Award of International Geophysical Union	Dr. R K Chadha	NGRI
Young scientist award, Kerala Science Congress, 2009	Shri Sumesh George	NIIST
Dr RC Tripathy Young Scientist Award, Orissa Chemical Society, 2009	Dr. B K Jena	IMMT

Young Scientist Award, Andhra Pradesh Akademi of Sciences, 2007	Dr. Ch Raji Reddy	IICT
Young Scientist Award, General Assembly of the International Union of Radio Science, 2008	Mr. Vinod Kumar (SRF)	NPL
Tamil Nadu Scientists (TANSA) Award, 2008	Dr. J Raghava Rao for Engineering Sciences Dr. (Mrs) Mary Babu for Medical Sciences	CLRI CLRI
Visvesvaraya Science Award	Dr. A R Upadhya	NAL
80th Birth Anniversary of Rajammal P Devadas Oration Award Lecture	Dr. V Prakash	CFTRI
Academy of Environmental Biology, Young Scientist Award-2008 on Environmental Chemistry	Dr. (Mrs) SS Tripathy	NPL
Andhra Pradesh Scientist Award, 2008	Dr. S Chandrasekhar	IICT
Australian Government's Endevaour Executive Award 2008 from the Department of Education, Science and Training, Australia	Dr. R Sankaranarayanan	CCMB
Bio Asia Innovation Award, 2009	Dr. Sunil K Verma	CCMB
Chair of the Chemical Division, Council of Bureau of Indian Standards	Dr. P K Ghosh	CSMCRI
Chairman, Food colours and Flavour sub-committee of Bureau of Indian Standards, New Delhi	Dr. Mukul Das	IITR
Chairman, Local Advisory Committee, Regional Science City, Lucknow	Dr. R Tuli	NBRI
Chairman, Whiteware Committee (CHD 9), Bureau of Indian Standards, New Delhi	Dr L K Sharma	CGCRI
CRSI Silver Medal, 2009	Dr. Suresh Das	NIIST
Dr I Karunasagar Award, 2008	Dr. A Parvathi	NIO
Dr BC Deb Memorial Award for Soil/ Physical Chemistry 2008-09 by the Indian Science Congress Association, Kolkata	Dr. G Narahari Sastry	IICT
Dr J Coggin Brown Memorial (Gold) Medal - 2007-2008	Dr. R Mukhopadhyay	NIO
ICI - Fosroc Award	Shri N P Rajamane	SERC
Indian Institute of Mineral Engineers Mineral/Coal Beneficiation Award	Dr. B D Pandey	NML
IEI Young Engineers Award for the year 2008 in aerospace engineering discipline by Institution of Engineers India	Shri Dattatraya S Kulkarni	NAL
Indian Shoe Federation (ISF) honours	Dr. A B Mandal	CLRI
Krishnan Gold Medal - 2007 by Indian Geophysical Union	Dr. S S Rai	NGRI
Laureate of the 22nd Khwarizmi International Award (IROST)	Dr. J S Yadav	IICT

M Sreenivasaya Memorial Award, 2008	Dr. Yogendra Sharma	CCMB
NASI-Reliance Industries Platinum Jubilee Award, 2008	Dr. S Chandrasekhar	IICT
	Dr. K S M S Raghavarao	CFTRI
Organisation of Pharmaceutical Producers of India Scientist Award, 2008	Dr. Atul Kumar	CDRI
President, Indian Nanoscience Society	Dr. Mukul Das	IITR
Prof BK Bachhawat Memorial Award in Young Scientist Lecture-2008, National Academy of Sciences, India	Dr. Saman Habib	CDRI
Prof Jiwan Singh Sidhu Award 2007 for Excellence in Teaching in the area of Food Science and Technology	Dr. P S Negi	CFTRI
Prof VP Bhide Memorial Award by Indian Society of Mycology and Plant Pathology, Udaipur	Dr. Rakesh Pandey	CIMAP
Scopus Young Scientist Award, 2008 (Chemistry)	Dr B V Subba Reddy	IICT
Sistla Kameswari Sidhanti's Young Scientist Award 2008	Dr. A Venugopal	IICT
Sunder Lal Hora Medal-2008 by INSA, New Delhi	Dr. R Tuli	NBRI
The Bires Chandra Guha Memorial Lecture, Award, 2008 Indian National Science Academy	Dr. Amit Chattopadhyay	CCMB
The Indian Concrete Institute UltraTech Award	Dr. N Lakshmanan	SERC
The Thomson Reuters Research Excellence~ India Research Front Award	Dr. G P S Raghava	IMTECH
URSI Commission Chairman	Dr. P Banerjee	NPL
Member of BIPM's Consultative Committee for Mass and Related Quantities	NPL	NPL
Member Secretary, Indian National Science Academy, National Committee of IUGG-IGU	Dr. Sukanta Roy	NGRI
Member, ICSU-ROAP Science Planning Group on Sustainable Energy for Asia and the Pacific region	Dr. S S Rai	NGRI
Member, International Standing Committee of SCAR, UK	Dr. S S Rai	NGRI
Member, Maharashtra Academy of Sciences	Dr. Vidya Gupta	NCL
	Dr. P P Wadgaonkar	NCL
	Dr. C V V Satyanarayana	NCL

ANNEXURE II

Human Resource Development

CSIR through all its constituent laboratories and units continued to contribute towards knowledge creation, enhancement, training and skill upgradation of its staff and also offer the benefit of the same to students and researchers from academia and industry, as below:

CBRI

- Four training cum demonstration programmes on 'Appropriate Rural Housing Technologies' were conducted for (i) Bhopal Jail inmates (190 Nos.) (ii) Civil Engineering students (P.G. & Graduate) and field engineers (iii) District Rural Development Agency engineers, Block Development Officers, Village authorities and Masons (iv) Construction Engineers from MES and Faculty of engineering colleges.

CDRI

- Two basic flow cytometry courses were organized during 15th-18th September, 2008 and 10th-13th November, 2008.
- Four weeks training course was organized on Laboratory Animal Science from April 28th to 23rd May, 2008.

CECRI

- Three training programmes were organized on Surface coatings by Physical Vapour Deposition (PVD); Chemical Vapour deposition(CVD) and Surface analysis; and corrosion control of pipelines and various protective-coating systems;

CEERI

- Under a national level multi-institutional sponsored project, 1-week training programme on "Linux System Administration and Electronics Design Automation Tools" was organized during 12th-18th October, 2008. There were 26 participants from 16 institutes (NITs and premier universities).
- Under the CSIR-Bengal Engineering & Science University MoU on M. Tech. (Mechatronics) programme, the first batch of 17 students completed their second semester in April, 2008 and second batch of 14 students completed their second semester in the April, 2009.

CFTRI

- Two year M.Sc. programme in 'Food Technology' continues to be conducted.
- 12 months duration Certificate course in 'Milling Technology' continues to be conducted. This course is only of its kind not only in India, but in all of Asia for the formal training in Flour Milling Technology.
- 41 short-term training programmes were conducted to provide the knowledgebase and informatics in varied areas of food science and technology, which benefitted a total of 684 participants.

CGCRI

- Training programme on 'Stained art glass by using 'lead came' (grooved slip) and copper foil' was conducted.
- Three training programmes on 'Kiln formed Glass Art' were organized.

CIMAP

- CIMAP Training School on Advance Instrumentation and Analytical Techniques for Natural Products (AIAT-2008)–9th-22nd June, 2008. Eighteen participants from various organizations participated.
- CIMAP Summer Training (CST-2008) on Techniques and Tools of Biotechnology and Bioinformatics for various undergraduate and postgraduate students was conducted from 23rd June to 22nd July, 2008 wherein twenty five trainees from various states of India participated.

CLRI

- 250 students were admitted and trained in Leather and Footwear Science and Engineering leading to B.Tech.(Full time as well as part time), M.S.(by Research), M.Tech. and Ph.D. programmes in collaboration with Anna University.
- Continued to conduct and coordinate courses involving augmentation of core competence to meet the specialized training requirement of the leather and leather products industry. A total of 50 students were trained.
- Executive training programmes in the field of 'leather processing, leather goods and footwear manufacture' was conducted. 45 executives underwent training in the programme.
- An Executive training programme in 'leather processing' was conducted for representatives from Sofeen Enterprises.

CMERI

- Two training programmes on 'CNC machining' were organized, each of five days duration, wherein 30 participants attended each programme.
- Training programme on software “ANSYS” was organized for 20 participants for Birla Institute of Technology, Mesra.

CRRI

- Two training programmes on 'Design construction and maintenance of Mastic asphalt surfacing' were organized for engineers of National Building Construction Corporation and National Thermal Power Corporation.
- Training programme on Geotechnical Engineering and Landslide Investigation was organized for 45 Engineers from state road and other infrastructure development agencies.
- Training programme on 'Planning, design, construction and maintenance of rural roads' for the technical staff of Provisional Road Development Authority, Srilanka was organized.

CSIO

- In collaboration with CMERI, Durgapur; CEERI, Pilani and BESU, Shibpur an M.Tech (Mechatronics) programme was conducted based on a unique operational model with a rich blend of high academic and state-of-art lab work.
- An eight week (16th) Management Development Programme on 'Operation, Maintenance & Repair of Bio-medical Equipment' and (3rd) Management Development Programme on 'Operation, Maintenance and Repair of Optical/Ophthalmic Equipment' were organized for the deputed participants of Third World countries. The (9th) Management Development Programme on 'Operation, Maintenance and Repair of Analytical Equipment' was also organized

under ITEC/SCAAP Programme of the Ministry of External Affairs, New Delhi.

IGIB

- 136 Students from various Universities/Institutes obtained summer training/project training to make them aware of the modern techniques used in Biotechnology and towards partial fulfillment of their degree course.

IHBT

- A training programme on 'Plant Tissue Culture: A Tool for Quality Planting Material' was organized. Ten Participants attended the programme.

IICB

- HUGO satellite meeting: A symposium on "Complex Diseases: Approaches to Gene Identification and Therapeutic Management", in association with Indian Statistical Institute, Chittaranjan National Cancer Institute & Saha Institute of Nuclear Physics, Kolkata was organized on 25th-26th September, 2008.
- The "14th Alexander Hollaender Course on Genetic Toxicology: Genomic and Proteomic Approaches" and a Special Workshop on "Arsenic Exposure Assessment" was organized from 10th to 12th December, 2008. The course and workshop were intended to review the advances in environmental mutagenesis and health.

IICT

- An 'Advanced Course on Bioinformatics' of six months duration was organized jointly with DAC & Jawahar Lal Nehru Technical University with an intake of 24 students.
- Refresher course on "Processing and analytical methodologies of oils & fats was organized.

IIP

- Eight training programmes on "Petroleum Refining Technology" were organized during the year. Around 200 engineers from various Oil companies attended the training.
- Two training programmes on "Laboratory Practicals" for Chemical Engineers of National Thermal Power Corporation, Noida, were organized wherein 50 engineers attended the training programmes.
- Two training programmes on "Vehicle Pollution" for Transport Department of different states, Ministry of Road and Highways, were conducted wherein about 50 officers participated.

IMMT

- Executive development programme was conducted on "Fundamentals of Mineral Engineering for Graduate Engineers" for M/s Brahmani River Pellets Ltd, M/s Essar Steel Limited, Visakhapatnam, M/s Tega Industries, Kolkata and M/s Tata Consultancy Services, Kolkata.

IMTECH

- Long Term Training Programme (6 months) for M.Sc. & B.Tech. students from various universities was conducted during the period. A total of 100 students underwent this training.
- An International Conference on "Open Source for Computer Aided Drug Discovery (OSCADD)" was conducted from 22nd-26th March, 2009 in which more than 200 participants from India and abroad participated.

- International Conference on "Protein-DNA transactions" organized during 2nd-5th March, 2009 in which more than 150 participants from both India and abroad participated.

IITR

- Four programmes on (a) Concept and application of advanced instrumentation monitoring, (b) Mercury management in fluorescent lamps, (c) Analysis of toxic metals in environmental samples, (d) Analysis of pesticides and other organic chemicals in environmental samples for the officials of State Pollution Control Boards, Universities and private sector enterprises were conducted.
- Four programmes, each of three days duration, on 'Water Quality Monitoring and Surveillance' were organized for officials/Engineers of Department of Water Supply and Sanitation, Punjab.

NAL

- A vast pool of student population (various disciplines of engineering, MCA students) underwent training at NAL, under various programmes of 8 weeks to 6 months duration. Industry recognizes the training/exposure in NAL and the raw students generally get the finishing touch at NAL and are readily absorbed in the industry.

NBRI

- A training programme on 'Biodiversity standards and digitization of natural history collections and data cleaning' was organized by Global Biodiversity Information Facility (GBIF), Copenhagen, Denmark.
- Five training programmes, each of two days duration, on 'Commercial Floriculture' were organized.

NCL

- About 380 students pursuing courses such as M.Sc., M.Pharma., B.E./B.Tech, M.E./M.Tech. at various Indian institutes including IITs, IISERs and NITs were trained as a part of their summer training.

NEIST

- Two training programmes were conducted at Santi Sadhana Ashram, Kalu Gaon, Sivasagar and Yanke Multipurpose Welfare Society, Chukitong village, Wokha, Nagaland on 'Cultivation of mushroom'.
- Training programme for preparation of incense sticks with mosquito repellent properties was organized.
- Two training programme were conducted on 'Cultivation of Aromatic and Medicinal plants'. More than 120 beneficiaries were trained on the cultivation of aromatic plants and mushroom.
- Three Workshops cum training programmes were conducted in collaboration with IICT to address the chronic problems faced in rearing of silkworm by farmers and also to demonstrate to them the newer and more beneficial technologies available that would help improve the yield. 100 sericulture farmers benefited from the training programme.

NIO

- A course on 'Fundamentals of Oceanography' was conducted for 28 summer trainees (post- graduates/engineering under-graduates from various universities of India). 102 under-graduates/post graduates underwent summer training including

12 students from various foreign universities.

NPL

- Twelve training courses on various fields like 'Metrology', 'Material characterization techniques', 'Calibration of thermocouples / platinum resistance thermometer' etc were organized.

SERC

- Three-day Advanced Course on 'Computational Structural Mechanics' was organized.
- Advanced Course on 'Fatigue and Fracture Behaviour of Materials, Components and Structures' was organized.

Annexure III

Intellectual Property from CSIR:
Application Filed/ Granted during 2008-09

	India		Abroad	
	Filed	Granted	Filed	Granted
AMPRI	3	7	0	0
CBRI	3	6	0	0
CCMB	1	2	25	1
CDRI	5	12	12	16
CECRI	2	28	6	1
CEERI	1	3	0	0
CFTRI	18	86	9	43
CGCRI	6	64	2	5
CIMAP	3	17	11	15
CIMFR	4	23	1	14
CLRI	5	17	3	6
CMERI	3	8	0	1
CRRI	0	0	0	0
CSIO	1	8	0	8
CSIR(SCH)	8	21	10	6
CSMCRI	16	20	56	34
IGIB	5	17	17	28
IHBT	7	13	17	8
IICB	5	5	9	6
IICT	18	76	62	42
IIIM	3	20	5	14
IIP	3	24	15	2
IMMT	3	23	6	0
IMT	1	4	18	5
ITRC	0	3	1	0
NAL	6	6	0	1
NBRI	3	11	0	21
NCL	13	102	39	26
NEERI	2	9	4	1
NEIST	5	14	3	1
NGRI	1	1	8	2
NIIST	7	11	26	12
NIO	0	9	7	3
NMITLI	0	0	8	0
NML	11	12	9	5
NPL	11	20	15	6
SERC	0	1	0	0
TOTAL	183	703	404	333

CSIR Copyright Applications filed during 2008-2009	
NML	1
CEERI	1
CIMFR	2
CLRI	1
CMERI	1
CRRI	3
IGIB	3
IICB	1
IMT	2
ITRC	1
NAL	13
NIIST	1
NML	9
NPL	3
Total	42

Annexure IIIA

CSIR Patents granted in foreign countries during 2008-2009

Lab	Patent No.	Title	Inventors
CCMB	EU 792934	Process for producing polypeptides	Gowrishankar Jayaraman, Poonam Bhandari, Kaveti Rajkumari
CDRI	PE 4960	Substituted 1,2,4-trioxanes useful as antimalarial agents and a process for the preparation thereof	Chandan Singh. Pallvi Tiwari, Sunil Kumar Puri
	UK 2425310	Novel n-phenoxypropanolyl-n'-phenethyl-urea/thiourea derivatives as appetite suppressant	Kalpana Bhandari, Shipra Srivastava, Chandeshwar Nath
	US 7365218	Process for preparing guggulsterones	Ram Pratap Singh, Dharmendra Pratap, Pal, Raghavendra Singh,
	SA 2007/6835	Synergistic combination kits of alpha, beta-arteether, sulfadoxin and pyrimethamine for the treatment of severe/multi-drug resistant cerebral Malaria	Renu Tripathi, Sunil Kumar Puri, Jagdishwar Sahai, Srivastava, Satyawan Singh, Omkar Prasad Asthana, Anil Kumar Dwivedi
	US 7404962	Combination kit used in the treatment of Malaria	Pinto Francis Joseph, Swati Ajay Piramal, Ram Pratap Bhaduri, Amiya Prasad Harsh Pati Thapliyal, Sunil Kumar Puri; Guru Prasad Dutta, Anil Kumar Dwivedi, Satyawan Singh, Pratima Srivastava, Vikash Chandra Pandey, Sudhir Srivastava, Shio Kumar Singh, Ram Chandra Gupta, Jagdishwar Sahai Srivastava; Omkar Prasad Asthana
	GEP 20084442B	Herbal medicaments for treatment of neurocerebrovascular disorders	M Ray, R. Pal, S. Singh, NM Khanna
	US 7427686	Novel (3r,4r)- trans 3,4-diaryl chroman derivatives useful in fertility regulation and the prevention or treatment of estrogen related diseases or syndromes	Sangita, Atul Kumar, Man Mohan Singh, Suprabhat Ray,Girish Kumar Jain

	EU 1020191	Method of treating hyperlipidemic and hyperglycemic conditions in mammals using pregnadienols and pregnadienones	R. Pratap Gupta, RC Kapoor, NK Chander R Khanna, AK Ghatak, A Asthana, OP Nityanand, S Dev, N Anand
	CH ZL200380 110723.7	Alpha-substituted naphthyloxy omega-substituted alky/aryl amino-substituted alkane derivatives as agent for treatment or prophylaxis of diabetes and related metabolic disorders	Devdutt Chaturvedi, Atul Kumar, Reema Rastogi, Arivend Srivastava, Priti Tewari, Rehan Ahmad, Ramaesh Chander, Anju, Puri, Geetika Bhatia, Farhar Rivizvi, Anil Kumar Rastogi, Suprabhat Ray
	CH ZL2802523.7	Substituted 1,2,4-trioxanes useful as antimalarial agents and a process for the preparation thereof	Chandan Singh, Pallvi Tiwari, Sunil Kumar Puri
	EU 1831172	Substituted carbamic acid quinolin-6-yl esters as acetylcholinesterase inhibitors	Neeraj Shakya, Zeeshan Fatima, Chandishwar Nath, Anil Kumar Saxena
	US 7495025	Spiro-1,2,4-trioxanes	Chandan Singh, Heetika Malik, Sunil Kumar Puri
CDRI + LUPIN			
	UZ 9878	Biodegradable, inhalable microparticles containing anti-tubercular drugs	Himadri Sen, Suryakumar Jayanthi, Rakesh Sinha, Rolee Sharma, Pawan Muttil
CECRI			
	EU 1831434	A low-cost lead-acid battery with high specific energy	Ashok Kumar, Surendra Kumar Shukla, Bellie Martha, Hariprakash, Shaik Abdul Gaffoor,Dinesh Chandra Trivedi
CFTRI			
	NO 325379	A process for the preparation of soy based low-fat & high protein snack	Thirumakudalu Chikkaraja Sindh
	AU 2002247929	A process for preparation of sugarcane juice powder	B Raghavan, K Ramalakshmi, BBR Borse, MN Ramesh, V Prakash
	SG 115193	A process for the preparation of jam from custard apple.	Manuswamy Ramanujam Vijayalakshmi, Nanjarajurs Shashirekha, Somasundaram Rajarathnam, Revathy Baskaran
	UK 2427199	A process for preparation of homogeneous blended oil	Yadahally Nareppa Sreerama, Ambale Gundappa Gopalakrishna, Belur Ramswamy Iyenger Lokesh

ID ID0021112	A process for preparation of sugarcane beverage base	Pasupuleti Vijayanand Aswathan
EU 1700117	A rapid detection kit for pesticide analysis based on charged couple device	Munna Singh Thakur, Naikankatte Ganesh Karanth, Anatharamaiah Kumar, Eshwar Amita Rani, NL Akmal Pasha
PH 1-2004-501500	An emulsifier system for cakes and a method for making improved quality cakes thereof.	Rajiv Jyotsna
SG 123803	A process for the preparation of high fibre biscuits	Madhugiri Lakshminarayan Sudha, Rathinam Vetrimani, Krishna Rau Leelavathi
RF 2326946	A process for production of dopa and dopamine from hairy root cultures of	Ravishankar Gan, B Suresh, SR Rao
EU 1487584	A process for preparation of decorticated finger millet (*eleusine coracana*)	NG Malleshi
KR 10-0843675	Ready-to-serve beverage from custard apple by microfiltration	Ngaseppam Iboyaima, Munis Singh
UK GB2428959	A process for preparation of expanded finger millet	Nagappa Gurusiddappa Malleshi, Ushakumari, Rambahadur Singh
JP 4154340	A process for the preparation of soy based low-fat & high protein snack	Thirumakudalu Chikkaraja Sindh
EU 1571929	A process for the preparation of antioxidant conserve from indian curry leaves (*Murraya koenigii spreg*.)	Lingamallu Rao, Jagan Mohan, Ramalakshmi, Kulathooran, Borse, Babasaheb, Bhaskarrao, Raghavan, Bashyam
ID 0021661	A method for the preparation of a dry formulation containing onion	Sukumar Debnath, Naveen Kumar Rastogi, Samkaramthadathil Gangadharan Jayaprakashan Kodangala, Keshava Bhat, Jayapal Hemav
LK 13741	A process for preventing development of pacha taint in ctc teas using antioxydants	Sreekantayya,Nagalakshmi Rao Lingamallu, Jagan Mohan, Nanjundaswamy, Chandrasekhar, N Muraleedharan
GB2427118	A device and an objective method for determining the doneness and end point of cooking of dhals and rice	Narasimha Hampapura, Venkatarama Iyengar, Sashikala Vadakkoot Balakrishnan, Vishwas Manoharrao Pratape

VN 7156	A high energy high protein food product & process for preparing the same	Sridevi Singh, Annapurna
KE KE271	A composition for stabilizing pink color of fresh large cardamom and a process for stabilizing the pink color of large cardamom	Jarapla Pura Naik, Sathyagalam Ranganatha Desikacharya Sampathu, Kambadoor Nagarajarao Gurudutt
JP 4176646	An improved process for preparation of soya protein concentrate with improved functional properties.	Swamylingappa, Bhagya
JP 4177267	A process for preparation of decorticated finger millet (*Eleusine coracana*)	NG Malleshi
ID ID0020811	An athermal process for the concentration of *Garcinia* extract	Ramakrishnan, Chinnaswamy, Anandha, Nagaraj, Naveen, Jayaprakasha, Guddadarangavvanahally, Krishnareddy, Jena, Bhabani, Sankar, Varadaraj, Mandyam, Chakravarathy, Raghavarao, Karumanchi, Sreesaila, Mallikarjuna, Srinivasa
CH ZL02107887.4	A process for the preparation of the binder formulations useful for preparation of agglomerated flavoured tea.	Srikantayya Nagalakshmi, Jarpla Pura Naik, Kadimi Udaya Sankar, Balaraman Manohar
US 7431951	An athermal process for the concentration of *Garcinia* extract	Ramakrishnan; Chinnaswamy Anandha , Nagaraj, Naveen, Jayaprakasha, Guddadarangavvanahally Krishnareddy, Jena; Bhabani Sankar, Varadaraj, Mandyam Chakravarathy, Raghavarao, Karumanchi Sreesaila Mallikarjuna Srinivasa
US 7431958	Use of fraction from *Cinnamomum zeylanicum* for preserving food	Jayaprakasha, Guddadarangavvanahally Krishnareddy
JP 41199116	A process for the production of egg yolk antibodies for organochlorine insecticides	Rani Bem, A Pasha, NG Karanth, RJ Rao, P Gowda

CH ZL02828846.7	A process for improving the sensory quality of steamed pudding containing defatted soy flour.	Susheelamma, Nugge, Halli, Sampathkumarachar; Asha, Ramaswamy, Ravi Ramasamy, Bhat, Kodangala, Keshava
CH ZL02830108.0	A process for the preparation of antioxidants from *Dillenia indica*	Jena, Bhabani, Sankar, Jayaprakasha, Guddadarangavvanahally, Krishnareddy, Ravendra Singh, Pradap; Sakariah, Kunnumpurath, Kurian
US 7462371	Process for the preparation of soy based low-fat and high protein snack	Kanya, Thirumakudalu Chikkaraja Sindhu, Chandrasekhara, Holenarasipura Nanjundiah, Indira Tyakal, Nanjundiah Rao; Appu Rao, Gopala Rao, Appu, Prakash, Visweshwariah
EU EP1696747	Rosemary herbal beverage powder and a process thereof	Babasaheb Bhaskarrao Borse, Kulathooran Ramalakshmi, Gurukuntla Sulochanamma, Bashyam Raghavan
EU EP1608747	A process for preparation of thermostable enzyme based biorector	Munna Singh Thakur, Renusarath Babu Vegesna, Naikankatte Ganesh Karanth, Anatharamaiah Kumar
KR 886262	A process for the preparation of angiotensin converting enzyme inhibitors from glycinin	Lalitha Ramakrishna Gowda, Appu Rao, Gopala Rao, Appu Rao, Vishweshwaraiah Prakash
US 7501141	Process for the preparation of colorant from oleoresin	Jarpla Pura Naik, Desikacharya Sampathu, Sathyagalam Ranganatha, Madhava-Naidu, Madeneni, Sowbhagya, Halagur Bogegowda
JP 4276539	A process for the production of cholesterol lowering structured lipids from coconut oil containing omega 6 polyunsaturated fatty acids	R Rao, K Sambaiah, BR Lokesh

CGCRI		
US 7368405	Process of making silicon--silicon carbide ceramic using biopreform, silicon--silicon carbide ceramic obtained thereby	Omprakash Chakrabarti, Himadri Sekhar Maiti, Rabindranath Mazumdar
JP 4141956	A process of making rare earth doped optical fibre	Ranjan Sen, Miss Minati Chatterjee, Milan Kanti Naskar, Mrinmay Pal, Mukul Chandra Paul, Shyamlal Kumar Bhadra, DA Kamal
GFR 10297836	Process for making biopreform from monocotyledonous caudex plant stem, biopreform obtained thereby and use thereof	Omprakash Chakrabarti, Himadri, Sekhar Maiti, Rabindranath Mazumdar
UK GB2423078	A synergistic composition for preparing high concentration fullerene(c60)-glass and a method for preparing the glass in bulk monolith	R Debnath , R Sahoo
CIMFR		
AU 2002368492	A process for the preparation of a catalyst useful for conversion of 3- & 4-cyanopyridines to useful products	SC Ray, B Singh, S Maharaj, H Prasad, PK Sarkar, P Dutta, SK Roy, AK Bandopadhyay, R Sen
KR 837827	A process for the production of plant growth stimulator from fly ash	SR Rao, SK Ghosh, G Singh, SK Hazra
NZ 541190	A process for synthesis of diphenic acid from phenanthrene	KK Tiwari, K Bit, SK Thakur, KK Mishra, SRK Rao
RF 2328343	A catalyst useful for synthesis of 2-&4-picolines	Pashupati Dutta, Subhash Chandra Roy, Shyam Kishore Roy, Tarun Kanti Goswami
PL 198673	Process for the production of fly ash slurry	SK Rao, SK Ghosh, SK Basu, BK Mall, SK Verma, G Singh, S Mazumdar
JP 4171426	A method of enhancing the purity of phenanthrene and a device therefor	Kaushal Kishore Tiwari, Sukuru Ramakrishna Rao, Sanjay Kumar Thakur, Som Nath Banerji
MX 259965	A process for the production of plant growth stimulator from fly ash	SR Rao, SK Ghosh, G. Singh G, SK Hazra

JP 4209915	A method of extraction of dimethylphthalate	Chandra Bit Kumares
AU 2002246313	A method of enhancing the purity of phenanthrene and a device therefor	Kaushal Kishore Tiwari, Sukuru Ramakrishna Rao, Sanjay Kumar Thakur, Som Nath Banerji
US 7455827	Process for preparing a catalyst for conversion of cyanopyridines to nicotinamides	Subhash Chandra Ray, Baldev Singh, Hiralal Prasad, Prodyot Kumar Sarkar, Pashupati Dutta, Shyam Kishore Roy, Anup Kumar Bandyopadhyay, Raja Sen
US 7481908	System and a process for obtaining high purity phenanthrene from phenanthrene enriched coal tar fraction	Kaushal Kishore Tiwari, Sukuru Ramakrishna Rao, Sanjay Kumar Thakur, Somnath Banerji
CIMAP		
KR 848394	Pharmaceutical composition containing cow urine distillate and an antibiotic	Suman Preet Singh Khanuja, Sushil Kumar, Ajit Kumar Shasany, Jai Shankar Arya, Mahendra Pandurang Darokar, Monika Singh, Prachi Sinha, Soumya Awasthi, Subhash Chandra Gupta, Vivek Kumar Gupta, Madan Mohan Gupta, Ramkishore Verma, Sweta Agarwal, Sunil Balkrishna Mansinghka, Suresh Haribhau Dawle
GFR 10297827	Use of phyllocladane diterpenoids for plant growth promotion and alleviatin of growth retardant allelochemicals	AK Singh, GD Bagchi, S Singh, PD Dwivedi, AK Gupta, SPS Khanuja
US 7435433	Process for the isolation of oleane compounds isolated from the bark of arjun tree *Terminalia arjuna*	Suman Preet Singh Khanuja, Madan Mohan Gupta, Santosh Kumar Srivastava;, Kumar; Tiruppadiripuliyur Ranganathan Santha Digvijay Singh, Verma, Subash Chandra, Ankur Grag, Merajuddin Khan, Verma; Ram Kishor Mishra, Raghavendra Kumar , Subash Chandra Singh
US 7435877	Distinct type cultivar of *Ocimum basilicum* "cim-	Suman Preet Singh Khanuja, Raj Kishori Lal, Arun Kumar Agnihotri,

	-saumya"	Shasany, Ajit Kumar, Ali Arif Naqvi, Samresh Dwivedi, Misra, Hari Om, Dhawan, Om Prakesh, Kalra, Alok, Singh, Aparbal, Bahl, Janak Raj, Singh, Saudan, Patra, Dharani Dhar, Agarwal, Shilpi, Darokar, Mahendra Pandurang, Gupta, Anil Kumar, Gupta, Moti Lal, Chandra, Ram
US 7446243	High herb, phyllanthin and hypophyllanthin yielding cultivar of *Phyllanthus amarus* `cim-jeevan`	Anil Kumar Gupta, , Suman Preet Singh Khanuja, Madan Mohan Gupta, Ajit Kumar Shasany, Neeraj Jain, Ram Kishor Verma, Darokar, Mahendra Pandurang, Bagchi, Guru Das, Sushil Kumar
EU 1611148	A new nitrile glycoside useful as a bioenhancer of drugs and nutrients and the process of its isolation from moringa oleifera	Suman Preet Singh Kahnuja, Jai Shanker Arya, Tiruppadiripuliyur Ranganathan Kumar, Santha, Saikia Dharmendra, Harpre Kaur
CH ZL03808921.1	A process for insecticidal herbal formulation effective in controlling malarial vector, mosquitoes	Tripathi Arun Kumar, Prajapati Veena, Suman Preet Singh Khanuja
US 7473768	Primers and a screening method for identification of artemisinin producing plants	Suman Preet Singh Khanuja, Paul, Shilpi , Ajit Kumar Shasany, Darokar, Mahendra Pandurang, Shukla, Ashutosh Kumar, Gupta, Madan, Kumar, Anuruddha
VN 7463	Unique DNA marker for tagging high artemisinin yield in artemisia annua and use of method to screen high yielding plants	Suman Preet Singh Khanuja, Shilpi Paul, Ajit Kumar Shasany,Mahendra Pandurang Darokar, Ashutosh Kumar Shukla,Madan Mohan Gu
AU 2002347537	A novel method for one pot conversion of artemisinin into arteether	Bhakuni RS, Tewari A, Singh T, Khanuja SPS
US 7510836	Alpha arteether resistance domain	Suman Preet Singh Khanuja, Suchi Srivastava, Ajit Kumar Shasany, Tiruppadiripuliyur Ranganathan, Santha Kumar, Mahendra Pandurang Darokar, Preeti Chand, Sushil Kumar
CIMAP+CDRI		
MY 137775-A	Synergistic anti-malarial formulation	Guru Prakash Dutta, Dharam Chand Jain, Ranjendra Singh Bhakuni, Sudhanshu Saxena, Sangeeta Dhawan,Suman Preet

			Singh Khanuja, Sushil Kumar, Renu Tripathi, Aseem Umesh, Nuzhat Kamal, Anil Kumar Dwivedi,Satyawan Singh
CLRI			
	EU 1521850	A novel process for total lime-sulfide free unhairing in skins/hides using herbal enzymes(p02bp08)	Suguna Rose Chellan,; Rajini Lonchin, Samivelu Raju, Rathinasamy Natesan, Ramalingam Veerapan, Iyappan Samayavaram, Parvathaleswara Kuttalam, Ramasami Thirumalaichari Thotapalli
	CH ZL20038010 2620.6	A process for the simultaneous recovery of chromium and iron from chromite ore processing residues	KJ Sreeram, Ramasami Thirumalachari
	NZ 545688	A novel process for liquefaction of solid organic matter	Suthanthararajan Rangasamy, Chitra Kalyanaraman, Umamaheswari Balasubramanian, Ravindranath Ethirajulu, Rajamani Sengodagounder
	EU 1576196	A process for the preparation of a novel synthetic aluminium tanning agent	M Kanthimathi , P Thanikaivelan, JR Rao BU Nair, T Ramasami
	AU 2003274440	A novel bio-process for total elimination of lime using enzymes in leather processing	Thanikaivelan Palanisamy, Jonnalagadda Rao, Raghava Nair, RA Balachandran Unni ;
	KR 886010	A novel process for total lime-sulfide free unhairing in skins/hides using herbal enz ymes(p02bp08)	Rose, Chellan; Suguna, Lonchin; Rajini, Raju; Samivelu, Natesan; Rathinasamy, Veerapan; Ramalingam, Samayavaram; Iyappan, Kuttalam; Parvathaleswara, Thotapalli; Ramasami, Thirumalaichari
CMERI			
	EU 1537269B1	A novel sewing machine for decoratively stitching a cricket ball	Hardyal Singh, Surinder Singh Sehmby, Narayan Prasad Mukherjee, Balamurugan Gopalsamy; Uma Datta, Joydeb Roychoudhury
CSIO			
	CH ZL01823210.8	A new multifiber 2d-array device for sensing & localizing environment perturbations using speckle image processing	HK Sardana, JK Chhabra, S Bandyopadhyaya, PK Goel

AU 2003290413	An opto-electronic device for angle generation of ultrasonic probe	Surjit Singh Ahluwalia
KR 10-0860610	Synthesis of platinum and palladium quantum well size nano-particles	Madan Lal Singla, Mewa Singh, Dharam Jain, Veer Singh, Ram Kishore, Ram Prakash Bajpai
KR 10-0869517	A new multifiber 2d-array device for sensing & localizing environment perturbations using speckle image processing	HK Sardana, JK Chhabra, S Bandyopadhyaya, PK Goel
KR 10-0884023	A new process for controlled blood transfusion with disposable valve circuit	KD Chattppadhyay, S Verma, P Raj, J Gupta
KR 885756	Fiber optic temperature switching immersion probe	N Singh, SC Jain, AK Aggarwal
JP 4276180	Development of new ceramic mixture for thermal / temparature sensor working on the principle of negative temperature coefficient (NTC) at 330°C ± 6%	ML Singla, B Raj, VR Harchekar, RP Bajpai
CSIR(SCH)		
EU EP1434503	Activated charcoal filter for effectively reducing parabenzosemiquinone from the main stream cigaratte smoke	LB Chatterjee
JP 4177760	Process for preparing cathode material for lithium batteries	Chandrasekaran Ramasamy, Vasudevan Thiagarajan, Mani Ariyanan; Ramaiyer Gangadharan;
EU 1488364	Method and system to build optimal models of 3-dimensional molecular structures from knowledge of their chemical structures	Gautham Namasivyam, Vengadesan Krishnan
KR 10-0868687	Isolation, characterization and mechanism of action of a new hazardous component of cigarette smoke: prevention by ascorbic acid	LB Chatterjee
EU 1758924	Peptide antagonists of a mycobacterial virulence factor	Abhik Saha, Archana Sharma, K Sujoy Das Gupta, Siddhartha Roy, Bhabatarak Bhattacharya, Pinakpani Chakrabarty

KR 10-0878882	A process for the preparation of novel pharmacutical composition useful for extended release of drug	Setal Garg
CSMCRI		
RF 2321576	A process for the eco-friendly synthesis of bromobenzene	Ashutosh Vasant Bedekar, Pushpito Kumar Ghosh, Subbaray Appa Adimurthy, Gadde Ramachandraiah
CH ZL02802456.7	Preparation of nutrient rich salt of plant origin	P Kumar, MP Reddy, JB Pandya, J Shambhubhai, SM Vaghela, Mr Gandhi, RJ Sanghvi, VGS Kumar, MT Shan
KR 827634	Process for the preparation of a molecular sieve absorbent for the size/shape selective seperation of air	RV Jasra, CD Chudasama, J Sebastian
RF 2323873	An improved process for the preparation of nonhazardous brominating reagent	G Ramachandraiah, PK Ghosh, S Adimurthy, AV Bedekar, DB Shukla
SA 2006/07831	Herbal extracts of *Salicornia* species, process of preparation thereof, use thereof against tuberculosis	Meena Rajnikanth Rathod,Bhupendra Dhanvantrai Shethia, Jayant Batukrai Pandya, Pushpito Kumar Ghosh, D Prakash Jagjivanbhai
US 7387728	Animal powered mechanical device for water desalination	Nagendra Pathak, Pushpito Kumar Ghosh, Sohan Lal Daga, Shah, Virendra Jayantilal, Patel; Sanat Natubhai
AU 2002228289	Preparation of non-hazardous brominating reagents	Ramachandraiah G, Ghosh PK, Mehta AS, Adimuthys, Jethva Ad, Vaghela SS
CH ZL20038011 1001	A process for the eco-friendly synthesis of bromobenzene	Ashutosh Vasant Bedekar, Pushpito Kumar Ghosh, Subbaray Appa Adimurthy, Gadde Ramachandraiah
JP 4149999	Device for estimation of brine density	Pushpito Kumar Ghosh, Majeethia, Kishor, Manmohandas, Gandhi, Mahesh, Ramniklal, Parmar, Jamnadas, Naranbhai, Bhatt, Ajoy, Murlidhar, Chauhan, Shanti, Amritlal, Vadakke, Puthoor, Mohandas, Hamidini, Abdulhamid, Usmanbhai
CH ZL01823809.2	Recovery of sodium chloride and other salts	Rajinder Nath Vohra, Pushpito Kumar Ghosh, Mohandas,

	from brine	Vadakke, Puthoor, Joshi, Himanshu, Labhshanker, Deraiya, Hasina, Hajibhai, Dave, Rohit, Harshadray, Halder, Koushik, Yadav, Ran, Bahadur, Daga, Sohan, Lal, Majeethia, Kishorkumar, Manmohandas, Saraiya, Upendra, Padmakant
US 7407906	Process for the preparation of a molecular sieve adsorbent for the adsorptive dehydration of alcohols	Jasra Raksh Vir, Sebastian Jince, Chudasama, Chintansinh Dharmendrasinh
LK 13743	Animal powered mechanical device for water desalination	Pathak N, Ghosh PK, Daga SL, Shah VJ, Patel SN
EU 1485200	Process for the preparation of molecular sieve adsorbent for selective adsorption of nitrogen and argon	Sebastian, Jince, Jasra, Raksh, Vir
MX 260163	Process for production of glycine micronutrient-enriched NaCl crystals with near spherical shape and improved flow characteristics	Parthasarathi Dastidar, Pushpito Kumar Ghosh, Amar Ballabh, Darskak Rameshbhai Trivedi, Amitava Pramanik, Velayudhan Nai
AU 2003300719	Novel integrated process for the recovery of sulphate of potash (sp) from sulphate rich bittern	Pushpito Kumar Ghosh, Kaushik Jethalal Langalia, Maheshkumar Ramniklal Gandhi, Rohit Harshadray Dave, Himanshu Labhshank
JP 4191038	Process for the operation of finely divided calcium carbonate	Rakesh Vir Jasra, Pravinchandra Mahasukhray Oza, Rajesh Shantilal Somani, Jatin Rameshchandra Chunnawala, Mrinal Vinodbhai Sheth, Vikram Vinodrai Thakkar, Yogi Mansukhlal Badheka, Jayalekshmi Ayyer, Virendra Bhikhabhai Patel
IL 161524	A process for recovery of common salt and marine chemicals from brine in integrated manner	Rajinder Nath Vohra, Pushpito Kumar Ghosh, Vadakke Puthoor Mohandas, Himanshu Labhshanker Joshi, Hasina Hajibhai Deraiya
JP 4206343	Preparation of nutrient rich salt of plant origin	Kumar P, Reddy MP, Pandya JB, Shambhubhai J, Vaghela SM, Gandhi MR, Sanghvi RJ, Kumar VGS, Shan MT

IL 148144	An eco-friendly method of preparation of high purity tetrabromobisphenol-a	Gadde Ramachandraiah,Pushpito Kumar Ghosh, Aditya Shantilal Mehta, Rajesh Popatlal Pandya,Ashok Dahyabhai Jethva,Sanjay Shambhubhai Vaghela, Sudhindra Nath Misra
US 7459139	Process for preparation of non-hazardous brominating agent	Gadde; Ramachandraiah, Ghosh Pushpito Kumar, Subbarayappa; Adimurthy , Bedekar; Ashutosh , Shukla; Dipak Balvantrai
AU 2002232114	Process for the recovery of low sodium salt from bittern	Vohra; Rajinder Nath
EU 1465835	Preparation of non hazardous brominating reagents	Ramachandraiah G, Ghosh PK, Mehta AS, Adimuthys, Jethva AD, Vaghela SS
EU 1633676	An improved process for the preparation of non-hazardous brominating reagent	Ramachandraiah G, Ghosh PK, Adimurthy S, Bedekar AV, Shukla DB
US 7473406	Process for recovery of Palladium from spent catalyst	Jasra, Raksh Vir , Ghosh Pushpito Kumar , Bajaj, Hari Chand, Boricha, Arvindkumar Balvantrai
AU 2003226644	An improved electrochemical method for oxidation of bromide to bromine	Ramachandraiah G, Ghosh PK, Susarla VKS, Vaghela SS
CSMCRI + CDRI		
AU 2003259548	A novel use of herbal extracts of *Salicornia* species active against *Tuberculosis* and process for the preparation thereof	Meena Rajnikanth Rathod,Bhupendra Dhanvantrai Shethia, Jayant Batukrai Pandya, Pushpito Kumar Ghosh, J Prakash, Dodia, BR
EU 1684778B1	A novel use of herbal extracts of *Salicornia* species active against *Tuberculosis* and process for the preparation thereof	Meena Rajnikanth Rathod,Bhupendra Dhanvantrai Shethia, Jayant Batukrai Pandya, Pushpito Kumar Ghosh, Prakash J Dodia, BR
US 7442393	Herbal extracts of *Salicornia* species, process of preparation thereof, use thereof against *Tuberculosis*	Rathod; Meena Rajnika, Shethia, Bhupendra D , Pandya, Jayant B. , Ghosh; Pushpito K , Dodia, Prakash J , Srivastava; Brahm, S , Srivastava, Ranjana , Srivastava, Anil , Chaturvedi, Vinita
IGIB		
IL 147435	A computer based method for identifying conserved invariant peptide motifs	Brahmachari Kumar, Samir

US 7363166	Computational method for the identification of candidate proteins useful as anti-infectives	Brahmachari Samir Kumar, Ramachandran, Srinivasan, Nandi, Tannistha , Bhimarao; Chandrika
EU 1706417	A novel protein capable of inhibiting Anthrax toxin activity	Naveen Arora, Kaiser Mohammed Bijli, Bhanu Pratap Singh, Susheela Sridhara
CH ZL02802565.2	Novel primers for screening Schizophrenia and a method thereof	Brahmachari SK, Ranjana, Chitra, Salim Q, Jain S
US 7381527	Method of detection of sp-a2 gene variants	Sarma, Puranam Usha , Madan, Taruna , Saxena; Shweta
AU 2002347536	Novel use of pbpb as anti asthmatic agent	Ram A, Ghosh B, Gangal SV
SA 2006/5542	A novel protein capable of inhibiting Anthrax toxin activity	Naveen Arora, Kaiser Mohammed Bijli, Bhanu Pratap Singh, Susheela Sridhara
SA 2007/5292	A process for the preparation of a specific microbial consortium to be used as seeding material for the BOD analysis of p&p wastewaters	Rita Kumar, Shikha Rastogi, Anil Kumar
CH ZL200380110273	A biological process for removal of total dissolved solids (tds) from tannery waste water	Kumar R, Sharma P, Beniwal P, Tiku DK
EU 1487791	A process for isolation of novel antifungal lead molecule	Sharma GL, Rajesh, Ali M
CH ZL02830127.7	Novel use of pbpb as anti asthmatic agent	Ram A, Ghosh B, Gangal SV
US 7396671	Biotechnological process for neutralizing alkaline beverage industrial waste water	Kumar, Rita, Kumar; Anil
JP 4163686	Rapid generation of enzyme catalyzed reaction products	Das RH, Nahar P
US 7424370	Computational method for identifying adhesin and adhesin-like proteins of therapeutic potential	Sachdeva, Gaurav , Kumar, Kaushal , Jain; Preti, Brahmachari, Samir K, Ramachandran, Srinivasan
CN 2420952	Antifungal molecule 2-(3,4-dimethyl-2,5-dihydro-1h-pyrrol-2-yl)-1-methylethyl pentanoate	Sharma GL, Rajesh, Ali M

DN 1706417	A novel protein capable of inhibiting Anthrax toxin activity	Naveen Arora, Kaiser Mohammed Bijli, Bhanu Pratap Singh, Susheela Sridhara
US 7429478	Microbial consortium useful as seeding material for bod analysis of pulp and paper industrial wastewater	Kumar, Rita , Rastogi, Shikha, Kumar, Anil
RF 2338788	Novel primers for screening Schizophrenia and a method thereof	Brahmachari SK, Ranjana, Chitra, Salim Q, Jain S
RF 2338789	A method of detection of pathogenic mycobacteria in clinical specimens	R H Das
JP 4220906	Novel primers for screening Schizophrenia and a method thereof	Brahmachari SK, Ranjana, Chitra, Salim Q, Jain S
US 7456309	Reusable universal polymer support for repetitive oligonucleotide synthesis	Kumar, Pradeep , Gupta, Kailash Chand
MY 136946	A rapid method for estimation of chemical oxygen demand(cod)	Kalia VC, Sonakya V, Raizada N, Joshi AP

IHBT

AU 2005201644	A novel method for converting dihydrotageone into coconut flavoured 5-isobutyl -3- methyl-4, 5-dihydro-2(3h)- furanone with two chiral centres: an analogue of natural whisky lactone and of coconut aldehyde	Sinha AK, Joshi BP, Dogra R
CH ZL01109826.0	One step method for micro - production of tea leaves	Indra Sandal, Amita Bhattacharya, Madhu Sharma, P S Ahuja
JP 4187660	A process for the preparation of pharmacologically active alpha-asarone from toxic beta-asarone rich *Acorus calamus* oil	Sinha, Arun Kumar, Joshi; Bhupendra Prasad , Acharya; Ruchi

KE KE290	Cloning of 3 novel genes modulated under draught stress conditions in tea (*camellia sinensis* (l) o. Kuntz)	Sanjay, Preeti, Ahuja PS
AU 2003217448	Thermolabile caffeine fraction of tea leaves and use of this fraction in an efficient method of introducing agrobacterium-mediated genetic transformation in plants	Sandal, Indra, Kumar, Ajay, Bhattacharya, Amita, Desikalhar, Ravindranath, Srigiripuram, Gulati, Ashu, Ahuja, Paramvir, Singh
KR 10-0890255	Process for the preparation of substituted trans-cinnamaldehyde, a natural yellow dye, from phenylpropane derivatives	Sinha AK, Joshi BP, Dogra R
IICB		
CH ZL00820077.7	Use of betel leaf extract to induce ifn-gamma production from human peripheral blood t cells and as a th1 type immunomodulator	Santu Bandyopadhyay,Bikash Pal,Samir Bhattacharya, Mitali Ray,Keshab Chandra Roy
CH ZL01112435.0	Coelomic fluid extract from *Pheretima posthuma* for providing sperm immotility	Mohua Mukherjee, Shampa Biswas, Malabika Datta, Samir Bhattacharye, Ranjan Bhadra, Alok Pal
EU 1083181	Process for preparation of a biomarker specific for o-acetylated sialic acid useful for diagnosing, monitoring treatment outcome, and predicting relapse of lymphoblastic leukemia	Mandal, Chitra ,Pal, Santanu,Chatterjee, Mitali
IICB+IGIB		
AU 2003202800	Two novel gnrhs from indian murrel brain: highly potential molecules for induced breeding of fish	Chatterjee; Abhijit
IICT		
US 7355021	A new process for the one-pot prepration of diazonaptho quinone sulfonyl esters	Vummadi Venkat Reddy, Boddu Ananda Rao, Maruthi Janaki Ram Reddy, Chiguru Srinivas, Chilukuri Ramesh, Vaidya Jayathirtha
JP 4125532	A process for the upgradation and bleaching of crude rice bran wax	Prasad RBN, Rao BVSK, Devi Blap, Roy SK, Kaimal TNB

JP 4128738	Preparation of new layered double hydroxides exchanged with osmate for asymmetric dihydroxylation of olefins to vicinal diols	Boyapati Manoranjan Choudary,Naidu Sreenivasa Chowdari,Mannepalli Lakshmi Kantam,Kondapuramvijaya Raghavan, Chinta Venkat Reddy Reddy
UK GB2424884	C8-linked pyrrolo[2,1-c][1,4] benzodiazepine-acridone/acridine hybrids as anti-tumour agents	Ahmed Kamal, Olepu Srinivas, Poddutoori Ramalu, Gujjar Ramesh, Pogula Praveen Kumar
JP 4139111	Process for the nitration of xylene isomers using zeolite beta catalyst	Choudary BM, Kantamml, Kumar NS, Prasad KV, Raghavan KV
JP 4142580	Process for *in situ* synthesis of supported heteropoly acids and salts thereof	Prasad PSS, Raghavan KV, Suryanarayana L, Rao KN, Lakshmi CC, Kumar MS, Reddy KB
UK GB2425309	Novel c2-fluoro pyrrolo [2,1-c] [1,4] benzodiazepine dimers useful as anticancer agents	Ahmed Kamal, Peram Surakattula Murali Mohan Reddy, Depatla Rajasekhar Reddy
HK 1048865	Method for chromatographic finger printing and standardization of single medicines and formulations	Vijaya Kumar Dadala, Kondapuram Vijaya Raghavan
JP 4159022	Process for the preparation of diazonaphthoquininesulfonyl chlorides using diphosgene and triphosgene	Reddy VV, Reddy Mjr, Rao VJ
JP 4159549	Processing of hydrogen by metal ion exchanged montmorillonite	Choudary BM, Ranganath KVS, Kantam ML
CH ZL02830110.2	Process for production of ethanol using stable yeast crystals in modified conventional batch reactor	Prakasham RS, Sarma PN, Mohan SV, Prasad KK, Raghavan KV
US 7407908	Eco-friendly photo-fenton catalyst-immobilized fe(iii) over hy-zeolite	Machiraju; Subrahmanyam, Valluri; Durga K. , Noorjahan; Mohammed
EU 1346984	Process for the preparation of 2-chloro-5-methylpyridine-3-carbaldehyde	Gangadasu B, Chinaraju B, Rao VJ
JP 4170599	Process for the isolation of oryzanols from rice bran oil soap stock	Rao KVSA, Rao BVSK, Kaimal TNB

JP 4173676	Process for the preparation of amine oxides	Chaudhary BM, Reddy V, Prakash BV, Bharathi B, Kantam ML
ID ID0021889	Recovery of sodium thiocyanate from industrial process solution by membrane based nanofiltration technique	Sridhar Sundergopal, Suryanarayana Murthy, Gorugant U, Suhanya Duraiswamy, Smitha Biduru, Ramakrishna Machiraju
UK GB2424883	Substituted benzimidazoles linked to pyrrolo[2,1-c][1,4] benzodiazepines as anticancer agents	Ahmed Kamal, Poddutoori Ramulu, Olepu Srinivas
EU 1608663	New pyrrolo[2,1-c][1,4]benzodiazepines useful as antitumour agents	Kama A, Reddy PSMM, Reddy Dr.
FRG 10297821	A method for preparing and self-assembling property of nanobinary and ternary oxy/hydroxides	Choudary BM, Jaya VS, Reddy BR, Kantam ML, Rao MM, Rao KK, Raghavan KV
RF 2338747	New pyrrolo[2,1-c][1,4]benzodiazepines useful as antitumour agents	Kama A, Reddy Psmm, Reddy Dr.
JP 4223710	Process for the preparation of amine oxides	Kantan L Et Al.
CH ZL02830007.6	New alpha-glucosidase inhibitors from a natural source	Rao JM, Srinivas PV, Anuradha V, Tiwari AK, Ali AZ, Yadav JS, Raghavan KV
CH ZL1823501.8	(+)-Cycloolivil as antioxidant obtained from natural source namely stereospermum personatum	Rao JM, Tiwari AK, Kumar US, Yadav JS, Raghavan KV
US 7465724	Bis-pyrrolo[2,1-c][1,4]benzodiazepine-anthraquinone conjugates and a process for the preparation thereof	Kamal, Ahmed , Ramu, Rondla , Khanna, Gollapalli Bhasker Ramesh
US 7468149	Process for preparation of conductive polymer dispersion	Palaniappan, Srinivasan, Amarnath, Chellachamy Anbalagan
EU 1348692	Process for the preparation of amine oxides	Chaudhary Bm, Reddy V, Prakash BV, Bharathi B, Kantam ML
CH ZL200380110893.5	A process for the preparation of substituted dihydropyrimidinones using polyaniline salts as catalysts	Srinivasan Palaniappan, Vaidya Jayathirtha Rao, Banda Gangadasu

JP 4249135	Preparation of new layered double hydroxides exchanged with osmate for asymmetric dihydroxylation of olefins to vicinal diols	Choudary BM, Ranganath KVS, Kantam ML
CN 2403117	A process for the preparation of 1,1,1,2 - tetrafluoroethane	Rao Jampani Madhusudana;
EU 1608664	New non-cross-linking pyrrolo [2,1-c] [1,4] benzodiazepines useful as potential anti-cancer agents	Kamal A, Ramesh G, Srinivas O, Ramulu P
JP 4252461	An improved process for the synthesis of novel cationic amphiphiles for intracellular delivery of therapeutic molecules.	Kumar MB, Chaudhuri A, Ramadas Y, Rao NM
US 7491828	Liquid phase process for the synthesis of annulated pyridines over molecular sieve catalysts	Kulkarni, Shivanand J, Kandepi, Veera V. Krishna, Nama, Narender, Raghavan, Kondapuram V.
US 7494676	Process for the pre-treatment of vegetable oils for physical refining	Chakrabarti, Pradosh Prasad, Rao, Bhamidipati Venkata Surya Kopeswara, Roy, Samir Kumar , Bethala, Lakshmi Anu Prabhavati Devi, Karna Narayana, Prasanna Rani, Vemulapalli, Vandana , Chelimi, Kalyani , Karthika, Gadam , Kale; Vijay, Prasad, Rachapudi Badari Narayana
EU 1685068	An environmentally benign process for the simultaneous preparation of nanocrystalline anatase titanium dioxide and hydrazine monohydrochloride	Manorama SV, Reddy KM, Basak P, Nisha CK, Reddy CVG
EU 1340071	A novel method for chromatographic finger printing and standardization of single medicines and formulations	Vijaya Kumar Dadala, Kondapuram Vijaya Raghavan
US 7510694	An environmentally benign process for the simultaneous preparation of nanocrystalline anatase titanium dioxide and hydrazine monohydrochloride	Manorama SV, Reddy KM, Basak P, Nisha CK, Reddy CVG

IICT+CDRI		
EU 1684781	Novel herbal compoition for the treatment of gastric ulcer	Rao JM, Tiwari AK, Kumar US, Sastry BS, Yadav JS, Raghavan KV,Dubey MP, Palit G, Balla DN, Varier PMK, Muraleedharan TS,
IIIM		
CH 200380101231.1	Antidiabetic activity of *Argyrolibin roseum*	Om Prakash Gupta, Zabeer Ahmad, Asha Bhagat, Kuldeep Kumar Gupta, Sukhdev Swami Handa
AU 2003224361	Hepatoprotective activity of 10-o-p-hydroxybenzylaucubin	Anil Prabhakar,Bishan Datta,Krishan Avtar Suri,Naresh Kumar Satti,Swadesh Malhotra,Rakesh Kamal Johri,Bupinder Singh Jaggi,Bal Krishan Chandan,Ashok Kumar Sharma,Devinder Kumar Gupta,Bal Krishan Kapahi,Kasturi Lal Bedi,Om Prakash Suri,Ghulam Nabi Qazi
CH ZL03810548.9	Hepatoprotective activity of 2'-p-hydroxybenzoylmussaenos idic acid	Anil Prabhakar,Bishan Datta,Krishan Avtar Suri,Naresh Kumar Satti,Swadesh Malhotra,Rakesh Kamal Johri, Bupinder Singh Jag
EU 1601778	Stereoselective chemoenzymatic process for the preperation of optically enriched phenylglycidates as precursors of taxol side chain	Anand N, Kapoor M, Taneja SC, Koul S, Sharma RL, Qazi GN
CH ZL200480006636.1	Stereoselective chemoenzymatic process for the preperation of optically enriched phenylglycidates as precursors of taxol side chain	Anand N, Kapoor M, Taneja SC, Koul S, Sharma RL, Qazi GN
EU 1509223	Hepatoprotective activity of 2-p-hydroxybenzoylmussaenos idic acid	Anil Prabhakar,Bishan Datt Gupta,Krishan Avtar Suri,Naresh Kumar Satti,Swadesh Malhotra, Kuldeep Kumar Gupta,Vijay Kumar Sharma,Rakesh Kamal Johri,Bupinder Singh Jaggi,Balkrishan Chandan,Shankar LA, Kasturi Lal Bedi,Om Prakash Suri,Ghulam Nabi Qazi
AU 2002234820	Novel substituted aryl alkenoic acid heterocyclic amides	Subhash Chandra Taneja, Surrinder Koul, Jawahir Lal Koul,Beenu Moza, Sukhdev Swami Handa

JP 4249712	A rapid and specific method for the detection of salmonella	Qazi GN, Verma V, Hassan SR
AU 2002228299	A novel composition for early and profuse sporulation in fungi and a method thereof	Rajinder Kumar Khajuria, Ram Vilas Parsad Sinha, Vijeshwar Verma, Ghulam Nabi Qazi, Sukhdev Swami Handa
CH ZL03826543.5	A potential hepatoprotective agent of plant origin	Qazi GN, Suri OP, Bedi KL, Suri KA, Gupta BD, Jaggi BS, Kapahi BK, Satti NK, Amina M, Chandan BK, Sharma N, Singh G
IIP		
SA 2006/8381	A process for metal working fluid from heavy aklylate	A K Singh, ON Anand, AK Gupta
JP 4242842	A process for the preparation of vanadyl pyrophosphate catalysts with improved structural characteristics for the selective oxidaiton of butane to maleic anhydride	Datta A, Dasgupta S, Agarwal M
US 7419640	Microporous filtration based dot immunoassay device for method for screening of analytes and method of use	Suri, Chander Raman, Raje, Manoj, Varshney, Grish Chandra
RF 2333241	A process for high cell density fermentative production of intercellular recombinant streptokinase	Vinay Venkatrao Vyas, Govindan Rajamohan, Ramandeep, Kanak Lata Dikshit
US 7462708	Temperature regulated promoters from *Schizosaccharomyces pombe* for expression of proteins	Jagmohan Singh, Raj Kumar
EU 1737955	Temperature sensitive promoter based vectors for expression of heterologous proteins in fission yeast *Schizosaccharomyces pombe*	Jagmohan Singh, Raj Kumar
MY MY-137579-A	The vaccine for the treatment of tuberclulosis and other intracellular infectious diseases	Agrewala JN, Sharma N
NAL		
AU 2006201026	An improved process for the manufacture of strontium doped lanthanum manganite ceramic powder	Andi Uday Kumar

NBRI		
AU 2003300707	A method for inducing synchronisation during somatic embroyogenesis in plant tissue culture	Tuli R, Kumar M
SA 2005/07887	Plant and soil health enhancer using cow urine and application thereof for promoting plant growth and controlling plant pathogenic fungi	Nautiyal CS, Mehta S, Singh HB, Mansinghka SB, Dawle SH, Rajhans NE, Pushpangadhan P
UK GB2426705	Development of herbal formulation in treatment of gastrointestinal disorders	Palpu Pushpangadan, Chandana Venkateswara Rao, Shanta Mehrotra, Sanjeev Kumar Ojha, Amresh, Ajay Kumar Singh Rawat
US 7390661	Artificial bidirectional promoter for activation of gene expression	Tuli; Rakesh, Vishwanath, Sawant Samir, Chaturvedi, Chandra Prakash, Kiran, Kanti, Mehrotra, Rajesh
US 7399491	Health promoting functional foods fortified with herbs	Palpu; Pushpangadan, Rawat, Ajay Kumar Singh, Rao, Chandana Venkateswara, Srivastava, Sharad Kumar , Govindarajan; Raghavan
EU 1708789	Development of herbal formulation in treatment of gastrointestinal disorders	Palpu Pushpangadan, Chandana Venkateswara Rao, Shanta Mehrotra, Sanjeev Kumar Ojha, Amresh, Ajay Kumar Singh Rawat
UK GB2426704	Herbal oro-dental care composition for the treatment of halitosis and mouth ulcer	Palpu Pushpangadan, Chandana Venkateswara Rao, Sanjeev Kumar Ojha, Kuttan Pillai Narayanan Nair, Madan Mohan Pandey, Aja
KR 10-0855376	Process for the preparation of custom made herbal health protective nutraceuticals	Palpu Pushpangadan
US 7429397	Herbal formulation as memory enhancer in Alzheimer condition	Pushpangadan Palpu, Chandana Venkateswara Rao, Kamal Kishore; Gupta, Yogendra Kumar, Kartik, Ramasami , Govindrajan, Raghavan
US 7438932	Method for treating stomach ulcers with herbal extract composition	Palpu; Pushpangadan, Venkateswara; Rao Chandana, Raghavan; Govindarajan , Shanta; Mehrotra , Nair; Radhakrishnan Krishnan
US 7442854	High yielding multiple disease resistant/tolerant stable variety `madakini` of opium poppy	Shukla; Sudhir, Singh; Sant Prasad , Singh; Harikesh Bahadur , Pushpangadan; Palpu

AU 2002345299	A synergistic bioinoculant composition comprising bacterial strains of accession nos. Nrrl b-30486, nrrl b-30487 and nrrl b-30488 and a method of producing said composition thereof	Nautiyal SC, Mehta S, Singh HB, Pushpangadan P
RF 2338431	Health protective herbal soft drink-2	Pushpangadan P, Mehrotra S, Ojha SK, Khantoon S, Rawat Aks, Rastogi S, Srivastava M, Seth Pk
AU 2002249560	A novel d-endotoxin protein improved for insecticidal activity and host range and a gene for its high level expression in plants	Rajesh Tuli, Pradhyomna Kumar Singh, Samir V Sawant,Chandra Prakash Chaturvedi
US 7459545	Chemically synthesized artificial promoter for high level expression of transgenes and a method for its synthesis	Tuli; Rakesh , Sawant; Samir V. , Singh; Pradhyumna K , Gupta; Shiv K.
EU 1641537	Dental care herbal formulation	Behl HM, Sidhu OP, Shanta M, Pushpangadan P, Saimbi CS
EU 1002869	Chemically synthesized artificial promoter for high level expression of transgenes	Tuli; Rakesh ; Sawant; Samir V ; Singh; Pradhyumna K. ; Gupta; Shiv K.
JP 4246736	Herbal oro-dental care composition for the treatment of halitosis and mouth ulcer	Palpu Pushpangadan, Chandana Venkateswara Rao, Sanjeev Kumar Ojha, Kuttan Pillai Narayanan Nair, Madan Mohan Pandey, Aja
US 7482031	Development of an anti-cough, anti-tussive and throat soothing herbal formulation	Pushpangadan; Palpu, Raghavan; Govindarajan , Madhavan; Vijayakumar , Mehrotra; Shanta , Singh; Rawat Ajay Kumar , Rao; Chandana Venkateshwara
UK GB2427549	Development of novel herbal combination used as a brain tonic and cognition based on traditional indigenous knowledge	Palpu Pushpangadan, Chandana Venkateswara Rao, Raj Kumar Goel, Satyabrata Acharya, Madhavan Somanathan, Ramasami Kartik,
SG 112008	A process for preparation of herbal colours useful for cosmaceutical applications	Pushpangadan Palpu; Mehrotra Shanta; Rawat Ajay Kumar Singh; Khatoon Sayyada; Govindarajan Raghavan

NBRI + ITRC		
CH ZL02830173.0	Health protective herbal soft drink-1	Pushpangadan P, Mehrotra S, Ojha SK, Khantoon S, Rawat Aks, Rastogi S, Srivastava M, Seth Pk
NCL		
US 7365204	Process for the production of pyridine and picolines	Kumar; Rajiv, Joshi; Praphulla Narahar , Chaphekar; Gopal Moreshwar, Niphadkar; Prashant Suresh , Agarwal; Ashutosh, Verma; Pradeep Kumar, Singh; Kumar Samir
US 7365214	Process for the preparation of cyclic carbonates	Srinivas; Darbha , Srivastava; Rajendra
NL 1701991	A new process for the preparation of conducting polyanilines	Radhakrishnan S, Deshpande SD
EU 1701991	A new process for the preparation of conducting polyanilines	Radhakrishnan S, Deshpande SD
US 7388056	Process for the preparation of crosslinked polyallylamine polymer	Gopalkrishna; Kulkarni Mohan, Thakaji; Kanawade Sandeep, Babu; Benjamin Swapnanjali
CH ZL03826408.0	Process for recovery of highly pure acrylonitrile	Purushottam BP, Madhukar GS, William SR, Yashwant GM, Narayan JC
AU 2001258725	A novel catalytic formulation and its preparation	Chaudhari Raghunah Vitthal, Mahajan Avinash Narendra
JP 4157477	Improved performance of artifical neutral network	Kulkarni Bhaskar Dattatray,Tambe Sanjeev Shrikrishna,Lonari Jayaram Budhari,Valecha Neelamkumar, Deshmukh Sanjay Vasantrao, Shenoy Bhav Anishankar,Ravichandran Sivaraman
US 7405319	Process for the preparation of carbamates	Srinivas; Darbha , Srivastava; Rajendra , Ratnasamy; Paul
US 7411099	Process for the liquid phase oxidation of toluene to benzaldehyde	Chaudhari; Raghunath Vitthal, Rajurkar; Kalpendra Baburao , Tonde; Sunil Sopana Rane; Vilas Hari
EU 1682591	Soluble polymers and process for preparation thereof	Kulkarni MGK, Karmalkar RN, Satav SS
EU 1234884	Process for the preparation of beta. Hydroxy-.delta. Lactone using novel intermediates	Ghorpade SR, Kalkote UR, Chavan SP, Bhide SR, Ravindranathan T

EU 1699833	Oligomers and preparation thereof	Kulkarni MG, Khandare JJ
US 7432222	High temperature stable non-noble metal catalyst, process for production of syngas using said catalyst	Choudhary; Vasant Ramchandra , Mondal; Kartick Chandra , Mamman; Ajit Singh
EU 1863872	Novel polymeric hindered amine light stabilizers based on end functionalized polyolefins and a process for the preparation thereof	Kummetha Raghunatha Reddy, Singh Raj Pal
US 7446234	Bisphenol compound and process for preparation thereof	More; Arvind Sudhakar, Wadgaonkar; Prakash Purushottam
DN DK/EP1234885	Process for the preparation of beta hydroxy-delta lactone using novel intermediates	Ghorpade SR, Kalkote UR, Chavan SP, Bhide SR, Ravindranathan T
KR 10-0869516	Improved performance of artifical neutral network	Kulkarni Bhaskar Dattatray,Tambe Sanjeev Shrikrishna,Lonari Jayaram Budhari,Valecha Neelamkumar,Deshmukh Sanjay Vasantrao, Shenoy Bhav Anishankar,Ravichandran Sivaraman
US 7455823	Process for the preparation of micron/nano sized inorganic material	Murali; Sastry, Debabrata; Rautaray
SG 145403	A novel dicarbonic initiator and its application for the synthesis of alpha, gamma difunctional polydienes, polystyrenes and sbs or sis triblock copolymers in non-polar solvent without additives	Gnanou Vyes, Matmour Rachid, More Arvind Sudhakar, Wadgaonkar Prakash Purushottam
US 7479536	Chiral, charged peptide nucleic acid oligomers from cyclic monomers	Kumar; Vaijayanti A., D'costa; Moneesha , Ganesh; Krishnarajanagar N.
US 7482480	Process for the preparation of hydrocarbon fuel	Srinivas; Darbha , Srivastava; Rajendra , Ratnasamy; Paul
US 7501478	Thermoprecipitating polymer containing enzyme specific ligands, process for the preparation thereof, and use thereof for the separation of enzymes	Vaidya; Alankar Arun ; Lele; Bhalchandra Shripad ; Kulkarni; Mohan Gopalkrishna ; Mashelkar; Raghunath Anant

NEERI		
US 7510659	Surface modified zeolites for sequestion of anions	Rayalu Sadhana Suresh, Meshram Siddharth Ulhas, Bansiwal Amit Kumar, Labhsetwar Nitin Kumar, Singh Rishi Narayan, Devott
NEIST		
US 7399889	Process for the preparation of vanillin from agricultural waste	Borthakur; Naleen
NGRI		
US 7440852	Stochastic analytical solution to quantify the earth's subsurface heat flow	Srivastava; Kirti , Singh; Rishi Narain
NIIST		
US 7390641	Production of peroxidase from plant cell and callus cultures	Abraham; Tholath Emilia, Devaki; Nisha Rani, Kuruvilla; Thomson, Joseph; Jegan Roy
US 7396554	Antioxidant sesame extract	Jayalekshmy; Ananthasankaran, Arumughan; Chami, Suja; Kizhiyedathu Polachira
AU 2003304660	A novel low temperature process for the synthesis of ultra-fine rutile phase titanium dioxide particles through vapor phase hydrolysis of titanium tetrachloride	Gerald Devasagayam Surender, Ani Kariumpanoor John, Kumara Pillai Rajendra Prasad, Sivaraman Savithri
AU 2004317862	A novel in-expensive and efficient process for isolation for imperatorin, a potent inducible nitric oxide synthase inhibitor and anti-inflammatory drug candidate from *Aegle marmelos correa*	Ponnapalli Mangala Gowri, Maheshwari Muralidharan Jeeja, Velupparambu Madam Vadirajan Venugopalan, Chami Arumughan
US 7413726	Synthesis of ultrafine rutile phase titanium dioxide particles	Surender; Gerald D., John; Ani K., Prasad; Kumara P. Rajendra, Sivaraman; Savithri
CH ZL1801640.5	Anti-diabetic agent obtained from the plant *Humboldtia decurrens* and a process for preparing the same	Rao; Janaswamy Madhusudana ; Sumathykutty; Mangattu Achutankunju ; Nair; Gopalan Vijay ; Damodaran; Alathur Damodaran ; Rathinam; Kodandaraman; Sivakumar; Rajagopal; Das; Kottilil Mohan; Nair; Narayanapillai Viswanathan
US 7456134	Process for the continuous production of magnesium	Upendran; Syamaprasad, Amma; Abhilash Kumar Raveendran Nair

	diboride based superconductors	Girijakumari , Kutty; Vinod Krishnan, Padmavathy; Aloysius Rajappan, Murikoli; Sarun Pallian, Subramanian; Thennavarajan , Perumal; Guruswamy
JP 4230362	A non-visualized permanent information recording system for use as security labels for authentication of documents and products	Das S, Davis R
EU 1758992	A process for the production of peroxidase from plant cell and callus cultures	Tholath Emilia Abraham, Nisha Rani Devaki, Thomson Kuruvilla, Jegan Roy Joseph
AU 2002247921	A non-visualized permanent information recording system for use as security labels for authentication of documents and products	Das S, Davis R
NIO		
CH ZL1807178.3	Natural fluorescent dye obtained from a marine invertebrate, compositions containing the said dye and their uses	Usha G, Anutosh G
KR 856480	An improved system for calibration of pressure transducer	Joseph A, Kumar V, Prabhudesai S, Mehra P, Desa E, Nagvekar SM
CH 1300353	Composition for treating white spot syndrome virus (wssv) infected tiger shrimp *Penaeus monodon* and a process for preparation thereof	Ulhas Manohar Desai,Chittur Thelakkat Achuthankutty,Rayadurga Anantha Sreepada
NML		
JP 4109114	Sensing device for the non-destructive evaluation of steel structures or components	Mitra; Amitava; Sagar; Sarmistha Palit ; Bhattacharya; Dipak Kumar
KR 10-084682	An improved process for the production of geopolymeric material from mechanically activated fly ash	Kumar Sanjay, Kumar Rakesh, Bandopadhyay Amitava, Mehrotra Surya Pratap
US 7410537	Process for the production of portland slag cement using granulated blast furnace slag	Kumar; Rakesh , Kumar; Sanjay , Bandopadhaya; Amitava , Mehrotra; Surya Pratap

KR 10-0857616	An improved process for the production of geopolymer cement from fly ash and granulated blast furnace slag	Kiumar Sanjay, Kumar Rakesh, Mittra Balai Kumar, Mehrotra Surya Pratap
SG 142681	A process fo recovery of iron from copper slag	Archana Agrawal, Kanai Lal Sahoo, Sukomal Ghosh, Banshi Dhar Pandey

NPL

US 7354565	Lead iron tungstate capacitive transducer, relaxor material therefor and method of manufacture of said relaxor material	Jain; Kamlesh Kumar, Kumar; Vinay , Kashyap; Subhash Chand
US 7364873	Method for manufacture of lactate biosensing strip	Pandey; Manoj Kumar , Chaubey; Asha , Pande; Krishan Kant , Sharma; Rajendra Kumar , Saini; Krishan Kumar , Malhotra; Bansi Dhar , Rajesh;
EU 1738437	A process for the preparation of a low contact resistance contact on a high transition temperature superconductors	Shrikant Ekbote, Gurusharan Kaur Padam, Narendra Kumar Arora, Mukul Sharma, Ramesh Sethi, Mrinal Kanti Banerjee
CH ZL02830191.9	A lactate bio sensing strip.	Pandey MK, Chaubey A, Pande KK, Sharma RK, Saini KK, Malhotra BD and Rajesh
Poland 199033	Reusable heat pack, method of manufacture thereof, mixture for use in a reusable heatpack and process for the preparation thereof	Sharma CP, Sharma RK, Kant C, Sarkar AK
KR 10-0875581	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	Rastogi AK, Jain K, Gupta HP, Kumar V

Code	Country Name	Code	Country Name
AU	Australia	PE	Peru
CN	China	PH	Philippines
EP	European Patent Office	PL	Poland
ID	Indonesia	KR	Republic of Korea
IL	Israel	SA	Saudi Arabia
JP	Japan	SL	Sierra Leone
KE	Kenya	ES	Spain
MY	Malaysia	CH	Switzerland
MX	Mexico	US	United States of America
NL	Netherlands	VN	Vietnam
NZ	New Zealand	SG	Singapore
FRG	Germany	LK	Sri Lanka
GEP	Gilbert Islands	HK	Hong Kong
NO	Norway	UZ	Uzbekistan

ANNEXURE IV

Table -1 Area-wise Research Publications (TOP 50 Papers)

BIOLOGICAL SCIENCES				
S. No.	Lab	First Author	Journals	IF
1.	CCMB	Vyas, N	CELL 2008, Vol 133, Iss 7, pp 1214-1227	29.887
2.	CCMB/IGIB	Mathivanan, S	NAT BIOTECHNOL 2008, Vol 26, Iss 2, pp 164-167	22.848
3.	IGIB	Hardy, BJ	NAT REV GENET 2008, Vol 9, Iss, pp S9-S14	22.399
4.	NCL	Kakade, B	NANO LET 2008, Vol 8, Iss 9, pp 2693-2696	9.627
5.	CMB	Sirdeshmukh, R	MOL CELL PROTEOMICS 2008, Vol 7, Iss 7, pp 1406-1407	9.425
6.	CCMB	Andreuzza, S	PLOS GENET 2008, Vol 4, Iss 11, pp e1000272	8.721
7.	IICB	Bosedasgupta, S	CELL DEATH DIFFERENTIATION 2008, Vol 15, Iss 10, pp 1629-1640	8.254
8.	CCMB	Chattopadhyay, MK	TRENDS MICROBIOL 2008, Vol 16, Iss 10, pp 455-455	7.618
9.	IGIB/IMTECH	Vivona, S	TRENDS BIOTECH 2008, Vol 26, Iss 4, pp 190-200	7.610
10.	CCMB	Diop, SB	EMBO REP 2008, Vol 9, Iss 3, pp 260-266	7.450
11.	IICB	Basu, S	NUCL ACID RES 2008, Vol 36, Iss 5, pp 1599-1609	6.954
12.	IGIB	Kumar, N	NUCL ACID RES 2008, Vol 36, Iss 13, pp 4433-4442	6.954
13.	CDRI	Ram, EVSR	NUCL ACID RES 2008, Vol 36, Iss 15, pp 5061-5073	6.954
14.	IICB	Home, P	NUCL ACID RES 2008, Vol 36, Iss 17, pp 5552-5561	6.954
15.	IGIB	Kumar, N	NUCL ACID RES 2008, Vol 36, Iss 17, pp 5610-5622	6.954
16.	IGIB	Ghosh, T	NUCL ACID RES 2008, Vol 36, Iss 19, pp 6318-6332	6.954
17.	IGIB	Yadav, VK	NUCL ACID RES 2008, Vol 36, Iss DBase, pp D381-D385	6.954
18.	IICB	Paul, S	GENOME BIOL 2008, Vol 9, Iss 4, pp R70	6.589
19.	CCMB	Rao, PR	ONCOGENE 2008, Vol 27, Iss 17, pp 2488-2493	6.440
20.	CCMB	Arimbasseri, AG	MOL CELL BIOL 2008, Vol 28, Iss 8, pp 2598-2607	6.420
21.	IGIB	Arora, A	RNA 2008, Vol 14, Iss 7, pp 1290-1296	5.840

22.	IMTECH	Thakur, M	J BIOL CHEM 2008, Vol 283, Iss 12, pp 8023-8033	5.581
23.	CDRI/IICB	Maity, P	J BIOL CHEM 2008, Vol 283, Iss 21, pp 14391-14401	5.581
24.	CDRI	Kapoor, P	J BIOL CHEM 2008, Vol 283, Iss 33, pp 22760-22773	5.581
25.	IMTECH	Saxena, R	J BIOL CHEM 2008, Vol 283, Iss 35, pp 23754-23764	5.581
26.	CCMB	Lin, YP	J BIOL CHEM 2008, Vol 283, Iss 37, pp 25140-25149	5.581
27.	CDRI	Luthra, A	J BIOL CHEM 2008, Vol 283, Iss 52, pp 36532-36541	5.581
28.	IICB	Bosedasgupta, S	MOL MICROBIOL 2008, Vol 67, Iss 1, pp 31-46	5.462
29.	CDRI	Tammana, TVS	MOL MICROBIOL 2008, Vol 70, Iss 4, pp 837-852	5.462
30.	CCMB	Singh, NP	BIOESSAYS 2008, Vol 30, Iss 11-12, pp 1058-1061	5.402
31.	NIO	Ghaskadbi, S	CELL MOL LIFE SCI 2008, Vol 65, Iss 20, pp 3312-3324	5.239
32.	NIO	Thakur, NL	BIOTECHNOL ADV 2008, Vol 26, Iss 3, pp 233-245	5.236
33.	IITR	Sinha, RA	ENDOCRINOLOGY 2008, Vol 149, Iss 9, pp 4396-4401	5.045
34.	CDRI	Trivedi, R	CURR MEDICINAL CHEM 2008, Vol 15, Iss 2, pp 178-186	4.944
35.	NIO	Woebken, D	ENVIRON MICROBIOL 2008, Vol 10, Iss 11, pp 3106-3119	4.929
36.	IICB/CDRI	Kumar, S	FREE RADICAL BIOL MED 2008, Vol 44, Iss 4, pp 602-613	4.813
37.	IICB	Bhattacharya, A	FREE RADICAL BIOL MED 2008, Vol 44, Iss 5, pp 779-794	4.813
38.	CFTRI	Lakshminarayana, R	FREE RADICAL BIOL MED 2008, Vol 45, Iss 7, pp 982-993	4.813
39.	CDRI	Chatterjee, M	FREE RADICAL BIOL MED 2008, Vol 45, Iss 8, pp 1084-1093	4.813
40.	IGIB	Tripathi, P	FREE RADICAL BIOL MED 2008, Vol 45, Iss 10, pp 1413-1419	4.813
41.	IICB	Dolai, S	FREE RADICAL BIOL MED 2008, Vol 45, Iss 11, pp 1520-1529	4.813
42.	IGIB	Nejatizadeh, A	FREE RADICAL BIOL MED 2008, Vol 44, Iss 11, pp 1912-1918	4.813
43.	CCMB	Chopra, VS	DEVELOP BIOL 2008, Vol 317, Iss 2, pp 660-670	4.714
44.	CCMB	Chattopadhyay, A	BIOPHYS J 2008, Vol 95, Iss 1, pp 166-175	4.627
45.	CCMB	Ganguly, S	BIOPHYS J 2008, Vol 95, Iss 1, pp 451-463	4.627

46.	IIIM	Desai, AG	CURR DRUG METAB 2008, Vol 9, Iss 7, pp 581-591	4.490
47.	CCMB	Ahmad, MF	J MOL BIOL 2008, Vol 375, Iss 4, pp 1040-1051	4.472
48.	IICB	Polley, S	J MOL BIOL 2008, Vol 376, Iss 1, pp 8-12	4.472
49.	CCMB	Aravind, P	J MOL BIOL 2008, Vol 376, Iss 4, pp 1100-1115	4.472
50.	CDRI	Pulavarti, SVSRK	J MOL BIOL 2008, Vol 378, Iss 1, pp 165-177	4.472
51.	CCMB	Ahmad, S	J MOL BIOL 2008, Vol 381, Iss 2, pp 324-340	4.472
52.	CCMB	Aravind, P	J MOL BIOL 2008, Vol 381, Iss 3, pp 509-518	4.472
53.	CCMB	Ahmad MF	J MOL BIOL 2008, Vol 382, Iss 3, pp 812-824	4.472

Table-2 Area-wise Research Publications (Top 50 Papers)

CHEMICAL SCIENCES				
S. No.	lab	First Author	Journals	IF
1.	NIIST	Misra, R	ACCOUNT CHEM RES 2008, Vol 41, Iss 2, pp 265-279	16.214
2.	NCL	Prasad, BLV	CHEM SOC REV 2008, Vol 37, Iss 9, pp 1871-1883	13.082
3.	NIIST	Nair, V	CHEM SOC REV 2008, Vol 37, Iss 12, pp 2691-2698	13.082
4.	IICT	Palaniappan, S	PROG POLYM SCI 2008, Vol 33, Iss 7, pp 732-758	12.809
5.	NCL	Choudhary, TV	ANGEW CHEM INT ED 2008, Vol 47, Iss 10, pp 1828-1847	10.031
6.	NCL	Kannan, R	ANGEW CHEM INT ED 2008, Vol 47, Iss 14, pp 2653-2656	10.031
7.	NIIST	Yagai, S	ANGEW CHEM INT ED 2008, Vol 47, Iss 25, pp 4691-4694	10.031
8.	NIIST	Srinivasan, S	ANGEW CHEM INT ED 2008, Vol 47, Iss 31, pp 5746-5749	10.031
9.	NIIST	Srinivasan, S	ANGEW CHEM INT ED 2008, Vol 47, Iss 31, pp 5750-5754	10.031
10.	NIIST	Sreejith, S	ANGEW CHEM INT ED 2008, Vol 47, Iss 41, pp 7883-7887	10.031
11.	NIIST	Neelakandan, PP	ANGEW CHEM INT ED 2008, Vol 47, Iss 44, pp 8407-8411	10.031
12.	CMERI	Chatterjee, D	COORD CHEM REV 2008, Vol 252, Iss 1-2, pp 176-198	8.568
13.	IICT	Kamal, A	COORD CHEM REV 2008, Vol 252, Iss 5-7, pp 569-592	8.568
14.	CSMCRI	Khan, Nuh	COORD CHEM REV 2008, Vol 252, Iss 5-7, pp 593-623	8.568

15.	NIIST	Pralnod, P	ADVAN MATER 2008, Vol 20, Iss 22, pp 4300-4305	8.191
16.	NCL	Thulasiram H.V	J AMER CHEM SOC 2008, Vol 130 Iss (6), pp 1966-1971	7.885
17.	IICT	Wei, Y	J AMER CHEM SOC 2008, Vol 130, Iss 11, pp 3473-3477	7.885
18.	NIIST	Reddy, JS	J AMER CHEM SOC 2008, Vol 130, Iss 12, pp 3718-3719	7.885
19.	NCL	Oberstrass, FC	J AMER CHEM SOC 2008, Vol 130, Iss 36, pp 12007-12020	7.885
20.	CLRI	Madhan B	J AMER CHEM SOC 2008, Vol 130, Iss 41, pp 13520-13521	7.885
21.	NCL	Srinivasu, P	ADV FUNCT MATER 2008, Vol 18, Iss 4, pp 640-651	7.496
22.	NIIST	Das, S	ADV FUNCT MATER 2008, Vol 18, Iss 11, pp 1632-1640	7.496
23.	NIIST	Vijayaraghavan, RK	ADV FUNCT MATER 2008, Vol 18, Iss 17, pp 2510-2517	7.496
24.	CDRI	Tiwari, RI	MED RES REV 2008, Vol 28, Iss 4, pp 483-544	7.264
25.	CDRI	Dwivedi, N	MED RES REV 2008, Vol 28, Iss 4, pp 545-568	7.264
26.	CIMAP	Negi, AS	MED RES REV 2008, Vol 28, Iss 5, pp 746-772	7.264
27.	IICB	Guha, S	SMALL 2008, Vol 4, Iss 11, pp 1993-2005	6.408
28.	NCL	Wang, M	BIOMATERIALS 2008, Vol 29, Iss 8, pp 1099-1108	6.262
29.	IMTECH	Gowthaman, U	J PROTEOME RES 2008, Vol 7, Iss 1, pp 154-163	5.675
30.	CCMB	Cenni, V	J PROTEOME RES 2008, Vol 7, Iss 11, pp 4727-4735	5.675
31.	NCL	Sawant, DP	CHEM-EUR J 2008, Vol 14, Iss 10, pp 3200-3212	5.330
32.	NCL	Dhar, S	CHEM-EUR-J , Vol 2008, Iss 14, pp 10250	5.330
33.	CDRI	Srivastava, AK	CHEM-EUR J 2008, Vol 14, Iss 15, pp 4675-4688	5.330
34.	NIIST	Pillai, AN	CHEM-EUR J 2008, Vol 14, Iss 19, pp 5851-5860	5.330
35.	CCMB/IICT	Begum, G	CHEM-EUR J 2008, Vol 14, Iss 21, pp 6421-6427	5.330
36.	CSMCRI/NCL	Delori, A	CHEM-EUR J 2008, Vol 14, Iss 23, pp 6967-6977	5.330
37.	NIIST	Babu, SS	CHEM-EUR J 2008, Vol 14, Iss 31, pp 9577-9584	5.330
38.	NCL	Ghumaan, S	CHEM-EUR J 2008, Vol 14, Iss 34, pp 10816-10828	5.330

39.	CSMCRI	Ghosh, A	ANAL CHEM 2008, Vol 80, Iss 14, pp 5312-5319	5.287
40.	IGIB	Gopinath, SCB	ANAL CHEM 2008, Vol 80, Iss 17, pp 6602-6609	5.287
41.	NCL	Gogoi, K	CHEM COMMUN 2008, Iss 6, pp 706-708	5.141
42.	NCL	Baruah, PK	CHEM COMMUN 2008, Iss 6, pp 712-714	5.141
43.	CSMCRI/ NIIST	Nair, V	CHEM COMMUN 2008, Iss 6, pp 747-749	5.141
44.	NIIST	Ajayaghosh, A	CHEM COMMUN 2008, Iss 8, pp 969-971	5.141
45.	NIIST	Reddy, JS	CHEM COMMUN 2008, Iss 11, pp 1326-1328	5.141
46.	NCL	Kendhale, AM	CHEM COMMUN 2008, Iss 22, pp 2541-2543	5.141
47.	CMERI	Chatterjee, D	CHEM COMMUN 2008, Iss 25, pp 2864-2866	5.141
48.	NIIST	Sreejith, S	CHEM COMMUN 2008, Iss 25, pp 2903-2905	5.141
49.	NCL	Ramana, CV	CHEM COMMUN 2008, Iss 27, pp 3151-3153	5.141
50.	IICT	Mishra, GP	CHEM COMMUN 2008, Iss 29, pp 3423-3425	5.141
51.	CSMCRI	Suresh, M	CHEM COMMUN 2008, Iss 33, pp 3906-3908	5.141
52.	NCL	Pitt M.A	CHEM COMMUN 2008, Iss 33, pp 3936-3938	5.141
53.	IICT	Amali, AJ	CHEM COMMUN 2008, Iss 35, pp 4165-4167	5.141
54.	NCL	Sureshkumar, G	CHEM COMMUN 2008, Iss 36, pp 4282-4284	5.141
55.	NCL	Tiwari, S	CHEM COMMUN 2008, Iss 37, pp 4445-4447	5.141
56.	IIP	Garg, S	CHEM COMMUN 2008, Iss 42, pp 5310-5311	5.141
57.	IICT	Kumaraswamy, G	CHEM COMMUN 2008, Iss 42, pp 5324-5326	5.141

Table-3 Area-wise Research Publications (Top 50 Papers)

ENGINEERING SCIENCES				
S. No.	lab	First Author	Journals	IF
1.	CLRI	Saravanabhavan, S	ENVIRON SCI TECHNOL 2008, Vol 42, Iss 5, pp 1731-1739	4.363
2.	IITR	Ram, S	ENVIRON SCI TECHNOL 2008, Vol 42, Iss 12, pp 4577-4582	4.363

3.	CECRI	Raju-T	ENVIRON SCI TECHNOL 2008, Vol 42 Iss 19, 7464-7469	4.363
4.	NEIST	Kalita, D	RENEW SUSTAIN ENERGY REV 2008, Vol 12, Iss 2, pp 455-471	3.774
5.	IIP	Goyal, HB	RENEW SUSTAIN ENERGY REV 2008, Vol 12, Iss 2, pp 504-517	3.774
6.	IIP	Saxena, RC	RENEW SUSTAIN ENERGY REV 2008, Vol 12, Iss 7, pp 1909-1927	3.774
7.	NIIST	Anupama, VN	WATER RES 2008, Vol 42, Iss 10-11, pp 2796-2802	3.427
8.	NAL	Vaitheeswaran, SM	PROG ELECTROMAGN RES 2008, Vol 81, Iss, pp 149-166	3.32
9.	NPL	Solanki, PR	BIOMED MICRODEVICES 2008, Vol 10, Iss 5, pp 757-767	3.073
10.	CGCRI/NML	Saha, D	SENSOR ACTUATOR B-CHEM 2008, Vol 128, Iss 2, pp 383-387	2.934
11.	CEERI/CSIO /NPL	Virdi, GS	SENSOR ACTUATOR B-CHEM 2008, Vol 128, Iss 2, pp 422-426	2.934
12.	CECRI	Angaleeswari, B	SENSOR ACTUATOR B-CHEM 2008, Vol 129, Iss 2, pp 558-565	2.934
13.	CLRI	Vijaya, JI	SENSOR ACTUATOR B-CHEM 2008, Vol 129, Iss 2, pp 741-749	2.934
14.	NPL	Kotnala, RK	SENSOR ACTUATOR B-CHEM 2008, Vol 129, Iss 2, pp 909-914	2.934
15.	NCL	Navale, SC	SENSOR ACTUATOR B-CHEM 2008, Vol 130, Iss 2, pp 668-673	2.934
16.	CECRI	Muralidharan, S	SENSOR ACTUATOR B-CHEM 2008, Vol 130, Iss 2, pp 864-870	2.934
17.	CGCRI	Ray, I	SENSOR ACTUATOR B-CHEM 2008, Vol 130, Iss 2, pp 882-888	2.934
18.	IICT	Jagtap, SV	SENSOR ACTUATOR B-CHEM 2008, Vol 131, Iss 1, pp 290-294	2.934
19.	NCL	Vaishampayan, MV	SENSOR ACTUATOR B-CHEM 2008, Vol 131, Iss 2, pp 665-672	2.934
20.	NPL	Srivastava, V	SENSOR ACTUATOR B-CHEM 2008, Vol 133, Iss 1, pp 46-52	2.934
21.	IGIB/NPL	Dhall, P	SENSOR ACTUATOR B-CHEM 2008, Vol 133, Iss 2, pp 478-483	2.934
22.	CLRI	Judithvijaya, J	SENSOR ACTUATOR B-CHEM 2008, Vol 134, Iss 2, pp 604-612	2.934
23.	CECRI	Selvarani, G	J POWER SOURCES 2008, Vol 178, Iss 1, pp 86-91	2.809
24.	CECRI	Shenouda, AY	J POWER SOURCES 2008, Vol 176, Iss 1, pp 332-339	2.809
25.	CECRI	Doh, CH	J POWER SOURCES 2008, Vol 179, Iss 1, pp 367-370	2.809
26.	CECRI	Balasubramanian, A	J POWER SOURCES 2008, Vol 185, Iss 2, pp 670-675	2.809

27.	CGCRI	Mukhopadhyay, J	J POWER SOURCES 2008, Vol 175, Iss 2, pp 749-759	2.809
28.	CECRI	Kuo, CW	J POWER SOURCES 2008, Vol 185, Iss 2, pp 807-814	2.809
29.	CECRI	Raju, M	J POWER SOURCES 2008, Vol 180, Iss 2, pp 830-835	2.809
30.	CECRI	Doh, CH	J POWER SOURCES 2008, Vol 175, Iss 2, pp 881-885	2.809
31.	CECRI	Lee, KM	J POWER SOURCES 2008, Vol 185, Iss 2, pp 1605-1612	2.809
32.	NEERI	Biniwale, RB	INT J HYDROGEN ENERG 2008, Vol 33, Iss 1, pp 360-365	2.725
33.	NIIST	Shukla, S	INT J HYDROGEN ENERG 2008, Vol 33, Iss 1, pp 470-475	2.725
34.	IICT	Mohan, SV	INT J HYDROGEN ENERG 2008, Vol 33, Iss 2, pp 550-558	2.725
35.	IICT	Mohan, SV	INT J HYDROGEN ENERG 2008, Vol 33, Iss 2, pp 559-569	2.725
36.	CSMCRI	Prasanth, KP	INT J HYDROGEN ENERG 2008, Vol 33, Iss 2, pp 735-745	2.725
37.	IICT	Mohan, SV	INT J HYDROGEN ENERG 2008, Vol 33, Iss 9, pp 2156-2166	2.725
38.	IICT	Ashok, J	INT J HYDROGEN ENERG 2008, Vol 33, Iss 11, pp 2704-2713	2.725
39.	IICT	Smitha, B	INT J HYDROGEN ENERG 2008, Vol 33, Iss 15, pp 4138-4146	2.725
40.	IICT	Mohan, SV	INT J HYDROGEN ENERG 2008, Vol 33, Iss 17, pp 4533-4546	2.725
41.	IICT	Ashok, J	INT J HYDROGEN ENERG 2008, Vol 33, Iss 18, pp 4809-4818	2.725
42.	CGCRI	Basu, RN	INT J HYDROGEN ENERG 2008, Vol 33, Iss 20, pp 5748-5754	2.725
43.	CECRI	Ananth, MV	INT J HYDROGEN ENERG 2008, Vol 33, Iss 20, pp 5779-5788	2.725
44.	NEERI	Dubey, N	INT J HYDROGEN ENERG 2008, Vol 33, Iss 21, pp 5958-5966	2.725
45.	IICT	Mohan, SV	INT J HYDROGEN ENERG 2008, Vol 33, Iss 21, pp 6133-6142	2.725
46.	NPL	Dhakate, SR	INT J HYDROGEN ENERG 2008, Vol 33, Iss 23, pp 7146-7152	2.725
47.	CGCRI	Roy S	J LIGHTWAVE TECHNOL 2008, Vol. 26, Iss 13-26, pp 2301-2322	2.196
48.	CGCRI	Bandyopadhyay S.	J LIGHTWAVE TECHNOL 2008, Vol. 26, Iss 21-24 pp 3853-3859	2.196
49.	IICB	Prasad, A	CHAOS 2008, Vol 18, Iss 2, pp 023111	2.188
50.	IICB	Tokuda, IT	CHAOS 2008, Vol 18, Iss 2, pp 023134	2.188

Table-4 Area-wise Research Publications (Top 50 Papers)

MEDICAL SCIENCES				
S. No.	Iab	First Author	Journals	IF
1.	IGIB	Sharma, M	AMER J RESPIR CRIT CARE MED 2008, Vol 177, Iss 7, pp 712-719	9.074
2.	IGIB	Agrawal, A	AMER J RESPIR CRIT CARE MED 2008, Vol 177, Iss 10, pp 1171-1171	9.074
3.	IGIB	Chatterjee, R	J ALLERG CLIN IMMUNOL 2008, Vol 122, Iss 1, pp 202-208	8.115
4.	IICB	Majumdar, KN	ARTHRITIS RHEUM 2008, Vol 58, Iss 3, pp 696-706	7.677
5.	IGIB	Mann, A	DRUG DISCOV TODAY 2008, Vol 13, Iss 3-4, pp 152-160	6.761
6.	CFTRI	Vasudevaraju, P	BRAIN RES REV 2008, Vol 58, Iss 1, pp 136-148	6.477
7.	CCMB	Srivastava, RM	J IMMUNOL 2008, Vol 180, Iss 2, pp 1117-1130	6.068
8.	IICB	Banerjee, A	J IMMUNOL 2008, Vol 181, Iss 2, pp 1386-1398	6.068
9.	IGIB	Mabalirajan, U	J IMMUNOL 2008, Vol 181, Iss 5, pp 3540-3548	6.068
10.	IICB	Sen, M	J IMMUNOL 2008, Vol 181, Iss 7, pp 4441-4445	6.068
11.	CCMB	Masson E	CLIN GASTROENT HEPATOL 2008 Jan; 6(1): 82-88	5.465
12.	IICB	Halder, B	CARCINOGENESIS 2008, Vol 29, Iss 1, pp 129-138	5.406
13.	CDRI	Tiwari, M	CARCINOGENESIS 2008, Vol 29, Iss 3, pp 600-609	5.406
14.	CFTRI	Nadler, Y	GLIA 2008, Vol 56, Iss 5, pp 552-567	5.380
15.	IICB	Mondal, T	J VIROL 2008, Vol 82, Iss 23, pp 11927-11938	5.332
16.	IGIB	Sharma, V	ALLERGY 2008, Vol 63, Iss 2, pp 189-197	5.014
17.	IGIB	Sudha, VT	ALLERGY 2008, Vol 63, Iss 6, pp 768-776	5.014
18.	IICB	Sen, N	CURR PHARM DESIGN 2008, Vol 14, Iss 9, pp 839-846	4.868
19.	IICT	Srivani, P	CURR PHARM DESIGN 2008, Vol 14, Iss 36, pp 3854-3872	4.868
20.	NIIST	Kunnumakkara, AB	MOL CANCER THER 2008, Vol 7, Iss 10, pp 3306-3317	4.800
21.	IGIB	Mann, A	J CONTROL RELEASE 2008, Vol 125, Iss 3, pp 252-262	4.756
22.	IICB	Banerjee, M	INT J CANCER 2008, Vol 123, Iss 2, pp 283-287	4.555

23.	IICB	Ghosh, S	INT J CANCER 2008, Vol 123, Iss 11, pp 2594-2604	4.555
24.	IGIB	Batra, J	CURR DRUG METAB 2008, Vol 9, Iss 6, pp 546-553	4.490
25.	CDRI	Trivedi, AK	EUR J CANCER 2008, Vol 44, Iss 11, pp 1516-1523	4.454
26.	IICB	Chatterjee, A	ANTIMICROB AGENTS CHEMOTHER 2008, Vol 52, Iss 1, pp 220-224	4.390
27.	IICB	Palit, P	ANTIMICROB AGENTS CHEMOTHER 2008, Vol 52, Iss 1, pp 374-377	4.390
28.	CDRI/IICB	Kumar, S	ANTIMICROB AGENTS CHEMOTHER 2008, Vol 52, Iss 2, pp 705-715	4.390
29.	CDRI	Verma, RK	ANTIMICROB AGENTS CHEMOTHER 2008, Vol 52, Iss 9, pp 3195-3201	4.390
30.	CCMB	Gautam, P	ANTIMICROB AGENTS CHEMOTHER 2008, Vol 52, Iss 12, pp 4220-4227	4.390
31.	IGIB	Nejatizadeh, A	J HYPERTENSION 2008, Vol 26, Iss 6, pp 1094-1101	4.364
32.	IGIB	Nejatizadeh, A	J HYPERTENSION 2008, Vol 26, Iss 12, pp 2452-2453	4.364
33.	CDRI	Nakka, VP	MOL NEUROBIOL 2008, Vol 37, Iss 1, pp 7-38	4.067
34.	IGIB	Ahluwalia JK	RETROVIROLOGY 2008 Dec 23;5(1):117.	4.040
35.	IICB	Banerjee, A	J ANTIMICROB CHEMOTHER 2008, Vol 61, Iss 1, pp 103-110	4.038
36.	CDRI	Manandhar, KD	J ANTIMICROB CHEMOTHER 2008, Vol 62, Iss 2, pp 376-380	4.038
37.	CDRI	Tiwari, P	J ANTIMICROB CHEMOTHER 2008, Vol 62, Iss 3, pp 526-534	4.038
38.	CDRI/IICB	Misra, P	J ANTIMICROB CHEMOTHER 2008, Vol 62, Iss 5, pp 998-1002	4.038
39.	IICB	Sen, G	J ANTIMICROB CHEMOTHER 2008, Vol 61, Iss 5, pp 1066-1075	4.038
40.	IICB	Palit, P	J ANTIMICROB CHEMOTHER 2008, Vol 61, Iss 5, pp 1120-1124	4.038
41.	IIIM	Kumar, A	J ANTIMICROB CHEMOTHER 2008, Vol 61, Iss 6, pp 1270-1276	4.038
42.	CDRI	Kumari, S	CURR DRUG TARGETS 2008, Vol 9, Iss 11, pp 938-947	4.035
43.	IICB	Bhowmick, S	INFEC IMMUNITY 2008, Vol 76, Iss 3, pp 1003-1015	3.996
44.	IICB	Bhowmick, R	INFEC IMMUNITY 2008, Vol 76, Iss 11, pp 4968-4977	3.996
45.	IITR	Chaturvedi, RK	EXP NEUROL 2008, Vol 210, Iss 2, pp 608-623	3.982
46.	CLRI	Ganesan, K	BONE 2008, Vol 43, Iss 4, pp 758-765	3.966

47.	IICB	Sinha, S	ANNALS SURG ONCOLOGY 2008, Vol 15, Iss 4, pp 1070-1080	3.917
48.	IITR	Johri, A	TOXICOL APPL PHARMACOL 2008, Vol 231, Iss 1, pp 10-16	3.846
49.	IITR	Kalra, N	TOXICOL APPL PHARMACOL 2008, Vol 226, Iss 1, pp 30-37	3.846
50.	IICB	Biswas, D	TOXICOL APPL PHARMACOL 2008, Vol 230, Iss 1, pp 57-66	3.846
51.	IITR	Pant, N	TOXICOL APPL PHARMACOL 2008, Vol 231, Iss 1, pp 112-116	3.846
52.	IITR	Jain, M	TOXICOL APPL PHARMACOL 2008, Vol 230, Iss 2, pp 247-251	3.846
53.	IITR	Babu, CK	TOXICOL APPL PHARMACOL 2008, Vol 230, Iss 3, pp 304-311	3.846

Table-5 Area-wise Research Publications (Top 50 Papers)

PHYSICAL SCIENCES				
S. No.	lab	First Author	Journals	IF
1.	IICB	Grosu, I	PHYS REV LETT 2008, Vol 100, Iss 23, pp 234102	6.944
2.	NPL	Singh, A	PHYS REV LETT 2008, Vol 101, Iss 24, pp 247602	6.944
3.	IITR	Ram, S	ENVIRON HEALTH PERSPECT 2008, Vol 116, Iss 4, pp 448-452	5.636
4.	IICB	De Chaudhuri, S	ENVIRON HEALTH PERSPECT 2008, Vol 116, Iss 4, pp 501-505	5.636
5.	NEERI	Kumar, S	CRIT REV ENVIRON SCI TECHNOL 2008, Vol 38, Iss 1, pp 43-U1	4.615
6.	NIO	Naik, H	GLOBAL BIOGEOCHEM CYCLE 2008, Vol 22, Iss 3, pp GB3020	4.335
7.	CLRI	Bhavan, S	ENVIRON SCI POLLUT RES 2008, Vol 15, Iss 4, pp 293-295	3.894
8.	NGRI/NIO	Subrahmanyam, C	EARTH PLANET SCI LETT 2008, Vol 266, Iss 1-2, pp 29-45	3.873
9.	NGRI	Oreshin, S	EARTH PLANET SCI LETT 2008, Vol 271, Iss 1-4, pp 75-87	3.873
10.	NGRI/NIO	Graindorge, D	EARTH PLANET SCI LETT 2008, Vol 275, Iss 3-4, pp 201-210	3.873
11.	NGRI	Mohan, MR	EARTH PLANET SCI LETT 2008, Vol 274, Iss 3-4, pp 479-488	3.873
12.	CGCRI	Bandyopadhyay, S	OPTICS LETTERS 2008, Vol 33, Iss 16, pp 1917-1919	3.711
13.	NPL	Kanseri, B	OPTICS LETTERS 2008, Vol 33, Iss 20, pp 2410-2412	3.711
14.	CGCRI	Dhar, A	OPT EXPRESS 2008, Vol 16, Iss 17, pp 12835-12846	3.709

15.	IICT/NGRI	Parthasarathy, G	GEOCHIM COSMOCHIM ACTA 2008, Vol 72, Iss 3, pp 978-987	3.665
16.	NCL	Kale, SN	APPL PHYS LETT 2008, Vol 92, Iss 1, pp 012512	3.596
17.	NCL	Mishra, YK	APPL PHYS LETT 2008, Vol 92, Iss 4, pp 043107	3.596
18.	NML	Radiguet, B	APPL PHYS LETT 2008, Vol 92, Iss 10, pp 103126	3.596
19.	IMTECH	Wangoo, N	APPL PHYS LETT 2008, Vol 92, Iss 13, pp 133104	3.596
20.	NPL	Verma, KC	APPL PHYS LETT 2008, Vol 92, Iss 15, pp 152902	3.596
21.	CGCRI	Sarkar, P	APPL PHYS LETT 2008, Vol 92, Iss 18, pp 182506	3.596
22.	CECRI	Murugan, P	APPL PHYS LETT 2008, Vol 92, Iss 20, pp 203112	3.596
23.	CECRI	Anwar, S	APPL PHYS LETT 2008, Vol 92, Iss 21, pp 212901	3.596
24.	NPL	Haranath, D	APPL PHYS LETT 2008, Vol 92, Iss 23, pp 233113	3.596
25.	NIIST	Rao, PP	APPL PHYS LETT 2008, Vol 92, Iss 25, pp 252906	3.596
26.	NCL	Sathe, Br	APPL PHYS LETT 2008, Vol 92, Iss 25, pp 253106	3.596
27.	NPL	Kumari, K	APPL PHYS LETT 2008, Vol 92, Iss 26, pp 263504	3.596
28.	NPL	Ansari, AA	APPL PHYS LETT 2008, Vol 92, Iss 26, pp 263901	3.596
29.	NPL	Ohlan, A	APPL PHYS LETT 2008, Vol 93, Iss 5, pp 053114	3.596
30.	NPL	Verma, KC	APPL PHYS LETT 2008, Vol 93, Iss 7, pp 072904	3.596
31.	NPL	Khan, AF	APPL PHYS LETT 2008, Vol 93, Iss 7, pp 073103	3.596
32.	NPL	Prakash, J	APPL PHYS LETT 2008, Vol 93, Iss 11, pp 112904	3.596
33.	NPL	Solanki, PR	APPL PHYS LETT 2008, Vol 93, Iss 16, pp 163903	3.596
34.	NPL	Singh, K	APPL PHYS LETT 2008, Vol 93, Iss 21, pp 212902	3.596
35.	NCL	Dhas, V	APPL PHYS LETT 2008, Vol 93, Iss 24, pp 243108	3.596
36.	CMMACS/ NAL	K. Rajendran	J CLIMATE 2008, 21(15), 3722--3739	3.550
37.	NGRI/NPL	Dilawar, N	J RAMAN SPECTROSC 2008, Vol 39, Iss 12, pp 1765-1771	3.514
38.	NIO	Yoneyama, K	BULL AMER METEOROL SOC 2008, Vol 89, Iss 12, pp 1889-1903	3.475

39.	NGRI	Jagadeesh, S	PRECAMBRIAN RES 2008, Vol 162, Iss 1-2, pp 4-15	3.247
40.	NGRI	Nagaraju, J	PRECAMBRIAN RES 2008, Vol 162, Iss 1-2, pp 86-101	3.247
41.	NGRI	Gopalan, K	PRECAMBRIAN RES 2008, Vol 167, Iss 3-4, pp 377-382	3.247
42.	NGRI	Manikyamba, C	PRECAMBRIAN RES 2008, Vol 162, Iss 3-4, pp 424-440	3.247
43.	NIO	Mazumdar, A	CHEM GEOL 2008, Vol 253, Iss 1-2, pp 30-37	3.231
44.	NGRI	Gopalan, K	CHEM GEOL 2008, Vol 247, Iss 1-2, pp 119-123	3.231
45.	CECRI	Murugan, P	PHYS REV B 2008, Vol 77, Iss 6, pp 064401	3.172
46.	NCL	Burnus, T	PHYS REV B 2008, Vol 77, Iss 12, pp 125124	3.172
47.	NPL	Mclaughlin, AC	PHYS REV B 2008, Vol 78, Iss 9, pp 094501	3.172
48.	NML	Barman, SR	PHYS REV B 2008, Vol 78, Iss 13, pp 134406	3.172
49.	NCL	Mitra S	FUNCT ECOL 2008, Vol 22(4), 606-615	3.157
50.	NCL	Banik S	J CHEM PHYS 2008, Vol 129 Iss 13, pp 134111	3.044

ANNEXURE V

Members of the CSIR Society (2006-2009)

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   (Dr. Manmohan Singh)
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   Udyog Bhavan
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   JN Centre for Advanced Scientific Research
   Jakkur, Bangalore-560064

8. Chairman
   (Prof. Sukhdeo Thorat)
   University Grants Commission
   Bahadur Shah Zafar Marg
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9. Ms. Kiran Mazumdar Shaw
   Chairman-cum-Managing Director
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   20th KM Hosur Road, Electronics City, Bangalore-560100

10. Shri N.R. Narayana Murthy
    Chief Mentor
    Infosys Technologies Ltd.
    Hosur Road
    3rd Cross, Electronics City
    Bangalore-561229

11. Shri B. Muthuraman
Managing Director
Tata Iron & Steel Company Ltd.
Jamshedpur-831001

12. Shri K.V. Kamath
Managing Director (CEO)
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ICICI Tower, Bandra Kurla Complex, Mumbai - 400 051

13. Prof. P. Balaram
Director
Indian Institute of Science
Bangalore-560012

14. Prof. M.M. Sharma
Formerly Director
University Institute of Chemical Technology
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Behind AKbarally's, VN Purav Marg, Mumbai-400071

15. Dr. Rita Sharma
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Dept. of Rural Development
Ministry of Agriculture
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Electronics Niketan
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*Also member of CSIR Governing Body

ANNEXURE VI

Comptroller and Auditor General Report

Performance Audit of Modernisation Programme in select laboratories of CSIR

National Aerospace Laboratories, Bangalore (NAL), a constituent unit of Council of Scientific & Industrial Research (CSIR), was set up in 1959 to provide scientific support to the aeronautical industry. NAL undertook various mission mode programmes, in-house, grants-in-aid, sponsored and other projects in order to achieve its mandate of 'development of aerospace technologies for general industrial applications'.

Audit observed that during 2002-2007, NAL could generate only 26 *per cent* of funds through external cash flow against a target of 50 per cent set for achievement by 2001 and continued to be largely dependent of CSIR funds. Further, success rate of NAL in transferring and commercializing technologies developed was abysmally low. Of the 146 projects test checked, NAL developed knowledgebase in 75 projects of which only 25 knowledgebase were transferred to the end users. Of these 25 knowledgebases transferred, NAL could commercialise only one knowledgebase for general industrial application. As a result, NAL's earning from transfer and commercialization of technologies were only ` 0.37crore during 2002-2007, which was 98 percent short of the target of `15 crore set by the Performance Appraisal Board. NAL also could not achieve its targets for filing of patents and impact factor of published research papers.

Fifty per cent of the selected projects were completed with time overrun ranging from six months to more than three years. Many projects taken up by NAL also failed to fully achieve their objectives. Documentation in a large number of projects was deficient as project proposals, project expenditure, completion reports etc., were not maintained adequately to ensure transparency and facilitate subsequent review. In respect of sponsored projects, NAL suffered a loss of ` 5.17 crore due to undercharging on account of intellectual fee and service tax, in violation of the norms fixed by CSIR.

The two-seater trainer aircraft HANSA, though developed, was still being manufactured with imported components as NAL was yet to develop these sub-systems indigenously. NAL also could not find a private partner for sharing the risk of development and commercial production for HANSA and had to take up its manufacturing without assessing the future commercial viability of the aircraft. After the initial order of 10 aircrafts, there is no further demand for it in the market. Similarly, the project on the 9-14 seater SARAS has suffered time and cost overrun. NAL is awaiting certification of airworthiness for SARAS from Director General of Civil Aviation (DGCA) as NAL failed to bring down its weight within the permissible limit. As per DGCA, NAL may have to build a third prototype, before it is granted certificate for airworthiness, which would further add to time and cost overruns.

In the meantime, NAL is proposing a new project for design and development of a 70 seater regional transport aircraft which needs to be reviewed in light of the limited success and difficulties faced in HANSA and SARAS projects.

ANNEXURE VII

List of Approved Projects in Eleventh Five Year Plan

Cluster Area: Biological Sciences

CCMB	1.	Plasma proteomics health, environment and disease
	2.	Nanomaterials and nanodevices in health and disease
	3.	Project on conservation of endangered species
	4.	Setting up a compact high energy light source radiation for the structural analysis of biomacromolecule
	5.	BSL-4 facility for infectious diseases caused by dangerous microorganisms.
CDRI	6.	New drug development programme for parasitic diseases and microbial infections
	7.	Diabetes mellitus -new drug discovery R&D, molecular mechanisms and genetic factors
	8.	Validation of identified screening models and development of new alternative models for evaluation of new drug entities
	9.	Identification and validation of drug targets for selected pathogens
	10.	Establishment of dog facility for research and testing purposes
CFTRI	11.	Niche food processing technologies for outreach of cost effective, safe, hygienic, nutritious and health food to the target population
	12.	Design and development of equipment with appropriate and adaptable automation for hygienic and safe production of processed and semi-processed foods in large scale.
CIMAP	13.	Pathway engineering and system biology approach towards homologous and heterologous expression of high-value phytoceuticals (artemisinin, picrosides, morphine, withanolides pdophyllotoxin
	14.	Biological & chemical transformation of plant compounds for production of value added products of therapeutic/aroma value.
CSIRHQ	15.	Discovery and Preclinical studies of new bioactive molecules(natural and semi-synthetic) & traditional preparations
IGIB	16.	An integrative biology approach in deciphering genotype - phenotype correlation for human complex disorders
	17.	Comparative genomics and biology of non-coding RNA in the human genome
	18.	Open source drug discovery programme (OSDD)
	19.	National facilities for functional genomic research a) Zebrafish Facility b) Cellomics Facility c) LC-NMR facility
IHBT	20.	High value products from agro forestry resources from the Himalayan region & improving productivity and quality of product development including facility for nutraceutical/value added product
	21.	Exploratory studies on Climate change and adaptation of species complexes
IICB	22.	Evaluation and correction of mitochondrial dysfunction in disease
	23.	Engineering peptides and proteins for new generation therapies

	24.	Development of diagnostics and target based molecular medicines against allergy bronchial asthma and chronic obstructive pulmonary disease
	25.	New insights in cancer biology: Identification of novel targets and development of target based molecular medicine
IICT	26.	Facility for chemical biology
IIIM	27.	Development of novel target based anticancer therapeutics
IITR	28.	Investigative toxicology: new paradigms
	29.	Environmental contaminants: new screening technologies and effect on human health
IMTECH	30.	Understanding the molecular mechanism of diseases of national priority: Developing novel approaches for effective management
	31.	Exploitation of India's rich microbial diversity
	32.	Advanced Centre for protein informatics, science, engineering & technology
NBRI	33.	Biodiversity assessment, prospection and conservation of plant resources of India
	34.	Enhancing water utilization efficiency in crop plants: prospecting plant diversity for genes and systems biology for drought tolerance
	35.	Transgenic crop plants and genes for resistance to insect pests
NCL	36.	NCL-IGIB joint research initiative: interfacing chemistry with biology
NIIST	37.	Evidence based neutraceutical/ herbal products for preventive health and disease management

Cluster Area: Chemical Sciences

CECRI	38.	Energy for cleaner and greener environment
	39.	Development of lithium-ion batteries for multifarious applications
	40.	CSIR battery performance evaluation centre
CIMFR	41.	Development of cost effective mine water reclamation technology for providing safe drinking water
CLRI	42.	Zero emission research initiative
	43.	Design centre for products
CSMCRI	44.	Development of specialty inorganic materials for diverse applications
	45.	Development of hollow fibre membrane technology for water disinfection/purification and waste water reclamation
IICT	46.	Agrochemicals and intermediates: integrated pest management include pheromones
	47.	Centre of excellence for lipid research
IIP	48.	To develop know-how and technology for environmental friendly conversion and utilization of biomass to fuels, lubricants and additives
NCL	49.	Conducting polymer paints and coatings for corrosion protection and shielding of concrete structures in strategic areas
	50.	Hydrogen energy initiative: overcoming materials challenges for the generation, storage and conversion of hydrogen using fuel cells.

NIIST	51.	Functional organic materials for energy efficient devices

Cluster Area: CSIR800

CSIR,HQ	52.	Rural, SC/ST, women, North East & tribals (RSWNET)

Cluster Area: Engineering Sciences

AMPRI	53.	Development of advanced lightweight metallic materials for engineering applications
CBRI	54.	High performance materials and construction technologies for sustainable built space
CGCRI	55.	Ceramic materials for emerging technologies involving liquid and gas separation
	56.	Photonics for communication, laser and sensor technology
	57.	Non oxide ceramic based advance structural materials: armours and refractories
CMERI	58.	Capability in mobile robot development for industrial, outdoor and hazardous applications
	59.	Modular re-configurable micro manufacturing systems (MRMMS) for multi material desktop manufacturing capabilities
CRRI	60.	Development of a management system for maintenance planning and budgeting of high speed road corridors
IMMT	61.	Development of advanced eco-friendly, energy efficient processes for utilization of iron resources of Indi
	62.	Innovation centre fro plasma processing
NAL	63.	Enhancement of knowledgebase in aerospace sciences and development of cutting edge technologies
	64.	Enhancement of aerospace research & technology development facilities including setting up a centre of excellence in flight mechanics and control. (CEFMAC)
NEERI	65.	Capacity building in molecular environmental science
	66.	Remediation eco-restoration and cleanup of contaminated ground & water resources
NML	67.	Development and forming of performance driven special steels
	68.	Technology for assessment and refurbishment of engineering materials and components
SERC	69.	Management tools for maintenance, scheduling and life enhancement of special structures
SERC	70.	Engineering of structure against natural & other disasters

Cluster Area: Information Sciences

CMMACS	71.	Multi-scale simulation and quantification of sustainability and vulnerability under climate variability and climate stress and othe natural hazards
	72.	Precipitation enhancement and modification through ground based cloud harvesting

CSMCRI	73.	Mapping of the marine biodiversity along the Indian coast
NISCAIR	74.	Consortium access to electronic journals
NISTADS	75.	Indian S&T - mapping, manpower and comparative capability
URDIP	76.	Patinformatics

Cluster Area: Physical Sciences

CEERI	77.	Technology development for smart systems
	78.	Design and fabrication capabilities for very high power microwave tubes
CSIO	79.	Appropriate technological solutions for societal applications
NEIST	80.	Seismic hazard-risk evaluation and earthquake precursor related studies
	81.	State-of-the-art analytical facility for North East
NGRI	82.	The evolution of the Indian lithosphere : focus on major eart processes and resources with a special reference to deccan traps and dharwar craton
	83.	Sustainable development and management of water resources in different problematic terrain
NIO	84.	Science for development of a forecasting system for the waters around India
	85.	Atmosphere carbon dioxide sequestration through fertilization of a high-nutrients-low chlorophyll (HNLC) oceanic regions with iron
NPL	86.	R&D on photovoltaics and other energy applications
	87.	Fabrication of LED devices and systems for solid state lighting applications
	88.	Advancement in metrology

ANNEXURE VIII

Welcome address on the occassion of SSB Prizes presentation ceremony : Shri Kapil Sibal, Hon'ble Minister of S&T and ES and Vice President, CSIR

It is indeed an honour for me to welcome Dr. Manmohan Singhji, Prime Minister of India this morning to this CSIR Awards function to do the honours. My hearty welcome to all the awardees, their friends and associates and the galaxy of luminaries from the S&T community that I see in front of me. A special welcome to my friends from the media who are doing their best to spread the message of science and scientists to the nation. Sir, today is an occasion to salute our achievers, our future 'Navratnas' and celebrate the triumph of science and technology. At the outset, my heartiest congratulations to the Bhatnagar Prize awardees as this is surely regarded as India's Nobel Prize. Today my friends you have joined the elite club of around 500 Bhatnagar Laureates. My dear friends, this recognition imposes an onerous responsibility on you to build further on what you have done and achieve higher successes and be the role models for our budding scientists. At this juncture, I would like to raise a question as to whether Nobel Prize winning discoveries, commonly understood to be associated with fundamental knowledge, like Raman Effect, are outside the realm of patents. Consider the example of Prof Alan Heeger of the University of California, one of three researchers who shared the Nobel Prize in Chemistry for the year 2000 for the discovery and development of conductive polymers. He has to his credit more than 150 patents. Then take the case of Dr Paul Lauterbur and Sir Peter Mansfield, recipients of the 2003 Nobel Prize in Medicine for their work on magnetic resonance imaging (MRI). They hold some 30 patents related to MRI technology. Similar is the case of Prof Stanley B Prusiner of the University of California, who was awarded the 1997 Nobel Prize in Physiology for his discovery of a new biological principle of infection caused by a new type of infectious agent called 'prion'. He has several patents to his credit for the discovery. I thus would like to tell my Bhatnagar awardee and other scientist friends gathered here that in the process of arriving at a conclusive research, basic or otherwise, there would definitely be intermediate findings, big or small, which may be inventive and novel in themselves to qualify for grant of patents and they may also have commercial value in their own way. Thus, you as scientists and researchers, must be alert to spot such inventions and seek intellectual property rights for these. To encourage and motivate our research community to be IPR conscious, we in the government have just introduced in this session of Parliament the Protection and Utilisation of Public Intellectual Property Bill. It will provide our scientists and researchers an incentive and means to protect their inventions and also enable them to have a share in the monies realized by the transfer and commercialization of their researches. Sir, I am confident that we will see many more patents emanating from our scientists in the next few years.

Sir, I am pleased to see that the CSIR Award for S&T Innovation for Rural Development is being awarded to two institutes this year for introducing improvements in animal breeding practices for the yak and the sheep. Sir, it is truly amazing to see such high level science being applied to impact the lives and livelihood of the people at the very bottom of the pyramid. I feel it is such a relevant science and technology problem and issue that our scientists should be addressing. In this regard, I must congratulate the CSIR for mounting the Project 800 – to address the needs of 800 million of our brethren who need our help the most. As an example of CSIR's endeavour in this regard, Sir, along with the Chief Minister of Delhi, I had the privilege of launching a Soleckshaw, the motorized, solar powered, ergonomically designed and engineered version of the ubiquitous cycle

rickshaw on Gandhi Jayanti day, this year. Designed and engineered by CSIR, we hope that Soleckshaw will replace at least a fraction of the eight million cycle rickshaws plying in the country and provide an ecofriendly mode of transport for middle class clientele to use in congested areas and for neighbourhood trips – undoubtedly a small step in reducing our carbon footprint.

My congratulations also to Mahindra & Mahindra for being awarded the CSIR Diamond Jubilee Award for Technology for their SUV Car – the Scorpio. The company through out-of-box approach has reduced the time and cost of development and engineering by involving major suppliers in this endeavour. Their success provides learning to us in the scientific community of the need and value of networking and alliancing. Often times, finding a solution to a problem is beyond the intellectual and even financial capacity of an organization or a firm however big and well endowed it may be. We need not feel squeamish about networking and partnering with others to build meaningful strategic relationships. The emergence of USA as the epicenter of innovation has been basically due to the ability of their industry and research community in forging such relationships. My humble plea to the industry friends is to come forward and forge relationships with our researchers in the universities and research institutions. We in the Ministry are committed to support any such endeavour.

Sir, I am also convinced that despite the remarkable progress of science and achievements of our technologists, the asymmetry in the distribution of wealth, health, comfort and safety has in fact increased globally as well as in India. A new social contract of science with society, especially in India is called for, with the intent and determination to address and solve these unbearable problems. I feel this can be done by the collaborative effort and partnership of the scientists and the users/ beneficiaries of research. I would thus like to plead with my scientist friends to develop more community based research projects which allow the direct users/beneficiaries to influence the choice of problems and technology. This collaborative effort would lead to better cost-benefit analysis, so necessary for on theground decision making and acceptance and ownership of the research outputs. Science and technology would then directly be able to help our brethren to live their life with greater dignity and comfort.

Sir, to conclude, I would like to thank you and the government for the un-flinching support to science and technology that you have accorded over the past five years. This is evidenced by the fact that the Plan budget allocation for the two Ministries that you have entrusted me have nearly quadrupled in the Eleventh Five Year Plan. Sir, given the faith that you repose in the scientific community, we resolve and commit to contribute our little mite to position India as formidable player in the comity of nations. Respected Pradhan Mantriji, a very warm welcome to you and all my friends gathered here today.

Thank you.

ANNEXURE IX

Speech by Hon'ble Prime Minister and President, CSIR, Dr Manmohan Singh during Shanti Swarup Bhatnagar Prizes presentation Ceremony : December 20,2008

I am very pleased to be here in your midst today to give away the Shanti Swarup Bhatnagar Prizes for the years 2007 & 2008. I congratulate each one of the award winners. And I shall also like to congratulate their spouses because this creative pursuit is a joint enterprise which is not often recognized. This is the most prestigious award for scientific excellence and is given to scientists who are under 45 years of age. The awards recognize past work but are also an inspiration for the winners to achieve even greater successes in the years to come. I sincerely hope that while we celebrate the achievements of these scientists, best is yet to come.

The Shanti Swarup Bhatnagar awards are named after one of our scientific pioneers and institution builders. Shanti Swarup Bhatnagar, along with Homi Bhaba, P.C. Mahalanobis and Vikram Sarabhai among others created the scientific infrastructure of our country. He was a visionary and laid the foundation of the great institution that is today the Council for Scientific and Industrial Research, a pride of India. Pandit Jawaharlal Nehru said about Shanti Swarup Bhatnagar that:

'Dr. Bhatnagar was a special combination of many things, added to which was a tremendous energy with an enthusiasm to achieve things. The result was he left a record of achievement which was truly remarkable. I can truly say that but for Dr. Bhatnagar you could not have seen today the chain of national laboratories.'

It is this energy and this enthusiasm of our scientists that we honour and celebrate each year on such events. The creativity and innovation of our scientists are a matter of great national pride for our country. They have pushed the frontiers of scientific knowledge to enable us to strengthen our defence capabilities; improve our healthcare and our agricultural economy; extend the reach of our communications and enable us to land on the moon.

The Diamond Jubilee Technology Award to Mahindra & Mahindra Ltd. symbolises the importance we attach to commercialization of scientific and technological research. The Rural Technology award given jointly to the National Research Centre on Yak for improvement of sustainable Yak husbandry practices in the Himalayan Region and to the Nimbkar Agricultural Research Institute along with the National Chemical Laboratory for genetic improvement of Deccani breed of sheep recognizes the difference these innovations have made to the livelihoods of the people in rural areas. My warm felicitations to these award winners.

I am happy that CSIR has undertaken a number of important initiatives over the past few years. We are the first country that has successfully mapped the entire genetic diversity of its population. This will lead to the identification of populations that are genetically at risk of various complex and infectious diseases including adverse drug responses. Another initiative that has immense economic importance for our farmers is a path breaking scientific discovery that enables mass propagation of even asexually produced seeds.

I convey my warm appreciation to Shri Kapil Sibal, our dynamic Minister for Science & Technology and to Dr. Samir Brahmachari, the Director General, CSIR for these achievements.

Even as we applaud these achievements, we have to address ourselves as a nation to the larger challenge before us. How can science, industry and government work as one efficient and integrated machine to deliver to the people the benefits of these scientific and technological advances?

This is an area where countries such as China and Japan have scored over us. Unless we apply ourselves to this task, the powerful scientific tools of social and economic change will remain confined to our laboratories and to our institutions. Our scientists, I suggest, should work to connect science to the daily lives of millions of our people. S&T based entrepreneurships and innovation in industry should be encouraged at all levels. And government should create a favourable enabling environment for this to take place.

Public-private partnerships should be used to commercialize the technologies emerging from R&D programmes being funded by various science departments. We should focus more on linking the lab with the market.

I urge CSIR to take the lead in this regard and define new strategies for translating cutting edge science and technology into globally competitive enterprises. To begin with, let CSIR work to commercially exploit its vast knowledge base, currently embodied in more than 3000 or so patents held nationally and globally.

The role of technology in supporting our counter terrorism and internal security efforts is I believe not adequately appreciated. Other countries have used modern science and technology in their security structures with great effect. It acts not only as a force multiplier but can also provide solutions to human problems relating to command, coordination and communication.

Some of the areas where greater work is required are surveillance systems, cryptography, near real time search and identification from distributed large data bases and computer simulation exercises to enhance our crisis tactics and responses. We should use scientific interventions to neutralize weapons of terror and mass destruction. I believe that investment in security technologies is vital if our security systems are to keep pace with the increasing sophistication of international terrorism and crime.

This is also a time when the world is confronted with potentially devastating climatic changes. It is also a time when the world is faced with a growing economic recession. But with adversity comes opportunity. We can use the ingenuity and inventiveness of science to find ways to 'leapfrog' to future technologies, which are affordable and also sustainable. We can use some part of the public investment, which we will spend to stimulate our economies, in these new technologies that will help build sustainable pathways to development.

We have proposed the creation of a National Mission on Strategic Knowledge for Climate Change as part of the National Action Plan on Climate Change. I understand that the Ministry of Science and Technology is currently putting together a plan that will provide us the framework for research and investigation in this area. I think public policy should increasingly adopt strategic approaches based on science.

Our government has worked hard for the rejuvenation of the S&T establishment in our country, including through a huge expansion of the learning infrastructure. This is a very important national priority and we will spare no resource to ensure that we realize the huge potential of our Science & Technology capability.

Our budgetary support to the Ministry of Science & Technology during the XIth Five Year Plan is three times higher than during the Xth plan. I hope that our scientific departments will make judicious use of these enhanced allocations based on a new vision, a new work culture and a renewed focus on scientific solutions that impact on the lives of the common man.

I recognize that if our scientific institutions of higher learning and research laboratories are to flourish, they require high quality manpower particularly at entry levels. We have made strenuous efforts in this regard, which I hope will show visible results in the years to come. We cannot be satisfied becoming a back office for providing Research & Development solutions for multinational companies.

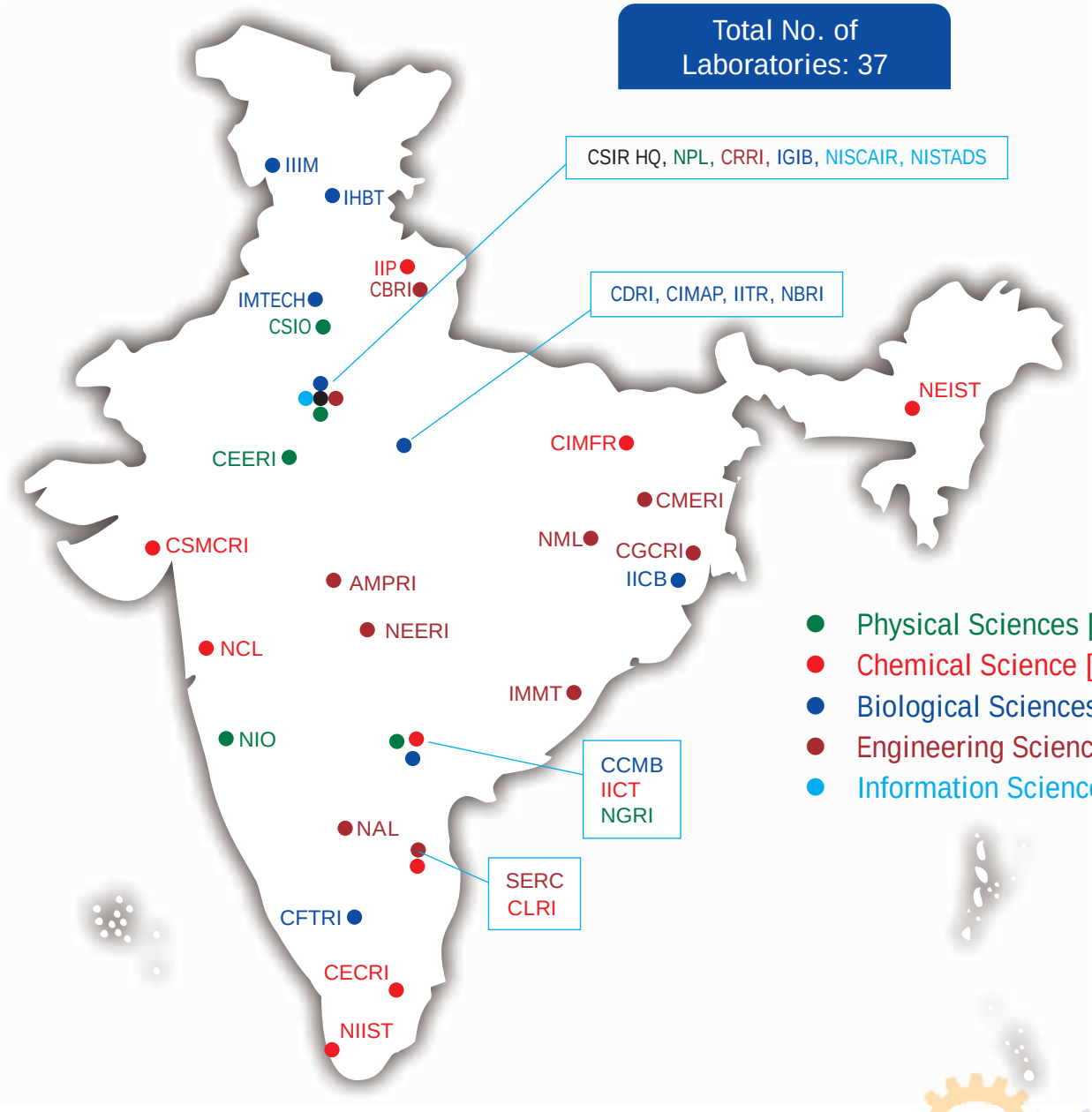
I am very happy that the scientific departments are making their own efforts to create a talent pool from which our scientific establishment can draw upon. In this regard, the STIO initiative of CSIR, the INSPIRE programme of the Department of Science & Technology and Welcome Trust Fellowship programme of the Department of Biotechnology are worthy of mention.

With these words, I once again congratulate the award winners and wish them many many years of stimulating and productive research career in the service of the country and in the service of humanity at large. Their intellectual drive and brilliance give us hope and confidence that Indian science can devise effective solutions for the many problems that confront our country and indeed the world.

CSIR LABORATORIES

AMPRI	Advanced Materials and Processes Research Institute, Bhopal - 462 026, www.ampri.res.in
CBRI	Central Building Research Institute, Roorkee - 247 667, www.cbri.org.in
CCMB	Centre for Cellular and Molecular Biology, Hyderabad -500 007, www.ccmb.res.in
CDRI	Central Drug Research Institute, Lucknow - 226 001, www.cdriindia.org
CECRI	Central Electrochemical Research Institute, Karaikudi - 623 006, www.cecri-india.com
CEERI	Central Electronics Engineering Research Institute, Pilani - 333 031, www.ceeri.res.in
CFTRI	Central Food Technological Research Institute, Mysore - 570 020, www.cftri.com
CGCRI	Central Glass and Ceramic Research Institute, Kolkata - 700 032, www.cgcri.res.in
CIMAP	Central Institute of Medicinal & Aromatic Plants, Lucknow - 226 015, www.cimap.res.in
CIMFR	Central Institute of Mining & Fuel Research, Dhanbad - 828 108, www.cmriindia.nic.in
CLRI	Central Leather Research Institute, Chennai - 600 020, www.clri.org
CMERI	Central Mechanical Engineering Research Institute, Durgapur - 713 209, www.cmeri.org
CRRI	Central Road Research Institute, New Delhi - 110 020, www.crridom.gobv.in
CSIO	Central Scientific Instruments Organisation, Chandigarh - 160 030, www.csio.res.in
CSMCRI	Central Salt & Marine Chemicals Research Institute, Bhavnagar - 364 002, www.csmcri.org
IGIB	Institute of Genomics & Integrative Biology, Delhi - 110 007, www.igib.res.in
IHBT	Institute of Himalayan Bioresource Technology, Palampur - 176 061 (HP), www.ihbt.res.in
IICB	Indian Institute of Chemical Biology, Kolkata - 700 032, www.iicb.res.in
IICT	Indian Institute of Chemical Technology, Hyderabad - 500 007, www.iictindia.org
IIIM	Indian Institute of Integrative Medicine, Jammu - 180 001, www.rrljammu.org
IIP	Indian Institute of Petroleum, Dehradun - 248 005, www.iip.res.in
IMMT	Institute of Minerals and Materials Technology, Bhubaneshwar - 751 013, www.immt.res.in
IMTECH	Institute of Microbial Technology, Chandigarh - 160 036, www.imtech.res.in
IITR	Indian Institute of Toxicology Research, Lucknow - 226 015, www.itrcindia.org
NAL	National Aerospace Laboratories, Bangaluru - 560 017, www.nal.res.in
NBRI	National Botanical Research Institute, Lucknow - 226 001, www.nbri-lko.org
NCL	National Chemical Laboratory, Pune - 411 008, www.ncl-india.org
NEERI	National Environmental Engineering Research Institute, Nagpur - 440 020, www.neeri.res.in
NEIST	North-East Institute of Science and Technology, Jorhat - 785 006, www.rrljorhat.res.in
NGRI	National Geophysical Research Institute, Hyderabad - 500 007, www.ngri.org.in
NIO	National Institute of Oceanography, Goa - 403 004, www.nio.org
NIIST	National Institute for Interdisciplinary Science and Technology, Thiruvananthapuram - 695 019, www.niist.res.in
NISCAIR	National Institute of Science Communication and Information Resources , New Delhi - 110012, www.niscair.res.in
NISTADS	National Institute of Science Technology and Development Studies, New Delhi - 110012, www.nistads.res.in
NML	National Metallurgical Laboratory, Jamshedpur - 831 007, www.nmlindia.org
NPL	National Physical Laboratory, New Delhi - 110 012, www.nplindia.org
SERC	Structural Engineering Research Centre, Chennai - 600 113, www.sercm.org

CSIR - Pan India Footprint



Map not to scale

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