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भारतीय राष्ट्रीय विज्ञान अकादमी  
Indian National Science Academy

Annual Report  
2007-08

**insa**  
74 years in pursuit of Excellence

Platinum Jubilee  
2009-10

*Annual Report*  
*2007-08*

INDIAN NATIONAL SCIENCE ACADEMY



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# Highlights

- The Council assumed the office after 73<sup>rd</sup> Anniversary General Meeting on December 23, 2007 at National Institute of Oceanography, Goa. Professor M Vijayan, FNA took over as President of the Academy from Dr RA Mashelkar, FNA who had served as President during 2005-2007.
- Process of election to the INSA fellowship has been made more rigorous while making the nomination process more simple. Research profile of nominees is being used to obtain peer review. Twenty one scientists were elected to the Fellowship of the Academy. Five overseas scientists were simultaneously elected as Foreign Fellows.
- Twenty four awards were announced (five general medals/lectures and nineteen subject-wise awards). Twenty three award lectures were delivered during the Anniversary/General meetings and under the aegis of Local Chapters of the Academy. Dr RA Mashelkar delivered the Second Indo-French Etienne Wolf-Ramanujan Lecture in France.
- The Academy continued to nurture young talent and identified twenty five scientists below thirty five years of age for the award of INSA Medal for Young Scientists. These Young Scientists awardees received the medal in the Anniversary Meeting in Goa.
- Shri Arvind Gupta of Inter-University Centre for Astronomy and Astrophysics, Pune delivered National Science Day Lecture on *Toys from Trash*. Over three hundred students and a number science teachers from various schools of Delhi enjoyed this highly informative lecture.
- During the period, there were forty six Fellows occupying senior Scientists' position and forty Fellows occupying Honorary Scientists' position. Ten Young Scientist Awardees were supported for their research programmes.
- The Academy developed scientific relationship with two other prominent Academies of the World i.e. German Academy of Sciences, Leopoldina and the Royal Society of Edinburgh. It also renewed its existing relationship with the French Academy of Sciences and the Chinese Academy of Sciences. One hundred twenty five Indians and ninety two overseas scientists were supported under Inter-Academy Exchange Programme. In addition, six hundred seventy one (including two hundred fifty six below thirty five years of age) Indian scientists were supported for participation in International Conferences abroad.
- The Academy continued its participation in the Inter-Academy Science Education Programme together with Indian Academy of Sciences, Bangalore and National Academy of Sciences (India), Allahabad. Fellows of the Academy actively contributed in Summer Research Fellowship Programme for science students and teachers and refresher courses for science teachers. The twelfth Jawaharlal Nehru Birth Centenary Medal Lecture was delivered by Sir David King, FRS in the Academy.
- The Indian National Committee for International Years has been very active during this period. It has strengthened outreach programmes of various Science Departments and NGOs which included student rallies, essay contest, displaying posters and calendars on current important issues to create public awareness. An All India Student Contest was also organized as a part of International Students Contest for official launch of the International Year of Polar Earth in February 2008 in Paris.
- Professor G Govil, FNA, Tata Institute of Fundamental Research, Mumbai delivered the first GN Ramachandran Lecture at Sixteenth International Biophysics Congress in California, USA in February 2008 initiated by the Academy.
- The Centre for Cooperation in Science and Technology in Developing Societies (CCSTDS) continued its programmes on Science Promotion and Capacity Building through INSA-JRD Tata Fellowship, INSA-CSIR-BRNS/DAE-ISRO/DOS-Microsoft Research lab-CCSTDS Travel Fellowship Programme, Science Awareness Programme for school children and prepared a TV Serial - *Science in our Environment*.



# Foreword

I have immense pleasure in presenting the Annual Report reflecting the programmes and the progress of the Academy during 2007-08, the first report after I assumed the presidency of our Academy. I am intensely aware of the great responsibility placed on me as well as expectations. I shall do my very best to maintain and enhance the prestige and the stature of the Academy.

The Academy being an apex body of scientists has been engaged in recognition of scientific excellence for the past seventy four years by, among other things, electing outstanding Indian and overseas scientists to the Fellowship. We inducted twenty-one distinguished scientists as Fellows of the Academy and five overseas scientists as Foreign Fellows in 2008. The Academy also nurtures and encourages young scientists who have potential to carry out independent scientific investigations and honours them with INSA medals for Young Scientists. During the year, twenty-five such young researchers were identified and recognized through a rigorous peer review system. The Academy supports a number of activities to nurture, promote and sustain excellence in Indian science in the global scenario.

One of the recent initiatives taken by the Academy is to discuss national and societal issues and provide authentic well considered opinions. The Science Education programme pursued jointly with the Indian Academy of Sciences, Bangalore and the National Academy of Sciences (India), Allahabad has been designed to improve the standard of science education through training students and teachers. The number and geographical spread of students and teachers participating in the summer training programme have registered a marked improvement this year. The number of teacher training workshops has also increased sharply. In fact, we face a shortage of Fellow supervisors. To overcome this problem, the Academies involve, in addition to Fellows, other distinguished scientists also in this important venture.

The Academy has continued to strengthen its international ties. This year we have newly established relationship with the Royal Society of Edinburgh and the German Academy of Sciences, Leopoldina. We have also renewed and strengthened relationships especially

with the French Academy of Sciences and the Chinese Academy of Sciences. We are also engaged in helping Indian scientists to do collaborative work abroad and to participate in major international conferences. The Academy discharges its national responsibilities as an adhering organization in India for the International Council of Science (ICSU) and its Unions. These activities are complementary to the programmes promoted by the science departments of the government and other agencies.



One of the most satisfying programmes of the Academy has been aimed at enabling and encouraging Fellows who have formally retired to continue to contribute to science and related activities. The Senior Scientists and the Honorary Scientists programmes have provided an important platform to utilize the expertise of this segment of our Fellowship. I am gratified that the contributions of the INSA Senior and Honorary Scientists have been very substantial.

Beginning 2009, the Academy will enter the seventy-fifth year of its existence. The Fellowship and the Council felt that this occasion should be used to initiate steps to convert the considerable prestige of the Academy into influence in the formulation of policy on science and science-related issues. In this context, the Academy plans to establish a science policy study unit. Also planned is the establishment of an INSA Archive. Furthermore, we hope to develop INSA into an electronic hub of science information. The Council has also planned various other activities to celebrate the Platinum Jubilee in a befitting manner. The Academy would endeavour to work closely with other Academies, professional societies, scientific councils and departments to make the celebrations memorable and meaningful.

I am conscious that we have so many tasks to complete during my tenure in the next three years. I shall heavily depend on our Fellowship for their valuable help, time and intellectual inputs.

**M Vijayan**  
President

# Council and Meetings

The management of the affairs of the Academy is entrusted to its Council, which is composed of a President, six Vice-Presidents and 20 Members representing different branches of science, making a total of 27. These members are elected for a period of three years. In addition, four INSA Fellows representing each of the cooperating organizations such as The Asiatic Society, Kolkata; The National Academy of Sciences (India), Allahabad; the Indian Science Congress Association, and the Government of India, make the Council a 31-member body. The Council is assisted by the Commission, Advisory/Standing Committees and subject-specific Sectional/National Committees and special Committees. One of the prime responsibilities of the Council is to recognize excellence in science by electing Indian scientists as Fellows and foreign scientists as Foreign Fellows of the Academy.

## COUNCIL MEETINGS

The Council met four times: May 28-30 (Delhi); August 7-8 (Delhi); October 4 (Delhi) and December 23, 2007 (Goa). The Annual General Meeting and the Anniversary General Meeting were held along with the October and December meetings of the Council, respectively.

## INSA COUNCIL – 2008

### President

Professor M Vijayan, FNA, Honorary Professor and Distinguished Biotechnologist, Molecular Biophysics Unit, Indian Institute of Science, Bangalore.

### Vice-Presidents

Professor N Balakrishnan, FNA, Aerospace Engineering and Supercomputer Education & Research Centre and Associate Director, Indian Institute of Science, Bangalore.

Professor AK Gupta, FNA, Director, National Centre of Experimental Mineralogy and Petrology, University of Allahabad, Allahabad.

Professor NK Gupta, FNA, Department of Applied Mechanics, Indian Institute of Technology, New Delhi.

Professor PK Kaw, FNA, Director, Institute for Plasma Research, Bhat, Gandhi Nagar.

Professor TP Singh, FNA, DBT Distinguished Biotechnologist, Department of Biophysics, All India Institute of Medical Sciences, New Delhi.

Professor AK Sood, FNA, Department of Physics, Indian Institute of Science, Bangalore.

### Members

Professor S Ananthkrishnan, FNA, Senior Professor, National Centre for Radio Astrophysics, TIFR, Pune University Campus, Pune.

Dr SK Apte, FNA, Head, Molecular Biology Division, Bhabha Atomic Research Centre, Mumbai.

Professor MK Bhan, FNA, Secretary to the Government of India, Department of Biotechnology, New Delhi.

Professor Kankan Bhattacharyya, FNA, Department of Physical Chemistry, Indian Association for the Cultivation of Science, Kolkata.

Professor BB Chattoo, FNA, Coordinator, Biotechnology Programme, MS University of Baroda, Baroda.

Professor SG Dani, FNA, Tata Institute of Fundamental Research, Mumbai.

Professor GR Desiraju, FNA, School of Chemistry, University of Hyderabad, Hyderabad.

Dr BS Dhillon, FNA, Institute of Plant Breeding Seed Science and Population Genetics, University of Hohenheim, D-70593, Stuttgart, Germany.

Dr J Gowrishankar, FNA, Director, Centre for DNA Fingerprinting and Diagnostics, Hyderabad.

Professor RV Hosur, FNA Senior Professor (I), Department of Chemical Sciences, Tata Institute of Fundamental Research, Mumbai.

Professor A Jhunjhunwala, Department of Electrical Engineering, Indian Institute of Technology Madras, Chennai

Dr VP Kamboj, FNA, formerly Director, Central Drug Research Institute, Lucknow.

Professor V Kannan, FNA, Department of Mathematics and Statistics, University of Hyderabad, Hyderabad.

Professor PP Majumder, FNA, Head, Human Genetics Unit, Indian Statistical Institute, Kolkata.

Professor Deepak Pental, FNA, Vice-Chancellor, University of Delhi, Delhi.

Professor Rajiva Raman, FNA, Department of Zoology, Banaras Hindu University, Varanasi.

Dr V Ravindranath, FNA, Director, National Brain Research Centre, Manesar, Haryana.

Professor SK Saidapur, FNA, Vice-Chancellor, Karnatak University, Dharwad.

Professor Ajit Iqbal Singh, FNA, Department of Mathematics, University of Delhi (South Campus), New Delhi.

Professor AK Singhvi, FNA, Planetary Geosciences Division, Physical Research Laboratory, Ahmedabad.

## Representatives of Co-operating Academies and Government of India

### Asiatic Society

Professor CK Das Gupta, FNA, Department of Biophysics, Molecular Biology and Genetics, University College of Science, University of Calcutta, Kolkata.

### Indian Science Congress Association

Professor R Ramamurthi, FNA, Department of Fishery Science, SV University, Tirupati.

### National Academy of Sciences (India)

Dr PK Seth, FNA, Chief Executive, Biotechnology Park, Jankipuram, Lucknow.

### Government of India (DST)

Dr T Ramasami, FNA, Secretary, Department of Science and Technology, New Delhi.

## 73<sup>rd</sup> Anniversary General Meeting, December 21-23, 2007, NIO Goa

The Anniversary General Meeting of the Academy was held in the National Institute of Oceanography, Goa during December 21-23, 2007. During the meeting a Seminar on *Climate Change and its Implications to India* was organized. In this seminar talks were delivered by Professor Victor Smetacek, Alfred Wegener Institute, Bremerhaven, Germany (*The Health of the Ocean in the Anthropocene*), Professor AK Singhvi, FNA (*Luminescence Dating in Quantitative Reconstruction of Continental Paleoclimates and Earth Surface Processes*) - Professor K Naha Memorial Medal (2007) Lecture, Dr AV Kulkarni, Space Application Centre, Ahmedabad (*Effects of Climate Change*

on the Himalayan Cryosphere), Professor BN Goswami, FNA (*Global Warming Potential for Mega-Droughts of Indian Monsoon*), Professor J Srinivasan, FNA (*Global warming, Aerosols and Monsoons*), Professor A Vaidyanathan, Centre for Development Studies, Thiruvananthapuram (*Water Policy in India: A Brief Overview*), Dr VS Arunachalam, FNA (*On Powering India*) - Professor Brahm Prakash Memorial Medal (2007) Lecture. In addition to the above, seven more award lectures were delivered during this meeting by Professor S Chandrashekar, FNA (*Synthetic Studies on Glycosidate Inhibitors*) - The Golden Jubilee Commemoration Medal for Chemical Sciences (2007) Lecture, Professor DP Roy, FNA (*Basic Constituents of Matter-Visible and Invisible*) - The Satyendranath Bose Medal (2007), Professor G Sundararajan, FNA (*The Structure-Property-Performance Correlation in Detonation Sprayed WC-Co Coatings*) - The INSA Prize for Materials Science (2007), Professor GP Talwar, FNA (*Research Towards Development of Products of Relevance to the Country: from Lab to Land*) - The Golden Jubilee Commemoration Medal for Biological Sciences (2007) Lecture, Professor GS Khush, FNA (*Biofortification of Crops for Reducing Malnutrition*) - CV Raman Medal (2007) Lecture, Professor K Vijayraghavan, FNA (*Constancy and Change in Brain Circuits*)-Jawaharlal Nehru Birth Centenary Lecture (2007), and by Professor NK Ganguly, FNA (*Avian Influenza*) - SS Bhatnagar Medal (2007) Lecture. Excerpts of the medal award lectures delivered during the Anniversary General Meeting appears in subsequent pages.

The newly elected Fellows were inducted to the Fellowship during Anniversary General meeting on December 23, 2008. Dr RA Mashelkar, President INSA also presented award to Young Scientists Medal Awardees for 2007.

## Excerpts of the Lectures Delivered during Anniversary Meeting at National Institute of Oceanography, Goa

**Professor Brahm Prakash Memorial Medal (2007)** lecture on *Powering India* by Dr VS Arunachalam, FNA, Center for Study of Science, Technology and Policy (CSTEP), Bangalore. In his lecture, Dr Arunachalam said that the growth and prosperity of human society depends on energy. Its availability, accessibility and affordability determine the level and sophistication of human development and economic prosperity. Among various forms of energy, electric power continues to be the preferred one. It is versatile, easily transportable and can be generated from different energy sources. India's electricity generation and consumption continues to be modest. The installed capacity amounts to 135 giga-



watts and annual per capita consumption is modest 1000 kilo-watt hours (kWh). Compared with United States consumption of 14,000 kWh and China's 1600 kWh. For India to improve its per capita consumption to at least 1000 kWh, it must increase its generation capacity by 1200 MW per month, for the coming ten years.

What then should be its options?. Add to this, the increasing concerns about green house gas emission that threaten the very life on our planet, and energy security. But powering India is a must to meet the growing aspirations of its people. The presentation also discussed various challenges and opportunities in the world of energy that are sustainable and environmentally acceptable.

**The Golden Jubilee Commemoration Medal for Chemical Sciences (2007)** lecture on *Synthetic Studies on Glycosidase Inhibitors* by Professor S Chandrasekaran, FNA, Department of Organic Chemistry, Indian Institute of Science, Bangalore. In his lecture Professor Chandrasekaran said that  $\alpha$ -Mannosidases are key enzymes that process carbohydrates, which are crucial for many biological processes in health and disease and hence are important drug targets. Compounds that selectively inhibit these glycosidases have tremendous potential in the treatment of infectious diseases, cancer, AIDS and diabetes. Synthesis of glycomimics with enhanced potency towards the inhibition of  $\alpha$ - Mannosidase is an important issue because of the significance of such inhibition to both viral expression and tumor growth. Although there are many inhibitors reported (mainly aza sugars) showing potency towards mannosidases, they are synthetically challenging and conformationally unstable. The mode of synthesis of novel thiosugar (thiolevomannosan) derivatives that have unique, conformationally locked structures were discussed. Thiosugar derivatives exhibit higher inhibition of  $\alpha$ -1 and mannosidase, than hitherto well-known, inhibitors of the enzyme. The advantage of thiolevomannosan over other inhibitors is the locked  ${}^1C_4$  conformation, which is required of the inhibitor and it obviates the need for the calcium ion binding in the active site of the enzyme. Professor Chandrashekar also discussed elaborately results of docking studies.

**The Satyendranath Bose Medal (2007)** lecture on *Basic Constituents of Matter - Visible and Invisible* by Professor DP Roy, FNA, Homi Bhabha Centre for Science Education, TIFR, Mumbai. In his lecture, Professor Roy said that the understanding of the basic constituents of matter has progressed from protons and neutrons to the underlying quarks and leptons, which have all been seen by now.

But the story is not complete yet. A consistent theory of their mass implies the existence of Higgs Bosons and Supersymmetric particles, which are yet to be seen. The discovery of these particles will shed light on the nature of phase transition the Universe went through after a few picoseconds of its creation, and the nature of invisible matter that permeates throughout the Universe today as relic of that early history.

**The INSA Prize for Materials Science (2007)** lecture on *The Structure-Property-Performance Correlation in Detonation Sprayed WC-Co Coatings* by Professor G Sundararajan, FNA, International Advanced Research Centre for Powder Metallurgy and New Materials, Hyderabad. In his lecture Professor Sundararajan said that the Detonation Spray Coating (DSC) technique, belonging to the family of thermal spray coatings, is capable of depositing thick and dense coatings of metallic, cermet and selected ceramic material. Prof Sundararajan went on with a brief description of the DSC process, applications developed, upscaling of the technology and subsequent transfer of the technology to Indian industries. However, bulk of the presentation concentrated on WC-Co coatings obtained by DSC and in particular, examine the influence of coating process parameters and feedstock characteristics on the microstructure, properties and performance of the coating. The presentation concluded with future directions in respect of detonation spray coatings and DSC technology.

**The Golden Jubilee Commemoration Medal for Biological Sciences (2007)** lecture on *Research towards Development of Products of Relevance to the Country: From Lab to Land* by Professor GP Talwar, FNA, Talwar Research Foundation, New Delhi. In his lecture Professor Talwar said that in early 1970's, India had the world's largest number of lepers. The causative organism, *M. leprae* was identified by A Hansen in 1874, but till date is not cultivable in any medium. Neither was it known why only few of those exposed to *M. leprae* contracted leprosy and why only a percentage of them develop the worst form of multibacillary disseminated disease, the *lepromatous leprosy* (LL). These patients offer a fertile "soil" for multiplication of *M. leprae* and for its transmission to others in the community. Our initial studies showed that the immune deficit in LL patients was the inability of their T cells to react to key *M. leprae* antigens and generate appropriate cytokines to activate macrophages to kill the bacilli. The defect was innate, a "hole" in the repertoire over and above the suppression acquired from a load of *M. leprae*. Homologous vaccination was unlikely to boost immunity as LL was not an auto-

regressive disease. We searched for a *heterologous mycobacteria*, cross-reactive with *M. leprae* and competent to generate signals from T cells of LL patients for killing of *M. leprae* by the phagocytic cells.

Five short-listed mycobacteria from the above studies were taken through animal models and delayed hypersensitivity skin test in both Tuberculoid and Lepromatous leprosy patients to zero-in to an atypical non-pathogenic mycobacteria coded as *w*. After preclinical toxicological study, approval of the Drugs Controller General of India and Ethics Committees, Phase II /III efficacy trials were conducted in LL patients. The vaccine given every three months as adjunct to standard multidrug regime, caused a faster clearance of bacilli, which in turn shorten recovery time significantly. The vaccine cleared also granulomas and disfiguring lesions. It was effective in 'slow' or drugs -non-responsive patients. Field studies in Kanpur Dehat confirmed the immunotherapeutic potential of the vaccine in addition to prophylaxis in household contacts. The vaccine received the New Drugs Authorization from the Drugs Controller General of India and of USFDA, the only one of its type in the world. It is manufactured and marketed by Cadilla Pharma. Besides leprosy, it is effective in category II tuberculosis. It is also under clinical trials in Crohns disease and some cancers. A National consortium of three laboratories has sequenced its genome by which it is considered as the saprophytic ancestor of *M. leprae*, *M. tuberculosis* and *M. paratuberculosis*. It has been assigned a new name, *Mycobacterium indicus pranii*.

Professor Talwar also described briefly the development of a Polyherbal vaginal tablet which is effective in curing up to 95% of women suffering from reproductive tract infections due to a variety of aerobic or anerobic micro-organisms. Three hundred million women suffer from vaginosis/vaginitis every year. Praneem inhibits also the transmission *in-vivo* of *Herpes simplex-2* and *Chlamydia trachomatis* and has potent inhibitory effect on HIV and *N. gonorrhoea in vitro*. An ongoing clinical trial at the Institute of Cytology & Preventive Oncology indicates the highly interesting therapeutic action of Praneem in elimination of HPV-16/18 in women with early cervical dysplasia and reversion to normal cervical cytology. Six million women get infected with HPV 16/18 every year, leading to carcinoma of cervix, the major cancer of women in India. Praneem is licensed to Panacea Biotec.

**CV Raman Medal (2007)** lecture on *Biofortification of Crops for Reducing Malnutrition* by Professor Gurdev S Khush, FNA, University of California, Davis, California, USA. In

his lecture Professor Khush said that Access to healthy diet is a fundamental right of every human being on this planet. Yet 800 million people, mostly in developing countries go to bed hungry everyday. Micronutrient deficiencies affect three billion people. Malnutrition hinders the development of human potential and the nation's social and economic development. Deficiencies of iron (Fe), zinc (Zn) and vitamin A are most acute. Rice which feeds half the world population is low in Fe and Zn and is completely devoid of vitamin A. Progress is being made to increase the level of Fe and Zn in rice through conventional breeding methods. Introduction of three transgenes into rice resulted in establishment of biosynthetic pathway leading to production of beta-carotene in rice endosperm. Beta-carotene is converted into vitamin A in human digestive system. It is hoped that varieties of rice with improved micronutrient content will become available for commercial production in 4-5 years. Rice with dense micronutrients will benefit the poor rice consumers. Similar efforts are underway to enhance the micronutrient content of other staple crops through the Harvest Plus Program of Consultative Group on International Agricultural Research (CGIAR). For optimum results, linkage between agriculture and nutrition programs is essential.

**Jawaharlal Nehru Birth Centenary Lecture (2007)** on *Constancy and Change in Brain Circuits* by Professor K Vijayraghavan, FNA National Centre for Biological Sciences, TIFR, Bangalore. In his lecture Professor Vijayraghavan said that the brain is a complex network of many millions of nerve cells. The 'wiring' that underlies brain function is built during development of the embryo. Although, because of its striking ramifications, the assembly of this 'wiring' appears impossible to understand. In fact, many aspects have been deciphered remarkably clearly using a range of molecular and genetic approaches. Once assembled, this wiring has two apparently contradictory tasks: It needs to remain constant during life, if it is to perform its function; yet it needs to change and adapt if it is to function when confronted with stress, damage or the need to learn and remember. How do nerve cells manage this? Using examples from the olfactory circuit of the fruitfly, Professor Vijayraghavan illustrated genetics can be used to decipher the mechanisms that underlie constancy and change.

**SS Bhatnagar Medal (2007)** lecture on *Global and Indian Scenario of H5N1: Status, Issues and Challenges* by Professor NK Ganguly, former Director General, ICMR, New Delhi. In his lecture, Professor Ganguly said that Influenza A viruses undergo major antigenic shift at unpredictable

intervals causing worldwide epidemics/pandemics with high morbidity and mortality. The present outbreak of H5N1 Avian Influenza in the South-East Asian countries merits attention because of increasing evidence to suggest that the avian strains are getting more virulent, capable of causing severe disease. As of now, it has already caused illness in 336 humans with 207 deaths (as on December 4, 2007), the virus being entrenched in many parts of Indonesia and Vietnam and some parts of Cambodia, China, Thailand, and possibly also the Laos People of Democratic Republic. H5 viruses are understood to be introduced to poultry flocks in their low pathogenic form and when allowed to circulate in poultry populations, can mutate, usually within a few months into a highly pathogenic form, a change marking the start of a pandemic. Today, the concerns of H5N1 are high as studies demonstrate continued evolution. Considerable circumstantial evidence suggests that migratory birds can introduce low pathogenic H5 viruses to poultry flocks, which then mutate to the highly pathogenic form.

India saw two outbreaks of highly pathogenic avian influenza A (H5N1) virus in poultry in Nandurbar and Jalgaon districts of Maharashtra and adjoining areas of Uchhal in Gujarat and Burhanpur in Madhya Pradesh from January to April, 2006, and subsequently during July, 2007 in Manipur. The full genome of two previously uncharacterized strains of H5N1 viruses were isolated at the National Institute of Virology (NIV), Pune, from post-mortem tissues of chicken. They were collected from Navapur, Nandurbar district during the outbreak. Results on these genomes have been presented. All the genes belong to clade 2.2 of the Z genotype and are close to the 2006 isolates from Iran, Afghanistan, Mongolia, Italy and Krasnodar. The Navapur isolates are closer to the those reported from Jalgaon than that from Navapur which does not support the earlier hypothesis of Pradhan *et al.* according to which the viruses in Jalgaon and Navapur caused outbreaks within 12 days, and were introduced at different times from different sources, based on the partial gene sequences of HA. Molecular markers suggest that the isolates are sensitive to both drugs, Oseltamivir and Amantadine. Mapping of amino acid residues responsible for pathogenesis, glycosylation and receptor binding have been studied. The relationship between the Indian viruses and those in the East Africa/West-Asia flyway of migratory birds and the position of Nandurbar in this route suggests that the viruses in India may have been introduced through migratory birds. The sequence of Manipur strain is a distinct offshoot of clade 2.2.

World Health Assembly in May 2006 called for immediate, voluntary implementation of the provisions

of the revised International Health Regulations (IHR 2005), relevant to a possible pandemic influenza, including rapid and transparent notification of outbreaks and the sharing of epidemiological data and samples. Implementation of the IHR will require that countries should have the capacity to reliably detect, confirm and contain influenza-like illness that might herald the start of a human pandemic. Integrated and coordinated animal and public health multi-sectoral strategies are essential at local, national, regional and global levels. Ensuring an intensive sustained response as well as maintaining strong, continued political and financial commitments, in addition to improvements in governance and legislation and strengthened public-private partnership, are some of the short and medium term actions and challenges before us for control and mitigation of H5N1.

### **Memento to Retiring Council Members and taking over Presidency by Professor M Vijayan from Dr RA Mashelkar**

Dr RA Mashelkar presented the shawls to the retiring members of the Council: Professors Anupam Varma and M Vijayan, Vice-Presidents, Dr Ashima Anand, Professors M Lakshmanan, T Padmanabhan and SR Shetye, Members, Professor HK Gupta and Dr VP Kamboj, Additional Members. Dr RA Mashelkar profusely thanked the members of the Council for their continued support to him in carrying out the



*Dr RA Mashelkar presenting shawl to retiring Vice President (Resource Management) Professor Anupam Varma*



programmes during his tenure as a President of the Academy. He emphasized that INSA must not only make a difference to Indian science and scientists but to the nation as a whole. To this extent, it must be proactive. He illustrated this by saying as to how within a month of Tsunami striking India, INSA got together with the other agencies and organized a national discussion on Tsunami, which was even attended by foreign experts. The recommendations of this meeting (such as installation of Tsunami warning systems) and many subsequent meetings led to a set of concrete recommendations, which have been implemented by the Government. Similarly, the action plan on Higher Education and Research, jointly prepared by all the three Academies have been taken up by the Planning Commission while formulating eleventh Five Year Plan. Similar joint activities by the three academies have already been initiated. Many positive changes have been brought in election process both for Indian and Foreign Fellowship. The nomination process has been made much simpler where as the scrutiny is much stricter. The entire issue of INSA awards and the ICSU programme in India were reviewed. The Academy signed a large number of MoUs with other cooperating academies and many leading international personalities visited the Academy during this period. He expressed confidence that this good work will be carried forward

with great enthusiasms by the new President and the Council.

Professor M Vijayan the incoming President, presented a shawl to out going President (Dr RA Mashelkar) and also an album containing representative photographs highlighting the major activities of INSA during the tenure of his Presidentship. Professor M Vijayan profusely thanked Dr Mashelkar for guiding the Academy and initiating many new programmes under his leadership. He expressed confidence that this support and guidance will be useful to the Academy for times to come. Dr Mashelkar has already constituted, as a first step, the Apex Committee which will coordinate the Platinum Jubilee celebrations of the Academy. Professor Vijayan hoped that Dr Mashelkar will constantly be associated with most of the major programmes of the Academy. While closing the meeting, Professor Vijayan expressed gratitude for Dr SR Shetye and his team of NIO scientists who worked sincerely in making the Anniversary and Council meeting a great success and memorable.

President, Dr RA Mashelkar delivered the Presidential Address on *Anomalous Transport in Macromolecular Systems: Some New Insights*. After the conclusion of the Anniversary Meeting, the Council (2008) led by Professor M Vijayan, FNA took over.



*Dr RA Mashelkar presenting shawl to Professor M Vijayan on his retirement as Vice President (Fellowship Affairs)*



*Professor M Vijayan incoming President presenting shawl to outgoing President Dr RA Mashelkar*



# Fellows and Foreign Fellows

Each year, Fellows and Foreign Fellows are elected out of the nominations made by the existing Fellows after a careful evaluation process. The election to the Fellowship is restricted to Indian citizens only and is limited to a maximum of 30 annually. Election to the Fellowship of the Academy is recognition of the excellent scientific contributions made by a scientist.

Foreign Fellows are eminent scientists who have been rewarded for their contributions to science and are domiciled outside the territorial limits of India. These scientists, in some way, must have contributed and enriched the scientific progress of India.

During the period 2007-08, the Academy elected 21 scientists as Fellows and 5 overseas scientists as Foreign Fellows. The number of Fellows at present is 770 out of a total of 1471 elected since inception. Similarly, presently there are 91 Foreign Fellows out of a total of 242 elected till date.

## FELLOWS ELECTED (2008)

The Annual General Meeting held on 4 October 2007 at INSA premises elected the following twenty one Fellows and five foreign Fellows to the Academy. These fellows were admitted to the Fellowship on December 23, 2007 at NIO, Goa.

**Tapan Kumar Adhya** (b.04.09.1949), PhD, Principal Scientist (Microbiology), Division of Crop Production, Central Rice Research Institute, Cuttack-753 006.

Dr Adhya has made significant contributions to the frontier area of agro-environment science that will have great bearing on climate change. His research on methane emission from Paddy cultivation in India indicated annual methane emission ranging between 4-6 Tg which is one-tenth of US-EPA estimate. This lower estimate was later entered in IPCC database. His



research identified flooded paddy as an important source of  $N_2O$ , another greenhouse gas. He has also worked on pesticide degradation in rice soils and isolated which can degrade recalcitrant b and d isomers of HCH under aerobic conditions.

**Manindra Agrawal** (b.20.05.1966), PhD, Department of Computer Science, Indian Institute of Technology, Kanpur.

He is renowned for his astonishing discovery (together with his two students) of a deterministic polynomial time algorithm for primality testing. This solved an age-old basic problem which has been intensively studied over the last three decades in the context of computer science. He has also made significant contributions to the theory of efficient reductions between computational problems, which are part of the program studying the well-known "P vs NP" question in mathematics/ computer science.



**Faizan Ahmad** (b.10.07.1949), PhD, Department of Biosciences, Jamia Millia Islamia, Jamia Nagar, New Delhi.

Dr Ahmad has made fundamental contributions to the analysis of protein stability. His analysis, especially using mixed denaturant solution has provided very strong support for the linear free energy model for evaluating protein stability. Further, he has carried out a very thoughtful analysis of the effects of osmolytes on protein stability. His early work on properties of unfolded proteins is classic.



**Soumitro Banerjee** (b.17.10.1960), PhD, Professor, Department of Electrical Engineering, Indian Institute of Technology, Kharagpur.

Dr Banerjee is well-known for his significant contributions to Non-linear dynamics and Chaos theory and its applications to electrical engineering. His results in bifurcation theory and its applications to circuit switching are particularly path-breaking.



**Vinod Bhakuni** (b.24.05.1962), PhD, Division of Molecular and Structural Biology, Central Drug Research Institute, Lucknow.



Dr Vinod Bhakuni has highlighted role of electrostatic interactions in maintenance of native structure of oligomeric proteins. In addition, he has shown that cooperativity and correlation of different interactions are critical in stabilization of intermediates during folding / unfolding of monomeric proteins. Further, he

has demonstrated the role of C-terminal domain in regulating the functional activity of enzymes.

**Somendra Mohan Bhattacharjee** (b.24.01.1957), PhD, Institute of Physics, Bhubaneswar.



He has been elected primarily for his outstanding contribution in the field of structural mechanics of phase transitions such as existence of a force induced unzipping transition of DNA, vicinal surface with a tricritical point and nonlocality in kinetic roughening transition.

**Vadapalli Chandrasekhar** (b.06.11.1958), PhD, Professor, Department of Chemistry, Indian Institute of Technology, Kanpur.



Professor Chandrasekhar has made several significant contributions in the area of main group and organometallic chemistry through innovative synthesis and structural investigations of inorganic clusters and inorganic polymers.

**Pratim Kumar Chattaraj** (b.26.04.1958), PhD, Department of Chemistry, Indian Institute of Technology, Kharagpur.



Dr Chattaraj has made many important contributions to the applications of several computational techniques involving quantum mechanics, nonlinear dynamics and *ab-initio* methods for understanding chemical concepts.

**Krishnaswamy Krishnamoorthy** (b.07.01.1952), PhD, Scientist G & Project Director, Space Physics Laboratory, Vikram Sarabhai Space Centre, Thiruvananthapuram.



He has been elected primarily for his insightful discovery of the hitherto unsuspected significant role of aerosols in influencing the radiative forcing and its consequent effect on the climate system.

**Gattamraju Ravindra Kumar** (b.15.06.1961), PhD, Associate Professor, Tata Institute of Fundamental Research, Homi Bhabha Road, Mumbai.



He has been elected primarily for his significant contributions to the behaviour of matter in intense ultrashort laser fields such as first ever experimental demonstration of ultrashort, megagauss pulses in dense, hot plasmas and 'real time' demonstration of electron-plasma wave breaking.

**Narinder Kumar Mehra** (b.04.11.1949), PhD, Department of Transplant Immunology and Immunogenetics, All India Institute of Medical Sciences, New Delhi.



He has pioneered transplant immunology and clinical immunogenetics and made original contributions in infectious, autoimmune and rheumatological diseases that have helped to understand molecular basis of their susceptibility.

**Rabindra Nath Mukherjee** (b.19.04.1953), PhD, Professor, Department of Chemistry, Indian Institute of Technology, Kanpur.



Professor Mukherjee has made significant contributions in co-ordination chemistry through directed synthesis of well-designed bio-mimetic model compounds and demonstrated their unusual magnetic interaction and studied structure-activity relationship.

**Javaregowda Nagaraju** (b.06.11.1954), PhD, Staff Scientist G and Group Leader, Laboratory of Molecular Genetics, Centre for DNA





Fingerprinting and Diagnostics, ECIL Road, Nacharam, Hyderabad.

Dr Nagaraju has been consistently working on genetic and genomic analysis of silk worm. He has developed a strategy to fight viral infection in silk worm. His contribution in developing hybrid silk worm has helped the farmers significantly.

**Ramakrishna Ramaswamy** (b.14.10.1953), PhD, Professor, School of Physical Sciences, Jawaharlal Nehru University, New Delhi.



He has made several important contributions in the area of non-linear dynamics understanding the onset of chaos and the implications of energy flow in molecules transcending borders of chemistry, physics and biology.

**Brindaban Chandra Ranu** (b.01.08.1949), PhD, Professor and Head, Department of Organic Chemistry, Indian Association for the Cultivation of Science, Kolkata.



Professor Ranu has made significant contributions in developing synthetic tools for Green Chemistry, has used ionic liquid as catalyst rather than medium and provided several innovative strategies in synthetic chemistry.

**Saurabh Dilsukhray Rindani** (b.13.06.1952), PhD, Senior Professor, Theoretical Physics Division, Physical Research Laboratory, Ahmedabad.



He has been elected primarily for his incisive contributions to the study of collider processes probing physics beyond the standard model, and his study of CP violation effects in top quark processes relevant to the proposed International Linear Collider.

**Manmohan Sarin** (b.26.07.1951), PhD, Professor, Planetary and Geosciences Division, Physical Research Laboratory, Ahmedabad.



He has been elected primarily for his versatile applications of geochemistry and isotope chemistry of river systems to

analysis of weathering processes and drawdown of atmospheric CO<sub>2</sub>.

**Chandrima Shaha** (b.14.10.1952), PhD, National Institute of Immunology, Aruna Asaf Ali Marg, New Delhi.

Dr Chandrima Saha has discovered a novel pathway and modes of cell death prevalent in Trypanosomatid parasite, *Leishmania donovani*, providing clues for potential points of interruption of infectivity. She has also identified novel pathways of apoptosis in spermatogenic cell death in response to toxic insult.



**Umesh Varshney** (b.26.10.1957), PhD, Department of Microbiology and Cell Biology, Indian Institute of Science, Bangalore.

Dr Varshney has made pioneering contributions in the areas of DNA repair and protein synthesis. His work showed that specific interactions between ribosome recycling factor and elongation factor G are crucial for ribosome recycling. Three-dimensional structures of a complex of Eco Ung with Ugi and extensive biochemical and mutational analyses by his research group have advanced our understanding of the mechanism of action of DNA repair enzymes.



**Karuppannan Veluthambi** (b.07.03.1953), PhD, Professor, School of Biotechnology, Madurai Kamaraj University, Madurai.

He has been elected primarily for his contributions to our understanding of T-DNA transfer mechanism and to the biology of mungbean yellow mosaic virus (MYMV), for developing an efficient agro-inoculation method for MYMV, and for developing a strategy for raising marker-free transgenic plants.



**Usha Vijayraghavan** (b.25.08.1961), PhD, Department of Microbiology and Cell Biology, Indian Institute of Science, Bangalore.

She has been elected primarily for elucidating the function of transcriptional regulators such as RFL, OsMADS1 and OsMADS2, which control inflorescence



branching and floral organ development in rice. Her recent work provides insights on the regulatory network between transcription factors and signaling molecules in control of floral organ differentiation.

### Foreign Fellows Elected – 2008

**Philip Warren Anderson**, (b.1923), *Professor, Department of Physics, Princeton University, Princeton NJ 08544, USA.*

Professor Anderson is the leading condensed matter physicist of the second half of the twentieth century. His work has started a number of areas e.g. localization of electronic states in disordered systems (Anderson localization); magnetism in insulators (Kramers-Anderson super-exchange) and metals (Anderson impurity and lattice); spin glasses (Edwards Anderson model); superfluidity in  $He^3$ ; broken symmetry and its quantum implications; weak localizations prebiotic evolution; quantum magnetism, resonating valence bond and high temperature superconductivity.

**David J Gross**, (b.1941), *Director and Federick W Gluck Professor of Theoretical Physics, Kavli Institute for Theoretical Physics, University of California at Santa Barbara, CA 93106-4030, USA.*

Professor Gross is one of the chief architects of the fundamental theory of the strong force which provides the basis for understanding the properties of strongly interacting particles and all of nuclear physics. He is also one of the discoverers of the “heterotic string theory”, which has the potential to incorporate all observed elementary particles and their interactions in a unified framework.

**Robert Harry Purcell**, (b.1935), *Co-Chief, Laboratory of Infectious Diseases, National Institute for Allergy and Infectious Diseases, National Institute of Health, Bethesda, MD, USA.*

Dr Purcell’s research on the aetiology of hepatitis has contributed to the discovery of every single hepatitis virus we know today. He has developed animal models to study the basic biology of these viruses and has developed blood tests for each of these viruses. His work has also contributed to the development of vaccines against hepatitis A, B and E.

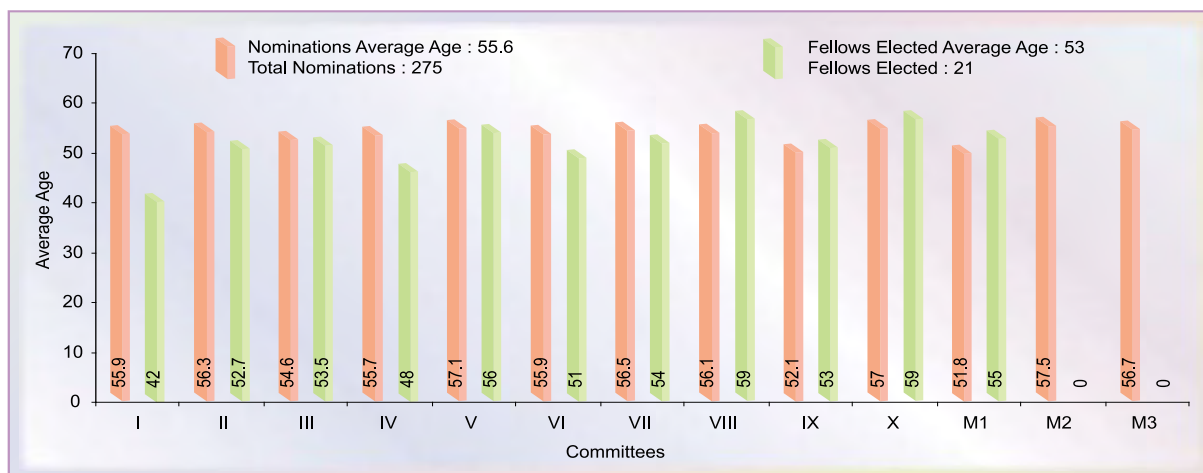
**Katepalli R Sreenivasan**, (b.1946), *Abdus Salam Research Professor and Director, International Centre for Theoretical Physics, Strada Costiera, 11, 34014, Trieste, Italy.*

For his significant contributions to fluid dynamics, condensed matter and statistical physics and allied areas.

**SR Srinivasa Varadhan**, (b.1940), *Professor of Mathematics and Frank J Gould Professor of Science, Courant Institute of Mathematics, New York 10012, USA.*

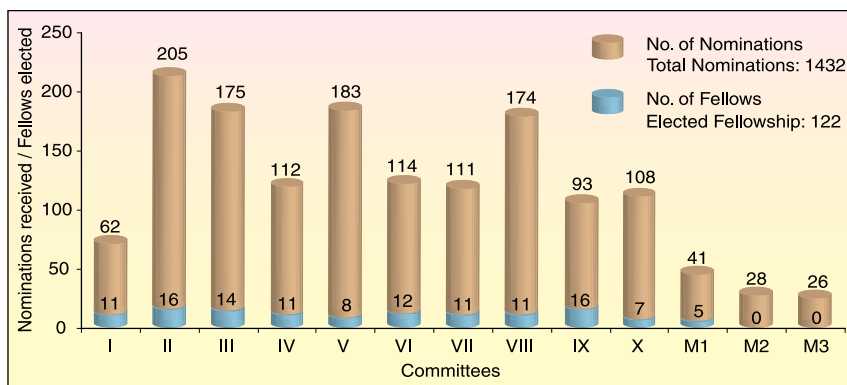
Professor Varadhan is an outstanding probabilist and a leading mathematician in the world today. He has provided unusual insights into probability theory and created powerful methods for a number of general problems; in particular for solutions of diffusion equations with non-Lipschitz coefficients and estimates for large deviation probabilities.

The Academy is deeply concerned about the age profile of the Fellowship. The average age of the Fellows is 66.6 years. Only 27 out of 770 Fellows are below 50 years. Therefore, there is a strong need to induct active young researchers. The Academy is also conscious about induction of women scientists in the Fellowship. At present, only 33 Women Fellows are in the Academy. Out of a total of 310 nominations, only 28 nominations of women scientists were received by the Academy for consideration of Fellowship. Data relating to the nominations received and Fellows elected are given in the following graphs.

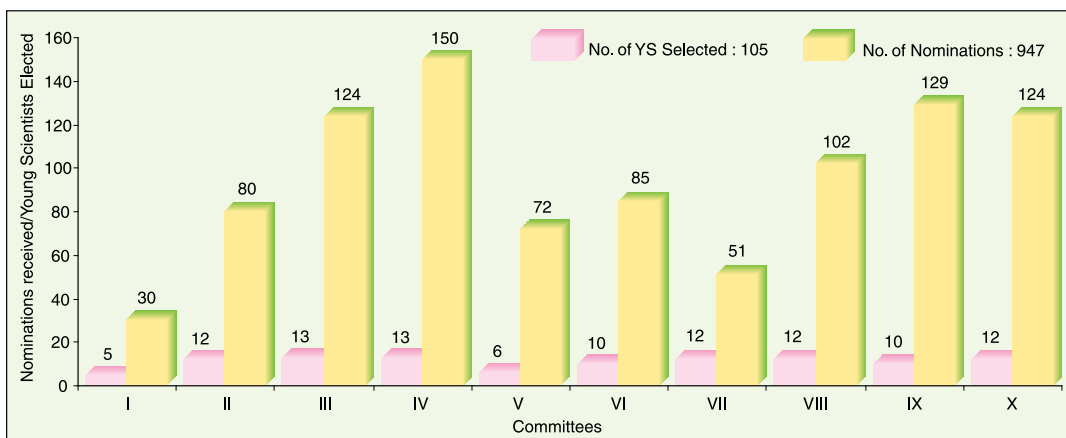


Nominations and Fellows Elected Average Age (Committewise 2008)

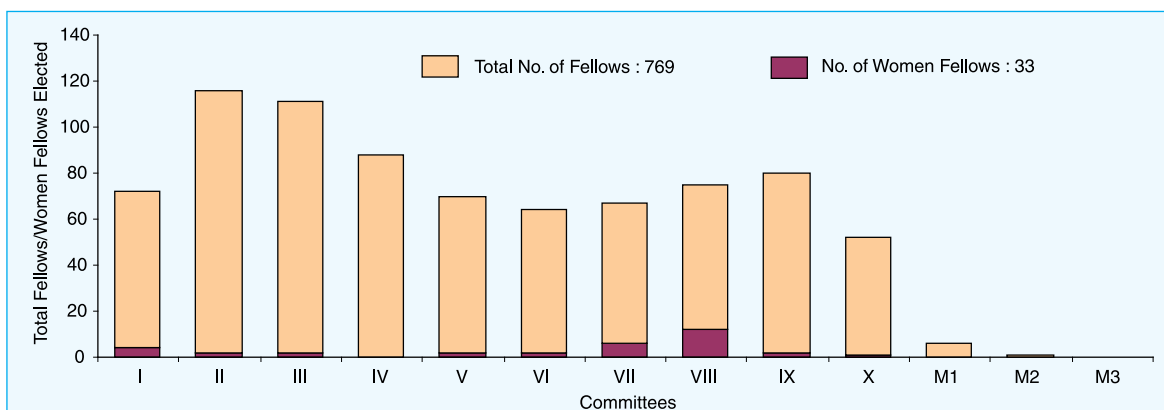




Nominations and Fellows Elected (Committeewise 2003-2008)



Nominations and Young Scientists Selected (Committeewise 2004-2008)



Number of Fellows vis-a-vis Women Fellows (Committeewise 2008)

### INSA MEDAL FOR YOUNG SCIENTISTS

The Academy instituted the INSA Medal for Young Scientists in 1974 with the aim of honouring young scientists of extraordinary promise and creativity who have made notable research contributions in Science and Technology. INSA Medal for Young Scientists award, considered to be the highest recognition of promise, creativity and excellence in a young scientist, is given annually to those distinguished for these attributes as evidenced by their research work carried out in India.

The award contains a medal, a certificate and a cash prize of Rs. 25000. This year (2007), 25 young research workers were honoured with INSA Medal for Young Scientists and one of the previous recipients, Dr Suman Chakraborty of Indian Institute of Technology, Kharagpur received the AK Bose Memorial Award. So far 503 young scientists have been thus recognized. Many of them have established a rewarding scientific career and continued to make outstanding contributions winning further honour both in the country and abroad.

## INSA Young Scientists Medal Awardees–2007

**Avinash Kumar Agarwal** (b.22.08.1972), PhD, Assistant Professor, Department of Mechanical Engineering, Indian Institute of Technology, Kanpur.



Dr Agarwal has been awarded Young Scientist Medal for his contributions to the development, utilization, lubricating oil tribology and impact assessment of biodiesel and its usage in compression ignition engines.

**Santanu Banerjee** (b.09.01.1976), PhD, Postdoctoral Research Fellow, Michael Granato's Laboratory, Department of Cell and Developmental Biology, University of Pennsylvania, School of Medicine, Philadelphia, USA.



He has been awarded for elucidating the role of intracellular calcium signaling in insect flight.

**Naveen Chandra Bisht** (b.01.02.1978), PhD, Staff Scientist II, National Institute for Plant Genome Research (NIPGR), JNU Campus, New Delhi.



He has been awarded for his work on developing improved molecular methods for pollination control used in heterosis breeding program. He was also involved in understanding the genetic mechanism and tagging of the loci involved in glucosinolates biosynthesis in *Brassica juncea*.

**L Sunil Chandran** (b.22.04.1974), PhD, Assistant Professor, Computer Science and Automation Department, Indian Institute of Science, Bangalore.



He has been awarded for elucidating fundamental insights in graph theory and its application to algorithms.



**Sangeeta Dhawan** (b.20.10.1975), PhD, Postdoctoral Fellow, 900A Weyburn Place North, Larry L Hillblom Islet Research Center, University of California at Los Angeles, CA-90095, USA

She has made significant contribution in understanding of the molecular mechanics of gene expression leading to silk gland development and differentiation in *Bombyx mori*.

**Subhash Ghosh** (b.23.10.1972), PhD, Scientist C, Bioorganic Laboratory, Indian Institute of Chemical Technology, Hyderabad.

He has been awarded for his excellent contributions in the total synthesis of biologically active natural products, comprising macrocyclic lactones, employing modern synthetic methods.



**Amita Gupta** (b.09.07.1972), PhD, Lecturer, Department of Microbiology, University of Delhi South Campus, New Delhi.

Dr Amita Gupta has done commendable work in antibody engineering and applied that to develop a novel diagnostic kit for HIV, which she has further modified for single point detection of both HIV serotypes. She has also begun interesting work on biology of *Mycobacterium tuberculosis* focusing on toxin-antitoxin interaction.



**Mukesh Jain** (b.27.08.1978), PhD, Research Scientist, Department of Plant Molecular Biology, University of Delhi South Campus, New Delhi.

He has been awarded the Young Scientist Medal for characterizing a large family of F-box protein encoding genes from rice with ramifications in engineering flowering time and abiotic stress tolerance in crop plants. He has also functionally validated a unique class of topoisomerase genes in rice, providing evidence for their role in conferring stress tolerance.



**Tushar Jana** (b.06.01.1975), PhD, Reader, School of Chemistry, University of Hyderabad, Hyderabad.

He has been awarded for his excellent contributions on the development of novel polymer materials for various applications



such as polymer electrolyte membrane fuel cell, polymer hydrogel based sensors, thermally stable energetic polymer binders for propellant.

**Pawan Laxminarayan Kulwal** (b.10.04.1977), PhD, Assistant Professor, Biotechnology Centre, Department of Agricultural Botany, Dr Panjabrao Deshmukh Krishi Vidyapeeth, Akola.



He has been awarded for his interesting work on wheat Quantitative Trait Loci.

**Anish Kumar** (b.15.09.1975), PhD, Scientific Officer-E, Non Destructive Evaluation Division, Indira Gandhi Centre for Atomic Research, Kalpakkam.



He has made significant contribution in correlation of elastic constants to ultrasonic velocity and engineering application of ultrasonic parameters for characterization of microstructure and mechanical properties in metallic materials.

**Ramaswamy Manimekalai** (b.17.02.1973), PhD, C/o Dr Shoshi Kikuchi, Plant Genome Research Unit, Division of Genome and Diversity Research, National Institute of Agrobiological Sciences (NIAS), Kan'on dai 2-1-2, Tsukuba Ibaraki 305-8602, Japan.



She has made outstanding contribution in molecular markers in coconut and arecanut.

**Mohan Mondal** (b.03.11.1973), PhD, Scientist, National Research Centre on Mithun (ICAR), Jharnapani, Medziphema, Via Dimapur, Nagaland.

He has been awarded the Young Scientist Medal for his contribution towards the development of highly sensitive, rapid and economic ELISA for various protein and steroid hormones; his very extensive work on endocrinology of growth, reproduction and lactation in Mithun, an animal of North-east India.



**Sunil Nair** (b.11.03.1974), PhD, Alexander von Humboldt Fellow, Max Planck Institute for Chemical Physics of Solids, Dresden, Germany.



Dr Nair has built a state of the art high field Vibrating Sample Magnetometer and low field AC Susceptometers working at low temperatures. Using these systems, he has obtained valuable insights into phase transitions and glassy behaviour in manganites.

**Priya Panjabi** (b.15.12.1974), PhD, Research Scientist, Department of Genetics, Centre for Genetic Manipulation of Crop Plants, University of Delhi South Campus, New Delhi.

She has been awarded for developing a novel transposon mutagenesis system in plants as a powerful technique to decipher gene functions and its successful testing in *Arabidopsis*. She has also contributed significantly in the development of a comparative map between *Arabidopsis thaliana* and *Brassica juncea* by generating a large number of PCR-based markers from linkage groups of *Arabidopsis*.



**Subramaniam Anantha Ramakrishna** (b.30.11.1972), PhD, Assistant Professor, Department of Physics, Indian Institute of Technology, Kanpur.

He has made notable contribution in the design of negative magnetic permeability and negative refractive materials at optical frequencies, studies on the photonic properties and propagation aspects in these metamaterials.



**Anand Ranganathan** (b.04.12.1972), PhD, Research Scientist, Recombinant Gene Products Group, International Centre for Genetic Engineering and Biotechnology, Aruna Asaf Ali Marg, New Delhi.

Dr Ranganathan has invented a very original and novel procedure for *in vitro* protein evolution. This methodology is likely to have an impact in the areas of protein engineering and protein therapeutics.





**Majeti Naga Venkata Ravi Kumar** (b.26.06.1972), PhD, Assistant Professor, Department of Pharmaceutics and Center for Pharmaceutical Nanotechnology, National Institute of Pharmaceutical Education and Research, SAS Nagar, Punjab.



Dr Ravi Kumar, through independent work has generated proof of principle for several nano-based novel drug delivery systems related to cyclosporine and anti-cancer drugs.

**Arvinder Singh Sandhu** (b.19.07.1975), PhD, Sr. Research Associate, JILA, 440 UCB, University of Colorado, Boulder CO, USA.



Dr Sandhu has made notable contributions to experimental studies of laser-matter interactions. His innovative work has helped to unveil many hitherto little understood facets of strong field physics.

**PS Satheshkumar** (b.24.01.1977), PhD, Postdoctoral Fellow, Laboratory of Viral Diseases, NIAID, National Institute of Health, Building 33, Room 1E13C, 33, North Drive, MSC 3210, Bethesda, MD, USA.



Dr Satheshkumar made significant contributions towards establishing the mechanism of polyprotein processing and the functions of VPg as activator of the protease in *Sesbania* mosaic virus. He also established the assembly pathway of the virus by structure based mutational analysis.

**Dhruv Kam Sethi** (b.07.04.1976), PhD, Research Fellow, Dana-Farber Cancer Institute, 44 Binney Street, D 1410, Boston, MA, USA.



Dr Sethi has investigated the structural basis of generating antibody diversity and provided a novel mechanism for generating multiple specificity which involves varied antigen juxtaposition on the antibody.

**Navdeep Singh Sodhi** (b.24.01.1972), PhD, Reader, Department of Food Science and Technology, Guru Nanak Dev University, Amritsar.



Dr Sodhi has been given the Young Scientist Medal for his involved work on starches of rice which could replace corn based materials.

**Vishwanath Sriram** (b.17.03.1977), PhD, Young Investigator (Fellow-E), National Centre for Biological Sciences, UAS-GKVK Campus, Bellary Road, Bangalore.



He has made significant contribution in studies on membrane dynamics in a genetic system of *Drosophila*.

**Parinda Vasa** (b.06.05.1977), PhD, Postdoctoral Fellow (Alexander von Humboldt Fellowship), Theoretische Physik I, Technische Universitaet Ilmenau, Ilmenau, Germany.



Dr Vasa has made her contribution in understanding the optical properties of semiconductor and metal nano-structures and successfully designing and implementing a novel interferometric approach to study non-linear optical prospectus of nanostructures with unprecedented sensitivity.

**TNC Vidya** (b.05.08.1976), PhD, Postdoctoral Student, Dept. of Botany and Zoology, Stellenbosch University, Stellenbosch, South Africa.



Dr Vidya has been awarded for her pioneering application, in India, of molecular techniques to the study of social organization, conservation biology, and phylogeography of endangered species, especially the Asian elephant.

**Anil Kumar Bose Memorial Award for the Year 2007**

**Suman Chakraborty** (b.1973), Assistant Professor, Department of Mechanical Engineering, Indian Institute of Technology, Kharagpur.



Dr Chakraborty has been given the award for his paper on



"Transport mechanisms of falling crystals detached from the freezing front during solidification of a hypereutectic binary mixture" published in Physical Review Letters, 2005, V 95: pp 024504 (1-4).

### Fellows Deceased During 2007-08

*With profound regret the Academy reports the sad demise of the following esteemed Fellows during 2007-08.*

**KD Abhyankar**, formerly Professor of Astronomy, Osmania University, Hyderabad.

**Debidas Basu**, former Director, Indian Association for the Cultivation of Science, Kolkata.

**K Bhaskaran**, formerly Scientist, Central Drug Research Institute, Lucknow.

**PR Gajri**, formerly Sr. Soil Physicist, Department of Soil, Panjab Agricultural University, Ludhiana.

**J Ganguly**, formerly Chairman, Department of Biochemistry and Head of the UGC Centre for Advanced Study in Biochemistry, Indian Institute of Science, Bangalore.

**N Gopinath**, Emeritus Professor, All India Institute of Medical Sciences, New Delhi.

**PK Maitra**, formerly Emeritus Scientist, Indian Institute of Technology, Bombay, Mumbai.

**GK Manna**, formerly Professor and Head, Department of Zoology, Kalyani University, Kalyani.

**AP Mitra**, Honorary Scientist of Eminence, National Physical Laboratory, New Delhi.

**AS Mukherjee**, formerly Professor, Department of Zoology, Calcutta University, Kolkata.

**R Narasimhan**, Chairman, Engineering Mechanics Unit, Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore.

**AK Rao**, Professor and Director, Engineering Staff College of India, Viswesharayya Bhavan, Khairatabad, Hyderabad.

**Archana Sharma**, formerly Professor, Botany Department, Calcutta University, Kolkata.

**GP Sharma**, Professor Emeritus, Zoology Department, Panjab University, Chandigarh.

**J Thomas**, formerly Adviser, Department of Biotechnology, Indian Institute of Technology, Chennai.

**VVR Varadachari**, formerly Director, National Institute of Oceanography, Goa.



# Awards and Honours

A country's scientific progress is critically dependent on the scientific exploits and achievements of its scientists. The success of the scientific community, however, hinges not just on the facilities provided and the funds pumped in. Success in scientific endeavours demands, in equal measure, inspiration and encouragement that goad a scientist to reach for newer heights.

The Academy has taken it upon itself the extremely important responsibility of spotting scientific talent in the country, nurturing it, and encouraging and supporting it to explore ever-new horizons and scale new peaks of success. INSA plays a leading role in awarding excellence through a number of awards (63) that it has instituted in different categories like International Awards, General Medal/Lecture Awards and Subject-wise Medal/Lecture Awards. The Academy's awards are considered prestigious and are coveted by scientists of all disciplines.

About one third of the total awards (22-25) are given every year. Awards announced during the past year are given below:

## GENERAL MEDALS/LECTURES (2008)

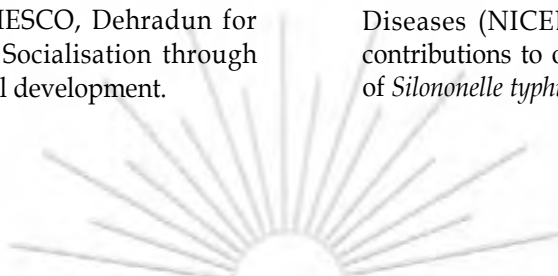
1. **The Indira Gandhi Prize for Popularization of Science** to Shri Arvind Gupta, Inter-University Centre for Astronomy and Astrophysics, Ganeshkhind, Pune.
2. **The INSA Medal for Promotion and Service to Science** to Professor MM Sharma, FNA, Emeritus Professor of Eminence and Formerly Professor of Chemical Engineering and Director, University Institute of Chemical Technology, Mumbai.
3. **Jawaharlal Nehru Birth Centenary Lecture** to Professor Biman Bagchi, FNA, Professor and Chairman, Solid State Chemistry Unit (SSCU), Indian Institute of Science, Bangalore.
4. **Jawaharlal Nehru Birth Centenary Lecture** to Professor Avadesha Surolia, FNA, Director, National Institute of Immunology, Aruna Asaf Ali Marg, New Delhi.

5. **The Daulat Singh Kothari Memorial Lecture** to Professor Yash Pal, FNA, National Research Professor and Chancellor, Jawaharlal Nehru University, New Delhi.

## Subjectwise Medal/Lecture Awards (2007)

1. **The Satyendranath Bose Medal** to Professor DP Roy, FNA, Homi Bhabha Centre for Science Education, Tata Institute of Fundamental Research, VM Purav Marg, Mumbai for extensive and influential contributions to the area of collider physics and neutrino oscillations.
2. **The Jagadis Chandra Bose Medal** to Professor SK Brahmachari, FNA, Director-General, Council of Scientific and Industrial Research (CSIR), Rafi Marg, New Delhi for establishing his leadership in functional genomics effectively integrating experimental and computational approaches.
3. **The Darashaw Noshervani Wadia Medal** to Professor VK Gaur, FNA, Distinguished Professor, Indian Institute of Astrophysics, Bangalore for his fundamental contributions to Earth Science research.
4. **The Syed Husain Zaheer Medal** to Professor KT Jacob, FNA, Department of Materials Engineering, Indian Institute of Science, Bangalore for his contributions to modeling of high temperature systems and processes; phase equilibria of a wide range of systems using the science to realize solid state sensors for process control.
5. **The Golden Jubilee Commemoration Medal for Chemical Sciences** to Professor S Chandrasekaran, FNA, Division of Chemical Sciences, Indian Institute of Science, Bangalore for his outstanding contributions to synthetic organic chemistry and in particular to Organometallic chemistry of molybdenum.
6. **The Golden Jubilee Commemoration Medal for Biological Sciences** to Professor GP Talwar, FNA, Talwar Research Foundation, New Delhi for his

- immense contributions to diverse areas of modern biology. His contributions with regard to immune interventions in fertility regulation and leprosy vaccine are well known.
7. **INSA-Vainu Bappu Memorial Award** to Dr T Padmanabhan, FNA, Dean, Core Academic Programmes, Inter-University Centre for Astronomy and Astrophysics, Pune for his critical analysis of the supernova data on acceleration of universe and the problem of dark energy.
  8. **Professor Brahm Prakash Memorial Medal** to Dr VS Arunachalam, FNA, Founder and Chairman, Centre for Study of Science, Technology and Policy (CSTEP), Bangalore for his outstanding contributions to materials science and engineering and for motivating a large number of colleagues and organizations. His research work in mechanical behaviour of two phase alloys and physical metallurgy of titanium alloys is outstanding. He is builder of programmes and institutes.
  9. **Professor K Naha Memorial Medal** to Professor AK Singhvi, FNA, Planetary and Geoscience Division, Physical Research Laboratory, Navrangpura, Ahmedabad for his fundamental contributions towards developing new dating techniques for understanding Earth Processes.
  10. **Professor Krishna Sahai Bilgrami Memorial Medal** to Dr SK Apte, FNA, Associate Director, Bio-Medical Group (B) and Head, Molecular Biology Division, Bhabha Atomic Research Centre, Mumbai for his significant work on understanding the molecular mechanism of highly proficient DNA repair and radio resistance of *Deinococcus radiodurans*.
  11. **The Chandrakala Hora Memorial Medal** to Professor Samir Bhattacharya, FNA, School of Life Sciences, Department of Zoology, Visva-Bharati, Santiniketan (West Bengal) for his seminal contributions on fish endocrinology which will find use in the formulation of new methods to augment egg productions in the commercially important fish species.
  12. **Professor Bal Dattatraya Tilak Lecture** to Dr Anil Prakash Joshi, Director, HESCO, Dehradun for Promotion of Technology Socialisation through Innovative approach to rural development.
  13. **Professor MRN Prasad Memorial Lecture** to Professor SK Saidapur, FNA, Vice-Chancellor, Karnatak University, Dharwad for his significant contributions to comparative reproductive physiology of vertebrates.
  14. **The Bashambar Nath Chopra Lecture** to Professor Akhilesh K Tyagi, FNA, Professor and Director, Interdisciplinary Centre for Plant Genomics and Department of Plant Molecular Biology, University of Delhi, South Campus, New Delhi for his contributions towards completion of the rice genome sequence and identifying a novel class of zinc finger protein genes with ramifications in engineering plants with increased abiotic stress tolerance.
  15. **Dr Biren Roy Memorial Lecture** to Professor V Ramamurti, FNA, Formerly Professor, Indian Institute of Technology - Madras, Chennai for his contribution in the area of Stress analysis and vibration related to mechanical Engineering and impact on Indian engineering industries.
  16. **Dr TS Tirumurti Memorial Lecture** to Professor UC Chaturvedi, FNA, Formerly Professor and Head, Department of Microbiology, KG Medical College, Lucknow for his contributions to understanding the mechanisms of dengue haemorrhagic fever.
  17. **Dr Nitya Anand Endowment Lecture** to Professor Santanu Bhattacharya, FNA, Department of Organic Chemistry, Indian Institute of Science, Bangalore for designing cationic lipid that could be used for the transfection of DNA/RNA into human cells.
  18. **INSA Prize for Materials Science** to Professor G Sundarajan, FNA, Director, International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI), Hyderabad for his major contributions to tribological behaviour of metallic and ceramic materials and to laser surface modification to improve wear resistance. High rate plastic flow of materials particularly under ballistic impact is another significant contribution.
  19. **Dr Darshan Ranganathan Memorial Lecture** to Professor Maharani Chakravorty, FNA, Honorary Scientist, National Institute of Cholera and Enteric Diseases (NICED), Kolkata for her significant contributions to our understanding to the biology of *Silomonella typhimuzation*.



# National Science Day

Shri Arvind Gupta, Inter-University Centre for Astronomy and Astrophysics, Pune was conferred on the Indira Gandhi Prize for Popularization of Science - 2008 on the National Science Day - 28 February 2008 after delivering the lecture entitled *Toys from Trash* in the Academy premises. Shri Gupta has been on science popularization activities since over 25 years after graduating in Electrical Engineering from Indian Institute of Technology, Kanpur. In fact, he worked tirelessly to make science interesting for school students through his innovative ideas producing toys made from inexpensive tools/teaching aids. Apart from this activity, he has been on the campaign for a long period creating/writing popular science articles published in Science Age, Science Reporter, Chakmak, Vigyan Pragati and several other magazines of popular interest. He has written a dozen books on low-cost innovative science



Professor M Vijayan presenting medal to Shri Arvind Gupta for Indira Gandhi Prize for popularization of Science after the National Science Day Lecture

experiments and toys primarily to generate interest in school children learning science as a fun. His debut book entitled "*Matchstick Models and Other Science Experiments*" was translated in thirteen Indian languages and widely appreciated.

Prior to the lecture on *Toys from Trash* a film show created by Shri Gupta was screened. This was a live demonstration of the toys and experiments he developed for the school children. This was followed by the lecture by Shri Gupta who started with demonstration of experiments with simple toys made out of matchsticks, plastic sheets, straws, jute fibre, newspapers etc. and narrated several simple scientific principles underlying the working of these toys which we encounter during our daily life but remain unnoticed. His created toys are extremely interesting to learn science and its principles for students at grass root level. Some of his toys and experiments are depicted in the following figures.

The lecture was well attended by a large number of school students from local public schools along with their teachers who took keen interest in observing the audiovisual live demonstration of experiments and toys developed by Shri Gupta for school students. Several distinguished Fellows of the Academy attended the lecture including Prof Yash Pal who has been a constant source of inspiration to him and was also his mentor when Shri Gupta was working with Hoshangabad Science Teaching Programme an innovative project to create science learning interesting among school students through inexpensive science teaching aids using locally available materials.

*Toys from Trash* books and photos can be seen on his website <http://arvindguptatoys.com>.





## Local Chapters

Nurturing science and promoting excellence in every corner of the country is one of the avowed objectives of the Academy. Towards this end, INSA has established Local Chapters in different regions of the country. These Local Chapters have been established at places where five or more Fellows reside. The primary aim of these chapters is stoking the fire of curiosity among students, popularizing science among the masses, strengthening existing scientific activities, and promoting interaction amongst the local scientific community, local academies and learned bodies and the Indian National Science Academy.

The activities undertaken by the Local Chapters range from scientific lectures by eminent and well-known experts and meetings/seminars on issues of critical scientific importance to workshops and debates for students. The implicit aim of the Local Chapters is spawning dynamic scientific movements in every corner of the country. Such activities are particularly helpful in awakening the latent scientific talent among students, guiding those who are on the verge of embarking on a career and inspiring those who have already ventured on to the path of a scientific career. Often scientific issues of critical importance to the country are debated and discussed at these Local Chapters providing solutions to weighty problems.

Presently, there are 18 Local Chapters in different regions of the country. Most of the INSA Award Lectures are delivered under the aegis of the Local Chapters (*Annexure-I*). Activities of some of the Local Chapters are described below:

**AHMEDABAD (Convener: Professor AK Singhvi, FNA, Physical Research Laboratory, Navrangpura, Ahmedabad):** The annual meeting of Fellows was enlarged to have an interaction with College Principals, Heads of Departments and Representatives of Gujarat Science Academy, Community Science Centre and Science City of Gujarat etc. The following lectures were organized and delivered under the auspices of Ahmedabad Local Chapter: (i) *Dimensions of Nano Sciences* by Professor AK Sood, FNA, Indian Institute of Science, Bangalore on September 26, 2007 at Ahmedabad

Management Association Hall, Ahmedabad; (ii) *Wonders and Challenges of Plasma Sciences* by Professor Abhijit Sen, FNA, Institute for Plasma Research, Bhat, Gandhinagar on October 26, 2007; (iii) *Challenges of being a Scientist: a Life of Toil and Fun* by Professor D Lal, FNA, Scripps Institution of Oceanography, San Diego, USA on January 18, 2008 (iv) *A Scientist's Search for the Truth* by Professor T Geherals, University of Texas on February 08, 2008; and (v) *The Challenge of New Horizons in Basic Sciences* by Professor GK Mehta, Inter-University Accelerator Centre, Jawaharlal Nehru University, New Delhi and Indian Institute of Technology-Kanpur on March 10, 2008 all at Ramanathan Auditorium, Physical Research Laboratory (PRL), Ahmedabad. The basic focus of these lectures was to bring to students, the excitement of science and the challenges for the next decades. These were well attended by the students of schools, colleges and parents. Given that parents are often the motivators in career choice; an extra effort was made to bring them to these lectures. The lectures were widely announced through electronic media and through newspaper advertisement. Competition for students for presentations on the theme "Winners of Nobel Prizes-2007" was organized. This was a new feature and was aimed to enthuse, school and college students to explore the works of Nobel laureates and make a presentation. The response was excellent and a competition to select the best presentation was held with the Jury being the Heads of the Departments of Physics, Botany and Chemistry of Gujarat University and two former Deans of PRL. Two categories were made, comprising pre- and post-higher secondary students and based on the quality of presentation and level of understanding of the subject (as determined by responses to questions from the Jury); five students were selected for presentation during the National Science Day at PRL. These included over 50 schools from the state of Gujarat. Enthused by the success of this activity, it is proposed that this will be held on a bigger scale next year in January and on a bigger scale.

**ALLAHABAD (Convener: Professor Amitava Raychaudhuri, FNA, Director, Harish-Chandra Research Institute, Allahabad):** The following programmes were

arranged under Science Education Programme at Motilal Nehru National Institute of Technology, Allahabad: (i) Lecture entitled *Superheated Liquid and its Application* by Professor SC Roy, Editor in Chief, Indian Science News, Kolkata on July 13, 2007 (ii) *The Dynamic Earth* by Professor VK Gaur, FNA, Distinguished Professor, Indian Institute of Astrophysics, Bangalore on August 13, 2007; (iii) *Rocks, Soils and Environmental Pollution* by Dr Bikas Raymahashay, Former Professor of Geology, IIT, Kanpur on September 28, 2007; (iv) *Some Interesting Fluid Dynamic Aspects in Solidification Phase Change of Binary Systems* by Dr Suman Chakraborty, Associate Professor, Department of Mechanical Engineering, Indian Institute of Technology, Kharagpur on November 05, 2007; (v) *Mysteries of Space, Time and Elementary Structure* by Professor Soumitra Sengupta, Indian Association for the Cultivation of Science, Kolkata on November 16, 2007. The series of lectures at HRI includes (vi) *Reminiscences of some Indian Scientists* by Shri Samarjit Kar, Editor, Indian Science News, Kolkata on July 13, 2007 at Harish-Chandra Research Institute, Jhansi, Allahabad; (vii) *Some Open Problems of Current Interest in the Physical and Earth Sciences* by Professor Soumitra Sengupta, Indian Association for the Cultivation of Science, Kolkata and (viii) *Physics and Chemistry of Earth's interior* by Professor Alok K Gupta, Vice-President INSA, University of Allahabad on November 18, 2007 at National Centre for Experimental Mineral Mineralogy and Petrology, Allahabad (ix) *The Play of Disorder and Intractions and Electron Systems* by Professor Pinaki Majumdar, Harish-Chandra Research Institute, Allahabad on December 10, 2007 at the Department of Physics, University of Allahabad, (x) Dr GP Chatterjee Memorial Lecture (2006) entitled *Towards Quieter Technologies* was delivered by Professor ML Munjal, FNA, Department of Mechanical Engineering, Indian Institute of Science, Bangalore on September 19, 2007 at Motilal Nehru National Institute of Technology, Allahabad. (xi) Professor BK Agrawal, FNA, Physics Department, Allahabad University arranged a brainstorming programme for the Higher Secondary school teachers. In this meeting, discussions took place about the *Wave Nature of Light*. Questions which cropped up during teaching this subject were addressed in the meeting.

**BANGALORE (Convener: K Muniyappa, FNA, Department of Biochemistry, Indian Institute of Science, Bangalore):** A meeting was organized by INSA Bangalore Chapter to induct Professor SR Srinivasa Varadhan, INSA Foreign Fellow into the fellowship of the Academy on February 05, 2008. The function was held in the Department of Biochemistry, Indian Institute of

Science, Bangalore. Professor M Vijayan, President, INSA, Professors N Balakrishnan and Ajay Sood Vice-Presidents and a few Fellows of the Academy and several others attended the meeting. Professor Vijayan introduced Professor Varadhan and presented the medallion and fellowship scroll to him. The following award lectures were organized under the auspices of INSA Bangalore Local Chapter: (i) Professor KS Bilgrami Memorial Medal (2007) entitled *Living Dangerously- The Deinococcus Way* was delivered by Professor SK Apte, FNA, Associate Director, Bio-Medical Group (B) and Head, Molecular Biology Division, Bhabha Atomic Research Centre, Mumbai on October 29, 2007; (ii) Dr TS Tirumurti Memorial Lecture (2007) entitled *Dengue-Specific Regulatory T Cells: Role in Pathogenesis* was delivered by Professor UC Chaturvedi, FNA, Formerly Professor and Head, Department of Microbiology, KG Medical College, Lucknow on November 23, 2007; (iii) Professor VV Narlikar Memorial Lecture (2006) entitled *Landau-Lifshitz-Gilbert (LLG) Equation of Ferromagnetism: A Challenging Nonlinear Evolution Equation in Applied Mathematics* was delivered by Professor M Lakshmanan, FNA, Professor of Eminence and DST Ramanna Fellow, Centre for Nonlinear Dynamics, Bharathidasan University, Tiruchirappalli on December 19, 2007 at Department of Mathematics, Indian Institute of Science, Bangalore.

**BHUBANESWAR (Convener: Professor AV Khare, FNA, Institute of Physics, Sachivalaya Marg, Bhubaneswar):** The Prasanta Chandra Mahalanobis Medal (2002) entitled *Overview of Indian Power System and Challenges Ahead* and The Syed Husain Zaheer Medal (2004) entitled *Energy and Environment* were delivered by Professor J Nanda, FNA, Visiting Honorary Professor, Department of Electrical Engineering, Indian Institute of Technology-Delhi, New Delhi on December 26, 2007 at Silicon Institute of Technology, Bhubaneswar under the auspices of Bhubaneswar Local Chapter.

**CHANDIGARH (Convener: Professor RC Mahajan, FNA, Deptt of Parasitology, Post-Graduate Institute of Medical Education and Research, Chandigarh):** The following activities were carried by Chandigarh Local Chapter: (i) Lecture on *From Pythagoras to Fermat's Last Theorem* by Professor Sudesh K Khanduja, FNA, Co-ordinator, Center for Advance Studies in Mathematics, Punjab University Chandigarh on April 27, 2007 in Department of Mathematics, Punjab University, Chandigarh; (ii) Lecture on *From the Model to Target to Proteomics: Where are we going* by Professor CS Dey, Head Department of Biotechnology, NIPER, Mohali on May 14, 2007 in Department of Zoology, Punjab University, Chandigarh; (iii) Lecture on *How Mycobacterium*

*Tuberculosis makes a living with the Enemy* by Professor Deepak Kaul, FNA, Department of Experimental Medicine and Biotechnology, PGIMER, Chandigarh on July 27, 2007 in Department of Biotechnology, Punjab University, Chandigarh; (iv) Lecture on *Vander Waals Interaction- A Modern Perspective* by Professor N Sathyamurthy, FNA, Director, Indian Institute of Science Education and Research, Mohali on January 24, 2008 in Seminar Room, Department of Biochemistry, Punjab University, Chandigarh.

The following activities were organized on the occasion of Science Day Celebration on February 27-28, 2008: (i) Lecture on *Student Education* by Professor RC Sobti, Vice Chancellor, Punjab University, Chandigarh on February 27, 2008; (ii) Lecture on *Tailored Nanomatter-Thin Film and Nanomaterials* by Professor KL Chopra, FNA by February 28, 2008; (iii) Lecture on *Agenda for Science - Who should decide* by Professor IP Abrol, FNA on February 28, 2008 all in Mathematics Auditorium, Punjab University, Chandigarh; (iv) *Model Display and Poster Presentation* entitled "Student Activity related to Science Dreams" - 15 teams from different Chandigarh Colleges and Science Departments of Punjab University participated; (v) *Creative Minds* entitled "Presentation of Creative Ideas related to Science in 2030" - 10 teams from different colleges and from different Science Departments of Punjab University participated; (vi) *Science Quiz* on February 28, 2008- 10 teams from different schools participated and (vii) *Panel Discussion* related to discussion about the scope of course offered by various Departments of the University.

**CHENNAI (Convener: Professor G Baskaran, FNA, Institute of Mathematical Sciences, Chennai):** The following series of meetings/lectures were organized by the INSA Chennai Local Chapter: (i) Prof Sajeew John (University Professor, University of Toronto) also Raman Professor of the Indian Academy of Sciences at Bangalore gave a Public Lecture on *Photonic Band Gap Materials: Semiconductors of Light* on October 16, 2007 at the Institute of Mathematical Sciences, Chennai and (ii) The Chandrakala Hora Memorial lecture for the year 2007 was delivered by Professor Samir Bhattacharya, FNA at National Institute of Ocean Technology, Chennai on November 15, 2007.

**DELHI (Convener: Professor Rajendra Prasad, FNA, School of Life Sciences, Jawaharlal Nehru University, New Delhi):** The following Lectures/Seminars/Discussion Meetings were organized by Local Chapter during the year: (i) Dr Darshan Ranganathan Memorial Lecture (2007) entitled *Bacteriophage MB78: Genomics and Proteomics* was delivered by Professor Maharani

Chakraborty, FNA, Hony' Scientist, National Institute of Cholera and Enteric Diseases (NICED, Kolkata on March 03, 2008; (ii) *Two Decades of Scientific* - Collaboration between Jawaharlal Nehru University and University of Bonn, Germany was delivered by Professor Milan Hofer, Institute of Botany, University of Bonn, Germany on February 25, 2008; (iii) *Life Sciences and Biotechnologies in the EU FP7 Research Programmes: Opportunities for EU-India Cooperation* was delivered by Professor Elisabetta Balzi, Scientific Officer, European Commission, Belgium on February 25, 2008; (iv) *Revealing the Complexity of the Erythorocyte Invasion Machinery of Plasmodium Falciparum: Global Screening of Putative Invasion-Related Proteins* was delivered by Dr Tim-Wolf Gilberger, Bernhard Nocht Institute for Tropical Medicine, Hamburg, Germany on November 14, 2007 and (iv) *SPINK/LEKTI: A Multidomain Serine Proteinase Inhibitor with Pathophysiological Relevance* was delivered by Dr Arumugam Jayakumar, Anderson Hospital, Texas, USA on August 10, 2007 all at Jawaharlal Nehru University, New Delhi.

**KOLKATA (Convener: Professor CK Das Gupta, FNA, Department of Biophysics, Molecular Biology and Genetics, University College of Science, University of Calcutta, Kolkata)** The Kolkata Chapter discussed the ways to promote science temperament to take research in science as a career. It was decided that the main thrust should be given in the rural and urban areas away from the Kolkata metro, since the students in Kolkata are generally privileged to have lectures, seminars, discussions etc. on science frequently in the city. The following Lectures / Seminars/Discussion Meetings were organized:

1. The Summer School at Indian Association for the Cultivation of Sciences during May 17-31, 2007 with about 100 High School students participation from all over West Bengal.
2. A Science workshop at Ananda Ashram Sarada Vidyapith, Kolkata on February 23, 2008 with High School Science students from 5 schools in North 24 Parganas. About 100 students from 5 schools attended it. There were two lectures on Molecular Biology and Chemistry followed by Poster presentation by the students who worked hard to collect information from books and mainly internet.
3. Open House in the Department of Biophysics, Molecular Biology and Genetics, College of Science, Calcutta University on 27.07.2007 for about 20 students of class XI from B.D. Memorial Institute at Narendrapur. They were told about the use of various instruments used in molecular biology labs



and demonstrated the use of some of them. They purified plasmids from cells and ran agarose gel electrophoresis.

4. Whole Day seminar in the Chemistry Department in Presidency College, Kolkata on March 18, 2008 in collaboration with West Bengal Council of Science and Technology. A number of distinguished speakers talked about their research and area of expertise. It was attended by many students from a number of colleges and schools in and around Kolkata.
5. The Jawaharlal Nehru Birth Centenary Lecture (2008) was delivered by Professor Biman Bagchi, FNA, Indian Institute of Science, Bangalore at IACS, Kolkata on February 13, 2008.

**LUCKNOW (Convener: Professor Rakesh Tuli, FNA, National Botanical Research Institute, Rana Pratap Marg, Lucknow):** The meetings of INSA Local Chapter were held on November 19, 2007 and January 01, 2008. The following four programmes with the school/colleges, university students, teachers scientists and several INSA Fellows were organized at National Botanical Research Institute, Lucknow under the aegis of INSA Lucknow Local Chapter: (i) *Inspiring Youth for Developing Leadership in Plant Sciences* on May 10-11, 2007; (ii) *Seminar on Revisiting Linnanean thoughts for Plant Diversity and Phylogenetic Analysis* on May 23-24, 2007; (iii) *Environmental Awareness Programme on Climate Change* on July 19, 2007 and (iv) Screening of the Film *An Inconvenient Truth* by Al Gore, Nobel Laureate on November 19, 2007.

**MADURAI (Convener: Professor G Marimuthu, FNA, Department of Animal Behaviour and Physiology, School of Biological Sciences, Madurai Kamaraj University, Madurai):** The following activities were carried out by Madurai Local Chapter for the period under report: (i) 64 students of Keswick School, Madurai alongwith a teacher visited the Madurai Kamaraj University, Madurai on June 29, 2007. The students were of VI to XII standards. They were taken to various Departments of the School of Biological Sciences of MKU; (ii) National Workshop on *GIS for Natural Resources and Disaster Management* was organized at Department of Geography, Bharathidasan University during March 3-7, 2008; (iii) A programme for school students was organized at the Centre for Marine Science and Technology, Manoonmaniam Sundaranar University, Tirunelveli, the first batch of 45 students was entertained on October 17, 2007, second batch of 41 students visited and was imparted with basic theoretical and practical knowledge in the field of Marine Science and Technology

on January 14, 2008 and the third batch of college students of 45 students visited the CMST on February 02, 2008; (iv) Visit of 1<sup>st</sup> Year (Physics) students of the American College was organized at Madurai Kamaraj University on March 24, 2008 (v) A one-day meeting *Science Day and Aqua-Terr Annual Conference* was organized at the School of Biological Sciences, Madurai Kamaraj University on March 29, 2008.

**MUMBAI (Convener: Professor SK Apte, FNA, Molecular Biology Division, Bhabha Atomic Research Centre, Mumbai):** Mumbai Chapter of the Indian National Science Academy organized the National Science Day celebrations on February 28, 2008 jointly with Bhabha Atomic Research Centre (BARC). As a part of the celebrations, about 200, XI standard science students were invited to BARC from various colleges, including the Atomic Energy Jr. College, Anushakti Nagar, SIES College, Sion; Swami Vivekanand College, Chembur and St. Xavier's College, Fort. The students were first briefed about the various facilities and thereafter taken around to visit DHRUVA Reactor, APSARA Reactor, Food Irradiation Processing Laboratory and Waste Management Division of BARC.

In the afternoon, three popular science lectures were delivered by Mumbai-based newly elected fellows of the Indian Academy of Sciences, Bangalore. Dr Srikumar Banerjee, FNA, Director, BARC, presided over the function held at the Central Complex Auditorium, BARC. He briefed students about the various R&D activities of BARC and elaborated the efforts that are being made to attract young minds to the field of R&D. Dr SM Sharma, Head, High Pressured Physics Division spoke on *Physics with Synchrotron Radiation*. Dr SK Apte, FNA, Associate Director, Bio-Medical Group delivered a talk entitled *Living Dangerously: the Deinococcus way*, wherein he described the extreme radio-resistance of this superbug and elucidated the biotechnological applications thereof. Prof Dulal Panda from the School of Biotechnology, IIT Mumbai discussed the importance of cell architecture in his talk entitled *Cytoskeleton and Human Disease*. Mr RK Sharma, Head, Media Relations and Public Awareness Section, BARC proposed a vote of thanks. The programme was attended by students and faculty member of several Mumbai colleges and a large gathering of scientists, engineers and other staff members of the BARC family.

**PUNE (Convener: Dr Sourav Pal, FNA, Physical Chemistry Division, National Chemical Laboratory, Pune):** The INSA Vainu Bappu Memorial Medal (2007) lecture entitled *Weight of the Cosmic Vacuum* was delivered by Dr T Padmanabhan, FNA, Dean, Core Academic

Programmes, Inter-University Centre for Astronomy and Astrophysics (IUCAA), Pune on August 17, 2007 at IUCAA Campus, Pune.

**VARANASI (Convener: Professor Rajiva Raman, FNA, Dept. of Zoology, Banaras Hindu University, Varanasi):**

The activities of the Varanasi Chapter were mainly focused towards the scheme of INSA for augmenting interest in Science in College students. Meetings of the Fellows were held periodically to discuss issues related to school Science Education as well as matters concerning research and teaching of science subjects in the Banaras Hindu University to which most of the local chapter fellows are affiliated. During March and May, 2007 a couple of meetings were held between the fellows and teachers from various schools in Varanasi to seek their advice and support in improving science teaching and kindle interest in science in school children. A calendar was adopted for lectures by INSA fellows (and other faculty from the University) in various schools and colleges in Varanasi city at nearby areas. Between July, 2007 and December various lectures were delivered in 5 schools of Varanasi who opted for these lectures. A two day workshop was held for school children (50 students) and their teachers (2 from each school) on September 8-9, 2007 in the Department of Zoology. In addition to two lectures each day in forenoon, students were taken around research labs in the Department of Geology, Physics, Zoology and Botany. During the workshop the students were encouraged to understand the working of the instruments, touch them and device some questions to perform small, virtual experiments upon them. On many occasions lectures were delivered in Hindi to make them understandable to the school children. The Darashaw Noshervanji Wadia Medal (2007) lecture was delivered by Professor VK Gaur, FNA, Distinguished Professor, Indian Institute of Astrophysics, Bangalore on

March 28, 2008 at Department of Geology, Banaras Hindu University, Varanasi. The function was presided over by Professor TV Ramakrishnan, FRS, FNA and presented the medal and citation to Professor Gaur. Varanasi Chapter of INSA also takes active interest in science teaching and research at Banaras Hindu University. During the current sessions, through its interventions, the local chapter drew University's attention towards plagiarism in science research in the country as well as the utility of foreign examiners for evaluating doctoral thesis. In our experience, motivating schools and colleges to interact with scientists and take benefit of it was an uphill task. The following lectures were organized under the aegis of Varanasi INSA Local Chapter: (i) *Origin of Man* by Professor Rajiva Raman, FNA, on June 23, 2007 at Delhi Public School, Varanasi; (ii) *What Atoms do when they get together in Large numbers* by Professor Y Singh on September 07, 2007; *What is Gene* by Professor SC Lakhotia and *Biotechnology: Its Scope and Applications* by Professor BD Singh on September 15, 2007 all at Bengali Tola School, Varanasi; (iii) *What is Gene* by Professor SC Lakhotia, FNA, on September 22, 2007; *Why a Career in Science: Possibilities and Preparation* by Professor TV Ramakrishnan, FNA on October 06, 2007 at Central Hindu Boys School, Kamachcha; (iv) *Our Universe* by Professor Y Singh, FNA on October 27, 2007; *Climate Change and Its Impact* by Professor JS Singh, FNA on October 30, 2007 and *What is a Gene* by Professor SC Lakhotia, FNA, on October 31, 2007 at Central Hindu Girls School, Kamachcha; (v) *What is a Gene* by Professor SC Lakhotia, FNA on October 02, 2007; *Can Stars Die* by Professor Y Singh, FNA on October 07, 2007; *Stem Cell Research and Prospects* by Professor Rajiva Raman, FNA on October 01, 2007; *Discover the Earth* by Professor Anand Mohan on November 03, 2007 and *How Does the Sun Shine* by Professor BN Dwivedi on November 21, 2007 all at Sunbeam English School, Bhagwanpur, Varanasi.



# International Programmes

## ADHERENCE TO INTERNATIONAL COUNCIL FOR SCIENCE (ICSU)

The Academy is the adhering body in India to the International Council for Science (ICSU) and to its 28 international Unions/Committees. ICSU activities in India are coordinated through an Indian National Committee. The Academy has also constituted a National Committee corresponding to each Union/International Committee. The National Committees are responsible for projecting the achievements of Indian science abroad and liaise with their international Unions/Committees.

The Academy facilitates participation of eminent Indian scientists to present achievements of Indian science in ICSU-sponsored General Assemblies/Congresses and also deliberate on policy matters that affect the International Science and Technology environment. The Academy facilitated participation of Indian scientists in the following Congresses/General Assemblies held abroad.

## ICSU-SPONSORED GENERAL ASSEMBLIES ABROAD

### General Assemblies held During 2007-08

1. XXIV International Union of Geodesy and Geophysics (IUGG) General Assembly in Perugia, Italy, July 2-13, 2007.
2. Scientific Committee on Solar-Terrestrial Physics (SCOSTEP) General Meeting in Perugia, Italy, July 14-15, 2007.
3. 44<sup>th</sup> International Union of Pure and Applied Chemistry (IUPAC) General Assembly, Torino, August 4-12, 2007.
4. 8<sup>th</sup> Conference of Asian Crystallographic Association, Taipei, Taiwan, November 4-7, 2007.
5. 16<sup>th</sup> International Biophysics Congress and International Union of Pure and Applied Biophysics (IUPAB) General Assembly, Long Beach, California, USA, February 2-6, 2008.

## Proposal to Organise ICSU Sponsored Meetings in India

1. International Congress of Mathematicians and International Mathematical Union (IMU) General Assembly 2010, Hyderabad, August 19-27, 2010.
2. 38<sup>th</sup> Committee on Space Research (COSPAR) General Assembly in Mysore in 2012.
3. International Geographical Union (IGU) Regional Conference in New Delhi in 2014.
4. International Union of Crystallography (IUCr) General Assembly in Hyderabad in 2014.
5. International Union of Geodesy and Geophysics (IUGG) General Assembly in Hyderabad in 2015.
6. International Union of Geological Sciences (IUGS) General Assembly in Hyderabad in 2016.

## Meetings of National Committees During the Period 2007-08

The following National Committees met during the period under report:

1. IUPAB (International Union of Pure and Applied Biophysics)
2. IUCr (International Union of Crystallography)
3. IUPAP (International Union of Pure and Applied Physics)
4. IAU (International Astronomical Union)
5. IUBMB (International Union of Biochemistry and Molecular Biology)
6. IUMS (International Union of Microbiological Societies)
7. IUGG-IGU (International Union of Geodesy and Geophysics - International Geographical Union)
8. IUGS-SCL-INQUA (International Union of Geological Sciences- Scientific Committee on Lithosphere-International Quaternary Research)
9. IUTAM (International Union of Theoretical and Applied Mechanics)



10. IMU (International Mathematical Union)
11. IUNS-IUPS-IUPHAR (International Union of Nutritional Sciences - International Union of Physiological Sciences - International Union of Pharmacology)
12. SCAR (Scientific Committee on Antarctic Research)
13. SCOR (Scientific Committee on Oceanic Research)
14. COSPAR-URSI-SCOSTEP (Committee on Space Research - International Union of Radio Science - Scientific Committee on Solar-Terrestrial Physics)
15. IGBP-WCRP-SCOPE (International Geosphere-Biosphere Programme - World Climate Research Programme - Scientific Committee on Problems of the Environment)
16. IUBS (International Union of Biological Sciences)
17. CODATA (Committee on Data for Science and Technology)
18. ICSU (International Council for Science)

### Scientists Contributing in International Bodies

A significant number of eminent Indian scientists have been elected to International Unions/Commissions/Committees involved in scientific activities under different capacities, such as Presidents, Vice-Presidents, Bureau Members, etc. The detailed list of such scientists is given in *Annexure-II*.

### Indian National Committee for International Years (2007-2008) – Report of Activities

On the 50<sup>th</sup> anniversary of the International Geophysical Year, the triennium year 2007 to 2009 is being celebrated as International Year of Planet Earth (IYPE, 2007-09), International Polar Year (IPY, 2007-08), Electronic Geophysical Year (eGY, 2007-08) and International Heliophysical Year (IHY, 2007-08). As a consequence of joint initiative by the International Union of Geological Sciences (IUGS), UNESCO and Founding Partners, the year 2008 is named as Year of Planet Earth by United Nations having more than 100 countries as its members. India has also, been involved in very inception of this initiative. The Academy constituted the Indian National Committee for International Years under the chairmanship of Professor HK Gupta, FNA. An MoU was signed between Indian National Committee of INSA and International Year of Planet Earth Corporation. The main agenda was to strengthen the Science and

the Outreach program of the International Years. Since then, several meetings related to international years are held and website <http://www.iypeinsa.org/> is created documenting the INSA initiatives.

Following are the activities carried out during the year 2007-2008:

- Counseling to strengthen the outreach programme of the various departments and NGOs.
- Organization of a workshop on the activities of International Years at INSA.
- Organization of all Indian Student contest as a part of the International student contest for the official launch of IYPE during February 12-13, 2008 at Paris.
- Encouraging India's participation in the International Events.

The outreach activities mainly connected with IYPE have been continued during last reporting year. It includes student rallies, student essay contest, putting of posters and calendars for public education on important issues like earthquakes, tsunamis, storm surges, ground water, oceans, floods, draughts, global warming etc. Professor Harsh Gupta, FNA and several members of the committee have been actively involved in the shaping of a massive outreach programme of Department of Science and Technology, Government of India (<http://www.vigyanprasar.gov.in/Planetearth/>), state departments (<http://mpcost.nic.in/ActionPlan.pdf>) and NGOs. A nation-wide contest for science posters by young students (18 to 20 years) as a part of international contest designed by IYPE International Secretariat, had received an excellent response. Entries were received from all over India and five students were selected from over hundred entries. It is pleasant to inform that all five of them were selected and invited by the International Committee of IYPE to participate in the Global Launch Event (GLE) of the IYPE at UNESCO Paris, and also to take part in the student contest, in which students from 67 countries participated. India was one amongst best represented countries other than China that had also sponsored five students to take part in the GLE.

Professor Harsh Gupta, FNA with five Indian Students attended the GLE, UNESCO, Paris meeting. The Indian students participated were Shri C Harish Kumar Gandhigram Rural Institute, Deemed University, Tamil Nadu, Aaditi Sinha, Lovely College, Rewari, B Ananthakrishnan, Gandhigram Rural Institute, Deemed University, Tamil Nadu, AM Vandana, Kasturba Gandhi

College for Women, Hyderabad, Vineetha Luther, DBS PG College, Dehradun.

Due to the global visibility of Indian IYPE programme, Ms. Aarti Mehra, Hon'ble Mayor of Delhi, was amongst the 10 invited keynote speakers in the official launch of IYPE at UNESCO, Paris on February 12, 2008. Participation of two major geoscience institutions represented by Shri PM Tejale, Director General, Geological Survey of India; Dr VP Dimri, Director, National Geophysical Research Institute; in the GLE, Paris had conveyed a very positive message of India's role in the international Years to the audience of Paris meeting. India as a country was most visible at the IYPE launch at Paris.



*Professor Harsh Gupta with five Indian Students in the GLE, UNESCO, Paris*

A meeting of national coordination committee was held on October 3, 2007 at INSA, New Delhi. On the same day a workshop was organised on the International Years. Eminent scientists from India and abroad spoke about International Years and discussed the Indian contributions and its role in the International Years. Professor Charles Barton, Chaire GY and Dr Werner Janoschek, Goodwill Ambassador of the IYPE participated in the workshop and appreciated Indian contributions.

During the entire period of 2007-2008, the INSA website on International Years (<http://iypeinsa.org/>) had been providing information about International Years and also connected to several other websites. The central secretariat located at NGRI, Hyderabad, has been serving as a nodal agency for interlinking the information about the activities of different organisations in and outside India. INSA has provided the financial support for maintaining the secretariat and website as well as partial support to other activities.

## International Cooperation with Overseas Academies and Organizations

Since its inception, the Academy has fostered scientific relationships with the prominent scientific academies and organizations of the world to develop and promote the internationalization of science. These relationships cover exchange of information/ publications and visits, organization of joint symposia/ seminars and collaborative research projects with the Science Academies/ Organizations in 37 countries in Europe, Asia, North America, South America and Latin America.

During the year 2007-08, 125 Indian scientists went abroad to work in academic and R&D institutions and 92 overseas scientists were received in India under the various exchange/International programmes. 89 Indian scientists have been selected to go abroad during 2008-09 to work in overseas R&D institutions in addition, two research projects under the INSA-JSPS Programme were initiated. The support to activities under INSA-JSPS Joint Research Projects and INSA-HAS Joint Research Projects approved for 2007-2009 continued.

### Signing and Renewal of Agreements

The Academy signed the MOU with the German Academy of Sciences Leopoldina on November 22, 2007 at INSA and with the Royal Society of Edinburgh (RSE) in Edinburgh on December 10, 2007 to promote cooperation in the field of S&T in the form of Joint Research Projects, exchange of scholars, for scientific and academic activities. The existing agreement with the French Academy of sciences was renewed on November 27, 2007. Agreement



*Professor M Vijayan and Professor VT Meulan exchanging the agreement of Scientific Cooperation between INSA and German Academy of Sciences, Leopoldina*





*Dr RA Mashelkar and Sir Michael Atiyah exchanging the agreement of Scientific cooperation between INSA and Royal Society of Edinburgh*

with the Chinese Academy of sciences was renewed on December 19, 2007 to further enhance and strengthen the cooperation with these academies.

### *Joint Seminars/ Symposia*

The 11<sup>th</sup> Indo-German Workshop on *Immunology and Health Disease* was held in Berlin from July 2-3, 2007 hosted by the Prof SHE Kauffman, Max Planck Institute for Infection Biology, Berlin with the participation of 7 member Indian delegation led by Dr SV Chiplunkar,

Head, Immunology, ACTREC, Mumbai. The workshop focused on Immunological aspects of disease and further enhanced scientific interaction and research collaboration in the areas especially relevant to our country viz tuberculosis, cancer, filariasis etc.

The 2<sup>nd</sup> Indo-Russian Symposium on *Organic Chemistry* was held as a part of the satellite symposium during the 100<sup>th</sup> Anniversary of Mendeleev Congress at the Zelinsky Institute of Organic Chemistry, Moscow, Russia during September 25-26, 2007. The symposium was hosted by the Russian Academy of Sciences. Professor S Chandrasekaran, Department of Organic Chemistry, IISc. Bangalore led a 10-Member Indian delegation to participate in the Symposium. The lectures delivered in the symposium encompassed many facets of organic chemistry including organometallic chemistry, new synthetic methodologies, carbohydrate chemistry, organofluorine chemistry, biologically active natural products, new chemical technologies and materials.

A Indo-German Joint Symposium on *Antimicrobial Drug Resistance and the Development of New Antibiotics* was held at INSA during November 21-25, 2007. The symposium was hosted by Professor SE Hasnain, Vice-Chancellor, University of Hyderabad and sponsored by the German Academy of Sciences Leopoldina. Eighteen German scientists in addition large number of Indian scientists participated in this Symposium.



*Delegates of organic chemistry Symposium*



A INSA-CAS Workshop on *Structural Biology* was held at Indian Institute of Science, Bangalore from December 21-24, 2007. It was hosted by Professor M Vijayan the then Vice-President, INSA. A 15 member Chinese delegation was led by Professor Jinghai Li, Vice-President, Chinese Academy of Sciences. In addition, a large number of Indian and Chinese scientists attended the meeting representing different areas of *Structural Biology* and also participated in the Workshop. The workshop was inaugurated on December 21 by Professor P Balaram, Director, Indian Institute of Science, at a function presided over by Professor N Balakrishnan, Vice-President INSA and Associate Director of the Institute. The gathering was addressed by Professor M Vijayan and Professor Jinghai Li, Vice-President of CAS. The function was followed by two keynote addresses, one by Professor SK Brahmachari, Director General, Council of Scientific and Industrial Research on *miRNA mediated novel regulatory networks: an in silico approach* and the other by Professor Rui-Ming Xu of Institute of Biophysics, Beijing on *Structural mechanisms of transcriptional silencing*. A third keynote address was delivered on the 22<sup>nd</sup> morning by Professor G Govil. The lecture was entitled *NMR studies on molecular details of intact spermatozoa*. Altogether 30

technical presentations, 20 by Indian scientists and 10 by Chinese scientists, were made at the workshop. They encompassed almost all aspects of structural biology. The programme also included a lively panel discussion on bioinformatics, involving six panelists and several participants from the floor. In addition, there were two discussion sessions, one on Indo-China interactions in structural biology and the other on the approaches and strategies in structural biology.

The 8<sup>th</sup> INSA-KOSEF Symposium on *Geo-science and Technology: Utilization of Geo-space as a Solution for Energy and Environment* was held during February 12-14, 2008 at Indian Institute of Technology, Kharagpur organized. The symposium was jointly sponsored by its Mining Engineering Department, and Geotechnical Engineering Division of Korea Institute of Geo-science and Mineral Resources (KIGAM), Korea. Five delegates from Korea and large number of Indian delegates from various academic institutions including one from Brazil attended the Symposium. Overall, this symposium deliberated on the production, utilization and security of energy with due consideration to the environmental issues and focused light on the advances, challenges and issues related to the effective utilization of geo-space



↑ Professor Jinghai Li addressing Workshop on Structural Biology held at IISc, Bangalore



→ Inauguration of Indo-Korea Symposium of Utilization of Geospace as a Solution for Energy and Environment

for the production of affordable energy with definite measures for the clean environment.

The India-UK Frontiers of Science Symposium was organized jointly by INSA and the Royal Society, London from March 4-7, 2008 at Ramoji Film City, Hyderabad. About 70 young post doctorate scientists both from India and UK participated in the symposium. Professor M Vijayan, President, INSA and Professor Lorna Casselton, FRS, Foreign Secretary, The Royal Society, London graced the Inaugural Session held on March 4, 2008. Professor Vijayan gave an invited lecture on *Half a Century of Molecular Structural Biology in India - A Personal Perspective*, which caught the attention of eminent scientists present there. Professor R Gadagkar, FNA, Indian Institute of Science, Bangalore on behalf of INSA and Professor Anne Donaldson, University of Aberdeen, Foresterhill, Aberdeen on behalf of the Royal Society, London Co-Chaired the Symposium. The main objective of the symposium was to bring together outstanding young scientists to discuss cutting-edge research in a variety of disciplines and to build ties between future scientific leaders in both the countries. The Symposium had eight Sessions covering the areas are 1) Microbiology -Chromatin packaging in the cell nucleus; 2) Geosciences-Crust-mantle interaction in tectonically active zones of the earth; 3) Astronomy/Astrophysics-Fluctuations in the early universe; 4) Macrobiology-"Listening in

the dark" - how crickets use song to attract and select mates; 5) Mathematics-Mathematical immunology; 6) Chemistry- Organic photovoltaics; 7) Neurosciences-Pattern formation in the central nervous system; and 8) Physics-Quantum Computing.

INSA-PAS Conference to mark the 20<sup>th</sup> Anniversary of the cooperation between Indian and Polish Lymphedema Research groups was held on February 14 & 15, 2008 at INSA. Professor Waldemar Olszewski, a renowned Lymphologist and Head of the Department of Transplantology, Medical Research Centre, Polish Academy of Sciences, Warsaw, Poland and Professor Pradeep Jain, Banaras Hindu University, Varanasi coordinated the organization of this Conference. Five Polish scientists led by Professor Z Czernicki, Director, Medical Research Centre, Warsaw attended the conference and in addition 18-20 Indian scientists participated. The conference was inaugurated by Professor M Vijayan, President, INSA, who gave an overview of the scientific cooperation established between the Indian and Polish scientists under the bilateral exchange programme. Keynote lectures and presentations were made by the Indian and Polish scientists covering a wide spectrum: Contemporary basics of human immunity, what is the lymphatic system, human limb infections, filariasis and bacterial infection in India and Europe, lymphedema of limbs and organs a medical and social problem, treatment



Participants of India-UK Frontier of Science Symposium





Professor Z Czernicki, Director Medical Research Centre, Warsaw in discussion with Professor M Vijayan, President, INSA

of lymphedema, future trends in diagnosis and treatment. A full session at the end was devoted to discussion on the consensus document on the Diagnosis and management of Filarial Lymphoedema during the Conference.

### Representation and Participation of Academy in International Meetings/Conferences

Professor M Vijayan, the then Vice-President, Professor TP Singh, Vice-President, and Dr Krishan Lal, FNA participated in the 8<sup>th</sup> Asian crystallography Association meeting held at Taipei from November 4-7, 2007. Professor Vijayan relinquished the Presidentship of the Asian Crystallography Association during the conference. INSA delegation extended their visit for a day i.e. November 8 and had discussions with the President and the Officers of the Academia Sinica to discuss implementation of the MoU signed by Professor Yuan T Lee on behalf of Academia Sinica, Taiwan with INSA. During the meeting some of the areas identified for joint Symposium to be supported under the Bilateral Exchange Programme are: *Crystal Growth and Characterization*, by Dr Krishan Lal; *Supermolecular Chemistry* by Dr GR Desiraju, FNA; and *Structural Biology and Drug Development* by Professor TP Singh, FNA.

Professor NK Gupta, FNA, Vice-President visited Trinidad and Tobago, West Indies during February 9-15, 2008, and participated in the first Latin American and Caribbean Congress of Theoretical and Applied Mechanics (LACCOTAM). The Congress was organized jointly by the Department of Mathematics and Computer Science and the Department of Civil Engineering at the University of the West Indies, St. Augustine Campus, Trinidad and co-sponsored by IUTAM, the ICTP (Italy) and the University of the West Indies.



Inauguration of first Latin American and Caribbean Congress

This Conference was also dedicated to the 65<sup>th</sup> year of Professor Harold Ramkissoon, Past President of the Trinidad and Tobago Science Academy. Professor Gupta delivered a keynote lecture in solid mechanics and also visited the Departments of Mechanical Engineering, Mathematics and Computer Science and other Departments of the University of West Indies. He also had discussions with Professor Ramkissoon, Former President, Caribbean Academy of Sciences, and Honorary President, LACCOTAM to foster relationship of INSA and the Trinidad and Tobago Academy of Science.

Professor M Vijayan, President, INSA and Professor TP Singh, Vice-President INSA visited Tokyo, Japan from March 16-19, 2008 and attended the meeting of the Science Academies of G8+5 countries hosted by the Science Council of Japan. Two joint science academies statements on *Climate Change Adaptation and the Transition to a Low Carbon Society* and on *Global Health* were drafted for submitting to the Heads of Govt. of these countries. Officially released statements duly signed by the Heads of the G8+5 Academies may be seen in the 33 to 36 pages. Professor M Vijayan and Professor TP Singh also had their meeting with the JSPS President and other officers on the existing bilateral cooperation.

### 2<sup>nd</sup> Indo-French Etienne Wolf-Ramanujan Lecture

On the invitation of the French Academy of Sciences Dr RA Mashelkar, the then President INSA visited France on November 26-28, 2007 and delivered the 2<sup>nd</sup> Indo-French Etienne Wolf-Ramanujan Lecture in France. The first Lecture was delivered by Professor Jules Hoffman, Vice-President, French Academy of Sciences on January 25, 2006 at INSA.





## Joint Science Academies' Statement: Climate Change Adaptation and the Transition to a Low Carbon Society

Since 2005, the Academies of Science for the G8+5 countries have called on world leaders to limit the threat of climate change. We have advised prompt action to deal with the causes of climate change and cautioned that some climate impacts are inevitable. However, progress in reducing global greenhouse gas emission has been slow.

In 2007 the Intergovernmental Panel on Climate Change (IPCC) reaffirmed that climate change is happening and that anthropogenic warming is influencing many physical and biological systems. Average global temperatures increased by 0.74°C between 1906-2005 and a further increase of 0.2°C to 0.4°C in the next 20 years is expected. Further consequences are therefore inevitable, for example, from losses of polar ice and sea-level rise.

Key vulnerabilities include water resources, food supply, health, coastal settlements and some ecosystems (particularly arctic, tundra, alpine, and coral reef). The most sensitive regions are likely to include the Arctic, Africa, small islands and the densely populated Asian mega-deltas.

As the concentration of greenhouse gases increases, these impacts become more severe and spread both geographically and sectorally. To stabilize the climate, emissions should eventually be limited to the net absorption capacity of the earth, which is less than half of current emissions. Immediate large-scale mitigation action is required. At the 2007 Helligendamm Summit, G8 leaders agreed to seriously consider halving global emissions by 2050. We urge G8+5 leaders to make maximum efforts to carry this forward and commit to these emission reductions.

Mitigation policies are essential, but not sufficient. Adaptation is necessary if the worst impacts of climate change, now and in the future, are to be alleviated. Mitigation and adaptation can complement each other and if pursued together can significantly reduce the risks of climate change impacts.

### Adaptation

Climate change is a pressing issue for today. Action on adaptation is needed now and failure to respond poses a significant risk. According to the IPCC:

- A global mean temperature change of only 2.0°C above 1990 levels will exacerbate existing impacts and trigger others, such as reduced water and food security.
- Increases of 2.0-4.0°C will result in widespread biodiversity loss, decreasing global agricultural productivity and long-term commitment to several metres of sea-level rise due to ice sheet loss.
- Increases above 4.0°C will lead to major increases in vulnerability, exceeding the capacity of many physical and human systems to adapt.

In April 2007, the UN Security Council addressed the threat that the aggregate impacts of climate change might cause, in particular the serious environmental, social and economic consequences and the implications for peace and security. All regions will be affected in the long term, but developing countries are likely to be affected most and their vulnerability will be exacerbated by pre-existing stresses.

Humans have been adapting to their environment throughout history. But the rate and scale of climate change means there is no time for complacency. A step-change in our response is needed, with action at global, national and local level. Local actors must be engaged in impact assessment and in identifying solutions. But global and national leadership is also required to manage the macro-scale effects that will accompany widespread efforts to adapt to climate change.

A strategic approach to adaptation must be based on the principle of sustainable development. As an immediate first step, governments can take measures to improve resilience to existing environmental stresses. Such measures will, in turn, reduce exposure to the threat posed by climate change. This involves governments recognizing the role that ecosystems and the natural resource base play in meeting basic needs (water, food and shelter). This strategic approach can be strengthened with more targeted measures once detailed assessments of the impacts and key vulnerabilities have been carried out.

Basic research, technology development and transfer will play a major role in improving the ability of nations to adapt. Understanding the underlying economic, social and environmental causes of vulnerability will enable the development of appropriate policy solutions, and strengthen the ability of the market to respond to the impacts. Governments and businesses can then develop adaptation solutions and avoid investment in technologies or infrastructure which fail to take climate change into account. This will also contribute to the achievement of other international priorities, including the Millennium Development Goals (MDGs).

### Low Carbon Society

The development of a low carbon society means not merely the replacement of energy sources with less carbon intensive ones, but energy conservation as well. Sustainable consumption requires fundamental changes in all sectors and levels of society, including energy-saving housing, low-carbon transportation and more efficient industrial processes.

A movement to a low carbon society will provide the opportunity to mitigate and adapt. Mitigation cannot provide all the answers, but many impacts can be reduced, delayed or avoided by cutting emissions.



There is also an opportunity to promote research on approaches which may contribute towards maintaining a stable climate (including so-called geo-engineering technologies and reforestation), which would complement our greenhouse gas reduction strategies. The G8+5 academies intend to organise a conference to discuss these technologies.

The transition to a low carbon society requires: setting standards; designing economic instruments and promoting energy efficiency across all sectors; encouraging changes in individual behaviour; strengthening technology transfer to enable leapfrogging to cleaner and more efficient technologies; and investing strongly in carbon-removing technologies and low-carbon energy resources: nuclear power, solar energy, hydroelectricity and other renewable energy sources. These points are also stressed in the InterAcademy Council report<sup>1</sup>.

Technologies should be developed and deployed for carbon capture, storage and sequestration (CCS), particularly for emissions from coal which will continue to be a primary energy source for the next 50 years for power and other industrial processes. G8+5 economies can take the lead globally to further develop CCS technologies. This will involve governments and industry working collaboratively to develop the financial and regulatory conditions needed to move CCS forward and international coordination in the development of demonstration plants.

Given the time-lags inherent in the global energy system, actions need to be taken now to reach the desired target by 2050. Whilst the developed world should take the lead and encourage technology transfer and collaboration with developing world partners, it is also an issue where the developing and emerging economies can and must make a significant contribution.

Transition to a low carbon society will also require reducing emissions caused by deforestation and degradation of ecosystems, requiring improved agricultural efficiency and sustainable forestry.

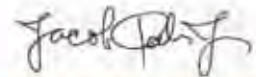
## Conclusions

Responding to climate change requires both mitigation and adaptation to achieve a transition to a low carbon society and our global sustainability objectives. We urge all nations, but particularly those participating in the 2008 G8 Summit in Hokkaido, Japan, to take the following actions:

- Call on G8+5 governments to agree, by 2009, a timetable, funding, and a coordinated plan for the construction of a significant number of CCS demonstration plants.
- Prepare for the challenges and risks posed by climate change by improving predictive and adaptive capacities at global, national and local level and supporting the developing world in carrying out vulnerability analyses and addressing their findings.
- Take appropriate economic and policy measures to accelerate transition to a low carbon society and to encourage and effect changes in individual and national behaviour.
- Promote science and technology co-operation, innovation and leapfrogging, e.g., by transfer of some basic critical low-carbon and adaptation technologies.
- Urge governments to support research on greenhouse gas reduction technologies and climate change impacts.

As national science academies, we commit to working with our governments to help implement these actions.

<sup>1</sup> "Lighting the Way – Toward a sustainable energy future". InterAcademy Council, October 2007 [www.interacademycouncil.net](http://www.interacademycouncil.net)



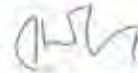
Academy of Sciences of Brazil



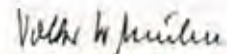
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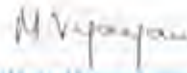
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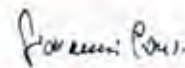
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Deutsche Akademie der Naturforscher  
Leopoldina, Germany



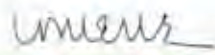
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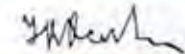
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Science Council of Japan, Japan



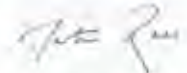
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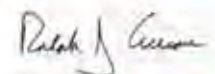
Russian Academy of Sciences, Russia



Academy of Sciences of South Africa, South Africa



Royal Society, United Kingdom



National Academy of Sciences, United States of America



## Joint Science Academies' Statement: Global Health

In 2008, WHO will commemorate the 30th anniversary of the Alma-Ata Declaration which called for "Health for all." The United Nations Millennium Summit in 2000 launched the Millennium Development Goals (MDGs) including three related particularly to health: reducing the infant mortality rate, improving maternal health and halting the expansion of HIV and other infections. The other five MDGs call for action on factors that are also critical for human health.

### Diseases - Future Challenges

The world's governments and science communities need to work together to better understand how, where and why infectious diseases emerge and spread. Often these are affected by environmental or social stress. Countries need to cooperate to monitor and contain infectious disease outbreaks.

There also must be greater international focus on, and collaboration to address, lifestyle-linked diseases. A rapidly growing number of people will suffer from heart disease, cancer, diabetes, obesity-related conditions, and neurological and mental disorders. Smoking is a challenge that has to be addressed in a timely manner.

In order to combat threats to human health globally, education, sharing of information and experience are key. Public health measures which could make a great deal of difference and deserve more attention include:

- Safe water, basic sanitation, and hygienic measures.
- Food safety.
- Equitable access to medical information and treatment.
- Training and retention of qualified medical and health professionals, and educators.

Nations should ensure that sustainable development plans include measures to share information on, and address and/or prevent, diseases.

### Social Capital for Human Health

Because there are many determinants of health, the achievement of good health is not a matter for the health sector alone but also requires, for example, adequate levels of research, human security, education, economic development, nutrition and sanitation. Therefore, the responsibility for health is shared by all policy-makers in government and international agencies. Although governments remain ultimately responsible for assuring the conditions for health, they must work with civil societies, universities, business, and media among others.

### The Way Forward

It is vitally important that we not only focus on the health of individuals, but also strengthen community health systems and the health workforce.

In order to address the challenges for global health, it is necessary to minimize the current obstacles to progress. Our agenda for change requires action across a broad front:

- Implementing previous funding commitments and encouraging the contribution of additional funding from all sources.
- Improving provision for public health programs and access to health care.
- Identifying and advancing research and innovation required to address unmet health and medical needs and support the generation of innovative health care products and services.
- Building a better evidence base on disease burden and on what interventions work – to assess the present situation and to target prevention and control measures.
- Meeting skill and infrastructure needs.
- Developing better coherence and connectivity among all those involved in addressing global health issues.
- Strengthening of preventive (prophylactic) medicine.



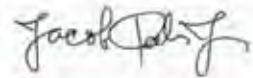


### Conclusions

We, the academies of science of the G8+5 nations commit to assist in meeting these health challenges. We will continue to build links within the world scientific community with the objective to strengthen the role of science in international development. The science academies will do more in the identification of emerging issues and pursuing systematic dialogue with national opinion-leaders, policy-makers and with multilateral organizations.

We urge our governments to:

- Increase international collaboration, scientific and medical research, locally appropriate capacity building, and technology transfer and sharing to achieve results.
- Commit to continued global monitoring, communication and sharing of information on all health-related issues. We recommend further concerted effort to identify major challenges in chronic and infectious diseases, as a basis for global collaboration on research and on disease management.
- Increase their commitment to evidence based health and science policy making.
- Further strengthen coordination of health related programmes and leading international organizations such as WHO, FAO, and OIE.
- Promote public-private partnerships to encourage and appropriately protect innovation.



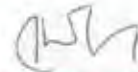
Academia Brasileira de Ciências, Brazil



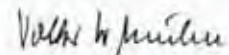
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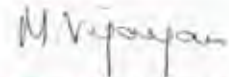
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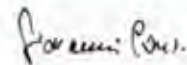
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Deutsche Akademie der Naturforscher Leopoldina, Germany



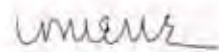
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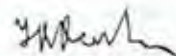
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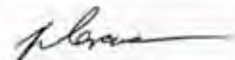
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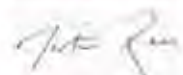
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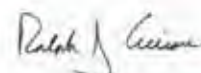
Russian Academy of Sciences, Russia



Academy of Sciences of South Africa, South Africa



Royal Society, United Kingdom



National Academy of Sciences, United States of America

## COOPERATION WITH INTERNATIONAL AND REGIONAL ORGANIZATIONS

### Inter-Academy Panel on International Issues (IAP)

The Academy continued to take a leading role in the activities of the Inter-Academy Panel on International Issues (IAP). The panel was constituted in 1994 as a joint forum of science academies from 98 countries for mutual consultation and joint action on S&T issues of global concern. The Academy has been coordinating and contributing to the IAP programme on various issues such as *Capacity Building for Academies, Water Research and Management, Science Education and Women's Health Education, Biosecurity, Access to Scientific Information, GMOs and Natural Disaster Mitigation*. Professor Anupam Varma, the then Vice-President of the Academy, who is also a member of Evaluation Committee, participated in the Executive Committee Meeting of IAP and contributed to all the IAP programmes.

The Academy played an active role in drafting the IAP's long-term Strategic Plan for the year 2007-2009 and also provided scientific input for the release of the IAP statement on Population Growth; Urban Development; Sustainability; Human Reproductive Cloning; Science Education; Health of Mothers and Children; Scientific Capacity Building; Science and the Media; Access to Scientific Information; Biosecurity and Teaching of Evolution. An INSA representative was nominated as one of the Co-Chairs of the Working Group of experts on the *IAP Enquiry-Based Science Education Project (IBSE)* at the International Platform. Professor Anupam Varma, Vice President and Dr Satish Shetye, Director, National Institute of Oceanography, Goa attended the Evaluation and Strategic Planning Meeting of the IAP Water Programme held in Trieste, Italy from May 29-31, 2007. The meeting discussed the future action plan for the year 2007-2008 and issues covering the scope of the programme, its relevance, the role of the Academies and how IAP can articulate other existing international programmes and organizations to bridge science and management, helping to enhance managerial capacity. IAP so far has organized 5 Regional Workshops: China (June 2006), Brazil (July 2006), South Africa (August 2006), Poland (September 2006) and Jordan (March 2007) and Russia during (July 2007).

The IAP Executive Committee Meeting was held during January 30-31, 2008. The meeting was hosted by the Royal Netherlands Academy of Arts and Science in conjunction with the IAC Board Meeting. It provided a

unique opportunity for the IAP Executive Committee and IAC board to align activities and prepare a agenda for future. To this end IAC Co-Chairmen Professor Bruce Alberts and Professor Yongxiang Lu signed a MoU with IAP. Four joint IAP-IAC joint regional workshops related to IAC studies on women for Science and Energy will take place in 2008. To celebrate the IAP's 15<sup>th</sup> Anniversary, EC agreed to organize a Conference for young scientists in 2008 *moving beyond scientific training*. The EC voted to accept the German Academy of Science (Leopoldina) as a new IAP member totaling IAP membership to 98.

### Inter Academy Council (IAC)

The Academy has also been supporting and participating in the activities of the Inter-Academy Council (IAC) constituted in 2000 as an executive arm of IAP to take up major research projects and policy investigations and to provide scientific advice to multinational audiences such as the United Nations, The World Bank, and other International Organisation. The IAP and IAC work closely to increase the effectiveness of their respective missions. The Academy significantly contributed to the four major studies taken up by IAC on *Inventing a Better Future - A Strategy for Building Worldwide Capacities in Science and Technology; Realizing the Promise and Potential of African Agriculture - Science and Technology Strategies for Improving Agricultural Productivity and Food Security in Africa* and *Women for Science and Lighting the way: toward a sustainable energy future*. The report on energy was launched during 2007 in Brazil and China.

Professor M Vijayan, President, INSA attended the IAC Board Meeting held at Amsterdam, the Netherlands from January 28-30, 2008. On the request received from the IAC Board, the Academy made the following suggestions/recommendations on various issues and studies of the IAC.

1. **For African Universities:** Professor G Govil, FNA have been recommended as an organizing group member for study on *Strengthening the Role of African University Education and Research*.
2. **For Water issues:** Professor Ramaswamy R Iyer, Centre for Policy Research, New Delhi, has been recommended to represent INSA in the study group.
3. **For Sustainable energy:** Dr VS Arunachalam, FNA has been recommended as a reviewer for the IAP proposal on convening regional conferences.
4. **Women for Science:** Dr MS Bamji, FNA has been recommended as reviewer for the IAP Proposal for regional conferences.

5. **Development Advisory Committee:** Professor PN Tandon, FNA has been recommended for the Development Advisory Committee membership.

### Federation of Asian Scientific Academies and Societies (FASAS)

The FASAS Council Meeting 2007 was held on November 27-29, 2007 on the invitation of the Science Society of Thailand. In conjunction with FASAS Council Meeting, an International Conference on "Science Education in the Asia Pacific" was also held. The meeting was hosted jointly by the Science Society of Thailand, the Association of the Academies of Science in Asia (AASA) and FASAS with the support of the Inter Academy Panel. Keynote presentations and plenary lectures were made on three themes, namely: *Best practices in science and mathematics education; Innovation in Science, mathematics and teacher education; and the role of science societies and academies in science and technology development.* Professor SC Lakhotia, FNA as a focal point person made a presentation on *What can Science Academies do to improve Higher Education in Science?* and highlighted the activities undertaken by three Science Academies in India for promotion of teaching of science at school, college and universities level. Professor S Kesavan from the Institute of Mathematics, Chennai during his participation in the Mathematics sessions made a presentation on *Mathematics Education in India - Efforts Outside the University System.*

### Participation in TWAS/TWANSO Meetings/Conferences/General Assembly

The Academy supported the participation of Indian scientists in the 18<sup>th</sup> General Meeting of TWAS and the meeting of the TWAS committees and council was held in Trieste, Italy during November 11-14, 2007.

### Distinguished Delegations/Visitors to India

A German Delegation led by Dr Reinhard Grunwald, Secretary General, German Research Foundation (DFG) Germany visited on April 5, 2007.

A 5 member Taiwanese delegation led by Dr Wen-Hsiung Huang, Deputy Minister, National Research Council, Taiwan, visited on October 22, 2007.

Professor KR Sreenivasan, Director, International Centre for Theoretical Physics, Trieste, Italy, visited on January 4, 2008.

A five member Chinese delegation Led by H.E. Mr Qi Rang, Vice-Chairman, Chinese Association for Science and Technology, (CAST) visited on January 7, 2008.

Professor Vladimir G Kadyshevsky, Member Presidium, Russian Academy of Science visited on February 14, 2008.

A three member Japanese delegation led by Mr N Murata, Executive Director, Japan Society for the Promotion of Science (JSPS) visited on March 31, 2008.

### Centre for Co-Operation in Science & Technology among Developing Societies (CCSTDS)

The CCSTDS (Centre for Cooperation in Science and Technology among Developing Societies) has coordinated the following programmes during this period.

#### 1) INSA - JRD TATA Fellowship (for Scientists/technologists from developing countries)

Indian National Science Academy (INSA) has instituted this programme through an endowment, received from Sir Dorabji Tata Trust to encourage scientists and technologists from developing countries to pursue their research in Indian scientific research institutions. This fellowship is offered for a duration of 3 months. This programme is being executed by CCSTDS since 2006.

The Fellowship provides an opportunity for young scientists, teachers and researchers from the developing countries all over the world to undertake research studies in India. It covers short-term, participatory research studies in all major disciplines of science and technology including engineering and medical sciences at the Indian Centers of Excellence.

Twenty three applications were received in the year 2007-08 from scientists/researchers from Belarus, China, Jordan, Nepal, Nigeria and Sri Lanka. Out of these, seven candidates were selected for award of fellowship for the academic year 2007-2008. The fellowship offers international air travel, a subsistence allowance and contingency grant of 2,000 rupees. During January 2008, Ms. Svetlana Barseghyan from Institute of General and Inorganic Chemistry, National Academy of Sciences of the Republic of Armenia underwent research training on *Mechanochemical Synthesis of Binary Oxides* at the Department of Materials Engineering, Indian Institute of Sciences, Bangalore under the guidance of Professor K Chattopadhyay. Other candidates selected under the fellowship are likely to commence research training at respective host institutions in India during May, June, August and December 2008.



## 2) *Research Training Fellowship for Developing Country Scientists – RTFDCS*

CCSTDS has launched this programme during the year 2007, with sponsorship from the Department of Science and Technology, New Delhi. The sanctioned amount from DST is Rs. 20 lakhs per annum. Ten Fellowships per year are offered. Each fellowship shall be for a minimum period of three months to 12 months. The fellowship offers return international airfare, boarding and lodging (up to Rs. 15,000 per month) and one time grant of Rs. 10,000 to support exposure to research-related events in India. Out of 5 applications that were received from candidates from Cameroon, Nigeria, Sri Lanka and South Africa, four candidates were awarded fellowship for the year, 2007-2008.

Mr. Oyadeyi Ayodele Stephen, Department of Physiology, Ladoke Akintola University of Technology, Nigeria is currently undergoing 12-month research training on *Bioassay-guided investigations of Nigerian Medicinal Plants in Attenuating Aluminium-induced Neuro-behavioural Deficits: Implications for Local treatment of Alzheimer's Disease* since January 2008 at Cell Biology and Physiology Division, Indian Institute of Chemical Biology, Kolkata under the guidance of Dr KP Mohanakumar. Other candidates selected under this programme are likely to undergo research training at respective host institutions in India during the months of May, June 2008.

## 3) *INSA-CSIR-BRNS/DAE-ISRO/DOS-Microsoft Research Lab-CCSTDS Travel Fellowship Programme*

CCSTDS provides partial travel support, registration fee and per diem expenses to Indian scientists/researchers in various disciplines such as Physics, Chemistry, Biology, Mathematics, Medicine, Engineering, Space, Computer science and related areas etc. to attend international scientific conferences, seminars and workshops abroad.

During the period April 2007- March 2008 CCSTDS received grant to the tune of Rs. 54.15 lakhs from various agencies and departments. Out of the total number of 758 applications, 289 candidates were selected for the award of fellowship. Two hundred sixteen candidates fall in the category of below 35 years.

## 4. *Science in our Environment – TV Serial – Sponsored by Department of Science and Technology*

CCSTDS was involved in the production of a 13 episode TV serial in Tamil on *Science in our Environment* for school children. This project was funded by Department

of Science and Technology, Government of India, produced by CCSTDS and telecast by the Chennai based Doordharshan channel *Podhigai*. The sanctioned amount for the project is Rs. 50.86 lakhs. Professor Balu Venkatraman, a retired Professor of Tata Institute of Fundamental Research was the Principal Investigator of the project. The subjects covered were Ocean and its environment, forest and its environment. M/s Krishnaswamy Associates, a Chennai based renowned production company, produced the serial. The 13 episodes programme has been telecast during the period October 2007 – January 2008.

## 5. *Science Awareness Program for School Children – Sponsored by Department of Science and Technology during 2007-2008*

CCSTDS is planning to organize this programme during May 2008.

The main aim of this programme is to bring out hidden potential, creativity in every student and introduce talented senior students to the excitement of a career in scientific research and development. The programme is designed to invigorate and stimulate the minds of the younger generation of the society through exposing them to all latest scientific and technological advancements through lectures, and demonstrations by eminent experts, visits to world-class laboratories, industries and scientific institutions etc.

DST has sanctioned a substantial amount for organizing one of the programme during, 2007–2008.

- Meritorious and talented students of Standard XI from various schools will be invited by nominations.
- Training sessions will involve lectures, demonstrations, discussion on career choices/opportunities, interactive sessions, question-answer sessions, quiz, debates/essay competitions, group projects etc.

## 6. *Training of Women Scientists on Patents*

The center has also taken up a Women Scientists Scholarship Scheme to offer training on Patents with the object to develop a pool of resource persons in Intellectual Property Rights (IPR). This programme is being coordinated along with Technology Information, Forecasting and Assessment Council (TIFAC)/DST who have sanctioned 37.14 lakh rupees to the center. 80 candidates per annum will be trained from three different centers – CCSTDS, Chennai, TIFAC, New Delhi and URDIP, Pune.

In addition to the above programmes, CCSTDS is also working on an IBM sponsored Kiosk - Try Science. This Kiosk will provide educational assistance - on exhibits, for school students, their parents and teachers,

through the use of a fun, attractive interface, with clear, consistent navigation and interactive educational scientific activities.



# Science Promotion

The basic mandate of the Indian National Science Academy, as visualized by its founding Fellows, was the promotion of science in India and harnessing scientific knowledge for the welfare of humankind. The Academy has evolved mechanisms over the years to identify scientific endeavours and projects in various institutions round the country that hold promise and potential.

The Academy believes that the right support at the right time for fruitful scientific projects can help achieve results with immense benefits for the country. INSA can clearly take credit for having supported several such endeavours in the past as part of its Science Promotion Programme. The Academy has also assisted in organizing several seminars/symposia/conferences at national as well as international level on issues of wide-ranging implications for the country, thus furthering the cause of Indian science.

During the past year, under the Science Promotion programme, the Academy used its limited resources to support various schemes such as, (i) Research Professorships, (ii) INSA Senior Scientists, (iii) Honorary Scientists, (iv) Young Scientists' Research Projects, and (v) Visiting Fellowships. Besides, the Academy provided assistance for organizing National/International Seminars and Symposia.

## Research Professor

The Academy in 1984 instituted Research Professorships to recognize the pioneering contribution of Indian scientists to science and/or technology. This prestigious Professorship is limited to one position a year, for a period of five years with the total number not exceeding five at any given time. The main aim of the Professorship is to provide recognition to a person who has made outstanding scientific contributions and to enable him/her to continue to contribute to the subject of his/her choice. The INSA Research Professor may continue to work in his/her own institution or in any other institution within India. The following five scientists continued their research programme with the available INSA Professorship.

1. Professor Virendra Singh, FNA, Tata Institute of Fundamental Research, Mumbai. *Chandrasekhar Venkata Raman Research Professor* (w.e.f. 2003).
2. Professor KS Valdiya, FNA, Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore. *Golden Jubilee Research Professor* (2003-2008).
3. Professor Paul Ratnasamy, FNA, National Chemical Laboratory, Pune. *Srinivasa Ramanujan Research Professor* (w.e.f. 2004).
4. Professor RC Mahajan, FNA, Postgraduate Institute of Medical Education and Research, Chandigarh. *Satyendra Nath Bose Research Professor* (w.e.f. 2004).
5. Professor PK Kaw, FNA, Institute of Plasma Research, Gandhinagar, Ahmedabad. *INSA Albert Einstein Research Professor* (w.e.f. 2007).

## Senior Scientists and Honorary Scientists

The Academy has instituted programmes of Senior Scientists and Honorary Scientists for active superannuated Fellows of INSA to continue to be involved in high-quality research in their specialized disciplines through recognized institutions/universities in India. Presently, there are 46 Fellows holding positions as Senior Scientists and 40 as Honorary Scientists under this programme [*Annexure-III(a)*].

## Young Scientists

The Academy provides initial research support or interim Fellowships to the INSA Young Scientist Medal awardees based on research proposals for support or for the award of interim Fellowship. Ten Young Scientist Awardees are being supported for their research programme. The names of these Young Scientists are mentioned in [*Annexure-III(b)*].

## International/National Seminars/Symposia/Conferences Sponsored

The Academy sponsored fifty seven symposia/conferences/seminars/meetings, which were held in various parts of India. Conferences sponsored/supported by the Academy are given in [*Annexure-III(c)*].



## Visiting Fellowship

In 1991, the Academy instituted the Visiting Fellowship Scheme with the aim to provide specialized training or to conduct advanced research in Indian research institutes/laboratories other than one's own institution. Twenty scientists were offered the Visiting Fellowship under this programme for collaborative research, and

to receive training for furtherance of their research capabilities within the country.

Highlights of research work carried out by INSA Research Professors/Senior Scientists, Honorary Scientists and Young Scientist Medal Awardees are mentioned in [*Annexure-III(d)*].



# History of Science

India has a long and proud scientific tradition. Science and technology has always been an integral part of Indian culture. India's earliest scientists are credited with remarkable scientific and technological discoveries in such fields as mathematics, astronomy, metallurgy, and medicine leading to several practical applications. The country also has a vast repository of traditional knowledge related to herbal medicine, nutrition, water harvesting, etc, which along with the rich scientific tradition needs to be studied, analysed and preserved for the generations to come.

The Academy, as a part of its History of Science programme, has been in the forefront of catalyzing and supporting programmes that seek to document, analyse and preserve India's rich scientific heritage. Such programmes have not only thrown light on scientific methodologies followed in India in the past but have also provided solutions to some intractable problems that the country faces today.

Collection of source material, its compilation, documentation, translation and critical evaluation is the major activity of the History of Science programme. The programme also involves writing of monographs, organization of discussion meetings and publication of the quarterly journal—the *Indian Journal of History of Science (IJHS)*. The programme is managed and organized under the guidance of the Indian National Commission for History of Science through the Research Council.

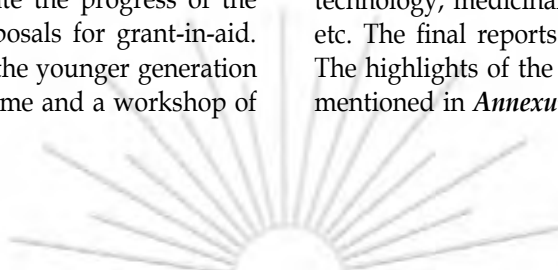
A Workshop-cum-Project Investigator's meet which was originally scheduled for March was finally organized in April 9-11, 2008 at Indian Institute Technology, Powai, Mumbai along with the annual meetings of the Indian National Commission for History of Science and the Research Council to evaluate the progress of the ongoing projects and new proposals for grant-in-aid. To inculcate an interest among the younger generation in the subject a lecture programme and a workshop of



*Participants at the Workshop-cum-Project Investigator's Meet at Mumbai*

project presentations were organized. This new initiative was introduced since 2004.

Three lectures were delivered by eminent speakers like Professor R Sridharan, MS Sriram and Dr SN Bhat, which were attended by a large number of participants and invited guests from reputed universities and institutions including local fellows of the Academy, eminent historians, social scientists and institutional heads with great interest. During the year the Commission recommended 5 new projects and renewed 20 ongoing projects on various topics like history of cannons, metals and metallurgy, nutrition and dietary, traditional medicinal knowledge, conservations, epilepsy, Cancer Research, Indian Childhood Cirrhosis, musical pillars, critical study of Sanskrit and Persian sources, biographies of scientists, documentation of sources, history of war technology, medicinal plants, technology of hill tribes, etc. The final reports of three projects were received. The highlights of the work done under the project are mentioned in *Annexure IV*.



# Science and Society

## Science and Society Meet

A meet on Science and Society during 13-14 March 2008 was held at the Academy premises. The purpose of the meet was to bring to the fore the role of science and technology in the societal and economic development of the society and to focus on the way ahead. Several eminent scientists, economists, educationists, environmentalist and representatives of NGO deliberated on different societal issues.

The meeting started with the presidential remarks by Professor M Vijayan, President, INSA and ended with a summing up by Professor N Balakrishnan, Vice-President (Science & Society), INSA.

The speakers in the three sessions of the meet included eminent agriculture scientists Professor MS Swaminathan on "Science for the betterment of rural population"; Professor SK Thorat, Chairman UGC, New Delhi has spoken "on Challenges in Higher Education - Approaches and Strategy under XI Plan"; Professor J PS Uberoi, Former ICSSR National Professor, Delhi University on "Right Left and Centre in the Sciences of nature"; Dr RR Navalgund, Space Application Centre, Ahmedabad on "Space Technology for Societal Benefits; and Dr R Gadagkar, Indian Institute of Science, Bangalore on "Integrating Natural and Human Sciences" - The beginning of an experiment at Indian Institute of Science, Bangalore.

In the second Session, Dr AR Vasavi, NIAS, Bangalore spoke on "Equity and Excellence in Education"; Dr N Kochupillai, MSR Medical College, Bangalore on "Science in Preventive Health Care in India" and Dr T Ramasami, DST, New Delhi on "Process Innovation for inclusive Growth".

In the third session, Professor Ashok Jhunjhunwala, Indian Institute of Technology - Madras, Chennai has spoken on "ICT for the benefit of the poor - an Indian Review"; Professor R Chidambaram, Principal Scientific Adviser to Govt. of India, New Delhi on "Science and Technology as a vehicle for economic development";



*Science and Society Meet at INSA*

Dr Arun Kumar, Development Alternatives, New Delhi on "Innovations for the Poor"; and Dr Samir Brahmachari, Director General, Council of Scientific and Industrial Research, New Delhi on "Taking Technology from Lab to people".

In the final part of the session Dr VN Shukla, Centre for Development of Advance Computing, Noida, spoken on "ICT for Empowering special Persons"; Professor PS Ramakrishnan, Jawaharlal Nehru University, New Delhi on "Knowledge System. The basis for community participatory responses for climate change linked Vulnerabilities"; Dr Kartikeya V Sarabhai, Centre for Environment Education, Ahmedabad on "Development at Cross Road with Society"; Dr Jyoti Parikh, Integrated Research and Action for Development, New Delhi on "Economics & Science of Development"; Dr Ajay Chowdhry, HCL, Noida on "ICT for rural development" and Dr P Anandan, Microsoft, Bangalore "ICT for Development".

## 12<sup>th</sup> Jawaharlal Nehru Birth Centenary Medal Lecture

Sir David King, FRS, Chief Scientific Adviser and Head of the Government Office was awarded the 12<sup>th</sup> Jawaharlal





Dr David King receiving Jawaharlal Nehru Birth Centenary Medal Lecture

Nehru Birth Centenary Medal for the year 2007 for his outstanding contribution in science. He delivered the Medal Lecture on *The Challenge of Sustainability: the aim for the 21<sup>st</sup> Century* at INSA on November 20, 2007. Sir David King in his lecture outlined the challenges faced by the human being pertaining to sustainable use of natural resources, reversing environmental degradation, defeating infectious diseases and tackling climate change. Sir David King mentioned: *Population growth is the biggest driver behind these challenges. Today there are around six billion people on the planet and by 2050 the population is expected to reach a peak of nine billion. In addition to the pressure on our diminishing natural resources comes perhaps the biggest challenge we face globally: climate change.*

### Science Education

The Indian National Science Academy, in August 2006, established the Science Education Panel to initiate and oversee the Science Education Programmes undertaken by the Academy for School and College students. The panel is chaired by Professor SC Lakhotia, FNA (BHU, Varanasi) and includes Professors Alok Gupta, FNA (Allahabad University, Allahabad), AK Sood, FNA (IISc, Bangalore), NK Gupta, FNA (IIT, Delhi), AK Singhvi, FNA (PRL, Ahmedabad), M Lakshmanan, FNA (CNFB University, Tiruchirapalli), J Gowrishankar, FNA (CDFD, Hyderabad), V Ravindranath, FNA (NBRC, Manesar) and Deepak Pental, FNA (Delhi University, Delhi). The panel, jointly, in association with Indian Academy of Sciences, Bangalore and the National Academy of Sciences of India, Allahabad sponsored a variety of activities that are aimed at strengthening of Higher Education in Science and encouraging the young students to take science as a career. The activities proposed under this banner are:

- 1) **Summer Research fellowships for Students and Teachers:** Under this programme, specific proposals are invited from students and teachers for the work they propose to undertake during the two month long Fellowship. Based on their plan of work Fellow supervisors are selected and the linkages established. The selected students/ teachers are provided round trip train fare and an honorarium to meet the boarding and lodging expenses at the place of work. Three hundred eighty seven students and 98 teachers and a total of 301 Fellows from all the three academies agreed to associate themselves with this activity. Out of this, 69 students and 22 teachers did not avail the Summer Fellowship programme. The very fact that more number of students and teachers could not be accommodated in this programme, was due to shortage of Fellow supervisors. The Indian National Science Academy has now proposed to include active non-Fellow faculty members (recommended by Fellows) as supervisors in this initiative.

Announcements for inviting proposals for 2008 Summer Research Fellowships were made in October–November 2007 through the website of all the three Academies, MHRD portal *Sakshat* and through the IASc journals *Current Science* and *Resonance*. Over 5500 applications were received from students and teachers all over the country. About 15000 posters were printed and dispatched to over 13000 colleges, universities, major scientific institutions etc throughout the country. Selection Committees representing Fellows from all the three Academies met early February to select the candidates for award of SRF, in 2008. The number of fellowships offered is 535 students and 84 teachers which represents an increase of 27% compared to last year. Over 600 Fellows of all the three Academies have agreed to act as guides. Communications to the selected candidates were sent during March 2008 after getting the consent from the Fellow-guides.

- 2) **A 2-week All India Refresher Courses for Teachers:** Two-week Refresher Course is aimed at capacity building of teaching community. The primary focus is to enhance the quality of science education at undergraduate and graduate levels. Refresher Courses are thus, primarily aimed at helping teachers to add value to their teaching. The Course content thus needs to be designed to meet the above need. While discussion of modern areas of topical interest is important, the Course should be so designed as to have direct relevance to the materials covered in the graduate and undergraduate programmes in universities and institutions in the country and are

not necessarily meant to be at an advanced research level. The courses organized during the period under report are given in Table 1.

- 3) **Lecture workshops for Students and Teachers:** Short-duration Lecture Workshops form an important segment of the activities under the Science Education Panel. These are of 2-3 days' duration, intended for the benefit of students and teachers at the undergraduate, graduate and research levels. While discussion of modern areas of topical interest is important, the Course should be so designed as to have useful relevance to the materials covered in

the graduate and under-graduate programmes and can then also cover some topics at research level. The Convener of the Lecture Workshop should be a Fellow of either of three Academies. The Convener could identify a Co-ordinator from the host institution to help in the conduct of the Workshop. Resource persons (speakers), ideally up to a total of about 6 to 8 (up to 6 for a 2-day programme, 8 for a 3-day programme) could include Fellows and others. It is desirable that at least half of them, and possibly more, are Fellows. The Lecture Workshops organized during this period are listed in Table 2 below.

TABLE 1

Subject	Venue	Dates	Fellows involved
Advances in biophysics	Centre for Cellular and Molecular Biology, Hyderabad	25 May 2007 – 8 June 2007	Ch. Mohan Rao Somdatta Sinha
Experimental physics	Anna Univ. Chennai	28 May 2007 – 10 June 2007	J Kumar R Srinivasan
Mathematics and its applications	Central Mechanical Engineering Research Institute, Durgapur	9-14 June 2007	JK Bhattacharjee GP Sinha S Sen Sharma
Marine geology and geophysics	National Institute of Oceanography, Goa	22 Oct. 2007 – 2 Nov. 2007	V Purnachandra Rao KS Krishna
Experimental Physics	Univ of Kerala, Trivandrum	22 Oct 2007 – 2 Nov 2007	R Srinivasan
Vistas in zoological teaching	University of Allahabad	Jan 30 2008 – Feb. 13, 2008	UC Srivastava

TABLE 2

Topic	Venue	Dates	Fellows involved
Physics of living matter	Aurora College, Hyderabad	19-20 July 2007	Ravi Paturi and LS Shashidhara
	Mar Ivanios College, Thiruvananthapuram	1-3 Aug. 2007	Diptiman Sen and VS Jayakumar
Frontier topics in Physics	CBKSB Sci, RV Comm and RJ Arts College, Akkalkot	10-11 Aug. 2007	DG Kanhere and Sulabha K Kulkarni
Recent advances in modern biology	S.V. University, Tirupati	Sept. 2007	Sathyavelu K Reddy and V Nagaraja
Creating academic partnerships in satellite oceanography	PG Centre of Marine Biology, Karwar	26-27 Oct. 2007	SK Saidapur
Frontier lectures in chemistry	V.V. Pura College of Science, Bangalore	5-6 Nov. 2007	HA Ranganath
Frontiers in biosciences	Sophia College for Women, Mumbai	29-30 Nov. 2007	Tarala Nandedkar
Trends in medical biotechnology	VIT University of Vellore	27-29 Dec. 2007	AS Balasubramanian
Frontiers in neuroscience	Sophia College for Women, Mumbai	4-5 Jan 2008	Veronica Rodrigues and Yasmin Khan
Recent trends in physics	NGM College, Pollachi	22-24 Jan. 2008	M Lakshmanan and K Anandan

Topic	Venue	Dates	Fellows involved
Gene structure and function – concepts to new developments Mathematics	Mar Athanasios College for Advanced Studies, Tiruvalla MLA College, Bangalore	31 Jan. – 1 Feb. 2008	V Nagaraja and Biju Dharmapalan
		31 Jan – 2 Feb. 2008	Mythily Ramaswamy and JV Sandhya
Concepts in chemistry II	Krishnath College, Berhampur	1-3 Feb. 2008	BM Deb and Somes Ray
Frontier topics in physics	Bishop Heber College, Tiruchirapalli	4-5 Feb. 2008	M Lakshmanan and T Kanna
Pharmaceutical chemistry and drug design	Sri Kaliswari College, Sivakasi	11-12 Feb. 2008	R Ramaraj and L Sakthi Kumar
Novel materials	Univ. of Mysore	22-24 Feb. 2008	R Srinivasan and TK Umesh
Quantum mechanics and computational chemistry	Mar Ivanios College, Thiruvananthapuram	7-8 March 2008	MS Gopinathan
Foundations in chemistry	Government V.Y.T.P.G. Autonomous College, Durg Chhattisgarh	7-9 March 2008	PK Chattaraj and Ajai Kumar Pillai
Frontier lectures in Physics	Bangalore University	11-12 March 2008	HA Ranganath and Ramani
Frontier lectures in Biology	Bangalore University	19-20 March 2008	HA Ranganath and RM Ranganath

In addition to above lectures, the local chapters of the Academy organized their own outreach programmes aimed at Capacity Building initiatives in Science Education. These are described under activities of different local chapters.





# Informatics

The Informatics Centre (IC) provides services to the secretariat and fellowship. The IC encompasses i) Library and the information resource centre, providing scholarly information and ii) Computer facility for facilitating a whole range of IT-related services for the Academy.

Constant endeavours are being made to improve and further widen the horizon of information services, on the one hand, and keeping in tune with the changing needs of information seekers in the electronic environment, on the other. The IC is suitably equipped with modern facilities covering IT products and tools and resources in the form of CD-ROMs, on-line database, audio, video-cassettes, books, journals, reports, etc.

The records of the library are available in electronic format and several indigenous databases have been created, which are accessible to users. The information resource centre focuses on History of Science, Philosophy of Science, Science Planning, Policy Studies, Science Education and Teaching, Science and Society, Works of Eminent Scientists, Nobel Lectures, Reports of National /International Institutions and agencies, etc.

The Library has over 12500 books, 32756 bound periodicals and has currently added 380 books during the year. The library receives 500 titles of journals covering a wide range of subjects, out of which around 400 journals are received through an exchange arrangement. To build an electronic resource collection, several databases have been procured on CDs/Online to facilitate electronic access to scientific literature.

The Informatics Centre provides information services to its users both on-site and remotely, using IT communication channels. Around 650 scholars used the information resources of the Centre at its premises, also entertained queries electronically. Besides the regular/

traditional services, the scientific community is also being served through the following services:

## Personalized Information Services (PIS)

- i) **Current Awareness Service:** Content pages of journals opted by scholars are being supplied at regular intervals, subsequently full articles are also sent on request. During the year 2007, journal titles comprising over 1608 issues were scanned and as a consequence requests for 3446 full articles were received which were entertained. The service is being rendered to individuals and Institutions also.
- ii) **Citation Analysis:** To ascertain the impact of scientists' research publications on the peer group, citation analysis are also undertaken and facilitated against request. Such studies are being carried out and used as one of the parameters for evaluation, in the award/reward system and in identifying trends in citation practices, citation mapping etc. During the year, 4185 research publications were analysed using quantitative Citoanalytical methods.
- iii) **Bibliography/Referal Services:** Access to bibliographic and full text digital and printed resources were provided to the scientific community on request for scholarly informations.
- iv) **Science Information Notes:** A quarterly publication comprising a collection of articles of topical interest is prepared and provided to restricted/interested readers on request. Besides the three general issues, a regular Hindi issue was brought out during the year.

INSA is also participating in the "Universal Digital Library" project by making available all INSA publications (books and monographs) in digital format, published since inception.



## Publications

Publication is one of the Academy's prime activities diligently pursued as a means of disseminating scientific information particularly to the scientific community and the public at large. The Academy considers dissemination of such information integral to the progress of the country and essential not only to update scientists to acquaint them with the latest scientific scenario but also help the public take informed decisions.

Over the years, the Academy has brought out several path-breaking publications of varied genres such as biographical memoirs, year books, status reports of national relevance, study reports, specialized scientific reports, apart from periodic journals. Three journals covering Mathematical Sciences, Physical and Biological Sciences and History of Science are published regularly.

During the period, the *Indian Journal of Pure and Applied Mathematics (IJPAM)*, a bimonthly journal, published five issues of Vol. 38 for the year 2007 and one issue of Vol. 39 for the year 2008 which brings total of 47 articles. During this period, the *IJPAM* received about 317 papers covering the broad spectrum of Pure and Applied Mathematics, Operations Research and Statistics. There was a steady increase in the subscription reflecting the growing popularity of the journal. The Impact Factor of the *IJPAM* presently is 0.109.

Research contributions for *IJPAM* covered in the issues are from China, England, Korea, Turkey, Spain, USA and Yugoslavia besides India spanning broad subjects like Linear Algebra, Topology, Number Theory, Fluid Mechanics and Biomechanics, Difference and Differential Equations, Functional Analysis, Mathematical Biology, Field Theory and Polynomials and Thermo Elasticity.

*Proceedings of the Indian National Science Academy* is an interdisciplinary journal devoted to publication of original research articles, review papers, short communications, commentaries, lateral thinking on emerging techniques and award lectures in the areas of Physical, Biological, Applied Sciences, Agriculture and also Engineering. Four issues of the journal are published in March, June,

September and December. During the year 2007, the volume 73 contained 20 research papers, seven review articles and one lecture.

The Indian Journal of History of Science was published quarterly during 2007 which contained 28 research articles, 13 short articles under the title historical notes, 7 book reviews, besides, conference reports and obituaries. Two monographs entitled, *Karanakautuhalam of Bhaskara – II* (Chaps. 1-5) and *Khadagalaksana Siromani of Navanappa – A treatise on swords (18<sup>th</sup> centuries)* were also published. The September and December 2007 issues of the Journal were Thematic one devoted to *Wootz Steel*.

The Academy brings out from time to time the *Biographical Memoirs of Deceased Fellows of the Academy*. The Memoirs contain the highlights of the life history and scientific achievements of the Fellows written by their close associates, colleagues and friends who closely worked with the Deceased Fellows. During the year, two such volume nos. 31 and 32 covering over 13 and 9 Memoirs respectively have been published. These include those of late Professors S Bhagavantam, KG Ramanathan, A Sreenivasan, RI Ananthakrishnan, MJ Thirumalachar, BD Tilak, CS Vaidyanathan, S Rangaswami, S Sen, AK Rao, A Roy, A Mookherjee, AB Chowdhury, SN Mitra, RC Paul, S Banerjee, UR Ghatak, VG Bhide, IJ Dewan, PR Adiga, SK Mukherjee and A Chatterjee, all distinguished Fellows of the Academy.

Besides, the Academy brought out the Year Book, Annual Report, and Newsletters. The Newsletters and the Annual Report are bilingual publications of the Academy. Apart from the printed version of the publications, the official website of the Academy ([www.insaindia.org](http://www.insaindia.org)) contains the electronic version of all publications of the Academy. The back issues of the *Indian Journal of Pure and Applied Mathematics (IJPAM)*, *Proceedings of the Indian National Science Academy (Physical Sciences: Part A)* and *(Biological Sciences: Part B)* and *Indian Journal of History of Science (IJHS)* are also available online at the above website.

## *Cooperation with Scientific Departments, Professional Academies and Societies*

The Indian National Science Academy is a national academy in the country, which receives funds from the Government of India, Department of Science and Technology for its programmes/activities and secretariat. The Academy maintains a very healthy relationship with the government whose nominee is a member of the council. The Government of India has officially designated INSA as an adhering body to the International Council for Science (ICSU) and all its affiliated unions/committees and programmes and discharge this responsibility on behalf of the nation. This responsibility is discharged by INSA through National Committees formed for each union. These National Committees are the link with the Indian scientific community on one hand and International ICSU Unions on the other. The subject specific professional societies are represented in the corresponding national committees. Some of the ICSU national committees have direct relevance to the programmes governed by government agencies such as COSPAR (Committee on Space Research) by Department of Space, SCAR and SCOR (Scientific Committee on Antarctic and Oceanic Research, respectively) by the Department of Ocean Development, WCRP (World

Climate Research Programme) by India Meteorological Department (IMD) and the like.

Centrally air-conditioned building, fitted with the most modern audio-visual equipments, conference facilities and attached with decent accommodation, has been built for the scientific community with the support of the Government of India, Department of Science and Technology. The Department of Science and Technology also offers financial and administrative support for major studies and events in India.

The Academy also from time to time addresses issues of national interest by associating with other science and professional academies. Subjects like Scientific Ethics, Water and Science Education are being attended jointly by all the science and professional academies. Some of these bodies are represented in the INSA Council and vice-versa. INSA has joint publications/programmes with the CSIR and the Indian Academy of Sciences. The nominees of the Academy also play a very constructive role in editorial boards, research councils and advisory committees of many such bodies. Scientific activities in the annual/bi-annual meetings of professional bodies are sponsored by the Academy.





# *Conferences and Meetings Facilities*

**INSA** is situated in the heart of Delhi at Bahadur Shah Zafar Marg. It occupies three acres of land. The 40,000 sq. feet of green expanse offers a clean environment.

In order to promote science and a scientific temper, INSA has created facilities to host seminars/conferences and meetings in a centrally air-conditioned auditorium and conference halls, meeting rooms and to hold parallel meetings for around 100-150 participants. A large exhibition hall, living rooms for around 60 persons attached with cafeteria and dining facilities are also available. Meeting facilities are equipped with power back-up, modern audio-visual and presentation equipment, stage lighting for performances. These facilities are extended to other scientific Societies, Departments, Councils, Institutions and they use all these facilities and arrange several meetings, conferences and seminars in the complex.

A computer room has been set up in the Informatics Centre with CD net facilities and internet/intranet access. All computers have broad band connectivity. The library has some cubicles with computer facilities for the use of scholars.



# *Welfare Measures*

The Academy prides itself in following a time-honoured tradition of caring for its employees and ensuring for them an enhanced quality of life. Employees are encouraged to enhance both professional capabilities and capacity through participation in professional courses/programmes/seminars, etc. in addition to the usual welfare measures that are in place.

## *Status of Implementation of Official Language Policy*

To promote the official language, the Academy organized the Hindi Fortnight during September 14-27, 2007 wherein

various programmes and competitions were organized. The Official Language Implementation Committee is in place, which makes suggestions for promotion of the official language.

## *Status of Reservation Policy for SC/ST/OBC*

Guidelines for reservation of SC/ST/OBC are observed.



## ORGANIZATIONAL STRUCTURE

### PRESIDENT

Vice Presidents	-	6
Council Members	-	20
Representative from Coop. Academies and Government of India	-	4

### EXECUTIVE SECRETARY

#### DY. EXECUTIVE SECRETARY

Publications  
and  
Administration

Science Promotion  
History of Science  
Informatics/Science  
and Society  
Estate and Facilities

#### DY. EXECUTIVE SECRETARY

Council,  
International  
Programmes  
Finance and Accounts

### SENIOR STAFF MEMBERS

Executive Secretary	SK Sahni
Deputy Executive Secretaries	AK Tagore
	AK Moitra
Asstt. Executive Secretaries	JM Gupta
	AN Thakur
	Sunil Zokarkar
	Sudhanshu Aggarwal
Advisors/Consultants	AK Bag
	Dinesh Chandra
	AK Jain
Civil Engineer	RK Sharma
Total Staff	73



# Auditors Report

**JAIN PRAMOD JAIN & CO**  
Chartered Accountants

Phone: 26952594; 26943877  
Fax: 26943877  
Email: jainpj@hotmail.com  
F-591, Sarita Vihar  
New Delhi-110 076


We have audited the annexed Balance Sheet of the Indian National Science Academy as at 31st March, 2008 and also the relevant Income & Expenditure Account and Receipts & Payments Accounts of the Academy for the year ended on that date with the help of the books of accounts and vouchers relating thereto.

It is the policy of the Academy to prepare its financial statements on the cash-receipts and disbursements basis. On this basis revenue and the related assets are recognised when received rather than when earned, and expenses are recognised when paid rather than when the obligation is incurred.

Fixed Assets register is being updated. Interest earned Rs. 51.27 lacs and expenditure incurred Rs. 50.00 lacs out of Corpus fund has been included in Fund instead of Income & Expenditure. No depreciation has been provided on fixed assets and books. Nonrecurring expenditure such as books, computer, furniture & fixtures etc. have been included in schedule 19 of Income & Expenditure Account since respective grant has been also included in Income & Expenditure Account. Stock of publication has not been included in Balance Sheet.

Subject to the foregoing the impact of the same on profit is unascertained, the Balance Sheet & Income & Expenditure Accounts give a true and fair view of the Assets and Liabilities arising from cash transactions of Indian National Science Academy at 31.3.2008 and of the revenue collected and expenses paid during the year then ended on cash receipts and disbursements basis as described in Note I(a).

For JAIN PRAMOD JAIN & CO.  
Chartered Accountants

  
(PK JAIN)  
Partner  
Membership No. 10479

Place: New Delhi  
Date: 14 July 2008



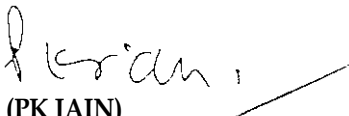
## INDIAN NATIONAL SCIENCE ACADEMY

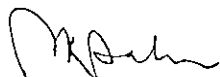
## Balance Sheet as at 31.03.2008

(Amount Rs.)

CORPUS/CAPITAL FUND AND LIABILITIES	Schedule	Current Year	Previous Year
Corpus/Government Fund	1	289168667.44	290720678.03
Reserves and Surplus	2	195859.34	543952.32
Earmarked/Endowment Funds	3	33756616.74	31357908.74
Unspent Balances of Various Schemes	4	4541336.27	2485547.06
Current Liabilities and Provisions	5	5802909.95	3883626.95
Employees Provident Fund	6	25262771.34	24774726.00
<b>TOTAL</b>		<b>358728161.08</b>	<b>353766439.10</b>
<b>ASSETS</b>			
G.P.F. Advance (Staff)	7	2047186.00	2097264.00
Fixed Assets	8	205960065.48	207308174.48
Investments	9	138498062.00	136737606.00
Current Assets, Loans, Advances, Etc.	10	12222847.60	7623394.62
<b>TOTAL</b>		<b>358728161.08</b>	<b>353766439.10</b>

As per our report of even date

For JAIN PRAMOD JAIN & CO.  
Chartered Accountants

  
(PK JAIN)  
Partner


  
(SK SAHNI)  
Executive Secretary


  
(SUNIL ZOKARKAR)  
Assistant Executive Secretary
Place: New Delhi  
Date: 14 July 2008

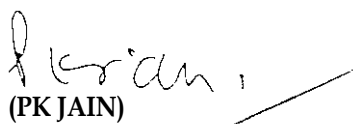
## INDIAN NATIONAL SCIENCE ACADEMY

## Income and Expenditure Account for the Year Ending 31.03.08

INCOME	Schedule	Current Year (Amount in Rs.)	Previous Year (Amount in Rs.)
Income from Sales / Services	11	4334345.00	5262845.00
Grants / Subsidies	12	98700000.00	89380000.00
Fees / Subscriptions	13	605.00	423.00
Income from Royalty, Publication etc.	14	1834205.29	1806319.57
Interest Earned	15	843404.00	796465.00
<b>TOTAL (A)</b>		<b>105712559.29</b>	<b>97246052.57</b>
<b>EXPENDITURE</b>			
Establishment Expenses	16	28545731.00	24780818.10
Other Administrative Expenses etc.	17	14919495.27	14783624.00
Expenditure on Grants, Subsidies, etc.	18	21393974.00	18007152.00
Non-recurring Expenditure (incl Golden Jubilee blg.)	19	1058858.00	5038116.50
TA/DA	20	5143812.00	4287550.00
Publications	20	1705203.00	1852100.00
Subscriptions to ICSU bodies	20	11255800.00	11520066.00
International Scientific delegations/ Exch Prog.	20	10490193.00	10968410.80
Seminars/symposia/Popularisation of Science activities	20	2067036.00	420854.50
Other Expenditure (Plan & Non-Plan)	20	9480550.00	8054719.00
<b>TOTAL (B)</b>		<b>106060652.27</b>	<b>99713410.90</b>
Balance being excess/(short) of Income over Expenditure (A-B)		(-348092.98)	(2467358.33)
Surplus from last year Balance Sheet		543952.32	3011310.65
<b>Balance Being Surplus/(Deficit) Carried to Balance Sheet</b>		<b>195859.34</b>	<b>543952.32</b>
SIGNIFICANT ACCOUNTING POLICIES	21		

As per our report of even date

For JAIN PRAMOD JAIN & CO.  
Chartered Accountants

  
(PK JAIN)  
Partner

  
(SK SAHNI)  
Executive Secretary

  
(SUNIL ZOKARKAR)  
Assistant Executive Secretary


Place: New Delhi  
Date: 14 July 2008



**SCHEDULE – 21****Significant Accounting Policies and Notes to Accounts****1. Significant accounting policies**

- a) The books of accounts have been maintained on cash basis.
  - b) No depreciation has been provided on Fixed Assets and Books. Fixed assets are stated at historical cost and no revaluation of fixed assets has been done.
  - c) Long term investments are stated at cost.
  - d) Gratuity and other retirement benefits are accounted on cash basis.
  - e) Funds/ Grants include interest of respective fixed deposits/ investments and related Expenses are also deducted.
  - f) Government grants have been accounted for on Cash basis. Fixed assets acquired out of Government grant are shown at purchase value.
  - g) Grants from Government relating to Fixed Assets are credited to specific funds and Fixed Assets acquired out of such grants are shown at cost.
2. Non-Recurring Expenditure such as Books, Computer, fixtures and addition to building and Advances have been included in Schedule 17 of Income & Expenditure Account since respective grant has also been included in Income and Expenditure Account.
  3. Interest earned Rs. 5127133.00 and expenditure incurred Rs. 5000000.00 out of Corpus Fund have been included in Schedule-1 of Fund instead of Income and Expenditure A/c.
  4. Stock of Publications of the Academy as on 31<sup>st</sup> March 2008 has not been included in the Balance Sheet, whereas, the same is the property of the Academy.
  5. Fixed Assets register is being updated.
  6. Grants in aids released to various institutions under various schemes are subject to their audit/ utilization certificate.
  7. Credit balance of Pension fund Rs. 3,31,137.97 has been transferred from Pension fund account to General Provident fund account. Excess interest earned on GPF investment Rs. 2,25,388.37 has been credited to Employees General Provident fund account in schedule 6 which is to be utilized in case of deficit in future.

For Jain Pramod Jain & Co.  
Chartered Accountants

  
(PK JAIN)  
Partner

  
(SK SAHNI)  
Executive Secretary

  
(SUNIL ZOKARKAR)  
Assistant Executive Secretary

Place: New Delhi  
Date: 14 July 2008



# Annexures

## ANNEXURE - I

### AWARD LECTURES DELIVERED – UNDER LOCAL CHAPTERS

1. **INSA Vainu Bappu Memorial Medal (2007)** entitled *Weight of the Cosmic Vacuum* was delivered by Dr T Padmanabhan, FNA, Dean, Core Academic Programmes, Inter-University Centre for Astronomy & Astrophysics (IUCAA), Pune on August 17, 2007 at IUCAA Campus, Pune.
2. **Dr GP Chatterjee Memorial Lecture (2006)** entitled *Towards Quieter Technologies* by Professor ML Munjal, FNA, Department of Mechanical Engineering, Indian Institute of Science, Bangalore on September 19, 2007 at Motilal Nehru National Institute of Technology, Allahabad.
3. **Dr Biren Roy Memorial Lecture (2007)** entitled *Vibration Problems in Industry-Indian Scenario* was delivered by Professor V Ramamurti, FNA, Formerly Professor, IIT-Madras, Chennai on September 29, 2007 at IIT, Mumbai.
4. **Professor KS Bilgrami Memorial Medal (2007)** was delivered by Professor SK Apte, FNA, Associate Director, Bio-Medical Group (B) & Head, Molecular Biology Division, Bhabha Atomic Research Centre, Mumbai on October 28, 2007 at Indian Institute of Science, Bangalore.
5. **Dr TS Tirumurthi Memorial Lecture (2007)** was delivered by Professor UC Chaturvedi, FNA, Formerly Professor and Head, Department of Microbiology, KG Medical College, Lucknow on November 13, 2007 at Indian Institute of Science, Bangalore.
6. **The Chandrakala Hora Medal (2007)** entitled *Molecular Regulation of Oocyte Maturation in an Indian Perch Anabas Testudineus* by Professor Samir Bhattacharya, FNA, School of Life Sciences, Department of Zoology, Visva-Bharati, Santiniketan on November 12, 2007 at National Institute of Ocean Technology, Chennai.
7. **Professor VV Narlikar Memorial Lecture (2006)** was delivered by Professor M Lakshmanan, FNA, Professor of Eminence & DST Ramanna Fellow, Centre for Nonlinear Dynamics, Bharathidasan University, Tiruchirappalli on December 19, 2007 at Indian Institute of Science, Bangalore.
8. **The Prasanta Chandra Mahalanobis Medal (2002)** entitled *Overview of Indian Power System and Challenges Ahead* and **The Syed Husain Zaheer Medal (2004)** entitled *Energy and Environment* were delivered by Professor J Nanda, FNA, Visiting Honorary Professor, Department of Electrical Engineering, Indian Institute of Technology-Delhi, Hauz Khas, New Delhi on December 26, 2007 at Silicon Institute of Technology, Bhubaneswar.
9. **Professor K Naha Memorial Medal (2007)** entitled *Luminescence Dating in Quantitative Resconstruction of Continental Paleoclimates and Earth Surface* was delivered by Professor AK Singhvi, FNA, Planetary and Geoscience Division, Physical Research Laboratory, Ahmedabad on December 21, 2007 at National Institute of Oceanography, Goa.
10. **Professor Brahm Prakash Memorial Medal (2007)** entitled *Powering India* was delivered by Dr VS Arunachalam, FNA, Founder & Chairman, Centre for Study of Science, Technology & Policy (CSTEP), Bangalore on December 21, 2007 at National Institute of Oceanography, Goa.
11. **The Satyendranath Bose Medal (2007)** entitled *Basic Constituents of Matter-Visible and Invisible* was delivered by Professor DP Roy, FNA, Homi Bhabha Centre of Science Education, Tata Institute of Fundamental Research, Mumbai on December 22, 2007 at National Institute of Oceanography, Goa.
12. **The Chandrasekhara Venkata Raman Medal (2007)** entitled *Biofortification of Crops for Reducing Malnutrition* was delivered by Professor GS Khush, FNA, Foreign Assoc., NAS (US) Blackhawk Place, Davis, California, USA on December 22, 2007 at National Institute of Oceanography, Goa.

13. **The INSA Prize for Materials Science (2007)** entitled *The Structure-Property, Performance Correlation in Detonation Sprayed WC-Co Coatings* by Dr G Sundararajan, FNA, Director, International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI), Hyderabad on December 22, 2007 at National Institute of Oceanography, Goa.
14. **The Golden Jubilee Commemoration Medal for Chemical Sciences (2007)** entitled *Synthetic Studies on Glycosidase Inhibitors* was delivered by Professor S Chandrasekaran, FNA, Division of Chemical Sciences, Indian Institute of Science, Bangalore on December 22, 2007 at National Institute of Oceanography, Goa.
15. **The Golden Jubilee Commemoration Medal for Biological Sciences (2007)** entitled *Research towards Development of Products of Relevance to the Country: From Lab to Land* was delivered by Professor GP Talwar, FNA, Talwar Research Foundation, New Delhi on December 22, 2007 at National Institute of Oceanography, Goa.
16. **The Jawaharlal Nehru Birth Centenary Lecture (2007)** entitled *Constancy and Change in Brain Circuits* was delivered by Professor K Vijayaraghavan, FNA, Senior Professor & Director, National Centre for Biological Sciences, TIFR, GKVK Campus, Bangalore on December 23, 2007 at National Institute of Oceanography, Goa.
17. **The Shanti Swarup Bhatnagar Medal (2007)** entitled *Global and Indian Scenario of H5N1 Status, Issues and Challenges* was delivered by Professor NK Ganguly, FNA, Director-General, ICMR, Ansari Nagar, New Delhi on December 23, 2007 at National Institute of Oceanography, Goa.
18. **Dr Nitya Anand Endowment Lecture (2007)** entitled *DNA and RNA as Drugs and Their Implications in Gene Therapy* was delivered by Professor Santanu Bhattacharya, FNA, Department of Organic Chemistry, Indian Institute of Science, Bangalore on February 07, 2008 at Indian Institute of Technology, Kharagpur.
19. **Dr Darshan Ranganathan Memorial Lecture (2007)** entitled *Bacteriophage: HB78 Genomics and Proteomics* was delivered by Professor Maharani Chakravorty, FNA Honorary Scientist, National Institute of Cholera and Enteric Diseases (NICED), Kolkata on March 03, 2008 at Jawaharlal Nehru University, New Delhi.
20. **The Jawaharlal Nehru Birth Centenary Lecture (2007)** entitled *From Enzyme Kinetics to Protein Diffusion along DNA: New Approaches to Old Unsolved Problems* was delivered by Professor Biman Bagchi, FNA, Professor & Chairman, SSCU, Indian Institute of Science, Bangalore on February 13, 2008 at Indian Association for Cultivation of Science, Kolkata.
21. **The Indira Gandhi Prize for Popularization of Science (2008)** entitled *Toys from Trash* was delivered by Shri Arvind Gupta, Inter-University Centre for Astronomy & Astrophysics (IUCAA), Ganeshkhind, Pune on February 28, 2008 at INSA Campus, New Delhi.
22. **Professor MRN Prasad Memorial Lecture (2007)** entitled *Reproduction: An Evolutionary Perspective* was delivered by Professor SK Saidapur, FNA, Vice-Chancellor, Karnatak University, Dharwad on March 12, 2008 at University of Delhi, Delhi.
23. **The Darashaw Noshawanji Wadia Medal (2007)** was delivered by Professor VK Gaur, FNA, Distinguished Professor, Indian Institute of Astrophysics, Bangalore on March 28, 2008 at Banaras Hindu University, Varanasi.





## ANNEXURE - II

## INDIAN SCIENTISTS OCCUPYING VARIOUS POSITIONS IN INTERNATIONAL ORGANIZATIONS

### ICSU

Professor G Mehta	President, ICSU
Professor Anupam Varma	Chairman, Regional Committee of ICSU for Asia and the Pacific

### URSI

Dr V Kumar	Member, Standing Committee on Young Scientists
Dr P Banerjee	Member, Advisory Panel on Future General Assemblies, Vice-Chair, Commission A (Electromagnetic Metrology & Member Commission B (Fields and Waves)
Dr MK Goel	Coordinator, Scientific Programme XXIXth General Assembly & Member, Standing Publications Committee
Professor S Ananthakrishnan	Vice-Chair, Commission J (Radio Astronomy)

### CODATA

Dr Krishan Lal	President, CODATA
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### IUPAB

Professor NR Jagannathan	Member, IUPAB Council
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### IMU

Dr SG Dani	President, Commission on Development & Exchanges (CDE)
Professor S Kumarasen	Member-at-Large, International Commission on Mathematical Instruction (ICMI)

### IUNS

Dr Kamala Krishnaswami	Member, IUNS Executive Board
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### IUPAP

Professor Sriram Ramaswamy	Member, Commission on Statistical Physics (C3)
Professor Suresh Tonwar	Member, Commission on Cosmic Rays (C4)
Professor N.Yathinda	Member, Commission on Biological Physics (C6)
Dr S Bhattacharya	Member, Commission on the Structure and Dynamics of Condensed Matter (C10)
Dr Pratibha Jolly	Chair, Commission on Physics Education (C14) & Vice President, IUPAP
Dr Deepak Mathur	Member, Commission on Atomic, Molecular and Optical Physics (C15)
Dr Dhiraj Bora	Member, Commission on Plasma Physics (C16)
Dr SS Jha	Secretary, Commission on Quantum Electronics (C17)
Dr T Padmanabhan	Member, Commission on Astrophysics (C19)

### IUGS

Professor SK Tandon	Member, IUGS Executive Board
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**IUGG**

Professor HK Gupta	Vice President, IUGG
Professor S Krishnaswami	Vice-President, IAPSO
Professor GS Lakhina	Member, Executive Committee, IAGA
Dr SK Verma	IASPEI Representative to the Solid Earth Geophysical Working Group (SCAR)
Dr VP Dimri	National Correspondent, IASPEI
Dr G Beig	Co-Chair, IAGA Working Group II F, Long-Term trends in the Mesosphere, Thermosphere & Ionosphere
Dr Mita Rajaram	Co-Chair, IAGA Working Group V- DAT: Geomagnetic Data & Indices
Dr UC Sharma	President, IAHS International Commission on Water Quality (ICWQ)
Professor BN Goswami	National Correspondent, IAMAS
Professor MN Kulkarni	National Correspondent, IAG
Dr JN Diddee	National Correspondent, IAHS
Professor RP Singh	Vice-Chair, Union Commission on Geophysical Risk & Sustainability (GeoRisk)
Dr RK Chadha	Secretary-General, Asian Seismological Commission
Dr GJ Nair	National Correspondent, IASPEI
Professor DK Nayak	National Correspondent, IAG
Dr Sandeep Singh	Secretary, IAVCEI Commission on Granites

**IUPAC**

Professor S Chandrasekaran	Member, IUPAC Executive Committee
Dr Vimal Kumar Jain	National Representative, Inorganic Chemistry Division Committee (II)
Professor AK Bakshi	National Representative, Committee on Chemistry Education (CCE) Division Committee (V)
Professor Uday Maitra	National Representative, Committee on Chemistry Education (CCE) Division Committee (V)
Professor SS Krishnamurthy	National Representative, Chemical Nomenclature & Structure Representative Division Committee (VII)
Professor Javed Iqbal	National Representative, Chemistry & Human Health Division Committee (VII)

**COSPAR**

Dr R Sridharan	Member, COSPAR Bureau
Dr Rajendra K Gupta	Vice Chair, Sub Commission A3: Land Processes and Morphology
Dr GS Lakhina	Chair, Sub Commission E1: Galactic & Extragalactic Astrophysics & Vice-Chair, Panel on Technical Problems Related to Scientific Ballooning (PSB)

**IUCR**

Professor G Desiraju	Member, IUCr Executive Committee
Professor TP Singh	Member, Commission on Biological Macromolecules
Dr Dhananjai Pandey	Consultant, Commission on Aperiodic Crystals
Dr K Byarappa	Member, Commission on Crystal Growth & Characterization of Materials

Dr VK Wadhawan

Member, Commission on Crystallographic Teaching

Dr NK Mukhopadhyay

Consultant, Electron Diffraction

## IAU

Professor G Srinivasan

President, IAU Commission on Space & High Energy Astro-Physics

Professor T Padmanabhan

Vice-President, IAU Commission 47 on Cosmology and Member, Division 8 of Galaxies and Universe

## WCRP

Professor GB Pant

Member, Scientific Committee for WCRP

## IGBP

Professor S Krishnaswami

Vice-President, Intl. Association of the Physical Sciences of the Ocean (IAPSO)

## SCOR

Professor R Ramesh

WG 113 on Evolution of the Asian Monsoon in Marine Records: Comparison between Indian and East Indian Subsystems & WG 117 on Synthesis of Decadal to Millennial Climate Records of the Past 80 ky

Dr SR Shetye

WG 111 on Coupling Waves, Currents and Winds in Coastal Models

Dr KKC Nair

WG 115 on Standards for the Survey and Analysis of Plankton

Professor MM Sarin

WG 116 ON sediment Trapp and 234<sup>th</sup> Method for Carbon Export Flux Determination

Dr M Dileep Kumar

WG 120 on Marine Phytoplankton & Global Climate Regulation: The Phaeocystis spp. Cluster as a Model

Dr SWA Naqvi

SCOR WG 128 on Natural & Human Induced Hypoxia and Consequences for Coastal Areas





## ANNEXURE - III(a)

## INSA SENIOR SCIENTISTS, HONORARY SCIENTISTS

## INSA Senior Scientist

1. **Professor D Chakravorty**, FNA, Indian Association for the Cultivation of Science, Kolkata.
2. **Dr Harjit Singh**, FNA, Department of Chemistry, Guru Nanak Dev University, Amritsar.
3. **Professor J Nanda**, FNA, Department of Electrical Engineering, Indian Institute of Technology, New Delhi.
4. **Professor K Gopalan**, FNA, National Geophysical Research Institute, Hyderabad.
5. **Professor D Mukhopadhyay**, FNA, Department of Geology, Calcutta University, Kolkata.
6. **Professor MS Srinivasan**, FNA, Department of Geology, Banaras Hindu University, Varanasi.
7. **Professor KR Shivanna**, FNA, Ashoka Trust for Research in Ecology and the Environment, Bangalore.
8. **Professor Shyam Prakash**, FNA, National Research Centre on Plant Biotechnology, Indian Agricultural Research Institute, New Delhi.
9. **Professor PN Takkar**, FNA, Division of Soil Science and Agricultural Chemistry, Indian Agricultural Research Institute, New Delhi.
10. **Professor Sarva Jit Singh**, FNA, Department of Mathematics, University of Delhi, South Campus, New Delhi.
11. **Professor SC Dutta Roy**, FNA, Department of Electrical Engineering, Indian Institute of Technology, New Delhi.
12. **Professor DJ Bagyaraj**, FNA, Department of Agricultural Microbiology, University of Agricultural Sciences, GKVK, Bangalore.
13. **Professor PK Sarkar**, FNA, Div. of Neurobiology, Indian Institute of Chemical Biology, Kolkata.
14. **Professor MS Jairajpuri**, FNA, Department of Zoology, Aligarh Muslim University, Aligarh.
15. **Professor TJ Pandian**, FNA, School of Biological Sciences, Madurai Kamaraj University, Madurai.
16. **Professor IBS Passi**, FNA, Department of Mathematics, Panjab University, Chandigarh.
17. **Professor SS Krishnamurthy**, FNA, Department of Inorganic & Physical Chemistry, Indian Institute of Science, Bangalore.
18. **Professor V Ramamurti**, FNA, Anna University, Chennai.
19. **Professor DK Paul**, FNA, Department of Geology, Presidency College, Kolkata.
20. **Professor KK Mahajan**, FNA, Radio & Atmospheric Sciences Division, National Physical Laboratory, New Delhi.
21. **Professor RS Tripathi**, FNA, National Botanical Research Institute, Lucknow.
22. **Dr (Mrs) MM Mathan**, FNA, Tuberculosis Research Centre, Chennai.
23. **Professor Kalluri Subba Rao**, FNA, Department of Biochemistry, School of Life Sciences, University of Hyderabad, Hyderabad.
24. **Professor Anil Saran**, FNA, Department of Pharmaceutical Chemistry, Bombay College of Pharmacy, Mumbai.
25. **Professor KP Gopinathan**, FNA, Department of Microbiology & Cell Biology, Indian Institute of Science, Bangalore.
26. **Professor Anupam Varma**, FNA, Advanced Centre for Plant Virology, Division of Plant Pathology, Indian Agricultural Research Institute, New Delhi.
27. **Professor RP Sharma**, FNA, National Research Centre on Plant Biotechnology, Indian Agricultural Research Institute, New Delhi.
28. **Professor T Parathasarathy**, FNA, University of Hyderabad, Hyderabad.
29. **Dr Krishan Lal**, FNA, National Physical Laboratory, Dr. KS Krishnan Marg, New Delhi.
30. **Professor NV Madhusudana**, FNA, Liquid Crystal Laboratory, Raman Research Institute, Bangalore.
31. **Professor SS Kapoor**, FNA, Bhabha Atomic Research Centre, Trombay, Mumbai.
32. **Professor NK Ray**, FNA, Dr BR Ambedkar Centre for Biomedical Research, University of Delhi, Delhi.
33. **Professor Amitabha Ghosh**, FNA, Mechanical Engineering Department, Indian Institute of Technology, Kanpur.
34. **Professor Ashok Sahni**, FNA, CAS in Geology, Panjab University, Chandigarh.
35. **Dr SM Naqvi**, FNA, National Geophysical Research Institute, Hyderabad.

36. **Professor Sushil Kumar**, FNA, National Centre for Plant Genome Research, New Delhi.
37. **Professor T Subramoniam**, FNA, National Institute of Ocean Technology, Pallikaranai, Chennai.
38. **Professor C Ramakrishnan**, FNA, Molecular Biophysics Unit, Indian Institute of Science, Bangalore.
39. **Professor IP Abrol**, FNA, Centre for Advancement of Sustainable Agriculture, DPS Marg, NASC Complex, New Delhi.
40. **Professor JS Singh**, FNA, Department of Botany, Banaras Hindu University, Varanasi.
41. **Professor PD Prasada Rao**, FNA, Department of Zoology, Nagpur University, Nagpur.
42. **Professor DM Banerjee**, FNA, Department of Geology, University of Delhi, Delhi.
43. **Professor AV Narlikar**, FNA, Visiting Scientist, UGC-DAE Consortium for Scientific Research, University Campus, Indore-452 017.
44. **Dr SK Dogra**, FNA, Dean, IISER, Bhopal.
45. **Dr JS Sandhu**, FNA, Department of Chemistry, Punjabi University, Patiala.
46. **Professor S Krishnaswami**, FNA, Planetary and Geosciences Division, Physical Research Laboratory, Ahmedabad.
10. **Professor P Mohanty**, FNA
11. **Dr HS Randhawa**, FNA
12. **Dr BN Das**, FNA
13. **Professor SP Moulik**, FNA
14. **Professor YP Abrol**, FNA
15. **Professor Mahdi Hasan**, FNA
16. **Professor KP Sinha**, FNA
17. **Professor ES Rajagopal**, FNA
18. **Professor HY Mohan Ram**, FNA
19. **Professor AS Gupta**, FNA
20. **Professor S Sriramachari**, FNA
21. **Professor SC Maheshwari**, FNA
22. **Professor Prem Narain**, FNA
23. **Professor IB Chatterjee**, FNA
24. **Professor KN Agarwal**, FNA
25. **Professor Narendra Bhandari**, FNA
26. **Professor RN Saxena**, FNA
27. **Professor RS Sharma**, FNA
28. **Professor D Chakravorty**, FNA
29. **Professor PS Ramakrishnan**, FNA
30. **Professor T Ramasarma**, FNA
31. **Professor P Krishna**, FNA
32. **Professor PK Gupta**, FNA
33. **Professor SM Chitre**, FNA
34. **Professor PL Sachdev**, FNA
35. **Professor J Nanda**, FNA
36. **Professor RG Rastogi**, FNA
37. **Professor OP Bhutani**, FNA
38. **Professor VS Rama Das**, FNA
39. **Professor Shyam Prakash**, FNA
40. **Professor SC Dutta Roy**, FNA

### Honorary Scientists

1. **Professor DK Chattoraj**, FNA
2. **Dr SK Jain**, FNA
3. **Professor RP Rastogi**, FNA
4. **Professor R Raghavarao**, FNA
5. **Professor DVS Jain**, FNA
6. **Professor SV Kessar**, FNA
7. **Professor SS Bir**, FNA
8. **Professor RP Gandhi**, FNA
9. **Professor Rajendra Prasad**, FNA



## ANNEXURE - III(b)

**PROJECT INVESTIGATORS – INSA YOUNG SCIENTIST MEDAL AWARDEE**

**Dr Sukumar Mishra**, Assistant Professor, Department of Electrical Engineering, Indian Institute of Technology, New Delhi.

**Dr Sindhu Radhakrishna**, Adjunct Associate, National Institute of Advanced Studies, Indian Institute of Science Campus, Bangalore.

**Dr Altaf Ahmad**, Lecturer, Department of Botany, Faculty of Science, Jamia Hamdard, New Delhi.

**Dr Baljit Singh**, Lecturer, Govt. College, Sector 11, Chandigarh.

**Dr Malabika Datta**, Scientist, Institute of Genomics and Integrative Biology, Mall Road, New Delhi.

**Dr Debashish Goswami**, Assistant Professor, Statistics-Math Unit, Indian Statistical Institute, Kolkata.

**Dr Veena S Anil**, Research Associate, National Centre for Biological Sciences, TIFR, UAS-GKVK Campus, Bangalore.

**Dr PS Chakraborty**, Reader, The Institute of Mathematical Sciences Campus, Taramani, Chennai.

**Dr Hardeep Singh Gujral**, Reader, Department of Food Science & Technology, Guru Nanak Dev University, Amritsar.

**Dr V Shankar**, Assistant Professor, Department of Chemical Engineering, Indian Institute of Technology, Kanpur.

**Dr Sharmistha Banerjee**, Lecturer, Department of Biochemistry, School of Life Sciences, University of Hyderabad, Hyderabad.

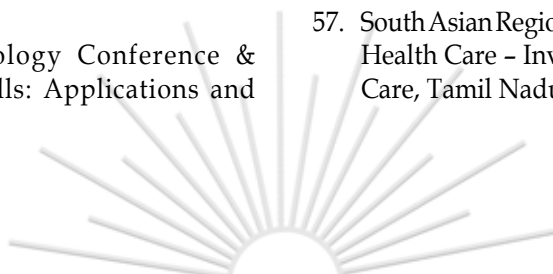
## ANNEXURE - III(c)

**INTERNATIONAL/NATIONAL SEMINAR/SYMPOSIA/CONFERENCES SPONSORED/ SUPPORTED BY INSA**

1. International Conference on the Applications of Mössbauer Effect, Kanpur.
2. Conference on Accelerator and Low Level Radiation Safety, New Delhi.
3. International Seminar on Frontiers in Polymer Science & Technology, Guwahati.
4. International Conference on Certain Emerging Areas in Applicable Mathematics, Jammu.
5. Indo-Australian Workshop on a CFD Approach on Fluid Flow, Heat and Mass Transfer followed by Symposium on CFD Applications in Multidisciplinary Areas, Roorkee.
6. IX National Seminar on Medico Legal Systems & Hospitals/Health Care Management, Pune.
7. Lens to Genes Theme for the CME - National Conference 2007, Mangalore.
8. 31<sup>st</sup> Annual Conference Ethological Society of India and National Symposium on Women in Agriculture, Bangalore.
9. Symposium on Probability & Statistics, Hyderabad.
10. Workshop on Molecular Cytogenetics Rapid Aneuploidy Diagnosis by FISH (Fluorescent In-Situ Hybridization), New Delhi.
11. CME/Workshop on Cytology, Allahabad.
12. *Bhartiya Vigyan Sammelan*, Bhopal.
13. 37<sup>th</sup> National Seminar on Crystallography, Kolkata.
14. 8<sup>th</sup> World Congress IHPBA, Mumbai.
15. International Conference on Radio Science, ICRS-2008, Jodhpur.
16. Seminar-cum-meeting of the Task Group of Exchangeable Materials Data Representation to Support Scientific Research and Education of Committee on Data for Science & Technology (CODATA) of International Council of Science (ICSU), Delhi.
17. International Conference on Operator Theory and Related Areas, Delhi.
18. 73<sup>rd</sup> Annual Conference of the Indian Mathematical Society, Pune.
19. International Conference on Condensed Matter Physics, Jaipur.
20. International Conference on Gravitation and Cosmology, Pune.
21. Annual International Conference of "POLYCHAR" 16 World Forum on Advanced Materials, Lucknow.



22. International Symposium on Vacuum Science & Technology IVS-207, Mumbai.
23. 19th Annual General Meeting of Material Research Society of India (MRSI-2008), Thiruvananthapuram.
24. National Conference on Liquid Crystals, Darjeeling, West Bengal.
25. National Conference on Green Aspects of Electrochemistry, Gwalior.
26. International Symposium on Recent Trends in Surface and Colloid Science, Kolkata.
27. International Conference on Microwaves and Optoelectronics, Aurangabad.
28. International Conference on Metals and Alloys; Past, Present and Future (METALLO 2007), Kanpur.
29. International Conference-cum-Workshop on Nanomaterials & Nanotechnology, Gurgaon, Haryana.
30. International Conference on Sensors and Related Network, (Seent'07), Vellore.
31. Tectonics of Indian Subcontinent, Mumbai.
32. International Conference & Field Workshop on Geology; Indian Scenario and Global Context, Kolkata.
33. National Seminar on Hydrology with a special Colloquium on Rainfall versus Resources in North-East India, Shillong.
34. International Conference on XVII Annual Conference of Indian Association for Angiosperm Taxonomy and International Seminar on Changing Scenario in Angiosperm Systematics, Kolhapur.
35. Tropical Ecology Congress 2007. Dehradun.
36. National Conference on Bio-sources Conservation and Management, Visakhapatnam.
37. National Symposium on Recent Advances in Phycology from Molecule to Eco-system, Chandigarh.
38. International Conference on Free Radicals & Natural Products in Health (FRNPH-08) and Seventh Annual Meeting of the Society of Radical Research India, Jaipur.
39. XXXI All India Cell Biology Conference & Symposium on "Stem Cells: Applications and Prospects, Varanasi.
40. National Symposium on Comparative Endocrinology and Reproductive Physiology: Insights and Challenges, Santiniketan.
41. XIX National Symposium on Chronobiology, Madurai.
42. 19<sup>th</sup> U.P. Congress of Obstetrics of Obstetrics & Gynaecology, Aligarh.
43. 39<sup>th</sup> Annual Conference of SNM, India & CME International Symposium on Molecular Imaging, Lucknow.
44. 1<sup>st</sup> National Annual Conference of Heart Failure Society, Hyderabad.
45. Child Health in Tribal Areas, Maharashtra.
46. International Symposium on Advances in Neurosciences and Silver Jubilee Conference of Indian Academy of Neurosciences, Varanasi.
47. Guha Research Conference 2007, Kolkata.
48. International Conference on New Horizons in Biotechnology, Thiruvananthapuram.
49. International Symposium on Recent Trends in Macromolecular Structure and Function - 2008, Chennai, Tamil Nadu.
50. National Symposium on Biophysics under the aegis of Indian Biophysical Society, Chandigarh.
51. International Ergonomics Conference HWWE 2007, Bhopal.
52. International Conference on Agrochemical for Crop Protecting Health & Natural Environment, New Delhi.
53. International Conference on Traditional Dairy Food 2007, Karnal.
54. Symposium on Viruses of Ornamentals and Temperate Fruits, Palampur.
55. International Conference on Advances in Mathematics: Historical Developments and Engineering Applications, Pantnagar.
56. International Seminar on History of Mathematics in Memory of Subhash Handa, Delhi.
57. South Asian Regional Symposium on Evidence Based Health Care - Investing Evidence for better Health Care, Tamil Nadu.



## ANNEXURE - III(d)

**HIGHLIGHTS OF THE RESEARCH WORK CARRIED OUT BY INSA RESEARCH PROFESSORS, SENIOR SCIENTISTS, HONORARY SCIENTISTS AND YOUNG SCIENTIST MEDAL AWARDEES****RESEARCH PROFESORS****Foundation and Applications of Quantum Mechanics****VIRENDRA SINGH****INSA - CV Raman Research Professor**

*Tata Institute of Fundamental Research, Homi Bhabha Road, Mumbai*

Professor Virendra Singh has been investigating the existence and construction of positive joint probability distribution over noncommuting phase space variables in Quantum Mechanics such that given marginal are reproduced. In view of importance of two qubit correlations to theories with local realism and in quantum information we have extended that work to this case now. The four EPR experiments need four single- and four two-particle observable detection probabilities to describe them. They play the role of marginal here. All four EPR experiments can be compatible with positive joint probability distributions only if Bell's inequalities are satisfied. We explicitly construct most general 8 parameter family which does that. Generically we can reproduce only the results of at most three EPR experiments using positive joint probability distributions. In this case the most general distribution has 7 parameters we give an explicit construction for that.

The paper giving the results of the most general positive joint probability distributions for the two quiet EPR experiments is published in:

- 1) Joint Probabilities reproducing three EPR experiments on two Qubits (with SM Roy, D Atkinson, G Auberson and G Mahoux), *Mod. Phys. Lett. A* **22**, 1717-1726 (2007).

**Book Chapters:**

- i) Scientific Realism and Classical Physics, ar Xive: 0805. 1780 (2008).
- ii) Bohm's realist interpretation of Quantum Mechanics, ar Xiv: 0805. 1779 (2008).

Both these will appear in a Project of History of Science, Philosophy and Culture in Indian Civilizations Volume edited by P Ghosh.

**Invited Lectures**

- i) Spooky Actions at a distance in Quantum Mechanics (Nalanda, November 7, 2007).
- ii) Bohm's realist interpretation of Quantum Mechanics (Kolkata, February 19, 2008).

**Geodynamic Evolution Embracing Subjects of Geomorphology, Tectonics, Sedimentation and Stratigraphy, Mineralization etc.****KS VALDIYA****INSA-Golden Jubilee Research Professor**

*Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore*

- A) **Research:** Intensive fieldwork in the Jadhganga valley, the main branch of the Bhagirathi-Ganga, in district Uttarkashi, Garhwal Himalaya, was carried out in early June 2007 in collaboration with Professor K. Pande at IIT, Mumbai. Considerable critical data on structure, petrotectonics and geomorphology collected.
- B) **Papers submitted for publication**
  1. KS Valdiya and K. Pande, 2008. Behaviour of basement-cover decoupling in compressional deformation regime, northern Kumaun Himalaya, *Proceedings, Ind. Nat. Sci. Acad.*, New Delhi.
  2. KS Valdiya 2008. Sinking of ancient Talakad temples on the Kaveri bank, Mysore Plateau, *Current Science*.
- C) **Book Writing**
  1. KS Valdiya 2008. The Making of India: Geodynamic Evolution, containing 953 pages and 382 illustrations, submitted for publication to Macmillan India Limited, New Delhi.
  2. KS Valdiya 2008. Facing Natural Hazards: Earthquakes and Landslides, *Gyanodaya Prakashan*, Nainital, 83p.
  3. KS Valdiya 2008. *Bhukamp Aur Bhusakhalan: Sankaton Kaa Saamana*, *Gyanodaya Prakashan*, Nainital.

## Study of genetic polymorphism in *Plasmodium falciparum* strain and correlation with chloroquine resistance and sensitivity and evaluation of the role of CR1, CD55 and CD59 in severe malaria

RC MAHAJAN

INSA-SN Bose Research Professor

*Emeritus Professor, Department of Parasitology, PGIMER, Chandigarh*

The study was planned to investigate the genetic polymorphism in Indian subjects of *Plasmodium falciparum* and correlate the same with Chloroquine sensitivity and resistance and also to evaluate the different chemokines in severe malaria pathology.

A total of 2497 subjects were screened for the presence of *Plasmodium* infection out of which 2315 were from North Indian states and remaining 182 were from the North East states of Assam and Arunachal Pradesh. Blood samples obtained from 30 positive subjects for *Plasmodium falciparum* were cultured in the Trager & Jensen medium and drug sensitivity performed.

In all 15 samples were investigated for Flow cytometry analysis. The FACS was performed to quantify the RBC surface Immunoglobulin IgG & complement regulatory proteins, CD35, CD55 & CD59 in eight (8) *Plasmodium falciparum* infected patients, seven (7) normal healthy controls. Expression of CD35 & CD55 RBC surface proteins was found to be decreased in malaria infected cases compared to the healthy controls. CD59 was more expressed in malaria patients. The study did not show any correlation between the extent of fluorescence exhibited by RBC surface receptors CR1, CD55, CD59, IgG and parasite density. However more cases are required to be investigated to arrive at a statistically tentative conclusion.

## Catalytic Selective Oxidation Reactions

PAUL RATNASAMY

INSA-Srinivasa Ramanujan Research Professor

*National Chemical Laboratory, Pune*

Novel, solid catalysts for the manufacture of biodiesel based on double metal complexes and molybdenum oxide-phosphorous oxide-alumina have been discovered and are being developed for commercialization in the industry, both in India and abroad. These catalysts are much more eco-friendly than the currently used liquid alkali catalysts and are much more active and selective. The first plant based on this

technology is expected to be commissioned in USA during 2009.

The double metal complex catalyst is a pure solid Lewis acid catalyst. The molybdenum oxide-phosphorous oxide-alumina catalyst contains both Lewis acid sites (associated with molybdenum ions) and Bronsted acid sites associated with phosphorous oxide. The acidity of these catalysts has been characterized by adsorption of bases, like pyridine, DRIFTS spectroscopy and temperature programmed desorption of  $\text{NH}_3$ . One novel feature of the double metal complex catalysts is that the purity of the byproduct glycerol obtained is above 98% compared to the purity of about 50-60% observed in the case of conventional, liquid phase catalysts like sodium methylate or NaOH. This is a major significant advantage of the transesterification of vegetable oils process based on this catalyst.

## SENIOR SCIENTISTS

### Calixarene Based Synthetic Receptors

HARJIT SINGH

*Department of Chemistry, Guru Nanak Dev University, Amritsar*

With the aim of incorporation of nucleobases, the cornerstone of supramolecular biological reactions, one isomeric species of all uracilcalix[4]arene molecular architecture, has been obtained by 2+2 cyclocondensation of 5,5' - bisurascilylmethane with its N3, N'3 - bisbromomethyl derivative.

The critical review article entitled '*Metallacaliarene: Organo - Inorganic Hybrid Molecular Architectures*' has been published in *Advances in Heterocyclic Chemistry*, Ed. AR Katritzky, Vol. 96, p. 123 - 173 (2008). Finally, the review article on '*Conjugates of Calixarenes and Heterocycles*' generated by grafting heterocycles on the wider upper or narrow lower rim of vase shaped calixarene molecules and having the potential of creating newer chemical entities of contemporary relevance has been accepted for publication in the above series.

### Automatic Generation Control in Multi-Area Thermal And Hydro-Thermal Power Systems

J NANDA

*Department of Electrical Engineering, Indian Institute of Technology, New Delhi*

Modern power system consists of number of utilities interconnected together and power is exchanged between utilities over tie-lines by which they are



connected. Automatic generation control (AGC) plays a significant role in the power system by maintaining scheduled system frequency and tie line flow during normal operating condition and also during small perturbations. Almost all past research in the area of AGC pertains to design of governor secondary controllers or supplementary controllers and surprisingly little attention has been paid to the design of governor primary control, i.e. selection of proper governor droop or governor speed regulation parameter 'R' in Hz/pu.

It is known that with only primary control (i.e. secondary or supplementary control absent) the smaller the governor droop the smaller the steady state error in frequency but in the presence of supplementary control there is nothing to be sacrosanct about a small governor droop (of the order of 4% to 6% used in practice) and for any large but credible value of  $R$ , zero steady state error in frequency is guaranteed. However, what is the best value of  $R$  and the procedure for its selection remains unexplored. It is to be appreciated that the higher the credible value of  $R$ , easier is the manufacturing of the governor and cheaper is the cost of the governor.

In view of the above, considerable research has been carried out in investigating the suitable design of governor primary control (essentially selection of governor speed regulation parameter  $R$ ) in both thermal and hydro-thermal power systems. The significant findings of the investigations are the following:

a) A maiden attempt has been made to apply a powerful computational intelligent technique like *Bacterial Foraging* to simultaneously optimize effectively several important parameters such as integral control gains of the secondary control, governor speed regulation parameter  $R$  for the primary control and frequency bias parameters for automatic generation control of a multi-area thermal system with reheat turbines and appropriate generation rate constraints. Results of simultaneous optimization reveal that different areas have different optimum value of  $R$  and several areas may have much higher values of  $R$ , with some areas having a value of  $R$ , even 4 times the value of 4 % used in practice. Such high values of  $R$  are recommended for adoption in practice for design of governor so as to make the governor realization simpler and reduce its cost.

In the Hydro-thermal systems our research reveals that while for thermal systems we can adopt 4 to 5 times the value of  $R$  presently used in practice, for hydro areas it is difficult to have a value of  $R$  more

than twice the value used in practice as the system becomes unstable. When the parameters are optimized simultaneously we also obtain the best dynamic response of the system.

b) Sensitivity analysis reveals that the optimum values of controller gains, governor speed regulation parameter  $R$ , and frequency bias setting  $B$  at the nominal loading condition are quite robust and need not be reset for wide changes in system loading condition or in system parameters such as inertia constant, reheat coefficient, reheat time constant and size and location of the step load perturbations.

Some of the findings have been published/accepted in IEEE Transaction, besides in other international journals.

- 1) J Nanda, A Mangla, and Sanjay Suri 2006. Some new findings on automatic generation control of an interconnected Hydro-Thermal system with conventional controllers, *IEEE Transaction on energy conversion*, Vol. 21, No.1, 187-194.
- 2) J Nanda, Lalit Chandra Saikia and S Mishra, *Application of Bacterial Foraging Based Optimization Technique in Multi-Area Automatic Generation Control*, Accepted in IEEE Transaction on Power Systems.

## Coupled K-Ca and Rb-Sr Dating of Kimberlitic Micas

**K GOPALAN**

*National Geophysical Research Institute, Hyderabad*

Coupled K-Ca and Rb-Sr dating of kimberlitic phlogopites, if analytically feasible, will provide ages based on two independent but chemically similar parent-daughter systems. A coherence or regularity between the two ages will increase the confidence in them besides resolving the serious discrepancies often seen between Rb-Sr and Ar-Ar ages of kimberlitic micas. It is shown for the first time that reliable K-Ca ages of phlogopites from kimberlites can be measured using the same mild acid leaching technique as has been used hitherto for Rb-Sr dating. K-Ca model ages of phlogopite macrocrysts separated from two kimberlite intrusions from the Narayanpet kimberlite field in the Eastern Dharwar Craton, south India are close to 1100Ma. These ages are concordant with Rb-Sr ages previously measured on the same kimberlites and those from the Wajrakarur field 250 km to the south. This concordance casts serious doubts on a single Ar-Ar age of 1400 Ma measured in the Cambridge University and claimed as representative of the entire Narayanpet field and interpretations thereof of isotopically distinct source compositions for the two

spatially separated groups of south Indian kimberlites. The radiogenic  $^{40}\text{Ca}$  enrichment in phlogopites from one kimberlite is nearly 40% suggesting the feasibility of coupled K-Ca and Rb-Sr dating of much younger kimberlites using the same sample aliquot, mass spectrometer and analytical protocol.

### Patterns of Precambrian Crustal Evolution: Examples from North Singhbhum Fold Belt, Delhi Fold Belt and South Indian Granulite Belt

**D MUKHOPADHYAY**

*Department of Geology, University of Calcutta, Kolkata*

A comprehensive model of evolution of the North Singhbhum Fold Belt (NSFB) has been formulated on the basis of structural studies and evaluation of the metamorphic P-T conditions and the sequence of mineral transformations. The Mesoproterozoic NSFB is the eastern continuation of the Central Indian Tectonic Zone (CITZ) and in the Gondwanaland reconstruction appears to be continuous with the Albany-Fraser Mobile Belt of Australia-Antarctica. The southern segment of the NSFB is bounded by two movement zones, the Singhbhum Shear Zone (SSZ) in the south and the Dalma Thrust in the north. The deformation events comprising  $D_1$ ,  $D_2$ ,  $D_{2A}$  and ductile shearing are parts of the same deformation cycle with N-S compression combined with simple shear with top-to-the-south sense of movement. The last deformation episode  $D_3$  has gently folded  $S_1$  and  $S_2$  on transverse axial planes and is a result of longitudinal compression in the orogenic belt. The earliest phase of metamorphism ( $M_1$ ) was of low grade (low pressure) and produced andalusite porphyroblasts in high-alumina pelitic schists.  $M_1$  was either pre-tectonic or coeval with the early stage of  $D_1$  deformation. The main phase of regional metamorphism ( $M_2$ ) was of progressive Barrovian zonal type (intermediate pressure) and produced chloritoid, garnet, staurolite, kyanite and sillimanite. The peak metamorphic condition was attained after the  $D_2$  foliation was impressed on the rocks. A second generation kyanite and staurolite ( $M_{2A}$ ) formed at more or less the same temperature, but slightly increased pressure (ca.  $680^\circ\text{C}$ , 8.6 kb). It was caused by loading due to continued thrust stacking. The  $M_2$  episode includes cooling and decompression stage from the peak P-T condition to ca.  $590^\circ\text{C}$ , 5.2 kb.  $M_3$ , coeval with or postdating  $D_3$ , represents a stage of retrogression and hydration during cooling at a still lower temperature ( $450^\circ\text{C}$ - $535^\circ\text{C}$ ).  $M_2$  and  $M_3$  are parts of the same metamorphic cycle with initial loading and heating followed by exhumation and cooling.

Studies have also been carried out in the South Delhi

Fold Belt of Rajasthan and in the Southern Granulite Terrain of Tamil Nadu.

### Neogene Paleocyanographic and Paleoclimatic events in the Northern Indian Ocean: Results from DSDP and ODP Cores

**MS SRINIVASAN**

*Department of Geology, Banaras Hindu University, Varanasi*

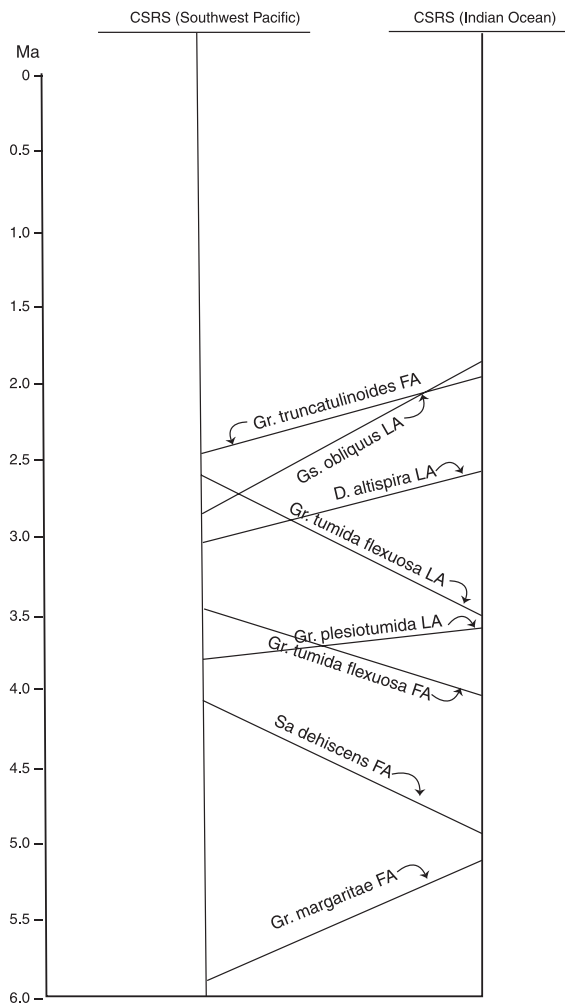
The datum level concept has received wide acceptance for biostratigraphic correlation in the recent years. A sequence of well defined biostratigraphic datum levels provides a grid for establishing precise correlation with its geographic effectiveness varying in accordance with the reliability of datum level species. Hence a critical examination of each of the important datum levels in terms of the taxonomy, phylogeny, paleobiogeography and geochronological position of the datum level species is necessary to evaluate its reliability in biostratigraphic correlation and paleocyanographic reconstruction.

Besides their wide application in biozonation, some planktic foraminiferal datums have also been used for defining the major epoch boundaries/stage boundaries. Studies conducted so far reveal the following category of biostratigraphic datum levels in a preferred order of reliability when used for correlation of stratigraphic boundaries:

- i) Datum levels marked by Evolutionary lineage.
- ii) Datum levels marked by Abrupt extinction.
- iii) Datum levels marked by Appearance of a Cryptogene.
- iv) Datum levels marked by Acme of a taxon, and
- v) Datum levels marked by Coiling change.

A critical analysis of the chronological succession of planktic foraminiferal datums clearly reveals many of the datums to be time transgressive and hence not reliable for time correlation. The datums unless established to be synchronous over wide latitudinal range, cannot satisfactorily be used for precise biostratigraphic correlation. Such problems require improved correlation techniques. This led to establish the synchronicity of microfossil datums from the combined use of datum levels with paleomagnetic stratigraphy and isotopic records. This effort was possible because of the availability of good quality Deep Sea sections from DSDP and ODP.

Another significant effort to improved correlation made during the last few years is the Graphic Correlation method. This method enables to identify the synchronicity and diachroneity of microfossil datums for correlation and to determine the seat of evolution and



**Fig. 1:** Diachrony of selected late Neogene planktic foraminiferal datums between Southwest Pacific and Indian Ocean (CSRS = Composite Standard Reference Section); FA = First Appearance; LA = Last Appearance

path of migration of oceanic microfossils (Fig. 1). Graphic correlation attempted between the DSDP cores of wide ranging latitudes in the Southwest Pacific deep sea cores revealed the following important clues:

- i) Identification of the major/important planktic foraminiferal datums in broad latitudinal region and evaluation of the degree of synchronicity of these events.
- ii) Determination of the extent to which these events maintain an invariant sequential order in various regions.
- iii) Determination of which of these events are evolutionary?
- iv) Determination of seat of evolution and path of migration of oceanic microfossils (Paleobiogeography).

Planktic foraminiferal datums can be broadly grouped under two categories, for correlation, namely: - First Order Datums and Second Order Datums. Former category includes the datum levels which are synchronous or nearly synchronous over wide latitudinal range. The second order datums include those which are diachronous over a wide latitudinal range. The first order datums are reliable for cross latitudinal biostratigraphic correlation and paleoceanographic reconstruction, whereas second order datums, because of their diachroneity are not reliable for correlation over a wide latitudinal range.

### Molecular Tagging of Fertility Restorer Gene in Mustard- *Brassica juncea* and Development of cytoplasmic Male Sterility-fertility Restoration Systems in *Brassica juncea*

SHYAM PRAKASH

National Research Centre on Plant, Biotechnology, Indian Agricultural Research Institute, New Delhi

A CMS and fertility restoration system in *Brassica juncea* based on *Erucastrum canariense* cytoplasm was developed in earlier years (Prakash et al. 2001). Tagging of fertility restoring gene was carried out to assist plant breeders. Large number of polymorphic primers of individual plants in fertile and sterile bulks were screened and SCAR markers were developed for fertility restorer gene which were cosegregated.

The second objective was to develop and stabilize cytoplasmic male sterility systems in *B. juncea* for developing heterotic hybrids. Three related wild species viz. *Erucastrum gallicum*, *Er. abyssinicum* and *Er. cardaminoides* were earlier combined with *B. rapa* and synthetic allopolyploids were obtained. These synthetic allopolyploids were repeatedly backcrossed to *B. juncea* (2n=36, AABB). Male sterile *B. juncea* plants carrying these cytoplasm were selected and characterized for morphological traits, chromosome cytology and pollen and seed fertility. Of these only two systems carrying the cytoplasm of *Er. gallicum* and *Er. abyssinicum* were stabilized. These are absolutely male sterile with normal female fertility (>95 %). Their meiosis showed normal chromosome number of *B. juncea* forming 18 bivalents. Pollen abortion in both the systems occurred after tetrad formation. Fertility restoring nuclear genes have successfully been introgressed for these two systems from respective cytoplasmic donors. Restorers are fully fertile without any meiotic abnormalities. F1 hybrids between CMS and restorers are absolutely fertile indicating the fertility restoring ability. Protoplast fusion



was resorted to rectify floral abnormalities in CMS (*Diplotaxis siettiana*) *B. juncea*. To introgress fertility restoring nuclear gene from *B. oxyrrhina* to CMS (*Oxy*) *B. juncea*, BC1 hybrids (*B. oxyrrhina* × *B. juncea*) were backcrossed to *B. juncea*. Synthetic allopolyploid *Diplotaxis erucooides* × *B. rapa* was crossed to *B. rapa* to develop chromosome addition lines of *D. erucooides* for locating genes for resistance to alternaria blight and to *B. juncea* to introgress such gene/s to *B. juncea* for conferring resistance. A review article entitled “*Brassica* and its Close Allies: Cytogenetics and Evolution” has been accepted in Plant Breeding Reviews Vol. 31.

### Studies on Clay Minerals, Clay-Organic Complexes and Oxides Formation and their Role in Retention and Release of Zn and K in Soils under Rice-based Cropping Systems

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Clay minerals transformation and their weathering stage, Kinetics of K and Zn release and carbon release rate from the clay fractions of soil profiles (0-7.5, 7.5-15, 15-30, 30-45, 45-60, and 60-75 cm depth) under long-term cultivation of 18 years of rice-wheat (R-W) and 33 years of maize-wheat-cowpea (M-W-C) cropping system (CS) at PAU Farm, Ludhiana and 50 years of rice-rice (R-R) and non-rice (N-R) CS at Mohanpur Farm, BCKV, West Bengal were investigated.

The soils of PAU Farm are alkaline calcareous in nature (pH: 7.10 - 8.0, CaCO<sub>3</sub>: 4.22 - 7.15 %) and very low (0.07 - 0.19 %) in organic carbon (OC) content. The soils of Mohanpur Farm are also alkaline calcareous in nature (pH: 6.90 - 7.50; CaCO<sub>3</sub>: 6.05 - 9.79 %) and low in OC (0.16 - 0.36 %) content.

Clay minerals composition in the soil profiles of PAU Farm show that mica is the dominant clay mineral (5-65 %) followed by inter-stratified mica (4-54 %), inter-stratified kaolinite (7-40 %), kaolinite (7-18 %) and sporadic occurrence of smectite and vermiculite. The mica content is markedly less (15-23%) in the soil profile of R-W CS than that of (41-50%) in the M-W-C CS, especially in the 15-60 cm soil layers. Contrary to this inter-stratified kaolinite followed by inter-stratified mica is strikingly more in the profile of R-W CS than that of M-W-C CS. The kaolinite content in the soil profile of the two cropping systems does not differ. Also in the soil profiles under R-R and N-R CS of Mohanpur Farm, similar are the differences in clay mineral composition

and their contents. But here the kaolinite content is more in the N-R than the R-R CS. Also smectite and vermiculite occur in appreciable content without reflecting much difference in their content in the soils of two cropping systems.

Weathering stage of clay minerals in each horizon of soil profile of R-W and M-W-C CS of PAU Farm and R-R and N-R CS of Mohanpur Farm computed considering pure phase of mica, vermiculite, smectite and kaolinite weathering stage of 7, 8, 9 and 10, respectively according to Jackson's sequence. On an average weathering stage of clay minerals of alluvial soils of Mohanpur Farm is higher than that of in the soil of PAU Farm (Fig. 1). By and large, clay minerals in soils under long-term R-R CS are more weathered, having higher weathering stage, than that under N-R CS, particularly in soil layers from 30 to 60 cm depth (Fig. 1).

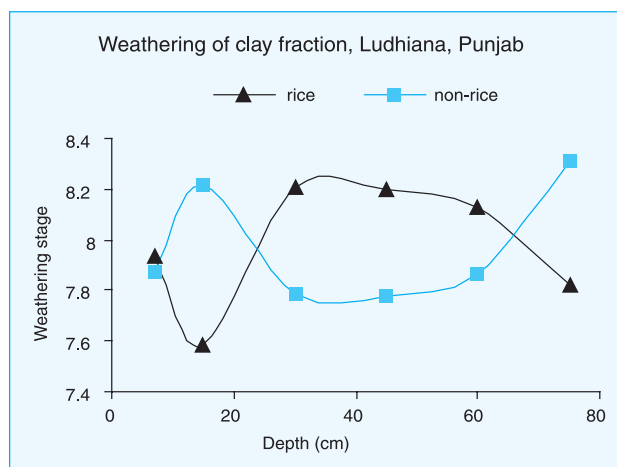


Fig. 1a: Weathering stage of clay minerals in soil profile of PAU Farm under R-W and M-W-C CS

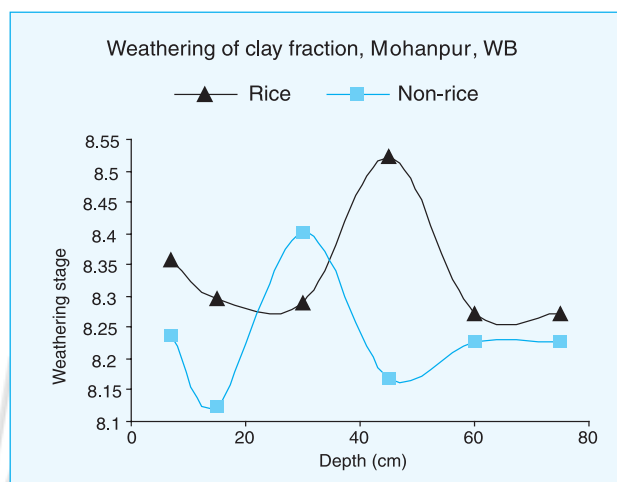


Fig. 1b: Weathering stage of clay minerals in soil profile of Mohanpur Farm under R-R and N-R CS

The release of organic C (humus) from the humus-clay fraction of soil profiles under R-W and M-W-C CS of PAU Farm was measured by extracting it with 0.1 M sodium hydroxide + 0.1 M sodium pyrophosphate solution. The release of organic C followed very closely the Elovich reaction kinetics with co-efficient,  $\alpha$  for the initial rate of release and  $\beta$  for the coefficient of stability. On the average the stability of the humus (organic C) on the clay fractions of R-W CS is 9.2 % higher ( $\beta= 8.814$ ) than those from the M-W-C CS ( $\beta=8.019$ ) and the average release of humus from the R-W CS is 0.7064 %, which is lower by 0.0924 % than that of 0.7988 % under M-W-C CS (Fig. 2). These results suggest a stronger retention of

humus (organic C) on clay fractions of soils under the R-W CS than under M-W CS.

## Modelling of Quasi-static Deformation of a Poroelastic Medium and Crustal Deformation

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The problem of the deformation of a poroelastic half-space by surface loads has been studied extensively. However, in most of these investigations, the hydraulic permeability is assumed to be isotropic. Permeability determines the ability of the porous medium to conduct fluid flow in its pores and, therefore, can be different in different directions. In most cases, the soil deposits are the result of a sedimentation process that produces horizontal stratification planes. Consequently, permeability in horizontal and vertical directions may differ. For important geophysical and engineering applications, it is useful to study the effect of anisotropy in permeability on the quasi-static deformation of a half-space by surface loads. We use the fully coupled Biot quasi-static theory of fluid-infiltrated porous materials to study the two-dimensional plane strain deformation of a poroelastic half-space by surface loads. It is assumed that the permeability in the horizontal direction is different from the permeability in the vertical direction and both the solid and fluid constituents are compressible. Biot's stress function is used to solve the governing equations in the transform domain. The problems of normal line loading, shear line loading and normal strip loading are discussed in detail. To study the effect of permeability anisotropy, we have computed the pore pressure and fluid flux as functions of time and depth for normal strip loading. It is found that the permeability has a significant effect. The pore pressure at points vertically below the mid-point of the surface strip for anisotropic permeability is greater (less) than the pore pressure for isotropic permeability if the vertical permeability is greater (less) than the horizontal permeability. Since, in general, the vertical permeability is less than the horizontal permeability, ignoring permeability anisotropy may lead to an over estimation of the pore pressure at points vertically below the point of application of the normal load.

## Publications

Quasi-static deformation of a poroelastic half-space with anisotropic permeability by two-dimensional surface loads, *Geophys. J. Int.*, **170**, 1311-1327, 2007 (in collaboration with Sunita Rani and Raman Kumar).

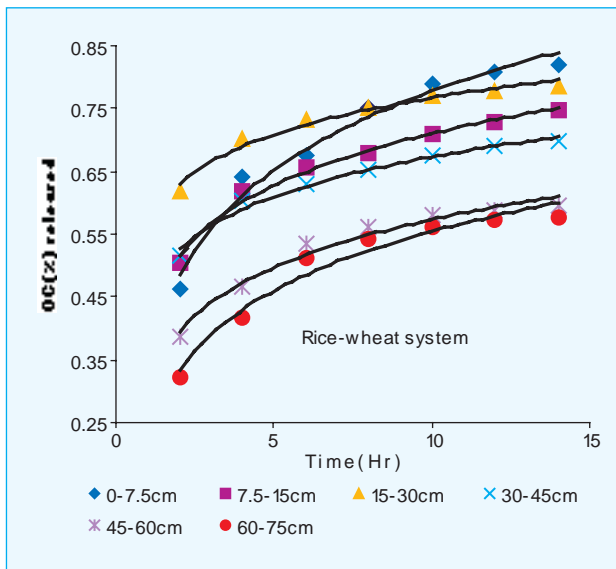


Fig. 2a: Organic C release from clay-humus fraction of soil under R-W CS for 18 years at PAU Farm

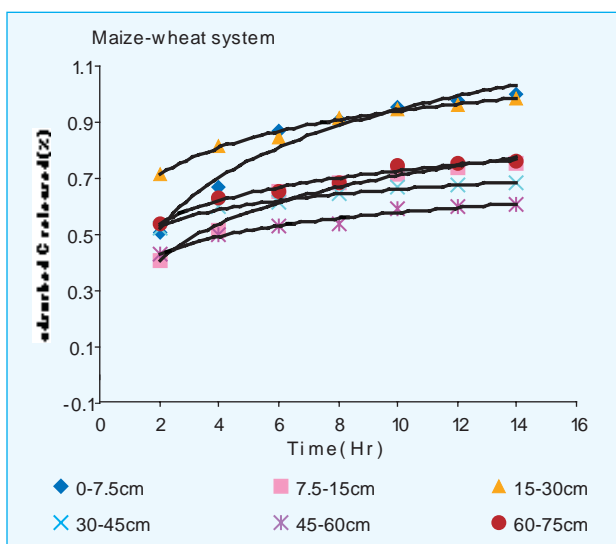


Fig. 2b: Organic C release from clay-humus fraction of soil under M-W-C CS for 33 years at PAU Farm

## Networks, Signal Processors and Related Educational Innovations

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The project aims at solving some fundamental problems on passive and active networks, with particular emphasis on impedance matching by lumped and distributed networks, analytical design of digital signal processors, and related educational innovations.

During the period under review, the problems of canonical FIR and IIR lattice realizations were solved<sup>1,2</sup>. The paradoxical behaviour of an infinitely long lossless transmission line has been investigated<sup>3</sup>; the inadequacies of various theories have been pointed out and the need for further investigation has been emphasized. It has been shown that the bridged-T coil can be comfortably analyzed by the classical techniques<sup>5</sup>, in contrast to the laborious method using the extra element theorem. Short comments were made on the rational discrete approximation of the  $s^{0.5}$  operator<sup>4</sup>.

An educational innovation during the period consists of a simple method for solving ordinary differential equations with constant coefficients<sup>6</sup> which is easily comprehensible by first year college students.

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- SC Dutta Roy, *IETE J. Research*, **53** 13, 2007.  
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 SC Dutta Roy, *IEEE Trans. Circuits Syst. II*, **54** 673, 2007.  
 SC Dutta Roy, *IETE J. Education*, **48** 77, 2007.

## Role of Neurofilament Proteins and Oxidative Stress during the Thyroid Hormone Deficiency etc.

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Earlier investigations revealed that thyroid hormone (TH) plays an important role in regulating the level of GSH in the developing rat brain. To elucidate the role of the hormone in GSH metabolism, the effect of TH on the activity of glutamate cysteine ligase (GCL), the key enzyme involved in the biogenesis of GSH, has been investigated. Kinetics of induction of GCL by TH was closely parallel to that of GSH and the induction was sensitive to both cycloheximide and actinomycin D. Quantitative RT-PCR analysis revealed that astrocytes

contained a basal excess of GCLC (catalytic subunit of GCL) mRNA, relative to that of GCLM (the modulatory subunit of GCL) mRNA, the ratio being 4:1. TH treatment led to a differential increase in the expression of these mRNAs resulting in a decline in the stoichiometric ratio of GCLC:GCLM mRNA favoring holoenzyme formation and thus increasing the catalytic efficiency. The overall results suggested that TH plays a positive role in maintaining GSH homeostasis in astrocytes and in protecting the brain from oxidative stress. Published in *Free Radical in Biology and Medicine* **42**, 617-626, 2007.

Experiments directed to assess the effect of hypothyroidism on the aggregation of neurofilament proteins, a phenomenon which is similar to that seen in several common neurodegenerative diseases - such as ALS and Alzheimers' are currently under investigation.

## Nematode Diversity in the Soil and Aquatic Ecosystems

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During the course of our study, in one of the soil samples collected from Bangalore we found a few specimens of the genus *Dorylaimoides*. The adult female was a normal adult, but it did contain a fully formed functional odontostyle (the feeding apparatus) of the animal and also an additional fully formed spare and non-functional odontostyle which was rather very amazing. Professor Jairajpuri has called this additional one as the "sixth" odontostyle. The formation of an additional or a spare odontostyle was detected for the first time in this group of nematodes which occur in a very large number of species throughout the world. Way back in 1965 while working at Rothamsted, Harpenden, U.K. in the year 1965, he had observed a similar formation of spare odontostyle in another nematode, namely *Metadorylaimus* which he had described from Malawi. Both *Dorylaimoides* and *Metadorylaimus* possess very short odontostyles and hence the phenomena of occurrence of spare odontostyle is very amazing. In those dorylaims which are long-speared like *Xiphinema*, *Paralongidorus* and *Longidorus* such a phenomena is not amazing as it may be regarded as a bit of hyperactivity of the long-sized odontostyle and such formation is usually very minute compared to the normal odontostyle and is often called a "mucro". Same was the case with *Metadorylaimus*, but the present case is unique as the spare odontostyle in *Dorylaimoides* is almost of same size as the functional odontostyle. Four new species of soil inhabiting nematodes belonging to the family Alaimidae



have also been described from the samples that were brought from Iran.

## Androgenetic Chemistry in Fish

### TJ PANDIAN

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Endosulfan, a widely used pesticide, which mimics estrogen, readily adheres to particles; its mean duration of persistence is 1½ years in waters, and 2 years in sediments and soils. From a life long study of an obligate air-breathing fighting fish, effect of discrete immersion of its hatchlings to endosulfan on survival, growth and reproduction was studied. On being immersed, the obligate air-breathing fighting fish may escape to the surface to breath atmospheric air and not expose the gills to the endosulfan. Thus, another reason for selecting the fighting fish is to know the effect of endosulfan on the air-breathing frequency of the fish. However, endosulfan reduced air-breathing frequency on the 5<sup>th</sup> and 8<sup>th</sup> dph, and the reduction in the frequency persisted even after a depuration period of 172 days. Besides significantly reducing survival, it also acted as a growth suppressant. In the ovary of the treated females, it reduced the number of vitellogenic oocytes and increased vacuolar area. In the testis of the treated males, it reduced the number of spermatogonia and increased the vacuolar area. The treated males could neither induce the female to spawn as many eggs nor accommodate as many fertilized eggs within the reduced bubble nest, as that of the control. Whereas the control females attained puberty on the 138<sup>th</sup> dph and spawned 120 eggs once every 15 days, the females, which were previously treated at 1,400 ng/l, postponed puberty to the 179<sup>th</sup> dph and prolonged inter-spawning period to 32 days. During the 240 day experiment, endosulfan reduced the cumulative progeny production from 760 to 144.

## Research Studies in Algebra

### IBS PASSI

*Centre for Advanced Study in Mathematics, Punjab University, Chandigarh*

The objective of the project is to undertake research studies in Algebra; more specifically, in the areas of group rings, geometric group theory, combinatorial group theory and homological methods in group theory.

During the year 2007-08 joint work with Roman Mikhailov on the research monograph "Lower central and dimension series of groups" was continued. The book has been accepted by Springer for publication in their series Lecture Notes in Mathematics; as such, a

press copy is now under preparation. In a joint work with SO Juriaans and A. C Souza Filio, a paper on "Hyperbolic unit groups and quaternion algebras" was completed. A series of lectures on "Historical Overview of Representation Theory" were delivered at the Advanced Instructional School in Representation Theory, Pune, July 2007.

## Transition Metal Organometallic Chemistry of Acyclic Bidentate Phosphorus Ligands based on the "P-N-P" Motif

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The main objective of the research program is the synthesis of new phosphorus ligands based on the "P-N-P" motif and phosphorus functionalized calix[4]arenes and to explore their organometallic chemistry with late transition metals. The highlights of the work during the year 2007 are: (a) The synthesis of a self-assembled silver(I) coordination polymer,  $[Ag_2\{\mu\text{-Pr}^i\text{N}(\text{PPh})_2\}(\mu\text{-NO}_3)_2]_n$  in which the diphosphazane ligand the adopts a unique 'C<sub>s</sub>' geometry and its reactions with various bidentate N-donor ligands such as DABCO, 2,2'-bipyridyl and 1,10-phenanthroline to generate novel supramolecular architectures; (b) The unusual reactivity of a sterically bulky "P-N-P" ligand towards (allyl) palladium chloro dimers and the isolation of a stable dinuclear ( $\eta^3\text{-allyl}$ ) palladium(I) diphosphazane complex,  $[(\eta^3\text{-C}_3\text{H}_5)\text{Pd}(\mu\text{-EtN}\{\text{P}(\text{OR})_2\}_2)\text{PdCl}]$ , which contains a coordinatively unsaturated T-shaped palladium center; (c) Successful attempt to bridge diphosphazane chemistry and calixarene chemistry resulting in the synthesis of a new diphosphorus ligand,  $\text{Ph}_2\text{PN}(\text{CHMe}_2)\text{P}(\text{Ph})\{1,3\text{-dimethoxycalix[4]arene}$ , in which the P-N-P unit is appended to calix[4]arene backbone and its  $\text{PdCl}_2$  complex; and (d) Cyclometallation in palladium and platinum complexes of double-bridged calix[4]arene bisphosphites.

### Publications

Structure and Solution Dynamics of a "P-N-P" Ligand Attached to Calix[4]arene Scaffold and its Palladium Dichloride Complex, A Sarkar, M Nethaji and SS Krishnamurthy *Polyhedron*, 2007, **26**, 3904-3910.

Unusual Reactivity of a Sterically Hindered Diphosphazane Ligand,  $\text{EtN}\{\text{P}(\text{OR})_2\}_2$  (R =  $\text{C}_6\text{H}_3(\text{Pr}^i)_2\text{-2,6}$ ) towards ( $\eta^3\text{-Allyl}$ ) palladium Precursors, H Krishna, SS Krishnamurthy, M Nethaji, R Murugavel and G Prabusankar, *Dalton trans.* 2007, 2908-2914.

From Infinite Tubular Arrays to Discrete Molecules and Back: An Example of Reversible Ring-Opening Polymerization in Silver(I) - Diphosphazane Chemistry, H. Krishna and

SS. Krishnamurthy, *Inorg. Chim. Acta*, 2007, **360**, 3462-3466.

Ruthenium hydride complexes of chiral and achiral diphosphazane ligands and asymmetric transfer hydrogenation reactions, TS Venkatakrishnan, SK Mandal, RKannan, SS Krishnamurthy and MNethaji, *J. Organomet. Chem.* 2007, **692**, 1875-1891.

## Dynamic Analysis of Cyclic Symmetry

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### Stress Analysis Helical Gear Tooth

In third exercise the helical gear with helix angle at  $32^\circ$ , module 10 and face width 70 mm is considered. To get the points of application of the load along the width of the helical gear, the following procedure is adopted. In the case of spur gears, all the axial sections of the tooth consist of involute with points of contact at any instant co-axial. In the case of helical teeth all the axial sections of the tooth consist of involute profiles generated from the base circles of the same radius but displaced circumferentially, the circumferential shift decided by the helix angle. For a helical gear of lead  $l$  and pitch radius  $r$ , it is well known that for an axial shift  $l$  of two identical involutes the angular shift will be  $2\pi$ . For an angular shift  $\theta$  in radians, the axial shift  $z$  will be  $= l \theta / (2\pi)$ . However the points of contact at any instant do not fall on a straight line, but have to fall on the unique common tangential plane to the two base cylinders of the gear pair [4.24]. If this property is made use of when  $O$  is the origin of the polar co-ordinate system, any point  $Q(r, \theta, z)$  at a given axial location  $z$  will be such.

$$\frac{OT}{OQ} = \cos(\phi - \theta) \quad \dots (1)$$

where  $\theta$  is angle between the line joining the centers of gear pair and the chosen radial line.

$$\text{Hence } \cos(\phi - \theta) = \frac{OP \cos \phi}{r} \quad \dots (1)$$

where  $OP$  is the pitch radius. Oince  $\theta$  is known the radial distance  $r$  will be computed.

Figure 1 shows the isostress, Figure 2 the deformation and Figure 3 stress distribution along the width of gear. For this problem,  $\theta = 20^\circ$ ,  $OP = 100$  mm. This helps one to fix  $r$  and  $\theta$  co-ordinates of the involute profile for any axial position of the profile along the width of the tooth.

### Discussion of Results

Figures 1 to 3 present results on deformation and stresses on gear teeth. The maximum value of circumferential stress in Figure 1 is 40 MPa. The following observations

can be made from these figures keeping in mind the fact that the spur.

The full paper has been published in INSA Proceedings, December 2007

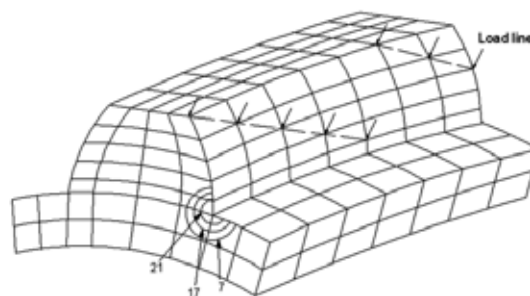


Fig. 1: Helical gear (CR=2) Iso stress  $\sigma_\theta$  in MPa

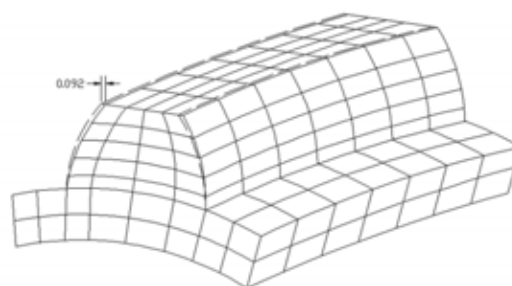


Fig. 2: Deformation (in mm) helical tooth (CR=2)

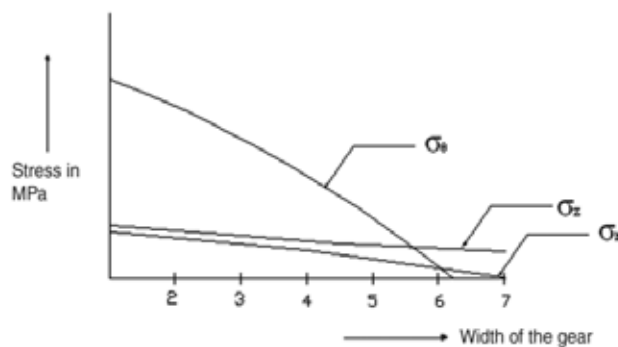


Fig. 3: Stress in MPa along width of helical gear (main tooth)  $CR > 1$  gear tooth and helical gear tooth used have the same module, same pressure angle. They are both subjected to same intensity of loading. Comparing the stresses in Figs. 1 to 3 one can observe that the stress around the fillet is the least for helical gears; circumferential stress is the highest in every case. Stress in the adjacent tooth is very small in relation to the stress in the main tooth

## Solar Terrestrial Relations: Space Weather and Climate of the Terrestrial Planets-Earth, Venus and Mars

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The major aim of the project is to study the space climate and space weather by using the satellite and/or ground

based measurements of the space plasma of the terrestrial planets Earth, Venus and Mars. This is achieved by examining the response of space plasma to long-term and short-term changes in solar EUV and XUV fluxes. A large number of electron density profiles (totaling to 5600) measured by the Mars Global Surveyor (MGS) were used to study the space climatology of Mars during the sunspot cycle 23 and compared with EUV/XUV fluxes measured by the SOHO satellite during this period. Long term changes in the Earth's space climate were re-assessed by examining the large body of ground based ionospheric data and other available information on the ionospheric plasma. Mars space weather was studied during solar flares by examining the MGS electron density profiles, which exhibited large enhancements at altitudes between 80 and 120 km, coincident with sudden increase in EUV/XUV fluxes measured by the SOHO satellite.

### Publications

KK Mahajan, Sachchidanand Singh, Ashok Kumar, Saroj Raghuvanshi and SA Haider (2007) "Mars Global Surveyor Radio Science Electron Density Profiles: Some Anomalous Features in the Martian Ionosphere" *Journal of Geophysical Research*, **112**, E10006, doi: 10.1029/2006JE002876.

KK Mahajan, Ashok Kumar and Neelesh K Lodhi (2007) "Long-term Trends in the Upper Atmosphere and Ionosphere: Models and Observations" *Ind. J. Radio and Space Phys.*, **36**, 543-555.

Ashok Kumar, Neelesh K Lodhi and KK Mahajan (2007) "Near - Terminator Martian Ionosphere during Sunspot Cycle 23 from Mars Global Surveyor Radio Science Measurements" *Ind. J. Radio and Space Phys.*, **36**, 457-465.

### Analysis of Ecological Implications of Invasion by alien Plant Species with particular reference to Biodiversity and Ecosystem processes

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The problem of invasion by alien plant species in recent years has assumed alarming proportion in several parts of India, and many high value biodiversity areas in the plains as well as hills are being adversely impacted due to luxuriant growth of invasive exotic plant species. The problem related to the invasion of alien plant species has engaged the attention of ecologists, foresters, agricultural scientists and government agencies, however, nothing tangible has been done to eradicate and manage those invading plant species that have already established and are extending their range of distribution due to man-induced habitat fragmentation and other kinds of anthropogenic stresses. The economic and ecological costs associated with the invasion of these alien plant species are indeed staggering. These fast spreading and luxuriantly growing plant invaders have

serious ecological implications for diversity, distribution and abundance of native species and ecological processes. In the light of this, the following questions were intended to be addressed in the study.

- To what extent the biodiversity of the area is dependent on the persistence and growth vigour of the invasive alien species growing around?
- Whether habitat fragmentation and degradation of land and forest have any facilitatory effect on the invasion of the alien plant species? If so, what is the underlying mechanism?
- What effect do these exotic plants have on distribution and abundance of native plant species, vegetation dynamics of the area which they invade, and on the ecosystem processes?
- The last and one of the most important objectives of the project is to produce a book on the biology of plant invasion based on the relevant data and information collected during the project implementation on some of the worst invasive plant species that are posing serious threat to the high value biodiversity areas of India such as north-eastern hill region and Western Ghats area.

The literature pertaining to plant invasion was extensively surveyed. The literature search was based on frequent visits to libraries of different research organizations and universities, study of scientific journals, reference volumes, standard books, reprints, internet, unpublished grey literature and personal communication with the researchers engaged in pursuing studies on biological invasions. A large amount of information and scientific data has been collected on the ecology, plant population dynamics, seed population dynamics in soil system, allelopathic influences, competitive ability and ecological implications of the luxuriant growth of selected invasive alien species that are now posing serious threat to the native flora, plant diversity, and natural ecosystems.

Special emphasis was laid on some of the most serious exotic weeds that have been spreading very fast and have become established and naturalized in several parts of India. Notable among such alien species are *Eupatorium odoratum* L. (syn. *Chromolaena odorata* (L.) King & Robinson), *E. adenophorum* Spreng. (syn. *Ageritina adenophora* (Spreng.) King & Robinson), *E. riparium* Regel. (*Ageritina riparia* (Regel.) King & Robinson), *Lantana camara*, *Imperata cylindrica*, *Parthenium hysterophorus* and *Mikania micrantha*. Some of the interesting aspects, and some of the exciting points that emerged as a result of



analysis and synthesis of the scientific information gathered on relevant aspects of plant invasion, are presented below.

- Shifting cultivation (called *jhum* in northeast India), deforestation, changes in land-use pattern, developmental activities, mining operations in certain parts of our country and other anthropogenic stresses have created habitats suitable for colonization by the exotic species.
- The genetic changes that may occur in a species subsequent to invasion in a new area, is certainly an issue of focus among conservation biologists. An invading species that has colonized a novel environment has to face a genetic challenge, because it has not experienced the selective pressures presented by the new environment. Despite the fact that alien species are genetically naïve to their new environment, they become successful invaders although they have to face challenges from the already well adapted native species. The biologists need to find out the underlying mechanisms and processes that make the invading species so successful in their new environment.
- Some invasive alien species may be intrinsically better competitors because they evolved in a more competitive environment. Thus they offer strong competition to native species in the invaded region. The native species show a decline in resource use and invaders can increase their distribution and abundance at the expense of the resident species of the area. This may cause a drastic reduction in population size of several native species which may even be eliminated from their natural habitats.
- Most of the invasive plant species possess high phenotypic plasticity coupled with hybridization capacity and highly efficient reproductive strategies. This attribute of invasive species contributes to their ecological success and capability to invade new areas.
- Many invasive plant species release chemical compounds into the environment, which are not generally harmful to them (i.e., they are not autotoxic), but those chemicals suppress the growth of plants of other species growing in the close proximity of invasive species which release chemical substances. This negative effect (often referred to as allelopathic effect) of invaders on the native species confers a tremendous competitive advantage on the former. The 'chemical release hypothesis' offers a plausible explanation for the spectacular success of invasive plant species in the new areas that they invade.

- The absence of their natural enemies such as herbivores and parasites or pathogens in new environments may provide invaders opportunities for luxuriant growth and more prolific reproduction, which allows them to out-compete native species, and expand their range of distribution. Invading species arrive in their new environments without co-evolved natural enemies (pathogens and herbivores) from their natural habitats that they had occupied in their native place. The so-called 'enemy release' or 'escape' hypothesis holds that emigration of a species from its native habitat separates it from the natural enemies.
- The above hypotheses or approaches explain why and how alien species are so successful, however, the question arises as to how any species can be successful without genetically adapting itself to its new environments? It is commonly assumed that preserving genetic diversity is absolutely necessary for species to continually adapt genetically in a changing environment.

The invasive plant species which produce inhibitory chemicals also bring about change in plant diversity by converting a complex plant community into a much simpler one, which is characterized by the dominance of only a few species. In extreme situations where the impact is severe, the single species-dominance may also result. This kind of effect of invasive species has grave implications for food chain length and complexity of food web, which are pre-requisites for ecosystem stability and smooth functioning of ecosystems. The literature related to impact of invasive plant species on ecosystem processes are scarce, however, a concerted effort is being made to gather information on this aspect as well, so that this important issue could also be addressed.

### Publications

- Tripathi, OP, HN Pandey and RS Tripathi (2006) Fragmentation and plant diversity status of major forest types of Meghalaya, Northeast India. *The Indian Forester* **132**: 1598-1608.
- Tripathi, RS, SPS Kushwaha and AS Yadav (2006) Ecology of three invasive species of *Eupatorium*: A review. *International Journal of Ecology and Environmental Sciences* **32(4)**: 301-326.
- Singha, LB, ML Khan and RS Tripathi (2007) Micro-environmental characteristics of the natural habitat of *Arundinaria maling* Gamble in Arunachal Pradesh, India. *J. Bamboo and Rattan* **6**: 101-114.
- Tripathi, RS and ML Khan (2007) Regeneration dynamics of natural forests - A review. *Proc. Indian Natn. Sci. Acad.* **73(3)**: 167-195.

## DNA Base Excision Repair in Aging RAT Neurons

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This lab has been concerned with different modes of DNA repair mechanisms in the cells of post mitotic organ like brain. Base Excision Repair (BER) mode of DNA repair is found to be the most predominant one in brain. This is the mode of repair that takes care of oxidative damage of DNA. We It was already shown by this lab that BER is adversely affected in neuronal cells during aging and this was due to the limitation of the levels of DNA polymerase  $\beta$  (pol  $\beta$ ) and DNA ligase. The work from this lab has also demonstrated that supplementation of neuronal extracts prepared from aging rats, with pol  $\beta$  and DNA ligase restored the gap repair activity to a significant extent. These results have been already published (1).

The work carried out during the year 2007 reveals that some of the drugs routinely prescribed for treating dementia may have adverse affect on the BER, as suggested by the results obtained with an experimental animal, the rat. Adult rats were orally administered for 15 days at two carefully calculated levels of the three drugs, Donepezil, Rivastigmine and Nootropyl (structures shown in Fig. 1) and the affect on the activity of most crucial BER enzyme, pol  $\beta$  was examined. It is noticed that Rivastigmine and Nootropyl in particular inhibited the pol  $\beta$  activity significantly whereas the action of Donepezil is not consistent (Table 1). Similar results were observed *in vitro* also, wherein pure DNA

polymerase  $\beta$  was incubated with the drugs. To understand the mechanism of this inhibition, bioinformatics data bases were searched to probe the possible structural interactions that could occur between these drugs and pol  $\beta$ . The data base information revealed that these drugs interact with the 8 Kd moiety of pol  $\beta$  and have no interaction with the 21 Kd moiety of pol  $\beta$ . It is known that the 8 Kd moiety of pol  $\beta$  is responsible for binding the single strand region of the damaged DNA substrate and removes the deoxyribose phosphate moiety on the down stream side (dRp lyase activity) to create a clear gap which will be filled by the 21 Kd moiety with appropriate base (polymerase activity). The suggested interaction of Rivastigmine with the 8Kd moiety of pol  $\beta$  is shown in Figure 2. Biochemical confirmation of the suggested interaction of drugs with 8Kd moiety and thus inhibiting the dRp lyase activity, is also obtained as shown in Figure 3. This study with experimental animals is first of its kind and brings in caution to use these drugs for prolonged times and the need to monitor DNA repair activity in such patients. These results are already published online and will appear in print soon(2).

Drugs are ingested at two concentration levels as indicated in the first column. The doses are arrived after

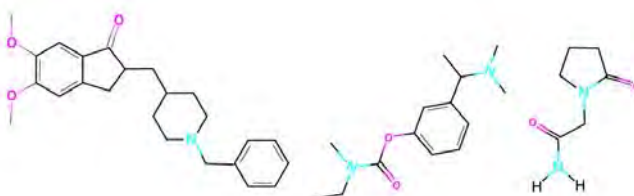


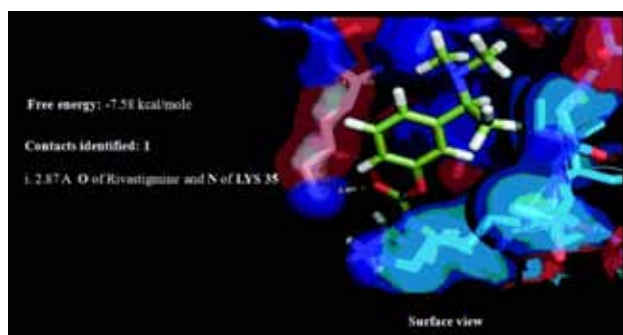
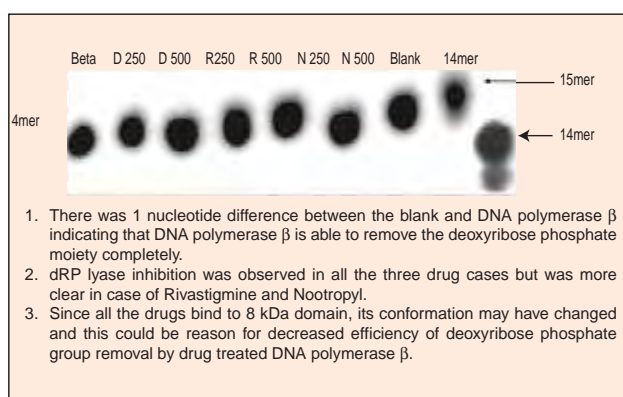
Figure 1

Table 1: Pol  $\beta$  activity in various tissues of control and drug treated rats

	Hypothalamus	Cerebellum	Cortex	Hippocampus	Liver	Kidney	Spleen	Ovary
<b>Control</b>	2.9 $\pm$ 0.4	10.2 $\pm$ 0.8	10.9 $\pm$ 2	3.0 $\pm$ 0.4	13.9 $\pm$ 1.4	9.20 $\pm$ 1	13.9 $\pm$ 1.6	7.6 $\pm$ 0.7
<b>D 25 <math>\mu</math>g</b>	4.7 $\pm$ 0.6	14.4 $\pm$ 1.4	10.9 $\pm$ 0.7	3.6 $\pm$ 0.5	18.6 $\pm$ 1	12.8 $\pm$ 0.8	21.8 $\pm$ 3.3	9.2 $\pm$ 0.9
<b>% Enhancement</b>	62	41	-	20	33	39	56	21
<b>D 50 <math>\mu</math>g</b>	3.9 $\pm$ 0.6	9.90 $\pm$ 1	9.50 $\pm$ 0.8	4.6 $\pm$ 0.4	13.0 $\pm$ 1.5	6.08 $\pm$ 0.5	10.9 $\pm$ 1.2	6.6 $\pm$ 0.8
<b>% Inhibition</b>	34 *	3	12.8	53 *	7	34	28	13
<b>R 30 <math>\mu</math>g</b>	2.1 $\pm$ .25	4.10 $\pm$ 0.3	3.90 $\pm$ 0.5	2.2 $\pm$ .3	6.80 $\pm$ .3	3.70 $\pm$ 0.4	5.5 $\pm$ .6	1.9 $\pm$ .2
<b>% Inhibition</b>	27	59	64	26	51	59	60	75
<b>R 60 <math>\mu</math>g</b>	2.4 $\pm$ .2	7.60 $\pm$ 1.4	4.20 $\pm$ 0.4	2.6 $\pm$ .2	9.60 $\pm$ 2	4.80 $\pm$ .1	6.70 $\pm$ 0.8	4.7 $\pm$ 0.7
<b>% Inhibition</b>	17	25	61	13	30	47	51	38
<b>N 40 mg</b>	3.0 $\pm$ .4	6.40 $\pm$ 0.8	3.80 $\pm$ 0.4	2.9 $\pm$ 0.5	3.90 $\pm$ 0.3	3.0 $\pm$ .2	4.60 $\pm$ .1	2.6 $\pm$ 0.6
<b>% Inhibition</b>	3	37	65	3	71	67	66	65
<b>N 80 mg</b>	.8 $\pm$ .1	3.4 $\pm$ 0.4	2.2 $\pm$ .4	1.1 $\pm$ .6	4.4 $\pm$ 0.6	2.6 $\pm$ .1	2.8 $\pm$ .3	1.1 $\pm$ .1
<b>% Inhibition</b>	72	66	79	63	68	71	79	85

**Table 2:** Effect of dementia drug treatment *in vitro* on the activity of pure Pol  $\beta$ 

Drug	100	Percentage inhibition	500	Percentage inhibition	1000	Percentage inhibition
Donepezil	2.56 $\pm$ .03	22	2.43 $\pm$ .04	26	2.27 $\pm$ .2	31
Rivastigmine	1.88 $\pm$ .1	44	2.02 $\pm$ .1	38	2.02 $\pm$ .03	38
Nootropyl	2.16 $\pm$ .1	34	2.06 $\pm$ .1	37	2.00 $\pm$ .08	39

Control: 3.29  $\pm$  .16**Fig. 2:** Human DNA  $\beta$  polymerase Vs Rivastigmine**Fig. 3:** dRP Lyase assay representing 8kDa domain activity alone

considering the dose levels normally prescribed for patients by physicians in India. D- Donepezil Hydrochloride, R- Rivastigmine, N- Nootropyl. Details regarding the preparation of tissue extracts and assay of Pol  $\beta$  activity are given in methodology section of text. Percentage inhibition or enhancement of the activity in drug treated rats compared to control is given in the row below each dosage of drug. Generally the activity was inhibited by the drug treatment except in two cases with higher dose of Donepezil hydrochloride (50 $\mu$ g) and these two values are indicated with an \*. All the values were found to be statistically significant with a p value less than 0.05 ( $p < 0.05$ ), except those italicized.

Values denote the specific activity of Pol  $\beta$  activity, control and drug treated and represent average from 6 or more separate experiments with standard error. 100, 500 and 1000 refer to dosage of drugs used in nanograms /1 unit of Pol  $\beta$ . Unit of Pol  $\beta$  activity is defined as that activity which would incorporate a total of 1 nanomole of deoxy nucleotides into water insoluble fraction. The percentage inhibition of activity in drug treated DNA polymerase  $\beta$  is given next to each dosage of drug and all the inhibitions were found to be statistically significant at a p value less than 0.05. The control DNA polymerase  $\beta$  activity is given below the Table 2.

### Papers Published

Reduced DNA-gap repair in aging rat neuronal extracts and its restoration by DNA Polymerase beta and DNA-ligase. T Hari Krishna, S Mahipal, A Sudhakar, H Sugimoto, Raghu Kalluri and K Subba Rao, *J Neurochemistry* 92 818-823 2005.

On the inhibitory affect of some Dementia drugs on DNA polymerase  $\beta$  activity

VN Vyjayanti, NS Chary\* and Kalluri Subba Rao\* Neurochemical Research. In Press 2007-08.

### Anti AIDS Retroviral Drugs

#### ANIL SARAN

Bombay College of Pharmacy, Santacruz (East), Mumbai

Since the time of recognition of HIV-1 integrase as a novel and rational target for HIV, remarkable progress has been made in the development of its inhibitors. Computational techniques have played a critical role in accelerating the research in this area. But most of the earlier computational studies were based solely on ligand information. In the present work, we describe an application of one of our recently developed receptor-based 3D-QSAR formalism, Comparative Residue Interaction Analysis (CoRIA) in exploring the events involved in ligand integrase binding. In this methodology, the non-bonded interaction energies (van der Waals and Coulombic) of the inhibitors with individual active site residues of the integrase enzyme



are calculated and, along with other thermodynamic descriptors, are correlated to the biological activity using chemometric methods. Different combinations of descriptors were used to develop, three types of QSAR models, all of which are found to be statistically significant by internal and external validations. It is nearly the first time that such a dedicated receptor-based 3D-QSAR approach is being applied to comprehend the integrase – inhibitor recognition process and that too by employing 13 different series of inhibitors, which is the most structurally diverse data set ever used in studying the inhibition of HIV-1 integrase enzyme. The major advantage of this technique is that it can quantitatively extract crucial residues and identify the nature of interactions between the ligand and receptor that modulate the activity. The models suggest that Asp64, Thr66, Val77, Asp116, Glu152 and Lys159 are the key residues influencing the binding of the ligands with the integrase enzyme, and majority of these results are in line with earlier studies. The approach facilitates easy lead to hit conversion and design of novel inhibitors by optimization of the interaction of ligands with these specific residues of the integrase enzyme.

### **Molecular Biology and Biotechnology of the Mulberry Silkworm *Bombyx mori***

**KP GOPINATHAN**

*Department of Microbiology and Cell Biology, Indian Institute of Science, Bangalore*

The work carried out on the current year was mainly on the patterning of appendages during silkworm development. During evolution there has been a trend towards the divergence of the number, morphology and function of limbs within different taxa. Understanding the mechanisms of development of these homologous structures is crucial in deciphering the evolution of the animal body plans. The adult body patterns in insects may develop either from juvenile instars that resemble the adults or from the imaginal discs. The imaginal discs are sacs of epidermal cells specified during embryonic development that proliferate during larval development and differentiate during pupal metamorphosis to give rise to adult derivatives. Here we have shown how the larval appendages of *B. mori* relate to their adult counterparts.

Using scanning electron microscopy we studied the morphology of the developing legs from the embryo to the adult. Three pairs of ectodermal evaginations originate vertically on the pro-, meso-, and meta-thoracic segments. The abdominal legs of *B. mori* are small non-segmented protrusions on the ventral surface of the

larval abdominal epithelium. The embryonic thoracic legs have three segments, and the segmented form further evolves to form the larval legs with five segments and a claw starting from the distal fifth segment. The segmental organization is maintained in the pupal and adult stages. We used the expression profiling of functionally conserved genes *Dll* and *exd* to follow the development of legs during embryogenesis. Further we also used perturbations and segmental excisions to complete the study of developmental patterning.

### **Biotechnological Management of Plant Viral Diseases**

**ANUPAM VARMA**

*Advanced Centre for Plant Virology, Division of Plant Pathology, Indian Agricultural Research Institute, New Delhi.*

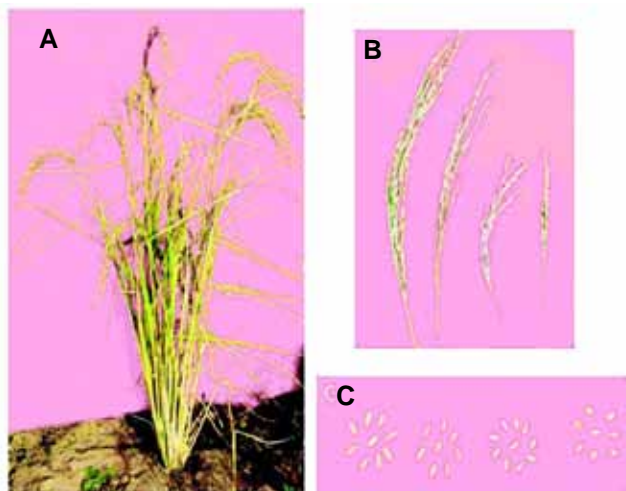
Plant viruses are emerging as serious constraint in improving the productivity of a wide range of economically important crops. Efforts have been made to develop molecular diagnostic tools and transgenic plants for the integrated management of plant viral diseases. One of the important outputs of these efforts is the establishment of a National Certification System for Tissue Culture Raised Plants by the Government of India. Virus resistant transgenic plants have a good potential for improving crop productivity. To utilize this approach a Network Project for the development of virus resistant transgenic crops, involving nine institutions located in different parts of the country is being coordinated. Under this network project transgenic banana, black gram, black pepper, sweet orange and watermelon are being developed for resistance to important viruses like badna, begomo-, clostero-, nano- and tospoviruses. Transgenic lines of cucumber developed for CP-mediated resistance to CMV were tested further; six plants have shown promise. Stability of resistance in these plants is being studied. The technology for the development of virus resistant tomato has been transferred to a seed company for use in developing leaf curl resistant tomato varieties. Transgenic tomato for resistance to CMV and a tospovirus are also being developed. Attempts are also being made to transform tomato with RMAi constructs for broader resistance.

### **Creation of Mutants for Functional Genomic Studies in Rice**

**RP SHARMA**

*National Research Centre on Plant Biotechnology, Indian Agricultural Research Institute, New Delhi*

Availability of knockout mutants for various traits is the primary requirement for assigning and confirming the



**Fig. 1:** EMS induced mutants of upland rice variety Nagina 22 with desirable plant structure(A), different panicle characteristics (B) and altered grain size and shape (C).

function of a given DNA sequence in the genome. Since, rice genome sequence is now available in public domain, there is a worldwide interest in assigning the function to the genomic sequences. In India, which was one of the partners in the international effort on rice genome sequencing, a number of laboratories are involved in *in silico* analysis and annotating the gene function. However, confirmation of the assigned function as well as studies on gene product interactions will require demonstration of restoration of function in corresponding knockout mutants. With this objective in mind, the present project on creation of mutants for functional genomics studies in rice has been initiated.

As a first step, *Nagina-22*, a drought tolerant rice variety has been chosen as an ideal genotype for creating genetic variability through induced mutagenesis for almost all the traits of breeding significance but more importantly for drought tolerance. Ethylmethane-sulphonate (EMS), being a monofunctional alkylating agent, was selected as a potent mutagen for affecting the mutagenic treatments.

In the present study the affectivity and efficiency of the mutagenic treatment were judged from the degree of mortality and the sterility observed in the mutagenized population in  $M_1$  and the number as well as the type of chlorophyll mutants recorded in the  $M_2$  population. These observations revealed that the mutagenic treatment was quite effective.

$M_2$  seeds derived from a total of 4000  $M_1$  plants harvested separately, were divided among the 5 co-opting research institutes/universities as partners and growing all the 4000  $M_2$  lines, 800 at each location. The

participating institutes and the contact scientists are:

- i) Dr T Mohapatra, Dr AK Singh and Dr C Viswanathan - Indian Agricultural Research Institute, New Delhi
- ii) Dr N Sarla, Directorate of Rice Research, Hyderabad
- iii) Dr Kuldeep Singh, Punjab Agricultural University, Ludhiana
- iv) Dr S Robin, Tamil Nadu Agricultural University, Coimbatore
- v) Dr SK Katiyar, Indira Gandhi Agricultural University, Raipur

Visual observations on each of the  $M_2$  plants at each of the above centres revealed that

- i) a large number of  $M_2$  lines segregated for chlorophyll mutants
- ii) the most prominent chlorophyll mutants included albino, straita, meculata, tigrina and chlorina
- iii) a number of macromutants such as dwarf, broad leaves, sterile, reproduction cycle absent, chlorina, very early flowering, late flowering, extreme grain size variation, long panicles (Fig. 1) etc. were identified

Most of the chlorophyll mutants, except chlorina died at different stages of development. Seed from the macromutants have been harvested will be used for confirming the breeding behaviour of these mutants and for transmission genetic studies.

## Solution Concept in Game Theory and Semidefinite Linear Complementarity Problem

T PARTHASARTHY

University of Hyderabad, Hyderabad

**Semidefinite Linear Complementarity Problem:** Let  $S_n$  be the space of real symmetric matrices and let  $L$  be a linear transformation from  $S_n$  to  $S_n$ . Given a  $Q \in S_n$ , semidefinite linear complementarity problem (SDLCP) is to find  $X \in S_n^+$  (= space of symmetric positive semidefinite matrices) such that  $L(x) + Q \in S_n^+$  with  $X(L(x)+Q) = 0$ . In the literature on SDLCP, three transformations, namely Lyapunov, Stein and Multiplicative transformations were considered.

It is known that  $Q$ -property =  $P$ -property in Lyapunov and Stein transformations. We prove the same result for multiplicative transformation in the special case when the matrix  $A$  is normal. (This is a joint work with R.Balaji). Problem remains open when  $A$  is not normal.

## To establish a World-class Facility for Structural Characterization and Elemental Analysis of Single Crystals, their Surfaces and Thin Films

**KRISHAN LAL**

*National Physical Laboratory, Dr KS Krishnan Road, New Delhi*

Recently, X-ray reflectometry has emerged as a very powerful technique for non-destructive characterization of surfaces and thin layers. Under the INSA Senior Scientist Scheme, it is proposed to establish a new high resolution experimental technique for investigation of X-ray reflection from solid surfaces at very small glancing angles and determination of their composition and structure. Attempt is being made to achieve unprecedented level of resolution in X-ray reflection experiments. A special feature of this technique will be the capability of direct imaging of reflected X-ray beams. A five crystal X-ray diffractometer developed earlier by Dr Lal and his co-workers has been modified for these experiments. A highly collimated and monochromated  $\text{MoK}\alpha_1$  X-ray beam is isolated and used for reflection experiments. This is achieved by combination of a long collimator fitted with a fine slit and a set of two plain silicon monochromators of Bonse-Hart type which are set in (+, -) geometry. The specimen is mounted on a special turntable, which has provisions for rotation around a vertical axis (perpendicular to plane of reflection) to change the glancing angles as well as for tilt and linear translation of the specimen across the X-ray beam. The detector position can be changed and for some experiments, it is placed at a distance of  $\sim 1.5$  m from the specimen. The exploring beam can be blocked whenever needed. This arrangement enables to measure reflection curves as well as for recording images of the reflected X-ray beams. The first set of experiments has clearly showed the images of X-ray beams reflected from deliberately prepared films as well as unavoidable deposits on crystal surfaces. Some of these deposits have thicknesses in nanometer range. Since this is a unique approach, a new method had to be developed for analysis of experimental results. This method is now being applied for analysis of results obtained with silicon, single crystals having deliberately deposited films as well as with crystals having unavoidable layers due to exposure to atmosphere. Some new experiments for precise measurements of electron density of the deposited layers are also planned. Two research papers have been published and 17 invited talks have been delivered at important national and international conferences.

## Accelerator Based Research and Applications

**SS KAPOOR**

*Physics and Electronics and Instrumentation Groups, BARC, Mumbai*

Professor Kapoor continued to pursue his research interests in the areas of heavy-ion induced fission and fission-like reactions, formation and fission decay of super-heavy nuclei via heavy-ion reactions, nuclear shell effects, nuclear level densities and relativistic heavy-ion collisions. He has been also associated with the work being carried out at BARC in the area of Accelerator Driven sub-critical reactor Systems (ADS).

On 2 November 2007, Professor Kapoor had delivered R.D. Birla Award Lecture on *Journey through five decades of nuclear research* on the occasion of presentation of Indian Physics Association (IPA) RD Birla Memorial Award-2006.

Professor Kapoor was invited to work as a member from India of the International Cost Review of the proposed International Linear Collider (ILC) to review the ILC with respect to the design and cost and had also participated in its meeting held at LNL Orsay, France during 23-25 May, 2007.

## Density Functional Study of Reaction Paths and Magnetic Properties of Some Molecules

**NK RAY**

*Dr BR Ambedkar Center for Biomedical Research, Delhi University, Delhi-110007*

Following reaction paths have been studied using density functional theory: a) Payne rearrangement of 2,3-Epoxypropoxide anion; b) [1,2] rearrangement of Silylmethanol; c) Formation of Silylketenes.

It has been shown that inclusion of electron correlation significantly decreases the barrier heights.

Estimated Carbon NMR chemical shifts of some furan, pyrrole, pyridazines and methyl purines are in good agreement with experimental results. Calculated C, H spin spin coupling constants for pyridazines and imidazoles are in good agreement with experiment.

## Investigation into some Fundamental Issues in Dynamics and Microsystem Technology: Design and Fabrication Aspects

**AMITABHA GHOSH**

*Mechanical Engineering Department, Indian Institute of Technology, Kanpur*

The primary objectives of the work as an INSA Senior Scientist have been to do some research work in the area of fundamental mechanics and introduce programmes



on advanced microfabricational science at IIT Kanpur and IIT Kharagpur in collaboration with University of Illinois at Urbana - Champaign, Northwestern University Evanston and University of California, Irvine. The work during the period December 2006 to April 2008 led to three publications (one published and two submitted). Besides he has delivered the S C Bhattacharyya Memorial Lecture at the Annual Convention of the Mechanical Engineering Division of the Institution of Engineers at Hyderabad in September, 2007. The preliminary draft of a book "Conceptual Foundations of Mechanics" is ready and the final manuscript is expected to be given to Elsevier by 2009. Professor Ghosh's efforts and coordination led to a very successful completion of the first phase of the "Indo-US Joint Centre on Advanced and Futuristic Manufacturing" funded by the Indo-US Science & Technology Forum, New Delhi. Looking at the success of the first phase, that has led to a number of DST and NSF collaborative projects among the participating scientists from the universities mentioned above, the Forum and the DST have sanctioned the second phase of the programme for creation of an "Indo-US Centre of Research Excellence in Fabronics". The scope and the participating team have both been expanded and the budget for the next three years is about Rs. 5.00 Cr. On the Indian side CMERI, Durgapur and Bengal Engineering & Science University, Shibpur have joined the team. During this period Prof Ghosh's guided one PhD student and Professor Ghosh has taught two courses at IIT Kanpur in the first semester of 2007-2008 and parts of two courses at Bengal Engineering & Science University in the second semester. An Indo-US Joint Workshop on Advanced & Futuristic Manufacturing was organized by him at IIT Kanpur in October 2007.

### Lower Eocene Western Margin Biopas: on the Indian Raft prior to the India-Asia Collision

ASHOK SAHNI

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One of the major planetary events was the northward drift of the Indian landmass from a position 40° S near Madagascar to its present south Asiatic location. One of the objectives of the project is to examine the biotic response of drifting large island continents (Australia is a good analog) with respect to "fossil" island ecosystems and biotic dispersals using the "McKenna Noah's Arc model". The current highlights include a communication published in *Science* (November 2007) by us demonstrating the oldest record of ungulates from a Cretaceous Intertrappean locality at Dindori east of Jabalpur; the oldest global record of rabbits,

Lagomorpha, (online pre-print Royal Society Proceedings B, 2008) and the dispersal of an ailuravine rodents to North America, Europe and India (*Acta Palaeontologica Acta* 2008).

#### Publications:

Prasad *et al* 2007. *Science*, v. 318, p. 937 + online material.

Rana *et al* 2008. *Acta Palaeontologica Acta*, v.53 (1), p. 1-14.

Rose *et al* 2008. *Proc. Royal Society B*, v.275, p.1203-1208.

### Genetic/genomic investigations in *Catharanthus roseus* and *Pisum sativum*

SUSHIL KUMAR

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In the medicinal-cum-ornamental plant *Catharanthus roseus* progress was made towards development of mapping populations and segregational analyses of selected DNA markers in the populations. A preliminary map based on 125 DNA markers and 6 morphological markers was developed. The map defines 14 linkage groups, altogether 1132 cM in length, with average inter-marker distance of 8.6 cM. Further analyses on intra- and inter-specific F<sub>2</sub> and RIL populations, using a wider spectrum of DNA markers, is making the genetic linkage map more detailed. Bulk segregant analysis led to mapping of a locus related with increased production of total alkaloids in leaves. A hypo-C-methylation mutant was also mapped. The stability of recombinant inbred lines harboring the *lli* hypo-C-methylation mutant was initiated. Expression of several genes related with alkaloid biosynthesis, leaf and inflorescence development and primary metabolism was found to occur at higher levels in *lli* mutant as compared to wild type.

Root essential oil of the antimalarial plant *Artemisia annua* was characterized. The oil rich in cis-arteannuic alcohol had fumigant activity against *Tribolium castaneum* beetles, a pest of food grains.

Genetic control of leafblade morphogenesis was investigated using all the combinatorial genotypes of wild type and mutant alleles of *UNIFOLIATA*, *AFILA*, *TENDRIL-LESS* and *MULTIFOLIATE-PINNA* (*MFP*) genes, in grain pea *Pisum sativum*. New pathways of leaflet formation were discovered. The *MFP* gene was mapped.

In *Triticum aestivum* tandem cultivation for two crops of bread wheat in the winter season in the agroclimate of Indo-Gangetic plains was demonstrated. Experiments to discover genes responsible for phenological plasticity in wheat, a much desired trait in the era of climate changed agriculture, was initiated.

## Protein DATA Mining

C RAMAKRISHNAN

*Molecular Biophysics Unit, Indian Institute of Science, Bangalore*

The work done during this period mainly centers around two aspects of the ongoing projects pertaining to disulfide bonds and prolyl geometry in Proteins. A new software named "INTERMODIP" based on the same principle used in an earlier software MODIP was developed which can automatically take into account the equivalent point information pertaining to the space group in which the protein is crystallized and predict sites in a protein compatible with *intermolecular* disulfide formation with neighboring molecules in the crystal lattice. This was applied to a model protein Thioredoxin which has dimers and multimers. Of the five predicted sites, four formed disulfide dimers, while one formed a chain-like polymer. Three of the mutant dimers crystallized readily in less than a week's time. In two of the three cases, the crystal structure of the mutant dimer was exactly as predicted by the algorithm, while in the third case, there were some differences in the relative orientation of the dimers. This shows that the methodology can be effectively used for fast and easy crystallization, modulation of oligomerization state and to produce linear chains or ordered three-dimensional protein arrays. The second part of the work pertains to the unique amino acid residue (imino acid residue) proline. A software named XTOPROMAKE developed earlier to identify suitable sites for introduction of Prolyl residues in a protein has been applied to the protein cell division or death B protein (CcdB), which is a 101 residue homodimeric protein encoded by F plasmid and does not contain any disulfides or metal ions. The application of this program to CcdB yielded only six positions for introduction of Pro with small or negligible steric hindrance. Of these six positions, Pro mutants were experimentally available which were soluble and showed a WT-like phenotype. However experimental data yielded more possibilities. Using a combination of experimental and Modelling exercises, a decision tree was created to classify Pro substitutions of a protein into perturbing and non-perturbing mutations. The decision tree was further validated on a large phenotypic dataset of 163 Pro mutants of T4 lysozyme at two different temperatures and a nonsynonymous single nucleotide polymorphism (nsSNP) database of Pro substitutions.

## Challenges, Opportunities and Constrains in Adoption of Conservation Agriculture Practices North-West India

IP ABROL

*Centre for Advancement of Sustainable Agriculture (CASA), National Agricultural Science Complex (NASC), DPS Marg, New Delhi*

The agriculture sector of the country faces serious challenges arising from a multiplicity of factors. Most importantly these challenges relate to stagnating productivity of most of important food crops (cereals, oilseeds, pulses), spiraling energy prices and needs, and widespread problems of resource degradation, declining water availability and quality, climate change related uncertainties. These challenges call for a serious relook at our past research for development strategies and to define new pathways aimed at enhancing productivity in ways which are more sustainable and address economic, social and environmental concerns.

It is in face of these challenges that Conservation Agriculture offers a route to new phase of agricultural research and development. The term "Conservation Agriculture" refers to the gamut of practices which have a basis in three basic principles, viz,

- Minimum disturbance of soil through practices such as ploughing, tillage etc, ideally no-tillage.
- Keeping the soil surface covered by leaving crop residues on the soil surface covered by leaving crop residues on the soil surface.
- Adapting diversified crop rotations/plant associations (agroforestry).

While the concept of CA has evolved in response to concerns of 'Agricultural Sustainability' worldwide, operationlizing the concept in the context of Indian



*Widespread adoption of Zero-tillage for seeding wheat crop*

Agriculture calls for a major paradigm shift in the way technical problems have been defined and answers sought development institutions.

Working together with scientists of CSSRI, PAU and HAW made efforts to share their concepts with farmers groups scientists at two sites, one each in Punjab (Fatah garh district) and Haryana (Karnal district) encouraging them to adopt new farming practices, understand the technical and policy related constrain in wider adoption of these practices, promoting farmer-scientist participating testing and refining of new institutional mechanism required to operationalize the concepts. Widespread adoption of zero-tillage for seeding wheat crop by farmers is largely driven by reduction of production costs. Farmers have yet to start adopting crop residue management by learning it on soil surface need for continues technological support based on multidisciplinary term effort and participating approaches constituted a key critical input for change.

### Pattern of Plant Species Diversity Along Dry-to-Moist Tropical Forest Gradient in Relation to Disturbance

JS SINGH

Department of Botany, Banaras Hindu University, Varanasi

The major objective is to investigate the pattern of species diversity of dry forest in reference to disturbance. Data were analysed to focus on understorey-overstorey plant community dynamics in a dry tropical forest to facilitate appropriate management decisions. Community composition and species diversity of the understorey vegetation among five dry tropical forest sites were compared. The non-metric multidimensional scaling (NMS) ordination revealed that human disturbance intensity, as well as the overall disturbance regimes, and soil water holding capacity controlled the organisation of dry tropical forest understorey composition through

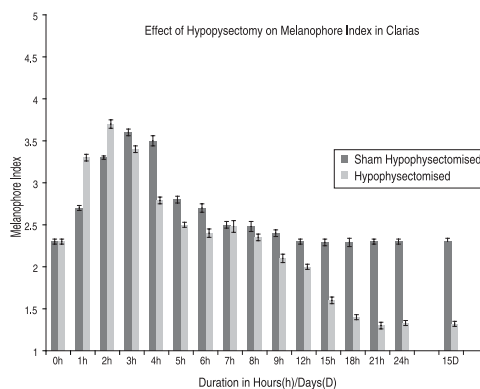
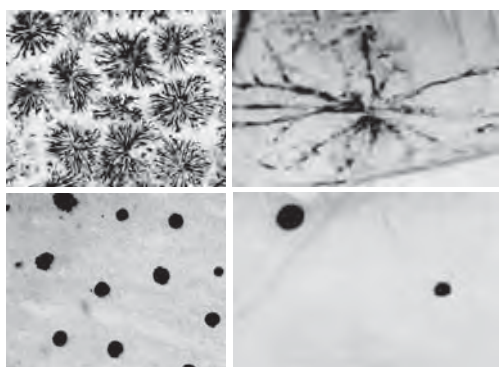
effects on soil organic matter. The  $\alpha$ -diversity and its components decreased with increasing human disturbance intensity, reflecting utilization pressure and decreased soil fertility, as also revealed by the analysis of overstorey tree layer. Results suggest that in the future, the existing understorey tree communities may replace the current dry tropical forest communities under prevailing environmental conditions. The results assert that the rate of species accumulation will be greater in more disturbed sites as well as at small spatial scale within each disturbance level.

### Melanophore Behaviour in Response to Environmental Conditions in Select Freshwater Teleosts

PD PRASADA RAO

National Environmental Engineering Research Institute, Nagpur

Two scaly teleosts, *Tilapia* and *Danio* and a scaleless catfish *Clarias* were tested separately for their adaptability to different backgrounds. The two former species adapted more rapidly to black (Figs. A, C) and white backgrounds (Figs. B, D) and turned dark (Melanophore index, MI 5) and pale (MI 1) respectively than *Danio*. *Tilapia* and *Clarias* readapted to reversed backgrounds effectively, indicating their superior ability for colour adaptation. Darkening results from dispersion of melanosomes, and blanching from their aggregation within the melanophores (MELs). In *Danio*, the melanosome movements were comparatively slow signifying limitations in usefulness of this species. The MEL response is manifested by neural and/or endocrine mechanisms. In order to verify the involvement of hypophysial hormones in MEL response, the changes in MELs was studied at different intervals ranging from 1 hour to a period of 15 days in hypophysectomised *Clarias* and compared with those in sham-operated fish (Fig. E). A statistically significant fall ( $P < 0.001$ ) in MI was evident at 9 hours post-



Figs. A-D: Melanophores (MELs) under different experimental conditions. Dispersed MELs after black adaptation in *Tilapia* (A) and *Danio* (B). Aggregated MELs after white adaptation in *Tilapia* (C) and *Danio* (D); E. Changes in melanophore index (MI) in hypophysectomised and sham-operated *Clarias* at different intervals



hypophysectomy that lasted up to 15 days. Studies are in progress to examine the ability of hypophysetomised fish for background adaptation and the extent of neural involvement in melanophore physiology through transection experiments.

## Precambrian Evaporites of Rajasthan

**DM BANERJEE**

*Department of Geology, University of Delhi, Delhi-110 007*

The low dipping Ediacaran evaporate succession in the Nagaur Ganganagar basin of the Marwar Supergroup incorporates hydrocarbon bearing strata in the western sector of Rajasthan. The origin of these evaporates, their age and position in the regional stratigraphic succession and their correlation with other parts of the world are contentious issues on which geoscientific interpretations vary widely. Outcrop level field information, supported by geochronology of detrital zircons in the underlying and overlying Jodhpur and Nagaur Sandstones and the Upper Vindhyan Bhandar Sandstones of the main Vindhyan basin, carbon and sulfur isotopic analyses of the evaporate bearing Bilara and Hanseran carbonates, high resolution microscopy of the nature of fluid inclusions in the evaporates and a collaborative study on the reconstruction of paleomagnetic poles for Upper Vindhyan and Marwar provided several additional tools for reinterpreting the origin of these Proterozoic evaporates. These studies clearly suggest (a) Bilara carbonate and the Hanseran evaporates in the sub-surface are not facies variants. Instead, Hanseran evaporate beds are younger than the Bilara carbonates, (b) Nagaur Sandstone overlaps both Bilara and Hanseran beds and constitute a major sequence boundary. (c) Paleopoles of Upper Vindhyan Bhandar Group suggest about 1000 Ma age and therefore older than the Malani igneous activity. On the other hand, the basal sandstones of Marwar are younger than youngest Malanis of ~660 Ma age. (c) The evaporate group overlies the sandstones and underlies the trilobite-trace bearing Nagaur Sandstone and represent a sequence boundary. The end-Proterozoic-early Cambrian boundary events are therefore masked at this sequence boundary.

*Presentations in International Conferences and Publications*  
Evaporite Sequence of the Nagaur-Ganganagar Basin, Western Rajasthan- New Data and New Interpretations: *International Conference on Precambrian Sedimentation and Tectonics & II GPSS Meeting*, December 10-12, 2007, IIT, Bombay (co-authors: P Phukan, M Joachimski, AJ Kaufman, W Altermann, S Grover, C Mayr, R Sussane).

Chemostratigraphic approach to re-interpretation of the Aravalli Stratigraphy in Girwa valley of south-central Rajasthan, *International Conference on Precambrian*

*Sedimentation and Tectonics & II GPSS Meeting*, December 10-12, 2007, IIT, Bombay (co-authors M Schidlowski, A Bekker, AJ Kaufman).

Paleomagnetism and detrital Zircon Geochronology of the Upper Vindhyan Sequence, Son Valley and Rajasthan: A ca. 1000 Ma age for the Purana Basin. *Precambrian Research, Accepted Article February 8, 2008.* (co-authors: SJ Malone, JG Meert, MK Pandit, E Tamrat, GD Kamenov, VR Pradhan, LE Sohl).

## Superconductivity of Cuprates and Magnesium Diboride

**AV NARLIKAR**

*UGC-DAE Consortium for Scientific Research, University Campus, Indore*

As per approved research program, both ruthenocuprate, Ru1222, and magnesium diboride MgB<sub>2</sub> were investigated. In the case of former, substituting Co at Ru-site has yielded new and interesting results on its magnetic and superconducting properties. While 7.5% Co seems to completely destroy superconductivity of the pristine sample, its original magnetic structure, which is weak ferromagnetic, tolerates 20% Co substitution. Interestingly, by exceeding the doping level further, from 20% to 80%, the doped material shows antiferromagnetic character. Preliminary FMR and NMR (at near zero field) of pristine and doped samples have led to some interesting observations which need to be investigated in detail. In the case of MgB<sub>2</sub>, nanodiamond incorporation has markedly improved flux pinning and critical current density, J<sub>c</sub>; the optimum concentration of nanodiamond being 3%. Similarly, Mo substitution (partial) for Mg also improves J<sub>c</sub> though the effect is comparatively less. In the case of YBCO, J<sub>c</sub> is markedly improved by partial substitution of Pr at the Y-site. This further marginalizes the adverse grainboundary effect as weaklinks. J<sub>c</sub> enhancement due to Pr substitution (6 to 8%) significantly exceeds similar effect due to Ca and Ni substitutions.

## Novel Sequence Specific Minor Groove Binding Ligands and Nucleic Acids

**SK DOGRA**

*BR Ambedkar Centre for Biomedical Research, University of Delhi, Delhi*

The main aims of this project are to synthesize novel ligands, which are not only non-toxic but also better radio-protective agents when bound to DNA. Keeping this in mind we have synthesized six ligands, three of them are bisbenzimidazoles and three are terbenzimidazoles. The interactions of the above ligands with Calf Thymus (CTDNA), and five different

olegonucleotides were studied using absorption, and fluorescence spectroscopic techniques at different ligand to DNA ratios (i.e.  $r=0.01$  and  $r=0.05$ ). The results have shown that bathochromic shifts in absorption spectra, blue shifts re observed in the fluorescence spectra when the these ligands re bound to CTDNA and A-T rich base pairs olegonucleotides and negligible changes are observed when these are bound to G-base pairs. These studies suggest that these ligands form complexes with these olego-nucleotides and CTDNA and the site of these ligands, where these bind, is less polar as compared to water. Studies regarding the stability of these DNA-ligands complexes by using thermal melting curves, CD spectroscopic studies, determination of binding constants, life time determinations etc. are in progress.

### Stereospecific Synthesis of Some Nitrogen Heterocycles and New Synthetic Methods

JS SANDHU

*Department of Chemistry, Punjabi University, Patiala*

In the pursuit of developing new knowledge in the area of "Stereospecific Synthesis of Some Nitrogen Heterocycles and New Synthetic Methods" it was necessary to have knowledge of past achievements in the well known Biginelli reaction {i.e. synthesis of 3,4-Dihydropyrimidin-2(1H)-ones} which is critically searched, this included well known antihypertensive agents of Nifedipine group. In the development of newer methods a catalyst  $\text{GaCl}_3$  is found to be more effective in the production of privileged molecules of Biginelli scaffold. In case of Hantzsch dihydropyridines (well known antihypertensive agents), DMSO along with aerial oxygen is demonstrated to be efficient oxidants.

#### Publications

Saini, S Kumar and JS Sandhu, 2007 Biginelli Reaction (Review), *J. Indian Chem. Soc.* **84**, 959-970.

### Weathering & Erosion in River Basins

S KRISHNASWAMI

*Planetary and Geosciences Div., Physical Research Laboratory, Ahmedabad*

1) *Spatial variability in Physical and Chemical Erosion in the Ganga basin.*

Professor Krishnaswami and his coworkers have completed a detailed study on the sources of sediments to the Ganga plain and spatial variations in – physical erosion among the various sub-basins of the Ganga. The findings of this study have been accepted for publication in the Journal Geophysical Research (Earth Surface). The abstract of the manuscript in press is attached.

2) *U-Th Series Nuclides in Aquatic Systems*

Professor Krishnaswami edited with JK Cochran a volume on "U-Th Series Nuclides in Aquatic Systems". The volume is published by Elsevier, Amsterdam, May 2008.

#### Publications during 2007-08

A Das and S Krishnaswami (2007) Elemental Geochemistry of river sediments from the Deccan Traps, India: Implications to source of elements and their mobility during basalt-water interaction. *Chem. Geol.* **242**, 232-254.

S Krishnaswami and JK Cochran (Editors) U-Th Series Nuclides in Aquatic Systems. Elsevier, Amsterdam (2008), 458 pp.

### HONORARY SCIENTISTS

#### Physicochemical Studies of Multiple Interaction between Biopolymers, Lipids and Solid Interfaces in Monolayers, Lipids and Dispersed Phases

DK CHATTORAJ, FNA

Studies of adsorption of soluble biopolymer beta-lactoglobulin on the hydrophilic surface of insoluble casein powder were extensively carried out in the presence of different neutral salts and urea respectively. The adsorption isotherms in presence of these salts are widely different from each other. for most of these salts, adsorption values are all positive but for KCl and KSCN these values are all negative due to the excess hydration of casein. The affinities or free energy decrease for adsorption of betalactoglobulin stands in the following order of neutral salts:

$\text{NaCl} > \text{CsCl} > \text{LiCl} = \text{RbCl} > \text{Na}_2\text{SO}_4 > \text{KCl} = \text{KSCN}$

This order agrees well with maximum values of adsorption of lactoglobulin on casein surface in the presence of these neutral salts. Interaction of lactoglobulin with casein and casein with long chain fatty acids in mixed film were studied from the comparison of pressure-area curves of their spread monolayers with their ideal pressure -area curves The results of such comparison indicate that mixture of casein with lactoglobulin or with fatty acid in the mixed film are not uniform but they remain in demixed state in monolayer phase.

From the water vapour adsorption studies of 20 different L-amino acid powders, one notes that for most aminoacids, water adsorption capacities are relatively lower than those of their acid residues present in polypeptide chain. The activity coefficients of several amino acids in gel state have been evaluated from thermodynamic consideration.

Altogether three papers are in communication and two review papers based on plenary lectures in International Meetings are ready for communication.

## Cross-Cultural Ethnobotany -Leads from Ethnomedicines

SK JAIN, FNA

*Work on Economic Plants:* Work on local names of psychoactive plants was continued; it is nearing completion. Some data on chemistry was incorporated in the species accounts. This work is continuing.

*Guidance of Research:* Guidance was provided to a doctoral student of Jammu University, one paper was prepared and published. The work is continuing. Help in research was extended to several scholars in the county through correspondence, on phone and during their visit to Lucknow.

*Other Scientific and Technical Work:* One invited paper on Life and work of Carl Linneaus was written and published. Another larger paper is being finalized. It will highlight prospects of future work on Linnean taxa in India for perpetuation and more useful utilization of such plants in Indian economy. One paper on life and work of Carl Linneaus were prepared (in Hindi).

The National Botanical Research Institute invited the HSD to act as expert and advise on their proposed new projects on conservation of biodiversity and digitization of herbarium. With a view to study some aspect of history of plant sciences and location of notable botanists. One paper was published and some are under preparation of Lichenology, Bryology and taxonomy.

For popularization of science one paper dealing with scientific names of plants were prepared and published in CSIR Hindi research journal also, one book review was also published.

In all six papers/articles (4 in English & 2 in Hindi were published).

### Publications

In English

Carl Linneaus: Life and Work in Indian perspective. *Proc. Nations. Acad. Sci. India*, **77(B)**, 221-230 2007.

Taxonomy of Plants in tradition of Prophet Mohammad & their availability in J&K. *Phytotaxonomy*, **6**, 116-119 2006 (Publ. 2007).

University Herbaria in India Ibid: **6**, 128-130, 2006 (Publ. 2007).

Scholastic Genealogy in ethnobotany – an appeal for study & record. *Ethnobotany* **19**, 144-146, 2007.

In Hindi: Two articles published.

## Non-Equilibrium Phenomena

RP RASTOGI, FNA

In continuation of the primary objective of the project to continue further researches in the field of Chaos and

Complex patterns, the book on “Introduction to Non-equilibrium Physical Chemistry -towards Complexity and non-linear Science” has been published by Elsevier in September 2007. It gives an account of recent developments in the field including author’s contribution in various sub-areas during last 60 years. It presents a critical and comprehensive account from both a theoretical and experimental perspective and covers a wide range of phenomena from near equilibrium to far from equilibrium i.e., Linear and non-linear Steady States, Bifurcation and Bistability, temporal and spatio-temporal oscillations, Chaos and fractal growth. An overview of new mathematical techniques for investigating such phenomena has also been presented.

Further, application of concepts developed during investigation of such phenomena in physico-chemical systems to Real systems in Nature such as Living State, Social Dynamics and Finance has also been discussed in the book.

In addition a paper on “Causality Principle, Non-equilibrium Thermodynamics and Non-linear Science of Open Systems” has recently been communicated.

## Azacarbanions and Related Reactions

SV KESSAR, FNA

Activation of C-H bonds is an area of abiding interest. In this context we have promoted the concept of Lewis acid complexation for metalation of heteroatom substrates. In the present project. It has been shown that in Pyrrolidines and indolizidines different diastereoselectively can be introduced in BF<sub>3</sub> promoted lithiations under conditions of kinetic and thermodynamic control. High enantio-selectivity can be introduced by using external chiral ligands for lithium. DFT computations on idealized substrates are in conformity with the experimental results. Experimental and computational work on directed ortho metalations is being taken up.

## Photoregulation of Biomolecules Containing Isomerizable Structural Moieties

RP GANDHI, FNA

During the period under report, investigations were carried out in the following areas:

- Syntheses of numerous P-S modified stereo-enriched [Rp] and [Sp] oligonucleotides possessing azobenzene substituent at pre-selected positions in phosphate backbone were accomplished using a new protocol, and their photoresponse in terms of altered physico-chemical characteristics examined. It was observed that, in both the [Rp] and [Sp]



isomers, placement of the azobenzene substituent close to 5'- and 3'-termini of the modified P-S oligonucleotides imparts maximum stability to the duplex (formed with modified P-S oligonucleotides and unmodified complementary oligonucleotides), while a gradual decline in stability occurs when azobenzene moves towards the middle of the duplex. Again, the azobenzene molecule, in N=N E-configuration, lends greater stability to the oligonucleotide duplex with respect to azobenzene in Z-configuration. In all present observations, the [Rp] isomers recorded greater stabilization as compared to the corresponding [Sp] isomers, which has been rationalized. CD studies on the P-S modified duplexes revealed, *inter alia*, that the global conformation of the duplex is relatively insensitive to the stereochemistry of the P-S backbone.

- b) A number of photoresponsive azobenzene-grafted dextran conjugates with varying degree of azobenzene-to-polymer cross-links were developed as self-aggregated particles (nanogels), which form a potential system for drug delivery and controlled release of bioactives agents. In a detailed study of the unloaded and loaded nanogels, it was observed that the release pattern of the encapsulated molecules i.e. rhodamine, aspirin is regulated by hv-induced trans-cis isomerization of the azo-benzene molecule in the crosslinker; The rate of release is slower with azobenzene moiety in E-configuration as compared to the rate observed with Z-azobenzene. Again, the pattern of drug release involving azo-dextran nanogels, during photoisomerization, is seen to be affected by pH and salt concentration of the dispersed media.

This work was done in collaboration with the Bioorganic group at IIGB and during the year, two papers were published on the above theme (*Int. J. Pharmaceutics*, **342**, 184-193, 2007; *Bioorg. Med. Chemistry*, **15**, 7840-49, 2007) in co-authorship.

## Zinc Coated Urea

### RAJENDRA PRASAD, FNA

About 50% of the Indian soils are deficient in Zn and response to Zn fertilization has been reported for several crops all over the country. Zn deficiency could be partly responsible for declining crop responses to NPK fertilization in the country. However application of Zn to crops even when a soil is deficient in Zn is far from satisfactory, specially by small and marginal farmers who do not apply even adequate amounts of phosphate and potash needed for balanced fertilization. The main

reasons for this are high cost of Zn fertilizers, their quality and timely availability. It was therefore considered appropriate to develop urea coated with small amounts of Zn, so that the farmers are able to apply some Zn to the crops. Urea was coated with zinc sulphate heptahydrate (20% Zn) or zinc oxide (80%Zn) at 0.5, 1.0, 1.5 and 2.0% Zn using an emulsifier and neem oil in the laboratory and the response of rice to these materials was studied under field conditions at the Indian Agricultural Research Institute, New Delhi. Factory (Indo-Gulf Fertilizers) made zinc sulphate and zinc oxide coated urea was also tested in these experiments.

Rice grain and straw yields and Zn uptake by rice increased with the level of Zn coating and was the highest at 2.0% Zn coating of urea. In general, zinc sulphate coated urea was better than zinc oxide coated urea and it was also superior to soil application of zinc sulphate. However, the recovery of applied Zn decreased as the level of coating was increased. Thus a mid level of 1.0% Zn coating would be a better choice. Zinc is a costly plant nutrient and coating at the 2.0% level nearly doubles the cost as compared to uncoated urea and the farmers can not afford this price. Thus again a 1.0% Zn coating is a better choice. Further, from the viewpoint of coating technique ZnO is a better material, because it is required in much smaller amount than zinc sulphate for the same level of coating. Considering all aspects a 1.0% Zn coating of urea with zinc sulphate or zinc oxide appears to be the choice. Coming from urea manufacturers the guarantee of the product will be assured to the farmers. The Fertilizer Control Order should therefore fix price for 1.0% Zn coated urea in addition to the price fixed for the 2.0% coating as at present. It would be advisable to fix the price of even 0.5% Zn coated urea, which would be useful as a prophylactic measure against the development of Zn deficiency in soil.

## Salt Tolerance of Mangroves and Photosynthesis and Heat Resistance

### PRASANNA MOHANTY, FNA

Differential Strategies for Salt Tolerance in Mangroves; *Bruguieras*, the true tree mangrove species constitute an important component of the coastal mangrove forests. Of some six *Bruguiera* species *B. gymnorrhiza* (BG) is known to be most salt tolerant although no rigorous comparative study has been made. We thus made experiments with hydroponically maintained *B. parviflora* (BP) and BG to find out relative salt tolerance effect between the two species by exposing to high salt (500mM NaCl) shock (1,2,3). The plants were kept in high salt for 6 days and

then removed back to normal situation for one week for recovery. High salt induced changes on pigments, leaf proteins, root and stem anatomy and some physiological parameters as well as some selected enzymes were monitored (1,2). It was observed that BG accumulated salt in xylem tissues to get resistance to high salt, the salt accumulation induce apparent dry mass (2) SDS PAGE profile analysis revealed that the relative abundance of a cytosolic soluble leaf protein of apparent molecular mass 37 kD, changes by salt stresses in BG (3) while in BP it is a 23 kD protein in BP. As reported earlier. The pigment contents and pigment ratio change significantly by salt shock in BG suggesting severe alterations in light harvesting complexes (LHC) and consequently decreasing photosynthetic efficiency in BG by high salt, which recovered partly. The extent of recovery was more in BG than in BP (1,2).

### Photosynthesis

Fast Fluorescence induction kinetics of Pea (*Pisum*) mesophyll protoplasts:

At the University of Hyderabad, pea mesophyll protoplasts are effectively used to study interactions between mitochondria and chloroplasts and signal transduction pathways. Protoplasts possess all in vivo features of intact leaf. We applied the fast chlorophyll fluorescence (OJIP) kinetic analysis for pea mesophyll protoplasts to compare the relative physiological efficiency of intact leaves and protoplasts. Our analysis showed that protoplasts remarkably retain the features of intact leaf (4) and are ideal for early events of stress like drought, salinity heat and interactions between bioenergetic organelles. and also signal perceptions in plants.

\*At the University of Indore (DAVV) the enhancement of biomass, linked to carbon sequestration, by exclusion of UVb and UVa components from solar radiation in soybean (*Glycine max*). This enhancement in biomass was ascribed mostly due to hormonal type regulations besides possible increase in the enzyme Rubisco contents (5) This aspect is important for global warming and climate change and it is tempting to screen plants' biodiversity for high CO<sub>2</sub> utilization capacity by UVb and UVa components, besides identifying the nature of biochemical regulations in enhancing biomass.

### Heat Stress

Mechanism of heat stress tolerance in plants is varied and is complex. Following our elucidation of translational regulation in the repair of PSII reaction centers (RC) damage by high light, we examined if heat stress damage and repair follow similar analogous

damage-repair pathways. The heat stress damage is complex as oxidative stress play a huge role. The aggregations of damaged RC proteins aggregate rapidly and also the processing of precursors of RC proteins in the repair process is heat susceptible (6) and turning point between reversible and irreversible heat damage. We also reviewed the ability of glycinebetaine (GB) in providing protection against heat and light stress is unique (6).

### Other Activities

- Cochaired the Session on "Renewable Energy" at the 95<sup>th</sup> Indian Science Congress held on January 04, 2008 at Andhra University, Vishakhapatnam, AP.
- presented a talk on: "Perspectives on Bioenergy Production from green and blue bacteria (dedicated to the memory of late David Hall of Kings college, London).
- Discussion on micro and macro algal biomass production for bioenergy.
- Quality improvements in *Jatropha* by genetic and tissue culture means and feasibility of its cultivation in sodic and saline conditions with Prof RN Mishra, Cuttack).

### Publications

- AB Das, S Samal, L Mallick and P Mohanty 2008, Short term effect of addition of high NaCl to hydroponically maintained true tree mangrove *Bruguiera gymnorhiza*: changes in photosynthetic pigments, proteins, and some metabolic components in roots and stems and anatomical features of roots and stems (for *Ind. J. Exptl. Biology*, Being revised).
- S Samal, AB Das, B Behera, D Panda and P Mohanty, Comparative analysis of high salinity tolerance potentials on *Bruguiera gymnorhiza* & *Bruguiera parviflora*: its biochemical and anatomical changes (For *Brazilian J. Biology*, Asked for revision).
- Bishnupriya Behera, AB Das and P Mohanty, Changes in SDS-PAGE profiles of soluble thylakoids proteins by high salt treatment in hydroponically maintained *B. gymnorhiza* (*Plant Molecular Biology and Physiology*, to be submitted).
- B Sunil, K Riazunnisa, T Sai Krishna, Gert Schansker, Rerto J Strasser, Agepati S Raghavendra and Prasanna Mohanty 2008 Application of fast Chlorophyll a fluorescence transient (OJIP) analysis to monitor functional integrity of pea (*Pisum sativum*) mesophyll protoplast during isolation. *Ind. J. Biochem and Biophy.*
- K Guruprasad, S Bhattacharjee, S Kataria, S Yadav, A Tiwari, S Baroniya, A Rajiv, P Mohanty 2007 Growth enhancement of soybean (*Glycine max*) upon exclusion of UV-B and UV-B/A components of solar radiations: characterization of photosynthetic parameters in leaves. *Photosynthesis Research*, 94-299.
- Suleyman SA, V Kreslaske, P Mohanty, VV Klimov, D Los, and R Carpentier: 2008, Heat stress impairment and acclimation mechanisms: an Overview (*Photosynthesis Research*, in press).

## **Cryptococcus neoformans and C. gattii: A Study of their Environmental Prevalence, Mating-type Alleles and Antifungal Susceptibility**

HS RANDHAWA, FNA

The annual report for 2006-2007 dealt with the natural habitats of the two potentially fatal human pathogens, their environmental distribution, mating type alleles and antifungal susceptibility. Since then several new host tree species native to India have been identified. Genotyping revealed that all of the isolates of *C. neoformans*, serotype A, were VNI and those of *C. gattii*, serotype B, were VGII. The most virulent genotype of *C. gattii*, VGII, was not found among the strains isolated. Multilocus sequence typing was conducted using five gene fragments for 78 isolates of *C. neoformans* var *grubii*. Population genetic analysis identified no evidence for significant differentiation among populations belonging to either different geographic areas or different host tree species. Despite the absence of mating type a strains, there was unambiguous evidence for recombination in the strain populations investigated. The results are consistent with the hypothesis of long-distance dispersal and recombination in environmental populations of *C. neoformans* var *grubii* in India.

### **Publications**

- Randhawa HS, A Chowdhary, G Khanna, Comments on Singh et al's 'cryptococcosis in a bandicoot rat' (Letter to the Editor), *Med. Mycol.* **45**, 655-656 2007.
- Khan ZU, HS Randhawa, T Kowshik, A Chowdhary, R Chandy, Antifungal susceptibility of *Cryptococcus neoformans* and *Cryptococcus gattii* from decayed wood of trunk hollows of *Ficus religiosa* and *Syzygium cumini* trees in north-western India. *J Antimicrobiol Chemother.* **60**, 312-316, 2007.
- Diwakar A, RK Dewan, A Chowdhary, HS Randhawa, G Khanna, SN Gaur, Zygomycosis - A case report and overview of disease in India. *Mycoses* **50**, 207-254, 2007.
- Capoor RM, D Nair D, M Deb, V Ramesh, G Khanna, Rajini, P Aggarwal, R Chand, A Chowdhary, AY Mussa, HS Randhawa. Endemic occurrence of sporotrichosis in Uttaranchal, India-report of two autochthonous cases. *Indian J. Dermatol.* **50**, 4 (Suppl. II), S10-S13. 2007.

## **Studies of Interference in Communication System**

BN DAS, FNA

### **Objective**

The objective is to investigate the mechanism of cloud to ground lightning for modeling the return stroke current and hence to determine the radiated field from the Lightning discharge. The radiated field is further utilized for the estimation of the voltage induced on an overhead line due to the nearby lightning.

Lightning is considered to be the strongest natural source of electromagnetic interference on the ground so far and is a threat to human life, houses, historical monuments, electronic and electrical systems. Lightning discharges radiate the bulk of their electromagnetic energy in the very low frequency (VLF, 3-30 kHz) and extremely low frequency (ELF, 3-3000 Hz) ranges. Through a good will of research the scientific community has come to some conclusion about the cause of lightning and its hazards to system. Many researchers have proposed different numerical models to derive return stroke model, the features of over voltages produced by lightning, the over voltage effect on transmission line, over and underground cables and communication systems.

In the temporal characteristics of channel base current is shown which is based on the data given below:

Waveform 1	Current Rise	Time Constant	Fall Time Constant
$I_{01}(kA)$	$(\tau_{11})\mu s$	$(\tau_{12})\mu s$	n
10.7	0.25	2.5	2
Waveform 2	Current Rise	Time Constant	Fall Time Constant
$I_{02}(kA)$	$(\tau_{21})\mu s$	$(\tau_{22})\mu s$	n
6.5	2.1	230	2

This characteristic follows that the channel base current is exponentially decaying in nature with time.

## **Surfactant Behaviour in Solution**

SP MOULIK, FNA

The work done comprises the following:

- 1) Interfacial and bulk behaviours of pure and mixed surfactants in aqueous medium with octadecyltrimethylammonium bromide, sodium dodecylsulfate, sodium dodecylbenzenesulfonate, and alkyltrimethylphosphonium bromides. The Regular solution theories of Rubingh and Rubingh and Holland have been used for data correlation and explanation.
- 2) Interaction of sodium dodecylsulfate (SDS) with polyvinyl pyrrolidone (PVP) has been studied in aqueous and aquo-isopropanol (IP) media using the methods of tensiometry and calorimetry. The data have been analyzed in terms of an interaction model.
- 3) The clouding behaviour of PVP in aqueous solution in presence of different salts, and its solvation by



both water and IP, and interaction with SDS micelles have been investigated, and involved energetic parameters have been evaluated.

- 4) The physicochemical behaviours of goat lung surfactants at the air/water interface have been studied with the help of a Langmuir Monolayer Film Balance by measuring the surface pressure and morphology by epifluorescence microscopy.
- 5) The preparation of biocompatible microemulsions using plant oils, Tween 20 and water has been attempted and the formulations have been used for encapsulation of drugs (coartem, chlorambucil, etc) and their *in vivo* delivery.

### Publications

- Basu Ray G, I Chakraborty, S Ghosh, SP Moulik, *Colloid Polym. Sci.*, 2007, **285**, 457-469.
- D Mitra, I Chakraborty, SC Bhattacharya, SP Moulik, *Langmuir*, 2007, **13**, 3049-3061.
- Chakraborty T, I. Chakraborty, SP Moulik, S Ghosh, *J. Phys. Chem. B*, 2007, **111**, 2736-2746.
- Chakraborty I, SP Moulik, *J. Phys. Chem. B.*, 2007, **111**, 3658-3664.
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## Nitrogen Use and Environmental Concerns: Asia – A Region of Rapid Change

YP ABROL, FNA

To address issues related to environmental degradation in Asia and prepare a policy paper an analysis was done of the various issues involved. A recently published global assessment - Global Environment Outlook (GEO4) has a regional focus, including a section on Asia and Pacific nations. The assessment highlights both the rapid changes occurring in Asia, and the environmental responses to those changes. This section of the paper uses material from the report to set the stage for how these changes enhance the reach of Asia on the rest of the world.

Economic growth in Asia and the Pacific has increased by greater than 5% since 2002, fueled in large part by the large increase in energy use, which has increased by 88% over the period 1987 and 2004 in Asia and the Pacific compared to the global average of 36%. With the strong drive for food security, agricultural land use has expanded in all regions but Central Asia. As a consequence, land degradation is being reported throughout Asia, raising the question of sustainability.

The rapid increases in both energy and food production has resulted in significant impacts on human and ecosystem health.

- More than 1 billion people in Asian countries are exposed to outdoor air pollutant levels exceeding WHO guidelines causing premature death of about 0.5 billion people in Asia.
- Asia has the world's highest burden of disease attributable to indoor air pollution.
- Adequate water supply is the major challenge to all Asian and Pacific nations. The region has 32% of the world's freshwater resources but has 58% of the world's population. 18% of the population in Asian and Pacific nations lack access to safe water.
- Asia and the Pacific nations have 59% of the world's remaining mangrove forests; most have been extensively damaged by industrial and infrastructure development.
- Asia and the Pacific nations have about 206,000 km<sup>2</sup> of coral reefs - almost 3/4 of the world's total. About 60% of these reefs are estimated to be at risk due to mining, destructive fishing, and other threats.

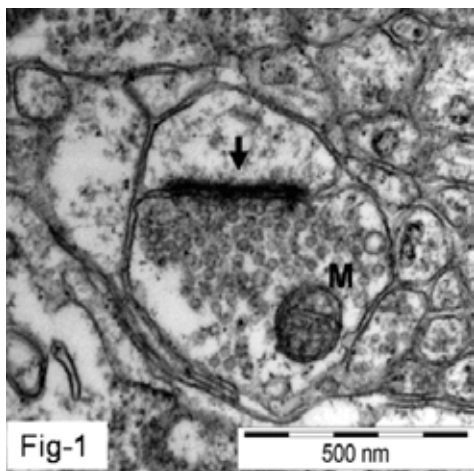
The findings of the above analysis are appearing in the forthcoming review journal: Annual review of Environment and Resources (USA). The article is co-authored by Abrol YP, VK Dadhwal and A. Vels Murugan along with scientists from *International Nitrogen Initiative(USA)* and China.

## Neuronal ageing: Role of Aluminium

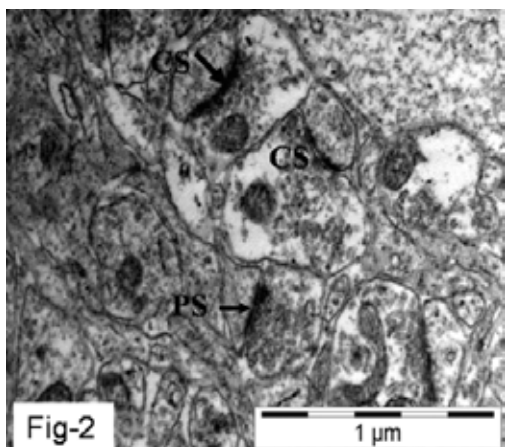
MAHDI HASAN, FNA

Accumulation of lipofuscin is a recognized hallmark of ageing. Atomic absorption spectrophotometry of this pigment shows presence of Fe, Al, Cu and Zn. The uptake of Al is greater, the older an animal becomes. Al administration increases Fe in rat frontal cortex. Higher rate of lipid peroxidation and decreased antioxidant levels were detected. Also, increased volume and altered ultrastructure of lipofuscin granules were discernible. Spongiform degeneration of lipofuscin often occurred

in Al toxicosis. Remarkably increased curvature and perforation of synaptic membrane were observed in Al toxicosis of aged rats. These findings support, to some extent, the hypothesis implicating Al with dementias of Alzheimer type.



**Fig.1:** Electron micrograph from neuropil of the frontal cortex of an old rat showing flat axodendritic synapses (arrow). A large number of round synaptic vesicles and mitochondrial profiles (M) are seen. Note the prominent postsynaptic density of the dendritic profile.



**Fig.2:** Electron micrograph of the neuropil from frontal cortex of Al intoxicated old rat brain. Thick arrow shows a curved (negative curvature) synapse. The axon (ax) shows a large number of synaptic vesicles and a mitochondrial profile. Flat perforated synapses are also seen in the lower left corner where as a curved perforated synapse is seen above.

## Chalcogenides and Related Materials

### ES RAJA GOPAL, FNA

Tin monosulphide has shown potential as a low cost eco-friendly material for solar photovoltaic cell applications, though the efficiencies are low at the moment. Micron thick films in the range from 0.1 μm to 1.25 μm were grown

by thermal co-evaporation on glass substrates, kept at 300° C. The optical and electrical data of the SnS films are well interpreted with the composition, crystal and surface structure data. Photo-luminescence studies were carried out at liquid helium temperatures on the (GeS<sub>2</sub>)<sub>80</sub>(GaS<sub>3</sub>)<sub>20</sub> glasses, doped with different amounts of Er and prepared by the Bulgarian coworkers. The present Er<sup>3+</sup> doped Ge-S-Ga glasses possess PL life time values of about 3.25ms. Work is also continuing on the development of polymer based electro-chromic devices based on PRODOT material prepared by the IIT Bombay colleagues. Mono, di allyl and di naphthyl substituted materials were synthesised and polymerized electrochemically. All the monomers were characterised for their molecular structure and the polymers were characterised for their electrochromic properties. Efforts are under way to prepare an all-polymer electrochromic device.

## Science Education and Enlightenment

### HY MOHAN RAM, FNA

Drafts of textual material on the CD's prepared during 2006-2007 have been updated with additional information gathered from various sources and visuals photographed using a Nikon digital camera from Maharashtra, Himachal Pradesh, Meghalaya and Kerala. CD's on lotus, water chestnut (*Trapa*), sola (*Aeschynomene*) and Makhana (*Euryale ferox*) are nearly completed except for a few visuals which will be taken in the coming two months by visiting West Bengal, Meghalaya and Manipur. Some gaps need to be filled on the CD's on coconut, which will be completed in July, 2008.

The list of scientists whose short biographies are to be prepared have been short-listed after consultation with a few past Presidents and Senior Fellows and retelling their stories from the available biographical memoirs and other sources has been started.

## Studies on non-linear waves, heat and mass transfer in boundary layer flows and stability of viscous flows (SNW)

### AS GUPTA, FNA

An analysis is made of the steady shear flow of an incompressible viscous fluid past a uniformly rotating infinite porous flat plate subjected to uniform suction or blowing. Inside the boundary layer, the pressure gradient dominates the momentum transfer of the outer shear flow. Hence the shear induced component of the free stream shear flow inside the boundary layer is less than its viscous value. This results in flow reversal in the absence of suction. It is observed that the zone of

reverse flow becomes smaller and smaller with an increase in suction and when suction parameter exceeds a vertical value, no reverse flow occurs at all. The axial velocity toward the plate increases with an increase in suction but decreases with increase in flowing. It is found that a torque is exerted in a direction opposite to the direction of rotation of the plate and the magnitude of the torque is an increasing function of suction. Further the torque is not influenced by the shear in the external flow. The drag on the plate in the direction of the free stream shear flow is always positive when the suction at the plate exceeds a certain critical value. However in the case of blowing at the plate, this drag may be opposite to the direction of external flow for sufficiently high shear. (Published in *Physics of Fluids (USA)*, Vol. 19 073601, 2007).

## Fifty Years of Plant Science – from Botany to Plant Biology

SC MAHESHWARI, FNA

As per plan proposed while submitting the report for the earlier year, it was intended that a shorter review of *Fifty Years of Plant Science* which was already in its final stage would be published. However, as final touches were being given, major new ideas were evolving in certain areas with deep impact in the entire field of molecular and developmental Plant Biology. It was felt that, even if the objective of the original work plan was a *history* of our discipline, this account must incorporate any new development (affecting our basic concepts). During the year in review, therefore substantial change had to be made in the programme which I felt was at the same time *necessary* to attain the original objectives of a proper survey of all important researches.

The new area in question is that of a *new* Chromatin Biology, embracing many sub-areas or topics centering round the Polycomb Group of genes and proteins and unfolding a totally new view of "Heterochromatin", which has had a long history, having been discovered and distinguished from euchromatin by a German botanist, Emil Heitz as long ago as 1929. Despite this distinction of active and inactive areas in chromosomes, little was known about the significance of such cytological demarcation. By and large the prevalent view was that heterochromatin was useless or unimportant. This view was however challenged by the work of many scientists including the work of Sarah Elgin, a former colleague at Harvard in 1970s, and others. Work in the last decade, shows that transitions between the two states are not only possible but essential of development. Following new investigations with the recombinant

DNA methodology, the Polycomb Group genes, originally discovered in *Drosophila*, were found to be universally present in mammals in the nineties. About 10 years ago, the first Polycomb type gene was also found in plants.

The year's main work was therefore to delve into the *Drosophila* literature, as also that the investigations of Polycomb type genes in mammals, and to trace the new developments in plants from the various laboratories. Polycomb Group genes, work largely by binding to promoters of homeotic genes: however, do not have much ability to recognize DNA sequences. And following the work of Shiv Grewal and others on the fungus, *Schizosachharomyces pombe*, much evidence has come for a unique small RNA species which may be involved in targeting Polycomb Group Protein also in plants. Therefore not only a survey of the literature was completed on these aspects for incorporating in the main body of the history, but the survey was extended to reports of small RNA in plant kingdom. In the next and final year, it is proposed to bring out an integrated account of developments in the entire area of experimental Plant Biology.

## Interval Mapping of a Disease Gene Using TDT

PREM NARAIN, FNA

A general theory of the Transmission Disequilibrium Test for two linked flanking marker loci used in interval mapping of a disease gene with an arbitrary mode of inheritance based on the genotypic relative risk model was developed. The expectations of all the cells in a contingency table possible with four marker haplotypes (transmitted vs. not transmitted) were derived and chi-square tests were proposed for the null hypothesis of no linkage between the markers and the disease gene. The power of the tests was discussed in terms of the corresponding non-centrality parameters and sample sizes required for 80 % power at the significance level of 0.05 were computed. It was found that the results depend on, in addition to the marker gene frequencies, recombination probabilities, various association parameters etc., a composite parameter involving the genotypic relative risk of the homozygous disease genotype and the disease gene frequency instead of its constituents individually. The power increases with the decrease in the recombination probability in general but their magnitudes differ across the modes of inheritance. Additive and multiplicative modes of inheritance, in general, are found to give almost similar sample sizes. The sample sizes are found to be higher when the marker haplotype is not at the disease susceptibility locus than



when the markers are at it indicating loss of power of the tests in the former case. But these are lower than the sample sizes required in the single marker case, thereby showing the superiority of the strategy in adopting the two marker loci for transmission disequilibrium test. The computations for sample sizes required for 80% power at the significance level of  $5 \times 10^{-8}$  used in TDT for fine mapping and genome-wide association studies indicated that the sample sizes needed could be several times larger than those for the traditional significance level of 0.05.

## Cellular and Molecular Mechanism of Emphysema

IB CHATTERJEE, FNA

Emphysematous lung damage is a prominent component of cigarette smoke (CS)-induced Chronic Obstructive Pulmonary Disease (COPD), which is a major and growing cause of morbidity and mortality worldwide. However, the cellular and molecular mechanisms of emphysema are not clear. Moreover, there is no effective cure for emphysema. We had hypothesized that the sequence of pathophysiological events leading to CS-induced lung injury might be oxidative protein damage, followed by inflammation and apoptosis. So we considered that once protein oxidation was prevented, the subsequent events of apoptosis and lung damage might also be prevented. Vitamin C is the most common nontoxic essential dietary antioxidant. We demonstrate that exposure of guinea pigs to CS for 21 days results in progressive protein damage, apoptosis and lung injury and that administration of a moderately large dose of vitamin C almost completely prevents apoptosis and the lung damage.

## Health Care & Research Association for Adolescents

KN AGARWAL, FNA

1. The National Growth charts were printed and made available for common use. Also article written in magazine-"Growth charts and relevance for the population". These charts are available on Internet.
2. A book on "Nutrition in Medical practice" is in press.
3. A conference "Nutrition in Growth & Development" was organised and held in the INSA auditorium on 13th April 2008. Besides national faculty we had speakers from Nepal and Bangla Desh also.
4. Lectures delivered-i) North-East - Shillong and Gauhati; ii) Orissa-Sambalpur and Bhubneshwar iii) Uttar Pradesh-Agra and Varanasi. Total 10 lectures.

5. International Conference "Emerging Societies-Coexistence of Childhood Malnutrition and Obesity"- 30th March to April at Delhi. Moderated a session on "Epidemiology of the Nutrition Transition".
6. Research on Indian dahi is continuing in the University College Medical Sciences & GTB Hospital in collaboration with National Institute Biologicals, Sector 62, NOIDA and Mother Dairy Patparganj, Delhi.

One article has been submitted to the Indian Journal Medical Research for publication.

## Brain Neuropeptide- Comparative Study of their Role in the Gonadotropin Release

RN SAXENA, FNA

The project deals with the effect of three major neuropeptides *viz.* beta-endorphin, galanin and neuropeptide Y in the pituitary LH release and steroidogenesis in male rats. During the first year (report period) the work was started with beta-endorphin for its role in pituitary LH release and hypothalamic LHRH along with its receptor blocker the naloxone. Both *in vivo* and *in vitro* studies were conducted.

*In vivo:* Beta-endorphin or naloxone was subcutaneously administered in the adult male rats. After 1 hr. of administration the plasma LH (RIA) significantly decreased in beta-endorphin injected where as it increased in case of rats receiving naloxone. No change in the hypothalamic LHRH was seen after any of the treatments. This shows the beta-endorphin suppressed pituitary LH release by decrease in the endogenous LHRH action and thus acted as an antagonotropic factor. The antagonotropic property of beta-endorphin could be by virtue of its behaving as a competitor to LHRH for binding to gonadotroph receptors. However, its receptor blocker, the naloxone promoted higher LH release possibly by blocking the binding of endogenous beta-endorphin and hence making the hypothalamic LHRH more effective in binding. Absence of any change in hypothalamic LHRH following subcutaneous injections of either beta-endorphin or naloxone rules out their action via hypothalamus.

*In vitro:* Isolated pituitary gonadotrophs were incubated with LHRH either alone or along with beta-endorphin or naloxone. After 3 hrs. of incubation (in suitable medium at 37°C under 95% O<sub>2</sub> and 5% CO<sub>2</sub>) the LH release was significantly low in presence of beta-endorphin as compared to control (LHRH alone) while

in presence of naloxone LH level was almost same as in the control. This could be possible only when the peptide beta-endorphins either reduces the binding potency or LHRH receptors in the gonadotrophs or acts as a competitor to LHRH and occupy large percentage of binding sites. However, the naloxone in absence of LHRH has no effect on LH release by isolated pituitary cells. This initial study gives a positive indication of the antigonadotropic nature of the beta-endorphin. More extensive studies at the molecular level are underway.

### Optical Mineralogy: Concepts & Methods

RS SHARMA, FNA

This is a book-writing project titled, Optical Mineralogy: concepts and methods. The book covers both theory and practice of optical mineralogy and is meant for the graduate, post-graduate and research students in Earth Sciences, who can independently carry out thin-section studies of rocks and minerals under the Polarizing microscope. Out of 11 Chapters, six have been completed which give basic principles of optical mineralogy. The text is profusely illustrated, mostly with 3-D figures. All diagrams with third dimension are in clinographic projection - a type of projection that is familiar to the crystallographer. Five more chapters will be written in the next phase of the work.

Additionally, R.S. Sharma has also published 3 research papers in International and National Journals and delivered three invited talks during Project period 2007-08.

### Publications

Metamorphic Petrology and Supporting disciplines: Progressive path with time. *In* Proceeding Volume of National Seminar on Emerging Trends of Research in Geology with Special Reference to Northwestern India, PC Avadich and H Bhu (Eds.), Udaipur, 2007, pp.81-88.

Tracking Himalayan rocks in subduction-Collision Zones and their Exhumation: A Paradigm for UHP Crustal Rocks sans Lower Crust, *Himalayan Geology*, 2007, **28(3)**, pp39-41.

Evolution of the Central Indian Fold Belts: A Geodynamic Model. *Indian Assoc. Gondwana Res.*, 2007, Mem, 10, pp 41-54.

### Invited Talks during 2008.

#### I. Metamorphic Petrology: Recent Advances and Future Trends in the Indian Context

To be delivered at (i) CESS, Trivandrum on 18 Sept., 2008 and (ii) at IISC, Bangalore on 12 October, 2008, under the aegis of the Golden Jubilee Celebrations of the Geological Society of India

#### II Geohistory of Tso-Morari Crystallines, Eastern Ladakh, India: A Plausible

Model for UHP rocks. To be delivered in 23 Himalayan\_Karakoram-Tibet Workshop at Leh from 7 to 10 August, 2008.

### Socio-Ecological System Approaches for Sustainable Management of Natural Resources with Sustainable Development

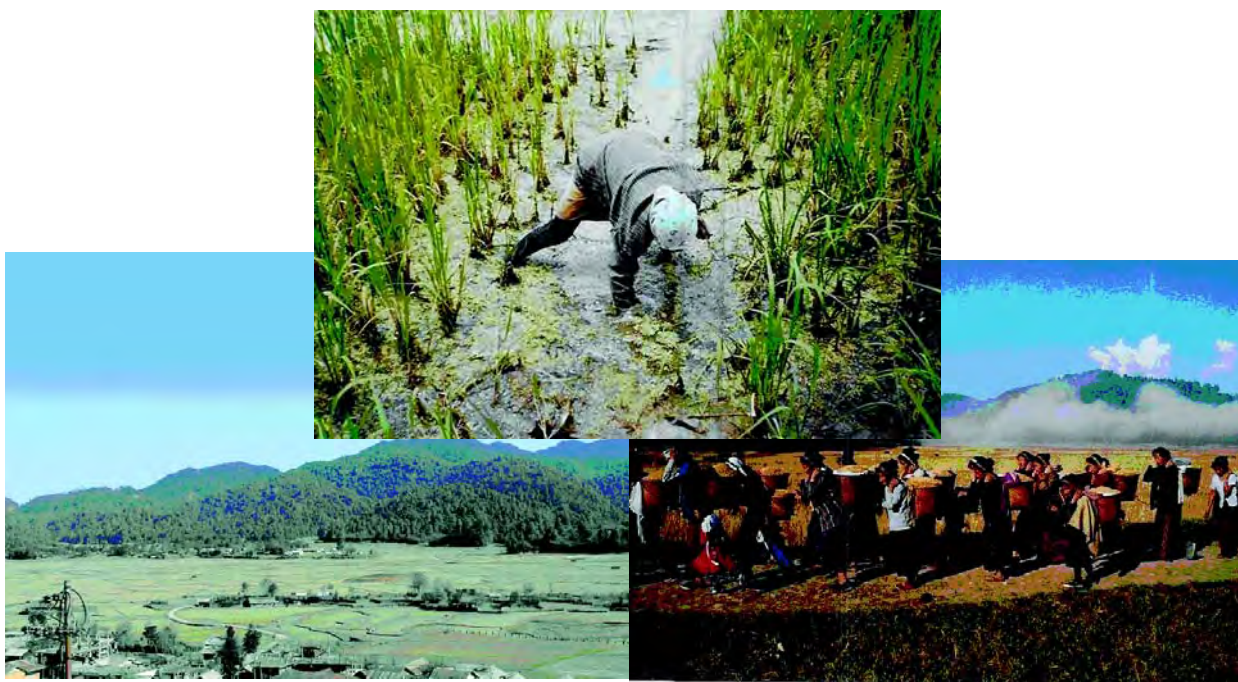
PS RAMAKRISHNAN, FNA

On the basis of extensive researches done over the past about 40 years of interdisciplinary researches done on socio-ecological systems analysis designed to link ecological conservation with sustainable livelihood/development of rural communities in general and traditional mountain societies in particular, natural cultural landscapes were identified as the window to address long-term sustainability concerns. In this context, based on over 400 research articles and 23 research volumes, efforts are currently being made to develop strategies for sustainable conservation linked sustainable development of the Arunachal Pradesh region in the north-eastern India through a major project initiative funded by the McArthur Foundation, and involving 5 research institutions and a network of about 35 scientists. The two chosen mega-cultural landscape areas are: that centered around the Apatani valley and the surrounding hill areas inhabited by many tribes on the eastern side; and the West Kameng and Tawang regional cultural landscape on the western region of Arunachal Pradesh. Work already initiated over the last six months is directed towards conservation linked sustainable development of these two regions. Study sites were chosen to cover a whole range of land use practices available in the region:

i) On the eastern front these exist land use systems ranging from a variety of traditional shifting agricultural practices, and equally diverse sedentary wet rice cultivation systems (with a unique one that the Apatanis have which is as productive as modern 'green revolution' but extremely energy use efficient, with an efficiency ratio of over 50 units per unit input obtained through traditional technologies linked with natural resource management and recycling, compared to that for modern agriculture 'green revolution' agriculture which is energy inefficient, with 0.5 units output per unit energy input. This apart, Apatanis have many lessons to offer in the area of sustainable forestry practices too (Fig. 1).

ii) On the western front there is a gradual transition from shifting agriculture based land use systems to nomadic rotational grazing practices for livelihood.

The ultimate objectives in all these efforts is to have policy documents (2) and audio-visual documentaries



**Plate 1:** Apatani cultural landscape, a part of the larger mega-landscape in the eastern region of Arunachal Pradesh, with its unique wet rice cultivation and linked community forestry systems in the background. Inset: women, the custodians of traditional ecological knowledge and linked cultural heritage traditions, involved with rice planting and harvest

(2), apart from research publications, all geared to conservation linked to conservation these mega-cultural landscapes (possibly also getting recognition for them as 'world heritage sites' of UNESCO and/or as 'globally important ingenious agricultural heritage systems' (GIAHS) of FAO. Such an effort towards global heritage status is already on in the context of the larger Apatani centred mega-cultural landscape involving all the other surrounding hill tribes in the region.

### Impact of Science on Society

**P KRISHNA, FNA**

The knowledge of Science is increasing exponentially with time. It is said that the total knowledge as measured by the number of publications, doubles every six years or so. This knowledge has brought tremendous power and ability in the hands of human beings. To ensure that this knowledge and power are used constructively and not destructively requires great wisdom and goodness but human society has not progressed in this direction.

Though science itself is value - neutral, the way science is done has many values which society can learn and apply also in areas other than science. The attached paper analyses how the scientific spirit can be applied also to the human quest for wisdom. It is concluded that education must not only develop and expand the knowledge of science but also inculcate in students the

scientific spirit. It has valuable application not only for doing science but also for solving social and religious problems of society.

### Development and Use of Molecular Markers for Plant Breeding

**PK GUPTA, FNA**

Professor PK Gupta, in the first year of his tenure as INSA Honorary Scientist, continued to supervise eight research scholars for PhD/post-doctoral research and was a Co-PI (with Professor HS Balyan as PI) for four R & D research projects funded by DBT; DST. This allowed him to continue working in a team for developing and using molecular markers for wheat and jute breeding, which included the following: (i) enrichment of molecular maps for three intervarietal wheat mapping populations; (ii) QTL analysis in wheat for a number of traits; (iii) use of molecular markers for enhancing grain protein content, pre-harvest sprouting tolerance and resistance against leaf rust in 10 elite Indian wheat cultivars; and (iv) development of >500 SSR and >1000 AFLP markers in jute. As a result, he authored/co-authored at least 10 research papers, besides editing two Special Issues of journals (one on 'Epigenetics' for PNAS, India; and the other on 'Plant Genomics' for *International J. Plant Genomics*).



## Neutrals in the Solar Atmosphere

SM CHITRE, FNA

Professor Chitre has been largely addressing the problem of the role of neutral particles dominating the mass density in the solar atmosphere which is made up of protons, electrons and the neutral hydrogen atoms, with a view to examine the effects of Hall & Ambipolar diffusion processes in the chromosphere/corona. These lead to the formation of magnetic field configurations with steep gradients and provide ideal sites for current sheets and the consequent dissipation of magnetic energy. With the accumulation of helioseismic data over the solar cycle 23, it is now possible to study the temporal variations of the rotation rate and its gradients as the activity cycle progresses. This has implications for the underlying mechanism driving the sunspot cycle. The results were presented at an International Conference held at the Institute of Astronomy, Cambridge. He has also been involved during this period in setting up the academic structure of the Centre of Excellence in Basic Sciences on the campus of the University of Mumbai.

## Complex non-equilibrium Phenomena and non-linear Science

RG RASTOGI, FNA

Professor Rastogi's main program has been to understand the Global morphology of the Equatorial Electrojet with respect to anomalies of background magnetic field components (1) due to solar electromagnetic emissions (2) due to the solar magnetic plasma eruptions (3) due to the various magnetospheric processes and general Space Weather Relationship. It has been found that the equatorial electrojet current in the anomalously high Declination region in Brazil flows in the direction normal to the magnetic rather than the

geographic meridian. A diagram showing the direction of the total H vector at different Brazilian stations from a paper under publication in Earth Planets Space is included here.

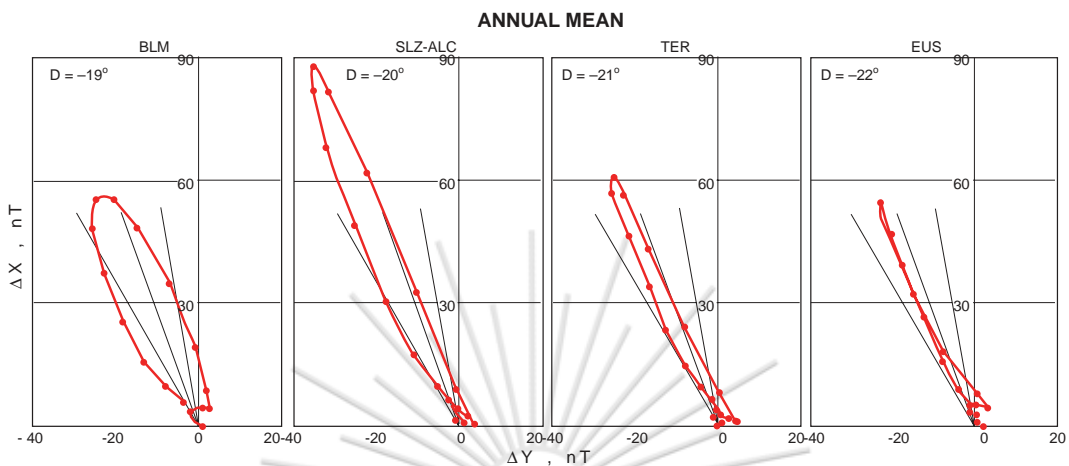
## YOUNG SCIENTISTS

### Comparative Study of Regulations of Nitrogen and Sulphur Metabolism in Rapeseed, Groundnut and Wheat

ALTAF AHMAD

Lecturer, Department of Botany, Faculty of Science, Jamia Hamdard, New Delhi

The objective of this study is to trace out the regulatory mechanism associated with the nitrogen and sulphur uptake and assimilation in rapeseed, groundnut and wheat to draw firm conclusions on the significance of signal molecules and enzymes of the assimilatory pathways of nitrate and sulphate in the whole plant since the current knowledge is fragmentary. Nitrate and sulphate uptake rates were studied at different nitrate and sulphate concentrations in S-starved seedlings of rapeseed, wheat and groundnut. Interestingly, it has been reported that sulphate uptake rate was 2-3 times higher in the S-starved plants compared to control plants. Nitrate uptake rate reduced to 30-55% in S-starved plants when compared to control. Restoration of sulphur supply to S starved plants resulted in restoration of nitrate and sulphate uptake rates of the plant species to normal levels i.e. as that control plants. For investigating the N and S assimilatory pathways under S-deficient conditions, wheat (*Triticum aestivum* L.) seedlings were grown for 30 days in Hoagland solution minus  $\text{SO}_4^{2-}$ . There was a decline in leaf blade nitrate reductase (NR) activity in S-deprived seedlings compared to normal seedlings. In vitro NR activity in fifteen-day-old



seedlings was diminished by 50% compared to normal seedlings. There was only 16% and 11% reduction in the activity of glutamine synthetase (GS) and NAD-glutamate dehydrogenase (GDH). NADP-glutamate dehydrogenase activity and leaf blade fresh weight were not altered by S deprivation. GOGAT activity was not affected by S-deprivation. A significantly higher concentration of  $\text{NO}_3\text{-N}$  was observed for leaf blade and stem (culms and leaf sheaths) fractions (59 and 35%, respectively) in S-deprived plants. Restoration of S supply restored the NR activity in S-deprived seedlings to normal. Similarly, nitrate deprivation affected the activity of APS reductase enzyme of S-assimilatory pathway more severely than the other enzymes.

### Wave Reflection Studies in various Anisotropic Thermoelastic Models with Additional Earth Parameters

**BALJEET SINGH GILL**

*Lecturer, Government College, Sector 11, Chandigarh*

Wave reflection study in anisotropic thermoelastic solid half-space with various Earth parameters" is aimed to study various models of Earth for wave propagation after considering various parameters e.g. microrotation, anisotropy, circular cracks, voids, pores, viscosity, initial stresses, thermal disturbances etc. present in the Earth's Crust. Some of the problems on wave propagation in such models are studied during last two years. For example, a generalized thermoelastic solid half-space with voids is considered for wave propagation study and presence of voids in such model affects the reflection process considerably. A model of a micropolar thermoelastic medium without energy dissipation is also studied and the existence of four plane waves are shown for two-dimensional model. The presence of thermal disturbances affects reflection coefficients as well as the energy ratios of various reflected waves for a particular incident plane wave. An effect of anisotropy on reflection coefficients of plane waves in fibre-reinforced thermoelastic solid is also studied. Various other problems involving different parameters are also studied. For studies on wave propagation in solids, the various parameters present in the Earth's crust must be considered to get more accurate information beneath the Earth's surface.

### Publications

Wave propagation in a generalized thermoelastic material with voids, *Applied Mathematics and Computation*, **189** (2007) 698-709.

Propagation of thermoelastic waves at liquid-solid interface in the presence of circular cracks, *Int. Journal of Applied Mechanics and Engineering*, **12** (2007) 799-811.

Effects of anisotropy on reflection coefficients of plane waves in fibre-reinforced thermoelastic solid, *International journal of Mechanics & Solids.*, **2** (2007) 47-57.

Reflection coefficients and energy ratios in a micropolar thermoelastic medium without energy dissipation, *ANZIAM, Journal*, **48** (2007) 433-447.

### Role of the Transcription Factor Foxa-23, in the Manifestation of Insulin Resistance in the Hepatocytes by TNF- $\alpha$ and its Implications

**MALABIKA DATTA**

*Scientist, Institute of Genomics and Integrative Biology, Mall Road, Delhi*

Type 2 diabetes is the predominant form of diabetes world wide accounting for almost 90% of the cases globally and an epidemic of type 2 diabetes is underway in both developing and developed countries. Type 2 diabetes is characterised by target tissue (adipose, liver and skeletal muscle) resistance to insulin that cannot be overcome by  $\beta$ -cell hypersecretion. The liver plays a significant role in glucose homeostasis as it can alternate between cycles of hepatic glucose output as is observed during fasting and also inhibit it in a well fed state. These are primarily governed by the forkhead family of transcription factors within the liver. The proinflammatory cytokine, TNF  $\alpha$  plays a significant role in the mediation of insulin resistance by inhibiting insulin signaling and is strongly associated with obesity and diabetes. Considering these, this project was aimed at studying the effect(s) of TNF $\alpha$  on the phosphorylation and nuclear translocation of Foxa2 and the subsequent effects on gluconeogenesis and hepatic glucose output. Results till now have shown that in HepG2 cells insulin incubation (50nM, 20 min) rapidly induced Foxa2 nuclear extrusion and most of it was localized in the cytosol. This was due to phosphorylation and inactivation of Foxa2 by p-Akt that was initiated by insulin. Pretreatment with TNF $\alpha$  prior to insulin treatment, increased Foxa2 localization in the nucleus predominantly presumably because its phosphorylation by activated Akt was withdrawn (Fig. 1). Since it is a major transcription factor regulating gluconeogenic enzymes, the resulting effect(s) of Foxa2 (being in the nucleus) on the status of gluconeogenic enzymes and hepatic glucose is therefore worthy of investigation. As compared to control, incubation of HepG2 cells with insulin caused a significant inhibition of the gluconeogenic enzymes, PEPCK and G6Pase gene expression. However when the cells were subjected to TNF $\alpha$  pretreatment prior to insulin incubation, the inhibitory effect of insulin on the levels of PEPCK and G6Pase was not observed (Fig. 2).

This indicates that in the presence of TNF $\alpha$ , HepG2 cells do not respond to insulin and exhibit elevated levels of PEPCK and G6Pase transcripts as compared to the cells incubated in the presence of insulin alone. Also, incubation of HepG2 cells with 50nM insulin for 24h showed an almost three fold inhibition of glucose release as compared to control cells. However, when the cells were treated with TNF $\alpha$  (1nM) for 24h prior to insulin incubation, the inhibition of hepatic glucose output that was observed in the presence of insulin alone was significantly waived i.e. in the presence of TNF $\alpha$ , the extent of inhibition of hepatic glucose output by insulin was markedly narrowed down. Overall results indicate that TNF $\alpha$  partially blunts insulin mediated inhibition of gluconeogenesis and hepatic glucose output and since Foxa2 was also found to be located majority in the nucleus in the presence of TNF $\alpha$ , it may have  $\alpha$  in modulation of gluconeogenesis; this remains to be investigated.

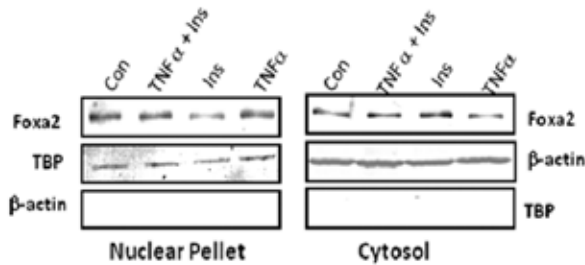


Fig. 1: Status of Foxa2 in the nucleus and cytosol

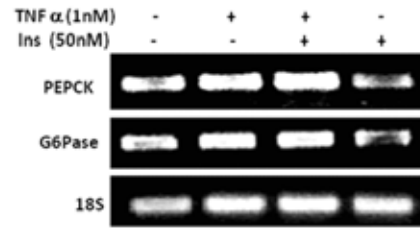


Fig. 2: PEPCK and G6Pase Transcript levels of HepG2 cells under the conditions mentioned in the presence and absence of insulin and TNF $\alpha$ .

## Effects of Germination on the Nutraceutical Value and Acceptability of Brown Rice

HARDEEP SINGH GUJRAL

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Two paddy cultivars short (ir-8) and medium (pr-106) were dehusked using mcgill rice sheller to produce brown rice. The brown rice was steeped in water for 24 h and then allowed to germinate in a seed germinator at 25°C for 12, 24, 36 and 48 hours. The germinated brown rice was immediately dried in a drier at 60°C to moisture content of 12%. The brown rice was analyzed for cooking behaviour and pasting properties. Brown rice from both ir-8 and pr-106 showed a reduction in the cooking time with increasing germination (Table 1). The elongation and width expansion (%) of the cooked germinated brown rice increased in both the cultivars with increasing germination time. The solids loss (%) due to leaching of

Table 1: Effects of germination time on the cooking characteristics of brown rice.

Cooking characteristics	Ir-8					Pr-106				
	Control	12h	24h	36h	48h	Control	12h	24h	36h	48h
Cooking time (min)	32	21	18	15	13	32	24	25	21	16
Elongation (%)	21.31±0.74	23.66±1.61	23.68±0.5	25.21±0.93	25.2±1.66	27.04±1.01	29.46±0.93	29.92±0.06	30.75±0.16	31.55±0.26
Width expansion (%)	66.42±2.42	71.15±1.61	91.12±0.5	82.06±0.93	98.76±1.66	35.99±0.28	44.48±0.96	48.56±1.86	48.35±0.63	52.31±1.02
Solids loss (%)	3.0±0	3.25±0.25	3.75±0.25	4.5±0	4.75±.25	2.8±0.15	3.7±0.2	3.7±0.25	4.3±0.2	5.1±0.2

± is standard deviation

Table 2: Effects of germination time on the pasting characteristics of brown rice.

Pasting characteristics	Ir-8					Pr-106				
	Control	12h	24h	36h	48h	Control	12h	24h	36h	48h
Peak viscosity (cp)	3199±19	3188±16	2321±116	924±26	201±26	1956±32	1619±4.5	1680±2.5	632±5.5	374±38.4
Breakdown (cp)	433.5±33.5	662±21	444.5±2.5	466±8	197.5±5.5	44±1	110±3	152±34	67±3	200±5
Final viscosity (cp)	8031±3	6487±58	4756±148	1419±6	71±34	4990±132	4572±102	4397±8	2157±27	580±46
Setback (cp)	5265±55	3961±21	2880±30	961±25	68±3	3070±99	3072±97	3864±16	1600±29	421±14
Peak time (min)	5.73±0.13	5.63±0.04	5.53±0	4.97±0.03	4.33±0	6.93±0	5.8±0.1	5.76±0.03	5.47±0.04	4.9±0.03
Pasting temperature (°C)	84.25±0.35	80.68±0.03	80.23±0.38	78.6±0.4	95±0	88±0.05	87±0.8	86.8±0.4	88.9±0.4	89.2±0.4

± is standard deviation



the solids in the cooking water increased with increase in the extent of germination. The pasting behaviour of the germinated brown rice flour was studied using a rapid visco analyzer. The peak and final viscosity of the cooked rice slurry decreased with the increase in the extent of germination (Table 2). The changes in the pasting

behaviour are attributed to the modification of the endosperm brought about by the enzymes produced during the germination process. The enzymes hydrolyze the starch into smaller fractions thus lowering the hot and cold paste viscosity of the germinated brown rice flour slurry.

## ANNEXURE - IV

### HIGHLIGHTS OF THE RESEARCH CARRIED OUT UNDER HISTORY OF SCIENCE PROGRAMME

#### Documentation and Study of the Archaeometallurgical Ethnometallurgical Evidence in Uttaranchal with Special Reference to Iron and Copper

DP AGRAWAL

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Uttarakhand in the Central Himalayas presents a very interesting case for studying the non-literate traditional knowledge systems, including archaeometallurgy.

The term *Traditional Knowledge System* was coined by anthropologists to denote a scientific system which had its own validity, in contradiction to Western science. United Nations University proposal defines Traditional Knowledge Systems as follows: *Traditional knowledge or local knowledge* is a record of human achievement in comprehending the complexities of life and survival in often unfriendly environment. *Traditional knowledge, which may be technical, social, organisational, or cultural and was obtained as part of the great human experiment of survival and development.*

#### Uttarakhand

For quite some time Uttarakhand was considered a backwater almost like a cul-de-sac, with no interaction with the Ganga valley. Our recent work has shown that despite the mountain barriers there has been a constant interaction between the two regions. In this report we propose to discuss two main areas of interaction, namely metallurgy and medicine. The Gangetic urbanization required iron and copper for its budding urbanization since it did not have the required mineral resources in its alluvium, it had to depend upon the central Himalayas. The latter region was replete with ferrous and non-ferrous mineral resources. From Pithoragarh region Copper Hoard type of artifacts have been reported which take back the antiquity of copper in Uttarakhand to the II-millennium BCE. For iron metallurgy there is very extensive evidence: there are large number of ancient workings and large slag deposits scattered over the whole region. One of the old iron

workings at Uleni, near Dwarahat, has given a date of c. 100BCE.

It appears that iron technology originated independently in this region, as perhaps in some other sites of the foothills. For warfare, clearance of forests and agricultural implements to tackle the hard kankar soil of the Doab, they required hard steel. As suggested by Balasubramaniam, there is a correlation between urbanization and technology of carburization in the Ganga valley. Perhaps Uttarakhand was supplying iron to the emerging fowns of the Ganga valley where experiments on ceramic technology were taking place in the middle of the I millennium BCE. In this environment of scientific experimentation emerged the steel making, which essentially seems to be an elite technology. Iron was known from the last centuries of the II millennium as evidenced at Lahur deva, Malhar, Jhusi and such sites in UP, but it was neither on a large scale, nor a production of steel. Despite several hundred years of iron technology it did not make any impact on society leading it to the creation of big towns.

The habitation in Uttarakhand probably goes back to the middle Paleolithic times. The close interaction of the people with the environment led to a deeper knowledge of animals, minerals and plants. The flora and fauna not only provided them adequate subsistence but also acquainted them with the medicinal and other properties of minerals, plants and animals. There are two thousand medicinal plants known to the local Himalayan Medicine System. Obviously, it was not a unified and systematized medicinal system but comprised local and regional oral medicinal knowledge. It is interesting to note that more than six hundred Himalayan medicinal herbs have become part and parcel of the materia medica of the Ayurveda.

Thus we see that Uttarakhand was supplying both copper, iron artifacts and ingots, as also medicines from this region. Both the iron technology and the medicine systems helped the urbanization processes and the accompanying scientific enrichment of the Ganga Valley.

## History of Development and Progress in Cancer Research & Control in Post Independent India: Focuses on Two Pioneering Institutions

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The first three major cancer centres of the country viz. Tata Memorial Centre, Mumbai, Chittaranjan National Cancer Institute, Kolkata and Cancer Institute (WIA), Chennai, provided the lead for formulation of the National Cancer Control Programme of India and development of the National Cancer Registries. In an endeavour to understand their role in different fields of cancer treatment, research and prevention the historical background of the foundation, evolution and growth of these three pioneering cancer institutes of India were traced since their inception. This presentation will focus on the Cancer Institute (WIA), an autonomous charitable organization, registered under the Societies Registration Act of 1860. The institute comprises of a cancer hospital, a research centre, the Dr. Muthulakshmi College of Oncological Sciences and the Centre for Preventive Oncology. The institute is recognized by the Government of India as a Regional Cancer Centre (RCC) for Southern India. Foundation of many of the cancer centres around the world may be traced to a background of a cancer related personal experience of grief and agony. The same holds true for the Cancer Institute of Chennai (Madras). As a young doctor Dr Ms Muthulakshmi Reddy had the painful experience of helplessly watching her sister suffer to death from rectal cancer in 1923 due to delayed diagnosis and lack of proper treatment facilities for the disease in the country in those days. Determined to improve this pathetic situation, a move for setting up of a cancer hospital in Madras was publicly launched by Dr Muthulakshmi Reddy in 1928, but it took years of hard work and toil before her dream could be realized. During the centenary celebrations of the Madras Medical College in 1935, with the persuasion of Dr Muthulakshmi Reddy a resolution was made for establishment of a *separate self contained cancer hospital for early diagnosis, treatment and research*. The Women's Indian Association (WIA), formed in 1917 in Adyar for the welfare of women particularly in the area of health and education raised funds for the cancer institute. Pandit Jawaharlal Nehru laid the Foundation stone of the building in October 10, 1952 formally declared open by Shri CD Deshmukh, then Union Finance Minister, on June 18, 1954. The major objectives and field of activities of the institute in the formative years and the shift of focus with time and its progress in the successive years, which was remarkable, will be traced and evaluated in the current context.

## A Critical Study of Indian Astronomical Tables – Sāriṇis, Koṣṭkas, Padakas and Vākyas

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*Makaranda sāriṇī* is a popular text containing a large number of tables based on the popular text, *Sūrya siddhānta*. These tables are worked out, with immense effort, by Makaranda, son of Ānanda, at Kāsi. The tables are worked out for the evaluation of (i) the ending moments of the five elements of *pancāṅga* viz., *tithi nakṣhatra*, *yoga*, *karaṇa* and *vāra*, (ii) mean longitudes of the Sun, the Moon and the five planets (*tārāgrahas*), (iii) the *mandaphalas* of each of the heavenly bodies, (iv) the *śīghraphalas* of the five planets, (v) the moments of solar ingress (*sankramaṇa*) to successive *nakṣhatras* and *rāsis*, (vi) lunar and solar eclipses etc.

In the chapter, *Tithyādi sādhanadhikāraḥ* for intervals of 16 years *tithi*, *vāra*, *daṇḍa* (*ghaṭī*), *pala* (*vighaṭī*) are given under the *tithi kanda*. Similarly, under the *nakṣhatra kanda*, *nakṣhatra*, *vāra*, *daṇḍa* etc. are provided. The procedure is followed for *yoga kanda* also.

The author of the text, Makaranda has made many innovations in the procedures for planetary positions and eclipses. He has introduced *bījas* (corrections) to the mean positions etc. of the heavenly bodies.

A critical study of the Makaranda's tables and procedures is carried out in this project at present.

## Catalogue and Technical Analysis of Forge Welded Iron Cannons in Deccan Forts

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The ongoing activities related to the cataloguing and technical analysis of forge welded cannons in Deccan forts will be highlighted in this presentation. The project work began in the month of July 2006 and the field work started from the month of August 2006. The work performed in the first eight months of the project was submitted in the report in March 2007. The presentation will highlight the field work performed in the last twelve months (from April 2007 to March 2008). During this period, field work was completed in a total of one hundred and sixteen forts spread across four states: Andhra Pradesh (36 forts), Kanataka (39 forts), Maharashtra (37 forts) and Tamilnadu (4 forts); the total number of forts in which cannons were discovered was

"53": The total number of cannons catalogued in these forts was as follows: forge welded cannons (152), bronze cannons (93), composite cannons (9) and cast iron cannons (159), thereby bringing the total number of cannons catalogued to 413. Some novel findings of the study will be highlighted in the presentation, with particular attention focused on the methods used for pivoting the cannons in fortifications. This important engineering aspect will be highlighted in this presentation. Important inscriptions on the cannons have been recorded and these need to be translated with the help of experts. The complete dimensions of all these cannons have been recorded and these dimensions will be utilized later for technical analysis of the extant pieces. The talk will conclude by providing an overview of the tasks still remaining in the project and the plan proposed to go about achieving the same.

### 1960-1999: Four Decades of Biochemistry in India

SRABANI SEN

*The Asiatic Society, Kolkata*

Teaching and research in biochemistry was initiated in early 1920s at the Applied Chemistry Department of the Calcutta University. A special paper on 'Fermentation' was offered at the time of its inception in 1920. 1930s saw the introduction of teaching and research in biochemistry at a few other universities. The first Department of Biochemistry was established at the Madras University in 1933, where studies were initiated on proteins. Special mention may be made of the following establishments

- 1946 Department of Biochemistry at Nagpur University
- 1948 Biochemistry Section in the Department of Chemistry at the Poona University
- 1954 Biochemistry Section in the Department of Chemistry at the University of Lucknow
- 1955 Department of Biochemistry at the Baroda University 1956 Department of Biochemistry at the University of Calcutta 1959 Biochemistry Department at the University of Lucknow
- 1956 Department of Biochemistry, University of Calcutta
- 1959 Biochemistry Department of the University of Lucknow

M Sc examination in Biochemistry was initiated in 1945 in Bombay University. M Sc course in Biochemistry started at the Mysore University and the Calcutta University in 1953 and 1956 respectively.

During the 40s and 50s of the twentieth century, there was a tremendous progress in Biochemistry in the West. In India not much attention was paid to this branch of chemistry during that period. To assess the status and standard of teaching and research in biochemistry, in 1959 the University Grants Commission felt it necessary to appoint a Review Committee under the Chairmanship of Prof. Bires Chandra Guha, the doyen of Indian biochemists. Under the education system followed at that time, the Committee felt that teaching of biochemistry should start at the M Sc level at the University. During the first year of the two-year MSc Course basic principles of biology and physiology along with some biochemical subjects were taught.

### Work Planned for 2007-2008

1. Role of Indian Universities in the progress of Biochemistry in India.
2. The contributions of Indian Research Institutes to biochemistry and molecular biology during 1980-1999.
3. Collection of abstracts on biochemical and molecular biology researches by Indians in India during 1980-1999.
4. Bibliometric analysis of the above data.

The work mentioned above reveals that from 1980s Indian scientists had the facilities of well equipped laboratories and modern biochemistry to carry out researches on modern biochemistry and molecular biology though most of the papers were published in average impact journals or low impact journals. Prof G.Padmanaban of the Department of Biochemistry, IISc, Bangalore commented in his article *Growth of Biochemistry in India*. It is interesting to note that till the mid-1950s the emphasis on biochemical researches were on applications and societal need and in the latter part of the 20th century, we have lost this concern in the name of basic research.

### Historical Appraisal of Indian Childhood Cirrhosis Evolving Spectrum of Epidemiology & Clinico-Pathology

S SRIRAMACHARI, FNA

**Introduction:** An unique disease of the liver in Indian children was first reported by BC Sen from Calcutta in 1887. Thereafter, it was recognized in several other parts of the country. It was associated with clinical and epidemiological features like predilection for certain communities & castes, familial clustering, dietary practices and preponderance of male children. Hundreds



were afflicted and it was considered to be invariably fatal. But once detected in a region, it seemed to persist for just 2 or 3 decades and thereafter practically disappear. But, in the last two decades equally mysteriously, it has virtually vanished from the face of India. To analyze the several historical issues, additional help of History of Science Commission of INSA was sought and granted.

**Historical Appraisal:** So far, over 150 original publications on the subject were collected from personal collection, supplemented by material available material at the National Medical Library. The ICC database is nearly complete. The information has been collected processed through Microsoft Access and is being used for analysis of several parameters or issues like Epidemiological, Clinical, Biochemical, Serological & Immunological patterns and above all, Histopathology & Pathogenesis under Light & Electron Microscopy. Some of the results have been presented and discussed in the previous Annual Report, submitted to INSA in February 2007.

**Ongoing Analysis:** The earlier information has been updated and critically evaluated in the context of the ICMR Report of the Multi-centric National Collaborative Study (MNCS) on ICC, of which this author was the Editor-in-Chief. The large series of nearly 750 cases, out of which 120 had been followed up with multiple repeat Biopsies, enabled a proper categorization of the *earliest lesion* and the subsequent sequence of the Pathological Spectrum of ICC. Thereby, before the disease became extinct, the lacunae of the last fifty years have been resolved. Further, Biological Trace Elemental Analyses (BTEA) of Hepatic Copper & Zinc of over 150 liver biopsy samples at two of our Centres, clearly established that elevated hepatic Copper along with non-toxic Zinc to be a *late consequence and not the cause of the disease*. Apart from disproving Tanner's theory of Dietary Copper Toxicity, it has opened other avenues of *Toxic Liver Injury*, such as the wrong use of potentially toxic *Domestic Therapeutic Remedies following Home Deliveries*.

**Impact of the Study:** *Hepatologists* across the country and abroad, like the Organizers of IHPBA 2008 Congress recently held in Mumbai, evinced genuine interest in the Historical studies on ICC. Accordingly, a Special Invited Lecture was delivered at Mumbai on 1st March 2008. It was largely based on the results of the MNCS Report of ICMR, our BTEA studies and the Historical Appraisal of the INSA - H. Sc Project on ICC. Also in response to a request by ICMR, a Draft Editorial on ICC has been submitted and is awaiting publication in the IJMR. At the forthcoming INSA Workshop in April 2008, the several facets of the historical evolution of ICC will be highlighted.

## A Military Revolution in India? War, Technology and Colonialism in South Asia: 1740-1849

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From the dawn of civilization, diffusion of technology from abroad has shaped the course of Indian history. This project highlights the role of European technologies in the construction of colonialism in early modern India. The study begins in 1740 when the East India Company (EIC) emerged as a substantial politico-military power in south India and ends in 1849 with the collapse of the last independent indigenous polity which had opposed colonialism. However, one must avoid the trap of technological determinism. The sociology of technology rightly rejects the notion of the natural development of technologies and explains the success of particular technologies in terms of the social networks that support them. This project attempts to analyze the complex interaction of ideas and instruments resulting in military innovations during early modern Indian history.

The system of warfare was the result of fusion of both material and non-material factors. Hence, in this project technology denotes military and non-military hardware plus theories and managerial techniques associated with their uses. The evolution and use of weapons have to be integrated within the overall social and cultural matrix. The use or non-use of a particular piece of hardware depended on the attitudes toward warfare. The twin issues of technology and military organization will bring into focus the dialectical relationship between war and state formation. Special importance is given to the cross fertilization of ideas between India and the outside world comparative analysis shows amalgamation of ideas and instruments of diverse origin in turn structured and the nature of colonialism in the subcontinent.

British expansion in India was part of the larger process of European expansion in the non-European world which started in the early modern era. The principal debates for explaining this phenomenon focuses on the problematic of Military Revolution and the appearance of military-fiscal polity which is the product of Military Revolution. The part played by military technologies in establishing British military supremacy in India especially between late eighteenth and early nineteenth century and the responses of the indigenous polities are yet to be studied comprehensively. This project aims to trace the evolution of EIC's military technology and the emergence of re-power centric warfare in India.

### Published Articles Related to the Project

A Military Revolution in Mysore? Technological Changes. Social Transformation and Military Modernization under Haidar Ali and Tipu Sultan between) 752-99, *Contemporary India*, 3(3) (2004) pp 19-37.

Military Synthesis in South Asia: Armies, Warfare and Indian Society. c. 1740-1849. *J. Military History*, 69(3) (2005) pp. 651-90. This article has won the Moncado Prize of the American Military History Society.

Firepower-centric Warfare in India and the Military Modernization of the Marathas: 1740-1818, *Indian Journal of History of Science*. 40(4), (2005) pp 597-634.

Rockets under Haidar Ali and Tipu Sultan, *Indian Journal of History Science*, 40(4), (2005) pp 635-55.

Technology and Transformation of Sikh Warfare: Dal Khalsa against Lal Paltans. 1800-1849. *Indian Journal of History of Science*, 41(4) (2006) pp 383-410.

The Armed Expansion of the East India Company. in Daniel Marston and Chandar Sundaram (eds.).

### A Comprehensive Study of *Kuttakara Siromani* by Debarâja

SAROJ V SINGH

The project consists of a detailed study of *Kuttakara Siromani* which includes a translation of the Sanskrit text and to understand the mathematics and astronomy contained in it.

*Kuttakara Siromani* is a monograph exclusively devoted to solving determinate equations by  $-ax = c$  for  $x, y$  in positive integers and where  $a, b, c$  are given integers. It is rare to find such a monograph length treatment of any particular specialized topic in the history of Indian Mathematics. *kuttakara Siromani* was written by medieval Indian mathematician Dewaja. It explains Kunitca method of Aryabhata given in two sutras (Verse 32,33) of Aryabhata. Devraja also wrote a self commentary, Maha Laksami Muktavali on *Kuttakara Siromani* to further explain the method. The word Kuna means breaking or dividing and therefore *Kuttakara* means something involving repeated divisions. By explaining this the author justifies the name of the book *Kuttakarn Siromani*. The *Kuttakara* mathematics in the book is mainly of two kinds: 'Sagra and Niragra. The first chapter of the book is on Sagra *Kuttakara*, second chapter deals with Niragra, Samslista and Varn and Vela *Kuttakara*. The third and the last chapter is on Misra Sreni Misra *Kutlakara*. Devraja explains the two *Kunaka sitras* of Aryabhata in the context of both Sagra and Niragra versions of *Kuttakara* method. The method is explained in detail clearly with the help of illustrations and its important applications to Astronomy.

During this period the investigator has completed the first version of the translation of all the three chapters

and tried to understand the mathematics and astronomy contained in it. A final version is under preparation.

### Towards an Understanding of the Indigenous Knowledge Systems of the Fishermen of Sundarbans in West Bengal and their Approach to Health, Sanitation and Climate

MAHUA SARKAR

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From the first installment of the funding from INSA, the investigator arranged five field trips into the interiors of the Sundarbans between 20th August 2007 and 31st March 2008. The field trips were made in the following blocks covering the buffer areas of the mangrove forests: 1. Gosaba, 2. Basanti, 3. Kakdwip, 4. Namkana, 5. Interior buffer zone around Sajnekhali. She took extensive interviews, collected available information and also made detailed photographs of the people's activities related to health sanitation and environment. The primary findings are the following:

**Health:** The life of the people are interwoven with the mangrove ecosystem of the Sundarbans. Most of them are fishermen and fisherwomen with very scanty agricultural land. Dire poverty urges these people to frequent the forests of forbidden areas in search of livelihood Their occupation has got severe health hazards. Apart from malnutrition and stomach problems constant touch with saline water causes skin problems and women's suffer from several feminine diseases. Due to their distance from hospitals and lack of proper amenities, these people are clinging to their traditional systems of knowledge for protection of their health. The people of the Sundarbans utilize the following flora for their health problems: *Rhizophora Mucronata* (Gargan) for skins, *Atalantia Correa* (Nona Lebu) for stomach, *Derris Scandense* (Kalilata) for treating worms, *Suadea Nudiflora* (Gire Sak) for worms, *Sonneratia Apetala* (Keora) for appetizers and *Nypa Fruticans* (Golpata) for quenching thirst. Besides the other local plants the *Harguza* is used as an antiseptic and *Thankuni* is used for treating chronic stomach disease. Honey is also used mostly in its raw form as the Sundarbans is the major producer of honey in India. It is an export item and is therefore scantily used by the collectors that is the poor people. The calorie value of honey is about 3040 calorie per kg.

For tiger bites the people use masks, iron rods and take the help of Baules or local gurus. For snake bites they are dependent on the local experts called ojhass who treat mainly with strings and prayers. Accidental mortality is very high in percentage. Women are not

accustomed to go to hospitals for childbirth and midwifery is therefore a very popular profession. The people in general take very small prawns or mostly crabs with cheaper vegetables or weeds with rice as their daily food. Apart from regular diseases the number of AIDs patients is increasing daily due to their long distancing from the village and commercialization of the local marts. There is no local knowledge to fight against such disease. She arranged the last trip at a time when the bird flue has been a serious problem in the entire South 24 parganas. But the people of the buffer area are not aware of the danger of this disease.

This is the general picture the health situations of the Sundarbans. The Government has taken some initiatives and NGOs like SHISH, SHAPP etc are working the people conscious of the modern diseases. The investigation is not yet complete. But the findings show that a large number are dying of accidental deaths by being tiger preys, by cyclones or by snake bites. Otherwise the general lifespan has been accommodated with the indigenous system of knowledge.

**Sanitation:** The Government has initiated some programmes for scientific sanitation. But the facilities cannot be implemented properly due to lack of finance and other problems. The people also nurtures a lack of faith in the western form of sanitation in private enclosed space. So in spite of regular hoardings and cautions by the local panchayats people use the riverbeds for sanitations. Mud is used for soap. The notion of polluting the river with sewage is absolutely unknown. Availability of non saline water is also a striking feature of these areas. The fishermen usually carry sweet water in their boats and collect drinking water from very few sweet water ponds in the forest areas. But in course of their fishing trips they are also used to drinking the saline water of the rivers containing planktons and other physical bodies. The demand for tube wells in the villages are increasing, but the fisherman somehow adjusts himself with the riverine salinity for his existence.

**Climate:** Contrary to the awareness regarding modern systems of health and sanitation, the people have become seriously concerned about the recent climatic changes including global warming and the rise of the sea levels. The fishermen still use their Dherited knowledge to understand the impact of the moon on the rivers (Kotals) and they adjust their occupation of fishing according to it. They perceive that they are dependent on this eco system for their food and fuel. They have developed their own forms of biological monitoring with the changing environment.

Still the problems of environmental degradation is seriously endangering the very existence of the Sundarbans. The author has collected photographs of the decaying embankments and have explored how the people are fighting against soil erosion with their own methods of double or triple bamboo fencing and plantations. Tourism is also destroying the indigenous ambience of the local eco system. She has utilized the first installment of Rs. 1 lakh (Out of sanctioned 2 lakhs per annum) completely between August 2007 - March 2008. Since the work consists of oral history research based on field trips, an extension of the grant is needed to continue the project, particularly to cover the other 14 blocks of the Sundarbans. The investigator has presented papers on the theme in different national and international seminars throughout the year. The solution of my historical investigation lies in a proper scientific management of the problems along lines of accommodation, adaptation and ways of greater sustainability.

### A Historical Study of Epilepsy from 1900 AD to 2005 AD

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The aims and objectives of this study are:

- i) To trace the historical developments of Epilepsy before 1900 AD in India and in other countries.
- ii) To analyze the socio-economic, legal and health problems faced by the individuals with Epilepsy between 1900 AD to 2005 AD.
- iii) To evaluate the contributions made by different Indian and international scientists and scholars during the above period.
- iv) To assess the different conventional and holistic treatment modalities currently available for Epilepsy.

Sufficient material on this disease has been collected from different primary and secondary sources in Delhi, Manesar (Gurgaon), Chandigarh, Agra, Madras and Bangalore. A paper entitled *Research on Epilepsy in Modern India* was presented at the 68th session of Indian History Congress held at Delhi University from 28th to 30th December 2007, under the Aligarh Historians Society Panel held on *Science and Technology in India's Past*. An article entitled *Epilepsy in India before 1900AD* is almost ready for submission to the Indian Journal of History of Sciences. Madras Medical College set up in 1835 and National Institute of Mental Health and Neuro Sciences



(NIMHANS), Bangalore (1956), the only institution in India which deals exclusively with mental illnesses including Epilepsy were visited in August 2007 and valuable archival material on the treatment of Epilepsy was collected.

In the next financial year, it is proposed to visit Kolkata Medical College and Grant Medical College, Mumbai both set up in 1835 to obtain a better perception of the disease and the types of treatment used during that period. Detailed information on the current ongoing projects on Epilepsy in different Indian research centres and hospitals will be collected to add more information on the current research on this disease. The Department of AYUSH, dealing with research on alternative therapies will be consulted for more information on treatment of Epilepsy by Ayurvedic, Unani, Siddha, Homoeopathy, Yoga and other therapies. More details on contributions of Indian scientists towards Epilepsy are to be collected. A few more articles will be written and the Final Report will be prepared in the coming year.

Perusal of all the material collected so far has shown that before the 20th century, four systems of Medicine were available for diagnosis and treatment of Epilepsy in India i.e. Ayurveda, Siddha, Unani and Allopathy. In Ayurvedic treatises like Caraka Samhita, and Susruta Samhita etc. Apasmara, a disease similar to Epilepsy had been discussed in detail and different herbomineral preparations had been recommended for internal use, massage and for applying in the eyes and nose. Texts on Siddha practised in Southern India and the Greco-Roman or Unani system popular since the Mughal Period had also discussed various aspects of Epilepsy. Modern Medicine was introduced into India by the Portuguese, French and British rulers. Several medical colleges and hospitals were set up by the British rulers for Indian natives from mid-nineteenth century. These had subsequently developed in excellent research centres where treatment of all diseases including epilepsy was provided.

Data on the research on Epilepsy in India has revealed that it is caused by excessive electrical discharges in the brain triggered by Tuberculosis, tapeworm infestation, birth injury, genetic disorders and hot water and high grade fever. For diagnosis, several diagnostic tools had been invented like Electroencephalography, Computerized Axial Tomography (CAT), Magnetic Resonance Imaging (MRI) and Positron Emission Tomography (PET) Scanning. For treatment of Epilepsy several medicines, surgical techniques, ketogenic diet and vagus nerve stimulation have been discovered. The current problems faced by

people with Epilepsy are socially stigma with difficulty in employment, marriage, driving license, insurance, lack of epilepsy specialists, sparse health facilities, prolonged treatment and expensive medicines associated with several side effects. Several Indian and international voluntary organizations are working for the cause of Epilepsy by increasing awareness about the disease and trying to solve associated social, political and legal issues. More details on this disease are expected by visiting Kolkata Medical College and Grant Medical College, Mumbai both set up in 1835. Detailed information on the current research projects dealing with this illness and particularly the Alternative therapies will be collected. Contributions of Indian scientists towards the cause of Epilepsy, writing of a few more articles and the Final Report will be done in the coming year.

### Indigenous Knowledge on the Medicinal Plant Resources of Coromandel Coast Forests of Peninsular India in the Modern Period

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Traditional medicines play an important role in the provision of healthcare in many developing countries. Their use is also significant in developed countries, increasing their commercial value. Traditional medicine usually involves biological resources and the knowledge of indigenous people or traditional healers is important and it is interlinked with biodiversity conservation. The immediate concern is to preserve this knowledge through documentation. Medicinal plant knowledge of traditional healers was documented during October 06 to January 07 in Coromandel coast forest stretch from Marakkanam to Pondicherry. The area represents ecologically and culturally diverse zones, differing in floristic diversity etc. Ethno-medicinal uses of 112 plant species belonging to 54 families, used by the traditional healers in this region were documented. For each plant, botanical name, vernacular names, part(s) used and popular medicinal uses were noted. The recorded medicinal plants are used mainly for bites of poisonous animals, bone setting, jaundice, dysentery, and other common ailments, and their preservation methods practiced by various healers differed. In India, activities in the field of medicinal plants and for conservation strategy documentation is required, because many plants species associated with indigenous people have already disappeared and many more endangered, due to the impact of deforestation, urbanization and modernization, movement of the indigenous people from their natural habitats, and the very knowledge

which the forest dwelling tribes possess, particularly with respect to herbal drug, is disappearing and hence their importance is underlined. The final report is completed.

### Documentation of Cannons of Eastern India PRANAB K CHATTOPADHYAY

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The Centre for Archaeological Studies & Training Eastern India, has initiated a project on the documentation of cannons of Eastern India. As a neighbouring country, Bangladesh has also been included in this documentation, whose history is the same of Eastern India. Moreover, a number of cannons of Bangladesh, West Bengal and Assam have changed their places of origin. In India, the area covered in this project includes West Bengal, Bihar, Assam, Orissa, Meghalaya and Tripura. Initial search with the past studies on the published papers of last two hundred years, have been studied thoroughly. Publications in Bengali and English journals, gazetteers and also in literatures have been covered. Total number of references are nearly one hundred.

### Comparative Study of Planetary Models in respect of Epicycles in Classical Indian Astronomy vis-à-vis Ptolemaic and Copernican Models

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In the first year of Project (from June 01, 2005 to March 31, 2006), the procedures of Copernicus for the positions of planets were studied. The results are compared with those of the classical Indian astronomical texts like Surya Siddhanta, Ganesa Daivajna's Grahalaghvam and Nilakanta Somayaji's Siddhanta Darpana.

The peripheries (paridhis) of the mada and the sighra epicycles are compared with those corresponding to the "first equation" and the "second equation" given by Copernicus in his De-Revolutionibus and by Ptolemy in his syntaxes.

The helio-centric distances of planets are worked out based on the Indian astronomical procedures as also those of Ptolemy and Copernicus. The planetary positions according to these procedures are worked out for a modern date as also for a date in the sixteenth century. These results are compared with the computations using modern astronomical procedures. As an example, the peripheries (paridhis) of manda epicycles according to

Ptolemy (2<sup>nd</sup> century A.D), Aryabhata 1 (5<sup>th</sup> century A.D), Nilakantha Somayaji (1500 A.D), Ganesa Daivajna (1520 AD) are computed.

### Irrigation Technology in the Thar Desert (Jodhpur, Bikaner and Jaisalmer) during Medieval Times

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The progress report of the project consists of two parts: first documentation of all categories of data and second, fieldwork undertaken to collect data on the water harvesting structures.

Under the first category, archival and literary sources are being consulted to sort out the material on irrigation. Numerous village bahis of the 17<sup>th</sup> century (Hasil Bahis) of Bikaner containing information on agriculture is tapped to derive data on irrigation. Besides these official revenue records, chronicler's books (both published and unpublished) on different regions are consulted. Prominent among them are: Nainsi's Marwar ra-Pargana-ri-Vigat (3vols) and Khyat (4vols), Jalor Pargana-ri-Vigat (two volumes composed in 1680's by an anonymous writer), Dayal Das's khyat and Des Darpan and Nathmal's Twarikh Jaisalmer.

The material on irrigational devices from the Rajasthani bat (historical narration) and ghazals (city oriented poems) is being compiled. Innumerable bats are preserved in many private as well as government Libraries which contain data on diverse water structures. Many of them are published. Similarly, the ghazals are collected which also throw light on waterbodies in urban areas.

The inscriptions related to the water harvesting structures are being sorted out. Many of them are published but some are still on waterbodies. These would be photographed.

Paintings, sculptures and sketches are also being taken into consideration. Some maps are plans of waterbodies are photographed. Proverbs and legends are also compiled which throw light on the knowledge of common man of rural Rajasthan. Interview of some individuals are also taken.

Second part consists of fieldwork. For this, first we have chosen the district of Bikaner. Two visits were confined to collect relevant data from the Rajasthan State Archives, Bikaner and some private Libraries (25<sup>th</sup> November to 4<sup>th</sup> December 2006 and 10-14 January 2007).

Third and Fourth visits (25<sup>th</sup> Dec 2006 to 3<sup>rd</sup> January 2007 and 2-10 February 2007) were dedicated to the fieldwork. The documentation of the water structures was done in the form of photographs. Some structures such as tanks were marked to be measured for the preparation of their ground plan. Two or three visits are planned in the month of March. The February trip dedicated to some of the selected villages of the tahsil of Sri Dungargarh (Bikaner). Seven villages of the chira (pargana) Gusainsar were surveyed namely, Gussainsar baro, Punrasar, Norangdesar, Lakhasar, Rinmalsar, Kalu and Ahadsar. Interestingly, all the villages contained a tank except Kalu. Besides this, each village possesses more than two wells. Kalu is an exception which contained numerous wells. It is believed that some of them were probably used for irrigation. The tanks were designed to tap the rainy water. We could not get any documentary evidence about their use. For this, we have to search out material in the archives. More such survey trips would bring fruitful results.

### Anatomical Knowledge and the anatomy of Medical knowledge in India: Some preliminary inquiries

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Anatomy is a working science for problem solving and application in the practice and delivery of quality health care. The physical examination, medical imaging and other procedures, as well as the elements of the medical history, all generate clinical data that pertain to anatomical entities in the human body. Furthermore, from a philosophical point of view, anatomy is not merely the structural biology of human species which happens to be human. Because we are self-aware the study of the human has a unique place in establishing the image we have of ourselves, ultimately the prosaic descriptions of the bones, muscles, blood vessels and neural pathways are the context of our experience of life. The study of medicine in ancient India was the first momentous step forward from daiya-byapasraya bhesasja to yukti-byapasraua njesaka. Anatomical study (and pharmacology too) was a useful tool for it. Methods of directly perceptible results (pratyaksa-laksana-phala) constituted an important matrix of rational medical approach. Despite this fact there was schism between rational clinical acumen and anomalies observed. Surprisingly, anomalies in observations did not become an incentive for the improvement of theory or the formulation of new/supplementary rules for the knowledge of the body. We may think of - (1) the

importance of shifting characters meaning and translation-particularly of reconstitution of the concept of the "medical" body distinct from the "community" body and self in India, (2) reconstitution of epistemological categories of traditional medical practices in India; and (3) discursive formation of the "healthy" body and the body-in-disease through the introduction of anatomical study. Our aim is to locate (1) the centrality of anatomical knowledge and the "medical" body in medical education before and after arrival of the British. The "Indian" body was the very site of confrontation between the colonizing alien power and "true" Indian ways of knowing the body, (2) how asymmetric exchange between two knowledge systems changed the ways of knowing the body in ayurveda; and (3) to understand how this knowledge was instrumental in constructing professional authority of biomedical practitioners over their indigenous counterparts. Thereby, it will try to locate the paradigmatic shift from the bodily-being-in-the-world perception (where the body is assumed to be active and agential) to the objectified body of modern medicine Anatomical knowledge - with its emphasis on (1) emphasis on physico-chemical "reduction" and (2) an excessive horizontal (i.e. discipline-based) and vertical (i.e. clinical sectors) compartmentation was the cornerstone over which the victorious edifice of modern medical knowledge in India was erected. The constitutive principles of the knowledge of the body in Ayurveda were translated into and, in the end, displaced by those of western medicine. A strong correlation between disease manifestation and Surgical practices premised on modern anatomical knowledge was the fundamental distinguishing point between these two medical traditions. Methodologically speaking, our effort will be to explore- (a) the role played by the textual structure and perception of time and space in India, (b) how evolution of medical curricula with particular emphasis on anatomical knowledge occurred over a long period of time, and (c) how ethnographic studies may help us to understand the character and frame of Ayurvedic knowledge (specifically, of anatomy) being practiced now-a-days.

### Mineral Processing to Elemental Science in Medieval India

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The scheme has been designed to yield a press-ready monograph/manuscript with sharply focused eleven chapters. Out of the 11 chapters, the first four have already been penned. The tentative title of the eleven



chapters planned to the study are listed below:

- 1) **Introduction:** the Scope and Purpose of this Dissertation.
- 2) Minerals, their processing and chemical knowledge in the Ancient and Medieval India.
- 3) Mineral Processing in the 13<sup>th</sup> Century AD Text Rasa-Ratna-Samuccaya.
- 4) Earlier Centuries of Progress in Europe Leading to Agricola's Era.
- 5) Agricola and His De Re Metallica.
- 6) Biringuccio and Some other authors in the 16<sup>th</sup> Century Europe.
- 7) The quest for an Elemental Science (17<sup>th</sup> Century ADZZ).
- 8) The Emergence of the Concept of Chemical Elements.
- 9) Yasada (Zinc), Bidri and Wootz in India.
- 10) Why and How: Scientific Renaissance in Europe, but not in India.
- 11) The Quest for Causality in History of Science.

## Musical Pillars – an unique feature of Vijayanagar Architecture

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The musical pillars in the Vithala temple complex in Hampi are an important part of Indian heritage. It is recognized as a UNESCO world heritage monument. They are important not only due to their sculptural richness, but also due to their unique scientific and technological ingenuity. It is essential to understand these monuments from the point of view of science and technology.

In this programme, the main focus was on pillars and lithophones in temple architecture, petrological study as mentioned in ancient texts, and detailed study of musical notes from these pillars. The next part of the programme comprises petrological study of the rocks used in these musical pillars, and non destructive investigations to know the physical properties and other aspects.

In this context, the study was discussed with Dr Baldev Raj, Director, Indira Gandhi Centre for Atomic Research (IGCAR), Kalpakkam, and his colleagues regarding the feasibility of undertaking scientific characterization of musical pillars. Based on those discussions the following programme is proposed for

comprehensive scientific characterization of the musical pillars, comprising petrology, physical characterization and vibration analysis. This study would lead to understanding how the musical notes are generated from these rock sculptures.

The following methodologies are identified

1. **Chemical Analysis:** This will be done on any rock specimen, of about 25mm x 25mm, collected from a similar, but damaged, structure in the same complex. The collected specimen will be subjected to detailed chemical analysis using standard techniques.
2. **Crystal structure Analysis:** Crystal structure will be analysed using standard X-ray diffraction techniques. The samples needed for these studies will be obtained from the rock specimen mentioned in (1).
3. **Microstructure Analysis:** *In-situ* microstructural analysis will be used for this study. A few chosen regions on the rock sculptures will be analysed. The technique requires polishing of the surface of the rock which may involve removing about 100 microns thick rock material from the surface. The locations for *in-situ* microstructural analysis will be chosen from the less important regions such as base of the rock sculpture. The microstructure, along with (1) and (2) will help identifying the type of the rock.
4. **Physical Properties:** Density measurement Specimen obtained in Chemical Analysis will be used.
5. **Ultrasonic Testing:** This is a non-destructive method. It can be used to investigate the integrity and also to find the elastic properties of the rock.
6. **Vibration Analysis:** Acoustic analysis

This involves scientific recording of the acoustic sounds generated from the musical pillars. The data thus obtained will be subjected to detailed signal analysis.

## Science and Nationalism in Bengal (1876-1947): Asutosh Mookherjee

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The contributions of Mahendra Lal Sircar and Satis Mukherjee, Jagdish Chandra Bose, PC Ray were studied with regard to Indian science and the national movement in earlier phases of this project plan.

At present, Sir Asutosh Mukherjee and Mathematics (1864-1924) is under study. This will include life and

works, Educational career, works on mathematics, promotion of science and mathematics, promotion of science and mathematics and his contributions and science as freedom struggle.

### **Technology of the Tribes of North East India: with Special Reference to Arunachal Pradesh**

**AK THAKUR**

*Northeast Hill University, Shillong*

The study is focused on technology of the Tribes of Arunachal Pradesh towards documenting the relevant sources and subjecting the evidence to rigorous analysis, interpretation and probing its social contexts. The project is being carried out within the broader framework of technological study. The study of technology will also include the impact of technological know-how on social and cultural significance. The work is divided in seven chapters.

### **Minerals, Mining and Metal Working Crafts in Medieval India : 1600-1750 A.D. Based on Dutch Sources**

**ISHRAT ALAM**

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The study is based on archaeo-metallurgy and ethnological data. Scattered references are there in indigenous literary sources. The study also includes quality and complexity of technology which would suggest the state of cultural advancement and their creative potential. It will also be traced antiquity of minerals metal, the examination of process as practices in medieval times.

The study will be mainly focused on the understanding of sociology of technology along with the comparison with Europe's march ahead of us during the period under discussion.



