



CSIR NEWS

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CMMACS signs MoU with Indian Air Force

The CSIR Centre for Mathematical Modelling & Computer Simulation (CMMACS), Bangalore, has signed an MoU with Indian Air Force (IAF), for setting up meteorological observational towers at IAF sites, initially in and around Delhi. The MoU was signed by Dr Gangan Prathap, Scientist-in-Charge, CMMACS and Air Vice Marshall Dr Ajit Tyagi, VSM, Assistant Chief of Air Staff (Meteorology) in the presence of Dr R.A. Mashelkar, FRS, Director General, CSIR.

CSIR has initiated a comprehensive programme to develop a multi-scale environmental modelling and forecast platform specially calibrated for India with special concern towards high-impact weather events like episodes of extreme rainfall and fog. As a part of this programme, CSIR has christened the forecast platform 'Drishti-Kuha', to emphasize forecast-based vision to manage fog. The fog forecast platform developed and calibrated at CMMACS has a built-in Flight Schedule Decision Support System that allows flight rescheduling based on fog forecast and management parameters. This is India's first and only Flight Schedule Decision Support System with high-resolution, long-range dynamical forecasts, developed completely in-house.

CMMACS is currently involved in the implementation of 'High-Resolution Regional Atmospheric Analysis (HiRRAA) through Meso-scale Observation Network for Urban System (MONUS)'. The purpose of HiRRAA-MONUS is to develop a high-resolution data set over select vulnerable locations for model calibration and model validation. MONUS will be initially a pentad of observation stations with meteorological towers over Delhi, with subsequent expansion to other cities.





TKDL featured in Nature

INDIA'S Traditional Knowledge Digital Library (TKDL) has been prominently featured in the 27 July 2006 issue of the prestigious international journal, *Nature*. Citing the instances of India's fights against biopiracy that led to revocation of wrong patents on *Turmeric* and *Neem* during the past decade, the article 'Break with tradition' by K.S. Jayaraman in Business section of the journal (pp 342-343) speaks about digitization of traditional Indian medicine system in the form of TKDL at the National Institute of Science Communication and Information Resources in New Delhi, providing access to TKDL by international patent offices under non-disclosure agreement and potential of this database for deriving new drugs.

Excerpts:

Establishment of and access to TKDL:

"In an effort to mount a more systematic defence of its traditional knowledge, the Indian government decided to document as much of it as possible in digital format. And on 29 June, the cabinet agreed to make it available, in confidence, to patent examiners abroad, so that they can search the database before granting patents on any of its components."

Sharing/potential of TKDL for drug discovery:

"Advocates of sharing say that the database, which has been

under construction at the National Institute of Science Communication and Information Resources in New Delhi since 2000, could have a major impact on the process of drug discovery."

"The database has the potential to "slash the cost of drug development", says Vinod Gupta, a computer scientist and director of the institute."

"Gupta thinks the approach will benefit the country because the multinational firms, who are unfamiliar with the Indian traditional medicines, will need to collaborate with local companies and research institutions to make use of the database."

The article in *Nature* also reports the views of Dr Nityanand, former Director of Central Drug Research Institute, Lucknow; Dr Mrs Satyawati, former Director General, Indian Council of Medical Research; Mr Devinder Sharma, Environmental Activist; Mrs Suman Sahai, Gene Campaign, New Delhi; Dr Ranjit Chaudhury, Chairman, Indian Clinical Epidemiology Network Trust International, New Delhi; Dr P. Ram Manohar, Arya Vaidya Pharmacy, Coimbatore; and Vir Niranjan, President of RxMD Pvt, Chennai, regarding potential of TKDL for drug discovery.



CSIR TRANSFORMATION — THE PHENOMENON AND THE UNFINISHED AGENDA

NAL Foundation Day Lecture by

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



ONE of the most dramatic turnarounds during the past decade has been the transformation of CSIR, orchestrated by its Director General Dr R.A. Mashelkar. This amazing transformation has received accolades from business and scientific world as well as the political leadership. For example, within a short period of three years since the initiation of the process of transformation, the cover story of July 1999 *Business India* observed: “CSIR labs have been transformed by the power of enterprise and proactive management...” Later, CSIR earned the laurel of being “World Class in India” (together with Infosys, Wipro, Hindustan Lever, Reliance, Ranbaxy and others). Prof Jayant Narlikar termed the CSIR transformation to be one of the top ten Indian achievements at the turn of the century. The World Bank recommended the CSIR development model to “harness top quality R&D institutions”. And Hon’ble Prime Minister Dr Manmohan Singh expressed his happiness at seeing “CSIR flying higher and farther” and said, “I would like to congratulate CSIR for the remarkable transformation into a performance driven and user focused organization.”

This transformation of CSIR did

not happen by chance. It was the outcome of innovative initiatives and the concerted efforts of ‘Team CSIR’ under the visionary guidance of its Director General Dr Raghunath Anant Mashelkar. And telling the story ‘CSIR Transformation – The Phenomenon and the Unfinished Agenda’, on the foundation day of the National Aerospace Laboratories (NAL), Bangalore, on 21 July 2006, was Dr Mashelkar himself.

The CSIR’s eternal optimist (some even call him a “dangerous optimist”), Dr Mashelkar started with the good news. Of how 2005-06 has been CSIR’s best year so far: the highest total earnings, the highest private earnings, the highest number of SCI research publications, the highest impact factor ever achieved...and Why it is easy to predict that 2006-07 will be even better.

Dr Mashelkar then began from the very beginning in 1995 “when we met all CSIR Directors here at NAL”. Looking back, we now recognize how much that 1995 meeting contributed to CSIR’s transformation; historians in future could well call it “path-breaking”. It was at this meeting that CSIR declared its vision “*To provide scientific industrial research and development that maximizes the economic, environmental and*

societal benefit for the people of India”.

These days it’s routine for every big or tiny organization to proclaim its “vision”, but till 1995, CSIR didn’t have an explicit vision statement; Dr Mashelkar’s vision statement was important for two other reasons that weren’t immediately obvious: it deliberately replaced “scientific and industrial research” by just “scientific industrial research”, and it also, perhaps for the first time, talked of all the three: economic, environmental and societal benefits (“Of course, everyone talks of this triple bottom line now!”). Equally notable was Dr Mashelkar’s insistence that it should be a vision for the year 2001, when he would still be CSIR’s Director General.

In 1996, CSIR explicitly formulated its intellectual property (IP) policy statement: “*To maximize*



the benefits to CSIR from its intellectual capital by stimulating higher levels of innovation through a judicious system of rewards, ensuring timely and effective legal protection for its IP and leveraging and forging strategic alliances for enhancing the value of its IP”.

Of course what brought the country great joy was the way CSIR skillfully, and occasionally ruthlessly, implemented this policy. The US patent on the healing quality of turmeric was successfully challenged in 1997. This haldi win was followed by the basmati win in 1999 and the defence of neem. Dr Mashelkar was among the first to recognize that patenting is the only way to be globally competitive. Starting from 14 foreign patents in 1995, CSIR climbed to 272 foreign patents in 2005.

Dr Mashelkar’s financial initiatives were not always visible outside CSIR, but he initiated a series of extremely innovative moves that saw every CSIR establishment vying to be the leader in generating external cash flow (ECF). In his twentieth NAL Foundation Day Lecture, Dr Mashelkar indicated that his happiest innovation was the concept of the “lab reserve fund”, where every lab got to keep its intellectual fee and savings from its R&D projects for itself.

Dr Mashelkar’s third major foray as Director General was to recognize CSIR’s traditional weakness in marketing its R&D expertise and intellectual property (even before he took over CSIR’s reins, Dr Mashelkar had headed a committee to recommend how

CSIR must market its knowledgebase). To correct this, Dr Mashelkar set up technology marketing groups in every lab/institute, encouraged interactions with business development consultants, instituted awards for successful business development and encouraged CSIR scientists to work on the board of directors of the private sector (“when the private sector is represented on CSIR’s advisory committees, I can’t understand why CSIR persons can’t join private boards”). While these moves have been very valuable, one got the impression that Dr Mashelkar would like to do much more. (“My personal view is that CSIR is still shy of making a big marketing splash; perhaps this circumspection can be attributed to the aggression of that old-fashioned auditor of public accounts”).

Dr Mashelkar gave a lucid and exhaustive enumeration of CSIR’s contributions to public, private, strategic and social good. There’s a lot of truly wonderful work that sadly never seems to catch the public eye. The quality and numbers of CSIR’s scholarly publications is now quite impressive (Dr Mashelkar issued a stern note shortly after taking over in 1995: “don’t publish papers that no one wants to read!” ... a few years later he asked: “lifting averages is fine, but what about the peaks?” ... all this seems to have had a salutary effect). For the private sector, CSIR has developed a very large number of technology processes and products (e.g. an eco-friendly detergent grade zeolite-A plant with >99% whiteness, or a

light transport aircraft called *Saras!*). For the strategic sector, CSIR has developed a large number of subsystems for the *Tejas* light combat aircraft, and 40 kV-3 kVA deuterium thyratron units for use in a synchrotron radiation source facility, to mention just two developments. Finally for the welfare of its fellow countrymen, CSIR has developed a suite of solutions: e.g. water desalination plants, drinking water for earthquake victims (“when the country is in trouble, CSIR is always there!”), a wide variety of drugs, tractors, artificial eyes and collagen dressing for burn victims (“After treatment, I saw radiant smiles on the young burn victims of a fire; how does one quantify the value of these smiles?”).

Although the Pokharan-II nuclear tests stole the limelight at the CSIR Directors’ Conference, hosted by NAL on 11-12 May 1998, it was still an extraordinarily good meeting. One especially liked the Bangalore Declaration that all CSIR Directors signed: “India matters to us. It is our endeavour that we shall matter to India, more”.

Dr Mashelkar explained in his lecture how CSIR so admirably adapted itself to fulfil this resolve. His pithy observations were particularly illuminating; for example, “patience and continuous commitment pays” (Dr Mashelkar recounted NAL’s own two-decade long journey from LCRA to *Saras* to highlight this point), or “we must never stop dreaming” (and the CSIR Director General asked his NAL



colleagues to start dreaming of a 100-seater passenger aircraft to fly on 15 August 2020).

In the last part of his lecture Dr Mashelkar listed several “challenges” for CSIR. For instance, the challenge of *continuously re-inventing itself* (“IGIB’s evolution has been amazing, and I am so delighted that IICT is now a grandmother!”). Or the challenge of *rightsizing* (“we need fewer labs and outreach centres”), of *synergy* between Team CSIR and even Team India (by more intelligent networking, and by instruments such as the NMITLI). Dr Mashelkar also invited his CSIR colleagues to *think big* (“we now have 55 projects valued over Rs 20 crores; a decade ago we didn’t have even one; in fact the first time I had to appear before the CCEA was to explain the *Saras* project, but now it has almost become a habit!”). Finally, Dr Mashelkar listed the challenges of *freedom to operate* and *greater market orientation*.

In many cases, Dr Mashelkar indicated CSIR’s explicit policy decisions (e.g. “we delegated the approval of foreign travel for most scientists to the CSIR lab director itself, thus giving him greater freedom to operate”), but it was also clear that Dr Mashelkar would like to do much more (“we’ve moved quite a bit, but there’s still a long way to go!”).

Some of Dr Mashelkar’s thoughts to drive a greater CSIR market orientation were interesting and imaginative: *mobility of scientists between lab-industry-academia*, (“movement is encouraged from both domestic and international organisations”), *knowledge alliances with industry* (“CSIR lab provides the space, technical and intellectual inputs; private entity brings in financial, managerial and operational expertise”), *off shore CSIR business units, interdisciplinary fellowships, technology incubation centres* (“set up start-up companies to develop innovations based on CSIR knowledgebase”) *in labs etc.*

There is no doubt that this is the way for CSIR to go, although implementing this unfinished agenda, and steering it through India’s bureaucratic maze, could well be Dr Mashelkar’s greatest challenge. But every idea in the Mashelkar book is well and truly begging to be implemented: rightsizing CSIR, faster procedures for recruitment and assessment, setting up companies by scientists in service, spinning out companies, treating knowledge as equity, dual appointments, deemed university status, realizing full autonomy etc. ... if CSIR is to contribute seriously to making India the next knowledge superpower, this is the only way to go.

— Based on the coverage by
Dr Srinivas Bhogle in NAL Paste Board

The paradox in Indian “Aeronautica”

IN his annual lecture at National Aerospace Laboratories (NAL), Bangalore, Prof. Roddam Narasimha, former Director of NAL, talked of an apparent “paradox: when the basic fundamentals of Indian Aeronautica remain extremely strong, why isn’t the boom coming?”

Arguing that it would be suicidal for India to keep out of a globalizing Aeronautica, Prof Narasimha’s prescriptions for the future were:

- (a) Integrate buy with make (the Chinese drove a hard bargain before placing a big A320 order)
- (b) Encourage public-private partnerships (so that projects are driven faster)
- (c) Aggressively grow private small and medium enterprises
- (d) Leverage on defence purchases
- (e) Join multinational projects, but always with a view to build national capability
- (f) Make administration more flexible, and management more dynamic and aggressive and
- (g) Nurture tomorrow’s leaders.

“Aeronautica”, Prof Narasimha explained, “was the conglomerate - encompassing aeronautical S&T, civil aviation, certification, MRO, economic policies, industry, etc. etc.”



Protein β -sheet-like Structure of Acrylamide Oligomers

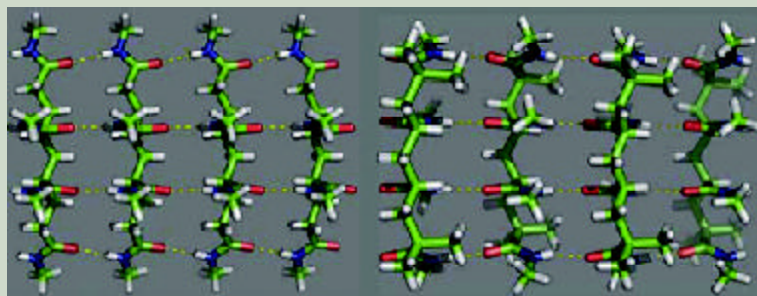
POLY-N-ALKYL ACRYLAMIDES are formed by the polymerization of acrylamide monomer units. As a class of functional materials, these synthetic polymers are gaining prominence, primarily, due to their enormous potential for applications in various fields, from disposable nappies to micro fluidic devices and from advanced drug delivery materials to high-tech materials. Notwithstanding considerable advancement made in the understanding of poly-N-acrylamide tacticity (stereochemistry), its exact correlation with conformational and hydrogen-bonding propensities remains a mystery.

The studies conducted by Amol Kendhale, Rajesh Gonnade, Pattuparampil R. Rajamohanam and Gangadhar J. Sanjayan at National Chemical Laboratory (NCL), Pune, have provided evidence that acrylamide chains form sheet-like structures similar to protein β -sheets. The scientists synthesized and crystallized isotactic acrylamide tetramers (molecules made of a chain of four acrylamide units with all amide side chains in same stereochemical orientations) using a method usually employed for protein crystallization.

They investigated the conformation of these oligomers by single crystal X-ray and two-dimensional NMR studies, and found a layered structure, held together by hydrogen bonds "reminiscent of protein β -sheets". This insight should help in understanding how the spatial arrangement of atoms and groups in the monomers (i.e. the stereochemistry) translates into final macromolecular shapes.

These findings may also shed light on the fascinating property of poly-N-acrylamides to reversibly precipitate out of solution with changes in temperature (thermoprecipitation) and help in the future design of polymers for use in areas such as controlled drug release, tunable optics and tissue regeneration. Polymers with protein-like shapes may eventually serve as useful peptide replacements in medicine with better *in vivo* stability than natural versions, since many biological functions are due to the folding of polypeptide chains.

This study entitled 'Isotactic N-alkyl acrylamide oligomers assume self-assembled sheet structure: first unequivocal evidence from crystal structures', has been published in *Chem. Commun*, **2006**, 2756 – 2758.

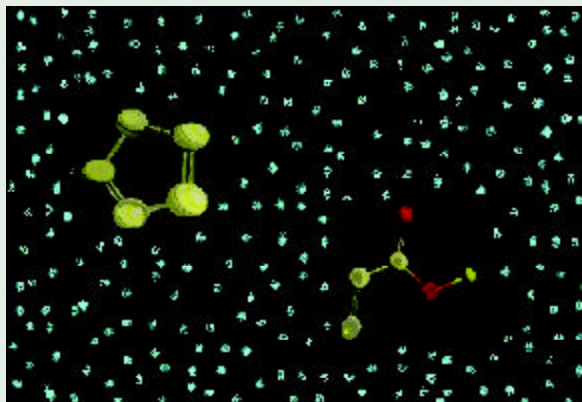


Protein β -sheet-like structure of acrylamide oligomers

Faster Organic Reactions in Water

MOST reactions in the laboratory and in the chemical industry are performed in volatile organic solvents. Organic solvents are a major source of waste during synthesis. The high vapour pressure of conventional organic solvents makes them hazardous, as the solvents evaporate easily into the air damaging the earth's atmosphere. Hence, the chemical processes are being re-evaluated with regard to the use of volatile organic compounds (VOC). Green solvents are being developed as more environment friendly alternative to VOC. Water, supercritical carbon dioxide, ionic liquids, etc. are greener alternatives to the organic solvents.

An ionic liquid is a compound, which is entirely made up of ions and is liquid at room temperature. Ionic liquids are good solvents for a variety of compounds and have no measurable vapour pressure. This makes them desirable substitutes for VOCs. Ionic liquids are emerging as possible green



Diffusion of diene and dienophile through viscous ionic liquid

solvents and much attention has been paid to the synthesis and characterization of room temperature ionic liquids. In the past few years, based on numerous studies, it has been assumed that ionic liquids can be potential substitutes for VOC in the synthetic organic chemistry both in laboratory and industrial processes. Ionic liquids have, therefore, been treated superior to many other solvents used frequently in chemical research. On the other hand, water, the nature's solvent of choice for ages, has found very limited use as reaction medium in synthetic organic chemistry.

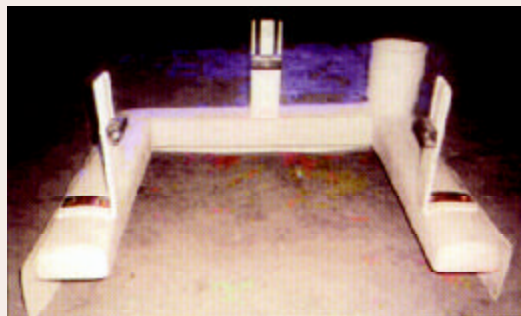
Dr Anil Kumar and Shraeddha Tiwari at National Chemical Laboratory (NCL), Pune, have been investigating solvent effects for a wide range of organic reactions. The main focus of their research has been the study of complex interactions of substrate with solvent molecules, which involve different factors – hydrogen bonding, polarity, solvophobicity, viscosity, internal pressure, etc. The scientists carried out simple Diels-Alder reaction (carbon – carbon bond forming reaction leading to six-member ring) involving cyclopentadiene with methyl acrylate, ethyl acrylate and butyl acrylate both in water and ionic liquids under identical conditions. They found out that the reaction of cyclopentadiene with methyl acrylate is 10-times faster in water as compared to ionic liquid. Similarly, the reactions of cyclopentadiene with ethyl acrylate and butyl acrylate are at least 3 to 4 times faster in water as compared to ionic liquid.

The NCL scientists experimentally demonstrated for the first time that ionic liquids are not superior to “universal solvent: water”. The scientists ascribe this observation to the high viscosity of ionic liquids as compared to water. In this investigation, Diels-Alder reactions have been observed to be faster in water than in ionic liquids. The outcome of this research raises an issue whether ionic liquids are really effective solvents in promoting organic reactions. The finding was published in *Angew. Chem. Int. Ed.* 2006, 45, 4824. This work has attracted the attention of the scientific community and was also featured in *Nature Research Highlights*.

Improved FRP Hopper

THE Bharat Heavy Electricals Limited (BHEL), Bhopal, is the manufacturer of hydro power plants in India. In a hydrogenerator, hopper controls the undesired flow of dust particles.

The hopper and piping system improve the environmental efficiency of the generator. Presently used steel hoppers are heavy and therefore their mounting, demounting, adjustment, alignment is difficult in the limited working space available in a hydrogenerator plant. Steel hoppers are prone to corrosion. These are not of exact size also, which allows dust to go out. These hoppers are made in segments which are welded to make a complete component.



Outer view of FRP hopper



Inner view of FRP hopper



To overcome the above problems, a suitable lightweight FRP material has been optimized to replace heavy low-carbon steel. The Regional Research Laboratory (RRL), Bhopal, and BHEL have modified the design of the steel hopper and piping system to suit the FRP material and there by improving the operation. The laboratory evolved the material specifications and finalized modifications in design in association with BHEL. An FRP hopper has been fabricated with modified design and installed at Tala Bhutan Power Plant under the joint supervision of BHEL and RRL.

Processes licensed and Sponsored/Consultancy Projects undertaken by CECRI

THE processes licensed and sponsored/consultancy projects undertaken by the Central Electrochemical Research Institute (CECRI), Karaikudi, include:

I. PROCESSES LICENSED

- Cement polymer composite coating (CPCC) system for corrosion protection of reinforcing steels — M/s Hemang Anil Bijurkarr, Mumbai
- Neutral paint removing jelly — Protektol Anticorrosives, Chennai

II. SPONSORED PROJECTS

- Electrochemical characterization of interfacial electron transfer processes in micelles and micro-emulsions — Department of Science & Technology, New Delhi
- Evaluation of paint coated mild steel panels — Intenational Paint Co., Bangalore
- Design, development and supply of a custom built four-probe resistance meter range — DRDL, Hyderabad
- Design, development and modeling of cost-effective environment-friendly cathode materials for lithium batteries — Department of Science & Technology, New Delhi
- Carbon nanotube based materials for electrochemical devices — Department of Science & Technology, New Delhi
- Design, development and supply of a voltametric sensor gadget for cadmium metal — Madurai Kamaraj University, Madurai
- Array of "Microtex" low maintenance batteries as per IRSS 88/04 specification for two types of cells/batteries —

Mysore Thermo Electric P. Ltd, Bangalore

- Studies on inter-granular and pitting corrosion of imported stainless steel — Bharat Earthmovers Ltd, Bangalore
- Feasibility study on zinc nickel electrodeposition on stainless steel — Hindustan Aeronautics Ltd, Bangalore
- Development of electro-catalysts for dialkyl sulphide and alkyl halides — DRDE, Ministry of Defence, Gwalior
- Design, development and supply of a computer controlled electrochemical analyzer — Sri Paramakalyani College, Alwarkurichi
- Synthesis and characterization of LiMPO_4 (M=Mn, Fe, Co and Ni), compounds as possible lithium battery cathodes — Department of Science & Technology, New Delhi
- Maintenance and modification of plating facility and gold plating on aluminium alloy component hardware for satellites — IISU, Trivandrum
- Design, development and supply of a computer controlled EC analyzer — Ku VEMPU University, Shimoga, Karnataka
- Gold plating on MWA and RWA minor parts used in satellites — IISU, Trivandrum
- Installation of solar lighting systems and conducting hands-on training programme for village youths and women self help groups — Aranmanaipatti Panjayat, Attangudi
- Investigations on the development of an amperometric methanol sensor for use in direct methanol fuel cell — Department of Science & Technology, New Delhi

III. CONSULTANCY PROJECTS

- Solar lighting and awareness programme for village women self help groups — Aranmanai patti Panjayat Atangudi
- Suggestions for suitable water treatment chemicals — NTPC, Vindhyanchal
- Spot study of the problem faced by M/s Grasim Industries — Grasim Industries, Nagda
- Deposition of CdSe/CdSe (Ag, Te, Tl, Cu, Zn) thin films for PEC solar cells using electron beam evaporation/vacuum evaporation technique — Amritha School of Engineering, Coimbatore
- Suggestion for a suitable surface preparation of the boiler houses turbine area, TTPS, Tuticorin — Jayam Enterprises, Chennai
- Assessment of quality of the paint, surface preparation and paint application — Esteem Engineers, Tuticorin

Feasibility Study for Development of Super Precision Ball-end-shaft and Cups

A project on 'Feasibility Study for Development of Super Precision Ball-end-shaft and Cups' was taken up by the Central Scientific Instruments Organisation (CSIO), Chandigarh, with funding from Bhabha Atomic Research Centre (BARC), Mumbai, in September 2004. The objectives of this project were:

- Technology development,
- Optimization of fabrication and metrology process, and
- Delivery of a few prototypes of super precision ball-end-shafts (BESs) and cups.

These super precision ball-end-shafts (BESs) and cups are to be deployed in strategic applications by BARC. The desired accuracies in these critical components are of micron-level dimensional integrity, surface profile waviness in sub-micron range and surface roughness in nanometric range.

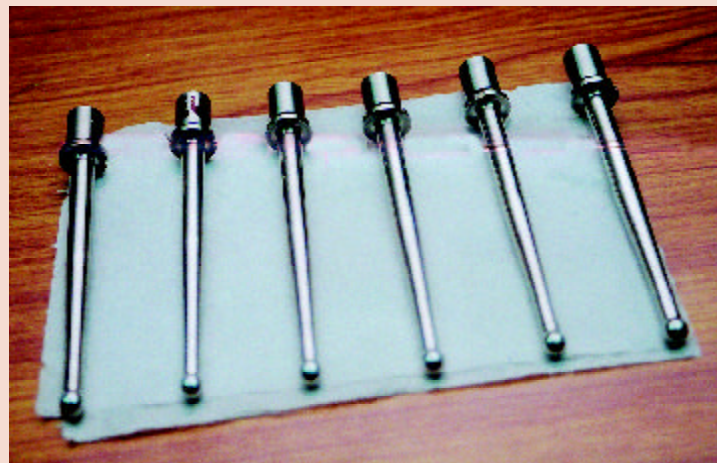
This project was executed at National Aspheric Facility (NAF) at CSIO. The project execution is based in Single Point Diamond Turning (SPDT)

and Precision Surface Profile Metrology. The R&D effort in fulfilling the objectives of this project included:

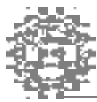
- Simulation and selection of special diamond tools for the SPDT of super precision cups and BESs;
- Machine parametric studies;
- Regression analysis of machining parametric study;
- Diamond tool-wear analysis;
- Cost-effectiveness analysis of diamond tools of various makes;
- Fabrication and metrology of prototypes of super precision cups and BESs.

CSIO has delivered the committed number of super precision cups and ball-end-shafts.

This project has resulted in enhancing the knowledge base at CSIO in the domain of precision machining and metrology in general and SPDT in particular. It is anticipated that the expertise so gained would be useful in taking up further R&D challenges in the field of precision machining and metrology.



A view of the super precision ball-end-shaft and cups developed by CSIO



Central Drug Research Institute

R&D Highlights 2005-2006

THE Central Drug Research Institute (CDRI), Lucknow, is gearing up to meet the challenges of the fast changing global drug research scenario. The issues attracting major attention of the institute pertain to: choice of problem disease areas and projects based on the current and future needs, upgradation of infrastructure and its judicious utilization, expert manpower development and their replenishment, benchmarking of business processes to international levels and quality certifications, adoption of best management practices, creation of appropriate authorities at institute level for IT/regulatory compliances/quality compliance, knowledge management, etc.

During 2005-06, the institute made steady progress on all fronts. A closer liaison and across the table discussions with pharma industry was given a top priority and this approach has paid rich dividends. Presented below are salient achievements of the institute during the past year:

Business Development and Contract Research

The institute licensed two of its products for manufacturing and marketing and signed several agreements with pharmaceutical companies for involving them in the New Drug Discovery and Development program. Major accomplishments:

- (i) Laboratory process know-how for preparation of specific DNA probes and oligonucleotides primers was licensed to Biotron Health Care Ltd, Mumbai, for manufacturing and marketing the **PCR based Tuberculosis Diagnostic Kit**.
- (ii) Process know-how for preparation of **Vegetable Capsules** was licensed to Strides Arcolab. Ltd, Bangalore, one of the largest manufacturers of soft gelatin capsules in India.
- (iii) Two marine fractions, namely **CDR-134F194** and **CDR-267F018** have been found to possess significant anti-hyperglycemic and anti-hyperlipidemic activity. CDRI has collaborated with Connexios Life Sciences, Bangalore for further studies. Both parties have tied up to develop the product for manufacturing and marketing. Three synthetic molecules, namely **S-001-469**, **S-002- 853**, and **S-002-857**, have been found to possess significant anti-hyperglycemic and anti-hyperlipidemic activity. Negotiations are on for joint development of these products. The data are being evaluated by a number of companies for commercial and research venture with CDRI.
- (iv) Several companies are approaching CDRI for collaboration related to its synthetic molecule **99-373**, an anti-resorptive (anti-osteoporosis) agent and a plant-based product **NP-1**, an anti-osteogenic (bone forming) agent. The data are being evaluated under secrecy agreement and are expected to be finalized shortly.
- (v) A material transfer agreement has been executed with Drugs for Neglected Diseases initiative (DNDi), Geneva, for *in vitro* and *in vivo* screening of five compounds from the institute's chemical library for their antileishmanial activity. An MoU was also signed with DNDi for training of CDRI scientist at DNDi identified institute to undertake *in vitro* screening of Institute's compounds against human African Tripanosomiasis. A CDRI scientist has been deputed to DNDi for setting up suitable screening model in CDRI after getting the above training.
- (vi) The toxicity testing of one of the export oriented products of Maharishi Ayurved Pvt. Ltd., Noida has been undertaken under a sponsored project.
- (vii) The institute collaborated with IPCA, Mumbai, under a DST funded project (CDRI-



IPCADST) for optimization of new antimalarial leads identified at the institute.

- (viii) A general advisory consultancy agreement was executed with Connexios Life Sciences, Bangalore, for consultancy in the area of structural and molecular biology which integrates computational and high throughput screening in its New Drug Discovery and Development programmes.

Progress in R&D Programs

Clinical Studies: Post marketing surveillance studies on CONSAP (contraceptive cream) were initiated. Multicentric clinical trials with Arteether (blood schizontocidal) were conducted for its efficacy in children suffering from *P. falciparum* malaria. Clinical trials were initiated at Dibrugarh, Rourkela, Jabalpur, Jodhpur and Guwahati and no side effects were observed during the study. Compound 80-53 (antirelapse antimalarial) was supplied, on request, to Seth G.S. Medical College, Mumbai, for evaluating its use as a gametocytocidal agent. With regard to Picroliv (hepatoprotective), clinical trials in patients of tuberculosis receiving MDT and in patients suffering from alcoholic cirrhosis are in progress at Seth G.S. Medical College, T.N. Medical College, Mumbai and KGMU, Lucknow. Studies related to antidiabetic agent CT-1 and compound 80-574 (hypolipidemic) are progressing well. Phase I single

dose tolerance double blind studies with CDR-134D123 (antihyperglycemic) were completed in 31 healthy human volunteers.

Pharmacokinetic Studies: Such studies were carried out on antimalarial compounds 97-78, 99-357, 99-408 and 99-411; anti-osteoporotic compound 99-373; anti-hyperlipidemic compound 80-574; antidiabetic compounds S-001-469, S-002-853, S-002-857; hepatoprotective Picroliv and Medicament for prevention and cure of cerebral stroke (both of these herbal preparations).

Toxicity Studies: A total of eight compounds were tested for systemic toxicity, two for genotoxic potential and one for teratogenic potential. Experimental toxicology work (expression studies using microarrays, rat whole embryo culture, short-term bioassays for carcinogenicity testing and CFUGM assay for haematotoxicity) also involved short-term training of 20 candidates.

Progress in R&D Project Areas

During the year 2005, a total of 1342 new synthetic compounds and 14 libraries consisting of 6559 compounds were prepared while the Botany Division collected 35 new terrestrial plants and 17 marine flora/fauna samples.

Biological Screening: The entire chemical library of the institute was subjected to high-throughput screening against *M. tuberculosis* H37Ra and selected 'hits' were further screened against *M. tuberculosis* H37Rv. Active compounds were short listed and

subjected to *in vivo* screening. Further work on these compounds, including lead optimization, is in progress.

Under the project on cancer drug development, being pursued in collaboration with Dabur, all compounds of the chemical library were screened against five type of major cancers (pancreas, ovary, prostate, breast and colon) and one normal (fibroblast) cell lines. Hit molecules belonging to four chemical classes, were short-listed for chemistry-based lead optimization.

CNS/ CVS & Other Disorders: Studies related to antistroke agents included a herbal medicament which was shown to produce neuroprotective effect on cerebral ischemia and mild anti-inflammatory activity. Around 158 synthetic compounds were screened against collagen and adrenaline induced thrombosis and several compounds exhibited better protection against collagen induced thrombosis than Aspirin. Several compounds/samples were studied for their CNS, BP, memory, anti-depressant, antioxidant and anti-inflammatory activities.

Filariasis: Five synthetic compounds, 18 new plant extracts and over 2300 extracts under CSIR coordinated project were evaluated for their antifilarial potential. Active ones are being investigated further. Immunoprophylactic studies with recombinant myosin and paramyosin of *B. malayi* adult female worms are continuing. Studies related to isolation of *S. cervi* antigen equivalent to filarial circulating



antigen suggest that parasite proteins present in the circulation of infected host play an important role in defining nature and mechanism of action of these molecules. Biochemical and molecular studies are being also carried out.

Leishmania: Primary biological screening of several synthetic compounds, plant and marine extracts was carried out and the active ones are being evaluated further for confirmation of activity. Studies related to identification of TH1 specific proteins for immunoprophylaxis exhibited good lymphoproliferative response and NO production in cured hamsters. Work on cloning and expression of serine hydroxymethyl transferase, pteridine reductase, trypanothione reductase, dipeptidase carboxy peptidase etc. continued during the year. An ACE inhibitor, catopril, was shown to inhibit LdDCP enzyme activity as well as promastigote growth suggesting thereby that this newly identified DCP could serve as a drug target in *Leishmania*.

Malaria: A total of 455 new synthetic compounds, 85 marine extracts and 2800 of natural origin, under CSIR coordinated network were screened *in vitro* against *P. falciparum*. Several materials exhibited activity at varying concentrations and promising ones are being followed up. Efforts were made to produce monoclonal antibodies against the conformational and linear epitopes of *P. vivax* MSP1 antigen. Analysis of replication within the apicoplast of *P. falciparum* revealed the

presence of partial and full length constructs of 2 proteins — GyrA and GyrB which have been cloned and expressed. Nearly 800 hundred samples from large families were collected for single nucleotide polymorphism analysis of TNFas well as 6 genes that are implicated in adhesion of *P. falciparum*. Initial results indicate subpopulation specific variation in polymorphic allele frequencies.

Microbial Infections: Two genes of *V. cholerae*, Vc0973 and Vc0974 were isolated and their interaction was confirmed. Vc0974 was cloned, expressed in *E. coli* and recombinant protein was purified. In tuberculosis, work is in progress in various areas viz. identification of genes of *M. fortuitum* involved in virulence, knockout mutant generation and its role in pathogenesis, human T-cell responses against *M. tuberculosis* membrane antigens, etc. Cloning and expression of *M. tuberculosis* genes: three *rpf* genes were amplified from genomic DNA and a promoter library of H37RV was constructed. Studies on molecular mechanisms involved in the intercellular survival of mycobacterium suggest that protein kinases play a pivotal role in regulating and coordinating metabolism and gene expression. Out of the nine compounds tested *in vitro* against HIV-RT, four showed promising activity. Under the studies related to fungal infections five new monoclonal antibodies were raised and identified against *A. fumigatus* and *C. albicans* cell wall antigens respectively. PCR products

have been sequenced and identified.

Natural Products: Collection, identification and documentation of 35 terrestrial plants and 17 marine flora/fauna were completed. Several plant products were studied for their antihyperglycemic/antidyslipidemic, antiulcerogenic, memory enhancing, antileishmanial, immunomodulatory, antidiabetic, antimalarial, antithrombotic and antistroke activities.

Technology Development

Process for 97-78 (antimalarial) was optimized on pilot scale. Technology development of three generic drugs, Simvastatin (hypolipidemic), Sertraline hydrochloride and Paroxetine hydrochloride (antidepressants), was undertaken based on their patent expiry and market profile. Isolation and screening of microbial cultures with antibacterial and antifungal activity was continued with considerable success. A very potent antibacterial strain, isolated during the study was taxonomically characterized as *Streptomyces halstedii*. The culture produced more than one active compound. One of the active compounds was extracted, purified and chemically characterized as actinomycin D. Fermentation aspects of optimum actinomycin production conditions were studied. Work on other microbial cultures showing antifungal or antibacterial activity is in progress. Purification of an antibacterial glycopeptide antibiotic and SDS-PAGE analysis of the active crude has demonstrated the presence of a major 65 KD peptide



band. Kojic acid producing fungal culture was isolated from the soil samples. Fermentation parameters and downstream processing are being optimized to achieve maximum yield.

Under a NMITLI project, inhalable microparticles containing two anti-TB drugs were taken up for product development. Methods for quality assurance, stability studies and pharmacokinetic analysis were developed and validated. Experiments for delivery systems for testosterone, GLP-1 and cyclosporine are progressing well. Inclusion complex of 80-574 with -cyclodextrin and/or hydroxypropyl- β -cyclodextrin were evaluated for solubility, dissolution rate and transport. Studies related to quality control included 6 compounds for which HPLC methods were validated.

The institute continued to find newer approaches in drug discovery and design and the important area of Reproductive Health Research.

Publications and Patents

During the year, the institute published over 200 research papers in national and international periodicals and contributed several papers and posters in national and international seminars/symposia and conferences. The success of institute's innovative approaches is well reflected in filing and grant of 15 patents of which six were Indian and nine foreign

Modernization of Infrastructure Facilities

The new facilities added in the

Sophisticated Analytical Instrument Facility Division include: (i) Open Access LC-MS: A Thermo Electron Advantage MAX Ion Trap LC-MS has been installed and is functional. This facility can record ESI and APCI and MS_n mass spectra of samples automatically. (ii) FT-NMR Open System: A new Bruker Avance 300 MHz FT NMR spectrometer has been installed. The system has a 120 sample autosampler with capability to record ¹H, ¹³C, ¹⁹F and ³¹P NMR spectra. (iii) FT-NMR with HR MAS:- A new Bruker 400 MHz FT NMR spectrometer with H R MAS and multinuclear inverse probe head has been commissioned. It has aH R M A S Dual probe head accessory.

Technical Services Provided

Sophisticated Analytical Instruments Facility (SAIF) and National Laboratory Animal Center continued to provide their services to the scientists, academia, industrial units, etc. SAIF analysed over 9600 external and 18700 internal samples for various spectral analyses. Eighty-seven samples were analysed under electron and cofocal microscopy from external users. Collaborative research projects in association with several scientific organizations continued. Under the national project on 'Development of Potential Drugs from Ocean', publication of quarterly bulletin *Ocean Drugs Alert* was continued

The Documentation and Library Services Division continued to publish current awareness bulletins viz. *Drugs & Pharmaceuticals - Industry Highlights* and *Drugs &*

Pharmaceuticals - R&D Highlights. Honours and Awards

Several CDRI scientists received recognition for their outstanding and meritorious achievements during the year.

Dr C.M. Gupta received Panjab University Pharmaceutical Science Oration 2004; Platinum Jubilee Lecture Award from Indian Science Congress, Ahmedabad; Prof. V. Ramakrishna Memorial Lecture Award from IIT, Delhi and Gujral - Bhargava Memorial Oration Award from KGMU, Lucknow.

Drs. Anup Kumar Misra and Atul Kumar received the CSIR Young Scientist Award-2005 in Chemical Sciences.

Dr. (Mrs.) Ranjana Srivastava received CSIR New Idea Fund Award and Best Poster Award for her paper on "Production of Antibodies Against Intact Microfilariae of *S. cervi*" at 17th National Congress of Parasitology, Dibrugarh.

Dr. Ram Raghbir was elected Vice President, Indian Pharmacological Society 2005.

Dr. Gautam Palit received the Dr. D.N. Prasad Memorial Oration Award and gold medal from Indian Council of Medical Research.

Dr. C. Nath was the recipient of Prof. G. Achari Oration Award 2005 of Indian Pharmacological Society.

Ms. Sushma Chaubey was conferred upon the Young Scientist Award for her paper "Translation within the *Plasmodium falciparum* Apicoplast".

Ms. Prachi Bhargava and Ms. Ritu Malik too were awarded for their research papers.



CIMAP Day Celebrations

THE Central Institute of Medicinal & Aromatic Plants (CIMAP), Lucknow celebrated the 28th CIMAP Day on 11 August 2006. Prof. K.P. Gopinathan of Indian Institute of Science, Bangalore, was the chief guest on the occasion and delivered the CIMAP Day Lecture on ‘The Silky Path of Biotechnology’.

Prof. Gopinathan began his lecture by describing the beauty and elegance of the mulberry silkworm (*Bombyx mori*) fibre, which is unmatched by any synthetic fibre. Nearly six million people are employed in sericulture, cultivation of the silkworms for the production of silk as their livelihood. But still, though the technology in agricultural and medical fields has advanced to a great extent in recent years, sericulture has remained traditional. Application of Biotechnology for the improvement

of silk production is therefore, of great significance for our country — the second largest producer of silk in the world,

In India, besides the mulberry silkworms, other species of insects are also utilized to produce the Tasar, Eri and Muga silks.

Sericulture is an agro-based, less power intensive cottage industry which can be run in the countryside. All these factors make sericulture an ideal candidate for research in India. Since the agriculture pest insects, which compete with human for food and therefore, treated as “The Man’s Worst Enemy”, plant and agriculture scientists have always



Prof. K.P. Gopinathan of Indian Institute of Science, Bangalore, delivering the CIMAP Day Lecture

directed their efforts towards controlling the insect populations. Unlike these insect pests, the lepidopteron insects such as the silk moth and butterfly are highly useful to man. The silkworm has

also served as a model organism for basic studies in Gene Expression and Development. This information is of vital importance to the advancement of Sericulture. Recently, the complete genome of the mulberry silkworm has been sequenced. Dr Gopinathan also highlighted how this system can be used through genetic engineering for therapeutic proteins, vaccines and drugs of tomorrow.

Earlier, while welcoming Prof. Gopinathan and other guests, Dr S.P.S. Khanuja, Director, CIMAP highlighted the main achievements of CIMAP during past one year. He pointed out that ‘Farming’ becoming ‘Pharming’ is not just a dream now but a reality catalyzed by CIMAP, especially during last five years with the working of scientists in multidisciplinary fields becoming the way of taking up challenges in science as mission. The example being set in by the PPP (Public-Private Partnership), the most sought after model. In this context,



Dr S.P.S. Khanuja, Director, CIMAP, welcoming the guests

Dr Khanuja cited the CIMAP model of agriculture-driven health sector in rural backdrop with 'biovillagers' being the force of translating technology from science for industry. And the driver of the mission is *Artemisia annua*, the plant that produces the antimalarial drug artemisinin. Today, the drug farming in CIMAP's biovillages is a visible venture extending from Uttar Pradesh, Uttaranchal, Haryana and Punjab to Maharashtra, Gujarat, Tamil Nadu, Madhya Pradesh and Andhra Pradesh. And this is still further expanding with new successes in new areas in the country for medicine for malaria from villages. The wonder variety of *Artemisia*, 'CIM-Arogya', a biotech product of CIMAP, has made it happen. This also sets an example of how plant varieties and linked patents (IP) can open new opportunities for business and societal health simultaneously involving pharma or other industries, whether MNCs or Indian, Dr Khanuja pointed out.

The laboratory observed open day and a large number of students, farmers and general public visited. About 400 students of different schools and colleges visited the laboratories and research farm of CIMAP and interacted with the scientists on various aspects of medicinal and aromatic plants. Students went round the special exhibition organized on this occasion and participated in the science quiz programme.

An Industry-Farmers business-technology interaction was also organized. In this, about 60 farmers hailing from Lucknow and neighboring districts participated and interacted with the representatives of Emami Group of Industries, Kolkata, Disinfecto Chemical industries Pvt. Ltd, Lucknow and Padmavati Herbs, Bareilly. Several industrial units have expressed their desire for contractual cultivation of medicinal and aromatic crops using CIMAP technology.

Prof. Samir Bhattacharya delivers 16th Sidhu Science Lecture



Prof. Samir Bhattacharya is delivering the 16th Sidhu Science Lecture at IICT

PROF. Samir Bhattacharya, School of Life Science, Department of Zoology, Visva Bharati University, Santiniketan (West Bengal) and former Director, Indian Institute of Chemical Biology, Kolkata, delivered the 16th Sidhu Science Lecture at the Indian Institute of Chemical Technology (IICT), Hyderabad, on 2 August 2006 on 'Molecular mechanism involved in type 2 diabetes'.

Welcoming a large gathering of scientists and researchers from Osmania University, Hyderabad, sister laboratories and staff members of IICT, Dr J. S. Yadav, Director, IICT, highlighted the remarkable contributions made by late Dr G. S. Sidhu in making Indian Institute of Chemical Technology (erstwhile Regional Research Laboratory), a glorious force to reckon with in the field of chemistry and chemical technology. Also, his inputs in all the disciplines like drugs, agrochemicals, oil and coal chemistry helped IICT to become an internationally known multidisciplinary institution with high creativity and achievements, aimed at excellence in global leadership in chemical research.

Dr Samir Bhattacharya, a doyen in the field of Comparative Endocrinology and Reproductive Biology, discussed at length the molecular mechanism in type 2 diabetes. He highlighted his work on reproductive biology, which is well recognized all over the world, fetching him more than 100 publications in top national and international journals and memberships of all the three major science academies of India.



Dr J.S. Yadav awarded TWAS Fellowship

DR J.S. Yadav, Director, Indian Institute of Chemical Technology (IICT), Hyderabad, has been honoured with the prestigious Fellowship of Third World Academy of Sciences (TWAS), Italy, in chemical sciences.



The citation by TWAS says:

“Yadav, Jhillu Singh (India) born 4-8-1950. Ph.D., Director, Indian Institute of Chemical Technology, Hyderabad, India. Dr Yadav has developed several new, eco-friendly methods in organic synthesis, especially for enantiomerically pure allylic and acetylenic alcohols and for spiroacetals. He has shown insight and skills in synthesizing important drugs such as taxol, camptothecine, discodermolide, scytopycin and polyhydroxy unsaturated fatty acids. His efforts are recognized by his election to two of the Indian science academies, and by a large number of awards such as the Bhatnagar, Ranbaxy, Goyal, and Vasvik awards – Elected as Fellow”.

TWAS is an autonomous international organization, founded in Trieste, Italy, in 1983 by a group of distinguished scientists from the South under the leadership of Nobel Laureate Abdus Salam of Pakistan. It was officially launched by the then secretary general of the United Nations, Javier Perez de Cuellar, in 1985. TWAS represents the best of science in the developing world. Its principal aim is to promote scientific capacity and excellence in sustainable development in the South.

Dr Arunabha Datta

DR Arunabha Datta, Scientist ‘G’, Indian Institute of Petroleum (IIP), Dehra Dun, has been honoured with the ‘Doon Ratna Award’ and ‘Shri Khurshaid Lal Science and Technology Award’ for the year 2005 by the Nagrik Parishad, of Uttaranchal. Dr Datta has made significant contributions to the areas of materials science and selective oxidation catalysis and has developed a class of novel vanadium phosphate phases through metal incorporation and mesostructure induction and by adopting new synthetic methodologies. Dr Datta has strong research collaborations with groups in Germany, Italy, and France and he has been a member of Indian scientific delegations to Hungary and Germany. He is also a member of a select International group formed to work on the commercially important vanadium phosphates. Apart from research activities Dr Datta is deeply involved in science education and popularization.

IETE award for NAL

THE Institution of Electronics and Telecommunication Engineers (IETE) has selected National Aerospace Laboratories (NAL), Bangalore, to receive the First IETE Corporate Award for performance excellence in the field of electronic instruments and instrumentation.

Dr Sekhar Majumdar

DR Sekhar Majumdar, Head, CTFD Division, National Aerospace Laboratories (NAL), Bangalore, has been invited to become a member of the Asian Fluid Mechanics Committee.

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