



98th Indian Science Congress :

Brief Report & Major Recommendations



The Indian Science Congress Association
Kolkata



Group photograph of dignitaries at Inaugural Ceremony



Dr Manmohan Singh, Hon'ble Prime Minister of India with other dignitaries during Inaugural programme



Prof. Amartya Sen, NL receiving memento from Prof. K. C. Pandey, General President and Prof. P. Satyanarayanan, Vice Chancellor, SRM University



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Brief Report
&
Major Recommendations



The Indian Science Congress Association
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1.0 INAUGURATION

The 98th Session of the Indian Science Congress was held at Chennai, under the auspices of the SRM University from January 3 to 7, 2011. Hon'ble Prime Minister, India, Dr. Manmohan Singh inaugurated the Congress in the morning of January 3, 2011.



Dr. Manmohan Singh, Hon'ble Prime Minister of India inaugurating the 98th Indian Science Congress

The Inaugural ceremony commenced with the invocation and presentation of Bouquets. Prof. K. C. Pandey, General President, 98th Indian Science Congress welcomed the dignitaries and also presented his speech on the Focal Theme "Quality Education and Excellence in Scientific Research in Indian Universities".

Hon'ble Prime Minister, India Dr. Manmohan Singh presented ISCA Awards to various awardees and delivered his inaugural address.

Hon'ble Union Minister for Science & Technology and Earth Sciences, Government of India, Shri Kapil Sibal delivered his speech. Deputy Chief Minister Tamil Nadu, Dr. M. K. Stalin was also present in the function

Dr T R Pachamuthu, Chancellor, SRM University proposed the formal Vote of Thanks on behalf of The Indian Science Congress Association.

2.0 PLENARY SESSIONS

A total of seventeen plenary sessions were conducted during January 4-7, 2011, on wide-ranging topics. Eminent scientists who are experts in each of the fields participated. The erudite discussions helped bring out a set of concrete recommendations to be pursued in the coming days.



2.1 Plenary: on "Biodiversity Focus on Fragile Coastal Ecosystems"

The National Biodiversity Authority (NBA) of India, has organized a special session on Biodiversity focus on "Fragile coastal ecosystems". Dr. P.L. Gautam, Chairperson, PPV&FRA chaired the session and highlighted the importance of protecting the fragile coastal ecosystem of India. Dr. Ahmed Djoghlaif, Executive Secretary, Convention on Biological Diversity, Canada was the Chief Guest of the function and delivered the inaugural address, during which he pointed out that the marine biodiversity continues to decline quickly than ever which is partly due to climate change and ocean acidification. He emphasized that, in the Arctic, for example, by 2032 the under-saturation of key carbonate minerals as a result of ocean acidification will disrupt the marine food web. In addition, one third of reef-building corals worldwide face elevated risk of extinction due to climate change. Hence, the Conference of the Parties to the Convention on Biological Diversity called upon all 193 Parties to the Convention to highlight the role of marine and coastal ecosystems within climate-change mitigation and adaptation; to promote sustainable management, conservation and enhancement of natural carbon sequestration services of marine and coastal biodiversity; and to enhance the resilience of coastal and marine ecosystems. He informed that Parties also adopted the new Strategic Plan of the Convention for the period 2011-2020, which includes three important targets for oceans, namely:

1. By 2015, the multiple anthropogenic pressures on coral reefs, and other vulnerable ecosystems impacted by climate change or ocean acidification are minimized;
2. By 2020, all fish and invertebrate stocks and aquatic plants are managed and harvested sustainably, legally and applying ecosystem-based approaches;
3. Also by 2020, at least 10 per cent of coastal and marine areas are conserved through protected areas.

Participants from International Union for conservation of Nature, Zoological Survey of India, Indian Council of Forestry Research and Education, National Bureau of Plant Genetic Resources, Presidency college, Institute of Forest Genetic and Tree breeding and C.P.R Environmental Education Centre and UNDP participated in the



session and made their presentations and suggested the following important recommendations for the protection of the fragile coastal ecosystem for the benefit of the coastal community.

Recommendations

- Designing ecologically and socio-economically sound coastal rehabilitation programmes for the coastal community.
- Institutional mechanism for involving all the stakeholders (NBA, SBBs, BMCs, research institutions/NGOs) in mangrove restoration and conservation programmes, periodic documentation of flora, fauna and annual monitoring of mangrove cover using remote sensing technology.
- Mangrove wetland delineation based on Ramsar criteria may be identified.
- In the coastal areas, Mangrove areas having high density of species and the genetic diversity are to be identified and conserved as “Mangrove Germplasm Centres”. These areas protect coastal communities from natural disasters and provide livelihood to the coastal population.
- Network of Genetically diverse mangrove hotspots has to be created.
- Formulate and implement ecotourism strategies in mangrove areas.
- Require funding support from Government agencies to work on marine microbial wealth.
- Need for knowledge base and capacity building on coastal planning, regulation, policy and management. Environmentally sustainable business practices in coastal areas.
- Promote national dialogues and share lessons learnt to improve the practices and policies in coastal zone management.
- Support environmentally sustainable livelihood among coastal communities.

2.2 Plenary: on “Critical and Challenging Science Issues of Climate Change”

Recommendations

- Efforts are to be made to simulate the present global climate and Indian



monsoon well, in global models. There are inherent uncertainties in the key assumptions and interdependencies about future population, socio-economic development and technical changes that are the bases of the IPCC SRES Scenarios, which need to be addressed for generating most representative emission scenarios for the future.

- The imperfect understanding of some of the processes and treatment of physics in the carbon cycle and chemistry models that generate uncertainties in the conversion of emissions to concentration, is to be addressed so as to explicitly simulate the carbon cycle and chemistry of all the substances needed.
- Organic Carbon (OC) / Black Carbon (BC) concentration ratios in India are significantly higher than those reported from US, China. Higher OC/BC ratios suggest dominance of scattering OC than absorbing BC. Hence, the scattering coefficient of OC need to be considered in regional scale climate models to estimate the net radiative forcing on this account.
- Due to large spatial and temporal scale variability in aerosol and cloud properties, aerosol radiative forcing is a regional scale issue to study the export fluxes of aerosols and their precursors from continents (e.g. megacities, biomass burning, desert dust). Also, it is necessary to examine how will human activities transform the dynamical and chemical properties of the future atmosphere.
- Rapid assessment of National Level LULC on finer scale than the on-going 1:250,000 scale using multi-temporal datasets with an emphasis on assessing the net sown area for different cropping seasons across the states for monitoring the agricultural yield impact on a continuous basis in response to the extreme climate variability.
- Detailed impacts of LULCC in respect of Deforestation, Agricultural Intensification, Urbanization, Wetland Dynamics, Disturbance Regimes/ Episodic Events viz. Forest Fire; Flood/Extreme Runoff etc. are to be studied across the country.
- Studies to understand relative influence of mass balance, debris cover and



other terrain parameters on retreat of the Himalayan glaciers need to be launched.

- Development of institutional network of glaciological observations using field, aerial and satellite techniques is necessary.
- An appropriate mechanisms to arrive at tradeoffs between the competing demands vs. environmental demands of sustaining minimal stream flow in accommodating various interventions viz. watershed management; rainwater harvesting, etc. to be built, so as to quantify the impact of manmade interferences.
- Basin scale integrated water resource development and management framework is required for all the river basins of the country
- Acidification and deoxygenation of seawater are two most serious threats to ecosystems of the North Indian Ocean arising from Global Change. Modulation of these threats with associated manifestation in terms of low levels of pH and Dissolved Oxygen in both coastal and offshore waters is to be monitored on continuous basis over the Arabian Sea and Bay of Bengal. Deoxygenating through eutrophication caused by fertilizer runoff/deposition also need to be monitored and examined in detail. Large changes in biogeochemical cycles/fluxes and ecosystem functioning with consequent socio-economic impacts are to be assessed all along the Indian coastal zones.

2.3 Plenary: on "Environmental Technology: Waste Management and Waste Conversion into Resource"

Recommendations

- Waste generation has been on the higher side the world over and more so in countries like India where the waste segregation practices are not in operation.
- Without segregation treatment options become minimal. Lakes and creeks are normally found choking not only with weeds but with organic debris.



- Sustainable management practices need to be put in place. Urban situation is really alarming and the projections of waste piling up in 10 years are frightening.
- Illegal waste dumps in cities must be dealt with severe punishment.
- Waste Segregation at origin-Colour Codes & Symbols.
- Chemical Treatment.
- Shredding// Incineration: Waste conversion into resource is to be encouraged.
- Land fills with proper Trench dimensions should be encouraged.
- Biomedical: blood, Tissues, Cotton, Cloth, Needles, Metal.
- 10% of infections-hospital based-Hospital management should take care of this Autoclave/ Microwave should be promoted.
- Rag pickers are worst affected.
- Dumping of e-wastes in port cities must be curtailed.
- Medical wastes are to be incinerated.

2.4 Plenary: on 'Academia-Industry Interactions - the Status, the Issues and the Future Road-Map'

Academia-Industry Interaction is already being promoted by Ministries/ Departments/ Organizations of the Government of India in various sectors of Science and Technology. Prominent amongst those are:

- (a) The Automotive Sector.
- (b) The Machine Tools Sector.
- (c) The Electronics Hardware Sector.
- (d) The Drugs and Pharmaceuticals Sector.
- (e) The Small and Medium Enterprises Sector.
- (f) The Rural Enterprises Sector.



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- (g) The University Research Parks.
 - (h) The Nuclear Sector.
 - (i) The Space Sector.
 - (j) The Defense Sector.

Additionally, the existing Academia-Industry Interaction needs to be strengthened and new areas of cooperation need to be explored. The Government may help identify and seed such cooperation by providing scientific and technical guidance and also by providing the seed money.

The Plenary Session was chaired by the Principal Scientific Adviser to the Government of India (PSA) and had the following speakers:

- (i) Pre-Competitive Applied Research and Directed Basic Research in Specific Sectors:

The Automotive Sector: Dr. P. Rama Rao, former Secretary, Department of Science and Technology, Government of India.

The Machine Tools Sector: Dr. P. Radhakrishnan, Director, PSG Institute of Advanced Studies, Coimbatore.

The Electronics Hardware Sector: Shri Ajai Chowdhry, Chairman, HCL Infosystems Limited, Noida, Uttar Pradesh.

The Drugs and Pharmaceuticals Sector: Dr. M.K. Bhan, Secretary, Department of Bio-technology.

The NIMTLI Programme: Dr. S.K. Brahmachari, Secretary, Department of Scientific and Industrial Research and Director General, Council of Scientific and Industrial Research.

The SME Sector: Dr. T. Ramasami, Secretary, Department of Science and Technology.

University Research Park: Dr. M.S. Ananth, Director, Indian Institute of Technology, Madras.

Industry Support to the Nuclear Programme: Shri Sudhinder Thakur, former



Distinguished Scientist and Executive Director (CP), Nuclear Power Corporation of India Limited, Mumbai.

Industry Support to the Space Programme: Dr. H.N. Madhusudhana, Director (BAE).

The Expanding Scope in the Defence Sector: Dr. V.K. Saraswat, Secretary, Department of Defence Research and Development, and Director General, Defence Research and Development Organization.

The Public Sector Industry Viewpoint: Shri B. P. Rao, Chairman and Managing Director, Bharat Heavy Electricals Limited.

The Private Sector Industry Viewpoint: Shri Subodh Bhargava, Chairman, Tata Communications Limited.

The IPR Issues: Dr. P. Ganguli, Scientific Consultant (Innovation and IPR Issues), Office of the Principal Scientific Adviser to the Government of India, New Delhi.

2.5 Plenary: on "Strategic Electronics Sector"

Strategic Electronics covers radar, communications, imaging, networking, space, computing, control, missile, spectrum warfare, nuclear plant electronics etc. In areas like communications and computing the commercial "mass applications" has made the technology advances far ahead than in the military sector. Chairman, Dr. V.K. Saraswat, in his introductory remarks took note of the advances that have taken place world over in strategic electronics and the specific areas in which academia has ample scope for research in India.

Sh. Avinash Chander, Distinguished Scientist from Advanced Systems Lab, has elaborated the developments that have taken place in missile electronics. sensor modeling, development of seekers in optical, infrared and micro-wave regions and dual mode seekers are already realized. Highly integrated processing with system-on chip processors and navigation on chip offer new opportunities for system designers. Tracking instruments such as phased array radars in C/S/X-band provide diversity. He also emphasized that Robust algorithms, rugged devices like TR models using GaAs technology, modular power amplifiers and super components are needed for state-of-the-art systems.



Sh. Y. S. Mayya C.M.D, ECIL, has indicated that the loss of indigenous hardware industry has resulted in dependencies and vulnerabilities as far as strategic programs are concerned. Presently, most of local industry migrated to licensed manufacturing and system integration jobs with technology tie-ups with global players. He has cautioned that while selecting COTS products, issues related to lack of verifiability, vulnerability to malware, restrictive IPR regimes, unpredictable licensing policy, high obsolescence rate and vulnerability to proliferation politics need to be addressed. The proliferation of electronics in Nuclear Reactors had a two-way influence on the advances in the area of reliability engineering, fault-tolerant architectures, failure mode studies, device qualification including radiation hardening, trusted platforms, verification technologies and tools. The unprecedented opportunities opening up in India for the rapid growth of Strategic electronics sector should be wisely leveraged to develop home grown products & IP.

Prof. S. K. Koul, I.I.T, Delhi, pointed out that the key driving force behind the revolution in the personal communications & networking is due to the advances in RF Technology and Integrated Circuits. There is growing interest in developing reconfigurable and tunable integrated RF MEMS front ends using high dielectric constant substrates such as Si and GaAs. High performance antennas can be directly integrated with the front ends on the high permittivity substrates resulting in cost effective subsystems. Trend in future will be to develop, (i) Multi-function Monolithic Microwave Integrated Circuit Modules, (ii) Radio Frequency MEMS and reconfigurable RF front ends, (iii) Integrated CMOS-RF MEMS chips, (iv) Millimeter wave Phased Array Transceivers, (v) 3-dimensional Integrated circuits including advanced packaging, (vi) Broadband Electronic circuits for EW systems, (vii) High performance Millimeter wave wafer level components, (viii) High Performance RF and Data Converters for Radar Applications, (ix) Anisotropic Conducting Adhesives for futuristic chip bonding, (x) Millimeter wave and Terahertz Imaging Systems for Defence against Terrorism and (xi) RF Nanotechnology.

Sh. I. V. Sarma, Director, R&D, B.E.L, indicated that products on platforms like fighters and submarines, need to be designed to meet the challenging environmental conditions. Consequently, evaluation process is tough and takes long time. At the time of manufacture, QA processes are again different from other



civilian electronics sector, requiring additional infrastructure and qualified manpower. Ordering cycle time is very long due to long evaluation cycle time and the Defence procurement procedure. He emphasized R&D collaboration among government labs, academic institutions and industry partners will enable India to develop world class products.

Sh.S.S.Sundaram, Distinguished Scientist, Instruments R&D Establishment, elaborated the concept of Electro-magnetic Spectral Warfare which consists of Communication Electronic Warfare, Radar Electronic warfare and Electro-optic Warfare concepts. He has shown the systems that are indigenously developed by DRDO, and indicated that countermeasures and counter-countermeasures concept is a continuously evolving process in strategic electronics. He also indicated the EM Spectral warfare requirements in the urban & jungle warfare. The industry is required to have captive R&D, as well as academic tie-up to nurture continuous flow of technology updates in the strategic electronic sector.

After deliberations, Chairman Dr. V.K.Sarawat, summed up the importance of coherent synergy between the R&D agencies, academic institutions & the industry, for progressing technology in the area of strategic electronics, in our developing country. Based on presentations & discussions held, in Radar electronics, R&D work on GaN, as an emerging substrate that is capable of providing high power, wide bandwidth and high efficiency in compact sized microwave components is highly relevant. Research work on DSP algorithms to further enhance the anti-jam processing gain, clutter & false alarm reduction in target acquisition should be taken up by universities. ADR waveforms, Cognitive radio, video streaming in auto-routing networks are some of the areas recommended. TDoA based Direction Finding, Follower jammers, Fibre-optic linked digital receivers and high stability gimbals are to be realized in product form by the industry, based on the technology available with R&D. Avionics on Chip, ultra-dense nano-computer memory, quantum computing and nano-photonics are the areas wherein work should commence now, to reap the benefits in the coming years. He again emphasized that today's efforts in science will definitely fructify into tomorrow's technology and the opportunities as illustrated by various speakers are to be utilized, while also taking into account the IPR & other procedural issues.



2.6 Plenary : on "Recent Advances in Asthma Research"

Dr. Parmar stressed the role of Neurotransmitters in Asthma. Many investigations are currently focused to elucidate the cellular and molecular mechanism of the Asthma. It is hoped that the identification and characterization of a specific neurotransmitter involved in the pathogenesis of Asthma may prove useful in the understanding of the disease and could ultimately lead into the development of new drugs for treatment of patients with Asthma. Dr. Murphy presented studies to elucidate the Cellular and Molecular mechanism of Asthma by investigating changes in the physiological profile of Airway Smooth Muscles (ASM). These investigations have shown that early sensitization of ASM with a single antigen may contribute to a long term AHR through the mediation of not only the Myosin Light Chain Kinase (MLCK) but also of other potential contractile proteins. Dr. Murphy also provided new evidence for the involvement of Serum IgE and high affinity "IgE Receptors" in airway hyper responsiveness observed with patients with Asthma. He also proposed and provided experimental evidence in ASM that the failure of anti-inflammatory agents in the treatment of patients with Asthma may be due in part to their interaction with IgE through specific "IgE Receptors". Further investigations with ASM should prove useful in the development of new "Agonists" and Antagonists" for specific "IgE Receptors" which would provide new specific therapeutics for the treatment of patients with Asthma.

Dr. K. G. Tirumurugaan, an associate of Dr. Mathur S. Kannan, presented their work in the absence of Dr. Kannan who was unable to visit to participate at the 98th Science Congress. Their work exhibited the first hallmark feature of Asthma in demonstrating the vital role of CD38, a Cell Surface Type II transmembrane glycoprotein, in airway hyper responsiveness. Their initial observations have suggested the possibility that CD38/cADPR signaling in the airways may contribute to the asthmatic phenotype. These investigations were focussed on the work with isolated cultured smooth muscle cells and with models of inflammatory airway disease in wild-type and CD38 knockout mice. Their studies have provided evidence that CD38/cADPR is altered in inflammation and that it plays a role in intracellular calcium regulation and contractility of airway smooth muscle. These findings could prove useful in the understanding of the molecular and cellular mechanism of



ASTHMA and ultimately to the discovery of new drugs for the therapeutic management of patients with Asthma.

Dr. Chew Seow presented work by comparing the mechanical properties of airway smooth muscle from human tracheas (8 asthmatic and 5 non asthmatic donors) and found that there were no significant differences in the maximal stress, the length-force and force-velocity relationships, or in maximal shortening between asthmatic and non-asthmatic subjects. However, there was a significantly reduced response to length perturbation in asthmatic smooth muscle. This difference could underlie the typical lack of bronchodilating effect of deep inspiration seen in asthmatic subjects. The findings have led to new insights into the pathogenesis of asthma.

Dr. D. K. Agrawal presented evidence exhibiting the role of immunomodulation in the Therapeutic Management of Bronchial Asthma, a chronic inflammatory disease marked with nonspecific airway hyper responsiveness to environmental allergens. The preclinical and clinical investigations undertaken by Dr. Agrawal have provided possible evidence towards cellular and molecular mechanisms for the actions of immunomodulators. A significant contribution by Dr. Agrawal has clearly established the role of Vitamin D and another novel immunoregulator, FLT3-ligand (Flt3-L) as an anti-inflammatory and immunoregulatory agents.

2.7 Plenary: on "Space Summit"

During the Plenary session on "Space Summit" presentations were made on various topics related to achievements & future challenges in Space technology. The title of the presentations during the session included (i) New frontiers of Space Exploration (ii) Satellite Navigation Systems (iii) Observing Planet earth as an integrated system (iv) Small satellite systems (v) Gravitational & Space biology- Current status & implications for Indian Space Programme.

Recommendations

- As the space faring nations are looking ahead towards new frontiers of space science and technology, the main parameters of the new space challenge are low cost access to space, reaching inter-planetary space for scientific exploration, resource utilization, and human habitat and also possibly for



defending planet Earth from the disaster of any possible major impact from Near Earth Asteroids.

- In view of the inherent complexity of the aerospace systems, these challenges offer a scenario in which multi-disciplinary optimization and the co-operation between academia, industry and aerospace agencies beyond national boundaries needs to be addressed.
- In the area of Satellite Navigation Systems and their applications which has been in the forefront of space technology for over a decade now, realization of Regional systems such as the Indian Regional Navigation Satellite System (IRNSS) is of utmost importance to meet the country's need. These navigational satellite systems are going to open up many newer areas of applications and technological innovations in practically all walks of life.
- For more than four decades, Space-based observations of biosphere, cryosphere, hydrosphere and atmosphere have been providing extremely important information to study the planet earth as an integrated system. Many scientific investigations related to aerosols and their transport, green house gases, glaciers and their retreat, land-cover changes, impact of climate change on agriculture, regional hydrology, and sea level rise have been carried out.
- Future challenges in Space-based observations include design and placement of adequate and accurate multi-platform observational systems to monitor all parameters related to various interaction processes and generation of long term calibrated climate data records pertaining to land, ocean and atmosphere.
- Due to its innovative approach to satellite technology, Small satellite systems are fast emerging and are catering to a wide spectrum of space missions. These systems are ideal for proving newer ideas in communication and sensor technologies, for carrying out biological experiments and also for testing of advanced propulsion concepts.
- Small satellites are preferred due to its low cost and where one can afford to



take calculated risk with the added benefits of quick realization of the mission. Use of small multiple satellites help in avoiding a single point failure in a constellation of several satellites.

- Small satellite technology has opened up the feasibility of having constellations and swarms of satellites for very specific applications. Simultaneous multi-point observations for remote sensing and astrophysical studies, large distributed network of virtual instruments in space and constellations of communication and remote sensing applications are emerging as newer possibilities.
- In the area of Gravitational & Space biology, during the past 50 years more than thousand different experiments have been performed in space microgravity on humans, bacteria, fungi, insects etc. These studies have established that cells/tissues with normal structure and function can be cultivated in microgravity. Several 'space crop plants' which provides carbohydrates, proteins, fats and mineral to people within a bio-regenerative system for space travel and outposts are being identified.

Space biology which has large potential applications in medicine, biotechnology, molecular synthesis, crop improvement, alternate agricultural systems, nutrition and food preservation for improving the quality of the environment needs to be perceived for.

2.8 Plenary : on "Science & Challenges in Energy Security"

The importance of rapid growth of electricity generation for the progress of the civilization is well recognized and was emphasized by all the four speakers in the Plenary session 'Science and Challenges in Energy Security'. Dr. Baldev Raj, Director, Indira Gandhi Centre for Atomic Research, Kalpakkam, India and Chairman of the session in his talk on 'Energy, Ethics and Equity' highlighted the intertwined subject of energy, ethics and equity, and described possible choices for India to meet the energy needs and the preferred bouquet of technologies. The role of nuclear energy and India's three stage nuclear power programme as a robust response to security and sustainability was brought out. He mentioned that sustainability in energy without ethics and equity is a limited pursuit without higher purpose.



Prof. Seeram Ramakrishna, National University of Singapore, in his talk on 'India, China and Singapore to Make Most out of Sunshine' brought out the potential of solar energy as an important share of renewable energy for electricity production for Singapore, India and China in view of significant solar radiation in these countries. He highlighted the research strategies for harnessing solar energy using the cost effective materials by advancing nanotechnology and recent developments on super hydrophobic surface coating to boost the light absorption of photovoltaic cells.

Dr. Alan E. Waltar of USA in his talk on 'Providing Nuclear Science & Technology for Energy Security: A Challenge that Must be Met!' highlighted the challenges to scale up the nuclear power from the present share of 15% of global electricity use. He brought out that the main renaissance of nuclear power is occurring in Asia. He listed safety, nuclear proliferation, waste disposal, public acceptance, economics and skilled work force as the primary challenges to the global nuclear power growth. He suggested that the fast breeder reactors, which are capable of extending the nuclear fuel supply, need improvements to reduce cost and enhance proliferation resistance.

Shri O. P. Bhutani, Director (Engineering, R&D), Bharat Heavy Electricals Ltd., New Delhi in his talk brought out the importance of coal base power stations at least up to the year 2050. He described the technologies of 1. Supercritical, Ultra Supercritical and Advanced Ultra Supercritical, 2. Integrated Gasification Combined cycle (IGCC), 3. Underground Coal Gasification (UCG) and 4. Combined Cycles Based on Advanced Class Gas Turbines, to increase the efficiency of power generation from coal and consequently reduce the amount of emissions.

Recommendations

- Research and Development in the energy sector should get high importance and priority to meet the challenges for long term energy needs and attaining energy security and economics of power generation with due concern of climate change.
- National Mission for Development of Advanced Ultra Supercritical Technology for thermal power plants should be set up to increase the efficiency of power generation from coal and reduce the amount of emissions generated.



- Nuclear energy, in particular fast reactors, is capable of significant contribution to the energy need. Efforts should be directed to improve economics and expedite growth of fast reactors. It is clearly recognized that large scale thorium utilization is possible only with the successful and large scale exploitation of fast reactors with closed fuel cycle.
- Solar energy economics and robustness needs significant improvement and efforts should be synthesized and synergized to improve design of photovoltaic and solar thermal plants through cost effective materials and nano coatings and other thermal plants.
- Smart grids should be adopted as an attractive option and specific efforts, centric to India should be made.
- India has made significant progress in energy efficiency. The potential is immense through science and technology and smart policy interventions. Priority needs to be accorded.

2.9 Plenary: on "Nano Materials and Nano Technology"

Prof. Rinti Banerjee, IIT-Bombay, spoke Nanomedicine is an emerging interdisciplinary field which deals with the applications of nanostructured materials in the development of newer diagnostic, regenerative and therapeutic modalities for healthcare. A close interaction is required between engineers, scientists of various disciplines and clinicians for the success of this field. Given the highly experimental nature of this field, infrastructure development in terms of central facilities in the form of centres of excellence and manpower development are critical areas that need to be enhanced. Facilities for nanoparticle characterization, evaluation of biological responses and toxicity in accordance with regulatory guidelines and preclinical *in vivo* evaluation in animal models should be set up as zonal hubs catering to the requirements of the researchers in the region. Another important link is to integrate cutting edge research into the integrative curricula of medical doctors in the form of short term research fellowships or joint degree (like MD-PhD programs) between technology and medical institutes. A strong



postdoctoral fellowship program dedicated to this area would help to attract bright young researchers in this field. Incentives for high risk research and product development in nanomedicine should be given to industries with dedicated and suitably designed private-public funding schemes with fast track decision making.

Dr. Tata Narasinga Rao, ARCI, Hyderabad, discussed on the urgent need, in India, for the focus of research on application development as India is in the right position to compete globally in nanotechnology field. The industry-academia cooperation is very essential for this to happen as the present education lacks this interaction. Another suggestion about the new courses especially master courses like M. Tech is very encouraging, but the research projects for the course should be done at Institutes focusing on application oriented research or in companies working in this field. The teaching staff at the colleges and universities teaching nanotechnology courses should also be given proper training in terms of attending domestic and international conferences on nanotechnology and taking special courses on nanotechnology from experts. Introducing nanotechnology related elective papers at the bachelor degree courses may be encouraged but not complete degree course on nanotechnology, which is disastrous to the student passing out with such bachelor's degree in nanotechnology, as nanotechnology by itself is not a core subject area, rather it is a highly interdisciplinary subject. This approach is very essential for the future young researchers to get employed after graduation.

Prof. Sarit K Das, IIT-Madras, informed that the human being's everlasting hunger for energy and efficiency has brought him at the cross roads of enormously increasing high heat flux, resulting in ever increasing demands for efficient cooling. There are two very important factors which need to be addressed, the cooling fluids and surface available for heat dissipation. For the most effective cooling, the surface area should be as large as possible. This is often constrained by the space available. The space constrain can be minimized by smaller diameter channels of micron dimensions called the micro channels, which has high surface area to volume ratio. The second method is to improve the cooling liquid. The improvement in cooling liquid got a facelift when nanometer sized particles (typically less than 100nm) were suspended in liquids. The main challenge is to prepare stable nanofluids. As of now we have developed oxide, ceramic, metallic (Cu, Al) and carbon (CNT,



Graphene) based nano suspensions. This has enhanced the thermal conductivity of the fluid to an unimaginable level (41% enhancement at 50° C, 1 vol % of CNT in water). The advantage of micro channel with nanofluids seems to be a promising alternative for thermal management which can ensure high efficiency of the devices. The enhancement in convective heat transfer in nanofluids inside micro channel is over and above the expected amount, attributed to thermal dispersion brought about by particle migration. Nanotechnology has touched medicine by redefining the scale and methods of drug delivery. Cancer nanotechnology is an interdisciplinary area with broad applications for molecular imaging, diagnosis, and targeted therapy. Metal nanoparticles efficiently generate heat in the presence of electromagnetic radiation. This process becomes strongly enhanced under plasmon resonance and also depends on the shape and organization of the nanoparticles. Plasmonic nanomaterials like Poly Ethylene Glycol (PEG) protected gold nanorods have the opportunity to considerably improve the specificity of cancer ablation by i.v. homing to tumors and acting as antennas for accepting externally applied energy. Nanomaterials can also play an important role for drug delivery to the cancerous cell. By virtue of their small size, nanoparticles entail a high surface area that not only paves the way for more efficient drug release but also a better strategy for functionalization. The fundamentals for super paramagnetic nanoparticles assisted drug delivery under external low frequency magnetizing field and external laser surface heating applicable for both DNA-mediated therapy has been developed. These studies will reveal that with the advents in high-speed computing, enormous potentials do exist for developing a truly fundamental-based approach towards analyzing nanoparticles mediated treatment instead of employing tunable parameters like Specific Absorption Rate (SAR).

Prof. V. Ramagopal Rao, IIT-Bombay, informed that in the last 5 years, while some initial steps have been taken by the Department of Information Technology, MCIT, Govt. of India in improving the research infrastructure in the Nanoelectronics area, there is still a lot that needs to be done considering the enormous commercial/manufacturing potential that is offered by the Nanoelectronics field. Just to cite a few examples where India needs to bridge the huge gap that exists right now is in the areas of compound semiconductor technologies (such as



semiconductor lighting), sensor technologies, MEMS and Nano-scale fabrication etc. In order reap the fruits of research in these fields, we also need more public-private partnerships in the country, which is sorely lacking right now.

2.10 In addition to the above plenaries, the following plenaries were also held:

- (1) "International year of Chemistry - Chemistry of Future" - Chaired by Prof. C. N. R. Rao.
- (2) "Science Academies Summit" - Chaired by Prof. M. S. Swaminathan
- (3) "Science Policy - Agenda for next five years" - Chaired by Dr. Kasturirangan
- (4) "Agriculture Biotechnology for Food and Nutritional Security" - Chaired by Dr. A. Parida
- (5) "Prospective of Human Health and Disease in Modern Society" - Chaired by Dr. K. M. Katoch
- (6) "Drug Development from Discovery to Market" - Chaired by Dr. Ramendra Pandey
- (7) "Cancer, Developments of Novel Drugs for the Therapy and Prevention" - Chaired by Dr. Srikant Anant
- (8) "Challenges of Maintaining Quality Education" - Chaired by Prof. S. S. Katiyar.

A special session on "International Co-operation" was organised by Dr. Rajiv Sharma, DST.

Besides the Plenaries, public lectures were given by the following Noble Laureates : Dr. Timothy Hunt, UK; Dr. Ada E. Yonath, Israel; Dr. Amartya Sen, USA; Dr. Martin Chalfie, USA; Dr. Venkataraman Ramakrishnan, UK and Dr. Thomas A. Steitz, USA.

3.0 CHILDREN SCIENCE CONGRESS

Children Science Congress was inaugurated on 4th January 2011. Dr.(Mrs.) Vijay Laxmi Saxena, General Secretary, (Scientific Activities) ISCA, gave the welcome address. There were special lectures by Noble Laureate, Dr. Martin Chalfie; Dr. Dinesh Singh, Vice Chancellor, Delhi University; Dr. K. K. Dwivedi, advisor, DST .



Dr. Venkataraman Ramakrishnan, NL, presenting Young Scientist's Award

Children Science Congress was inaugurated by Dr. Venkataraman Ramakrishnan, Nobel Laureate in Chemistry. In his inaugural address he stressed upon the importance of research in the field of Science & Technology. Dr. Amit Krishna De, Executive Secretary, ISCA, read out the names of the Young Scientist awardees who received awards from Dr. Ramakrishnan.

The Children Science Exhibition was inaugurated on the same day at by Dr. R. Chidambaram, Principal Scientific Advisor to the Government of India. He evinced great interest in the projects exhibited by school students. Close to 100 projects from various states of India selected by NCSTC and NCERT were exhibited. Nearly 15,000 school children in and around Chennai visited the projects on all the three days and benefited out of it.

One of the highlights of the 3rd day programme was 'Meet the Nobel Laureates' held on Jan 5, 2011. Nearly 1000 school students from various parts of Chennai attended the programme. They were highly inspired by the interaction with the Nobel Laureates Dr. Venkataraman Ramakrishnan and Dr. Thomas Steitz. Prizes were given by both the Nobel laureates to two best questions.



Dr. R. Chidambaram, Principal Scientific Advisor to Govt. of India, inaugurating the Children Science exhibition

In the valedictory function held on Jan 6, 2011, Dr. (Mrs.) Vijay Laxmi Saxena, General



Dr. Venkataraman Ramakrishnan, NL,
interacting with students

Secretary, (Scientific Activities), ISCA , delivered the valedictory address and also released the book 'We are future', featuring the details of the projects exhibited by the students. It was followed by the distribution of Infoys - ISCA Travel awards to the school students.

4.0 RASHTRIYA VIGYAN SANCHARAK SAMMELAN

The 4th Rashtriya Vigyan Sancharak Sammelan, (Science Communicators Meet) was one of the important sessions during the event. which was held from Jan - 4 to 6, 2011 at SRM University , Kattankulathur Campus.

The objectives of the Rashtriya Vigyan Sancharak Sammelan / Science Communicators Meet is to:

- Enhance & encourage scientific reporting of science related issues and matters in the Media.
- Create the awareness about the need to communicate.
- Impart science Knowledge effectively to the common people.

The theme of the Meet was '*Public Communication of Scientific Research: Bridging the Knowledge divide*'. The three-day session in the Science Communicators Meet enabled aspiring scientific reporters to improve the style of reporting and interact with senior journalists and researchers in this field.

Dr. Martin Chafie, 2009 Nobel Laureate in Chemistry from Columbia University ,USA inaugurated the event on 4th January 2011. Ms Anuradha Parakkat, Director - CASM, SRM University & the Convener of the 4th Rashtriya Vigyan Sancharak Sammelan



Dr. Martin Chalfie, NL
inaugurating Science Communicators Meet

Prof P Satyanarayanan, Vice Chancellor, SRM University.

Followed by the Inaugural ceremony, the first technical session started featuring two eminent speakers Mr. Senthil Kumaran, Director, Information, Education and Communication, MSSRF, Chennai & Dr Manoj Patariya, Director & Scientist-F, NCSTC, Dept. of Science & Technology. They elaborated on the topics 'Knowledge Empowerment of Rural Communities using ICTs for Sustainable Rural Development' & 'Journalist Cooperation for Better Science Communication' respectively. Mr Kumaran also received the citation of the B.C. Deb Memorial Award for Polularasation of Science from Dr Chafie , Nobel Laureate in Chemistry .

Around 22 speakers from 12 ISCA Chapters & 6 Invited Speakers made their paper presentations & delivered the theme address in their own unique way across the three days of the Meet. Encompassing the focal theme, papers presentation topics varied from fish biodiversity, eco-friendly herbicides & seismic risk-reduction to environmental awareness, climate change & Indian agriculture. Some papers highlighted the need for scientific communication through websites, audio visual device, human computer interaction. Mr Nellai S Muthu, the ISRO scientist & novelist took the audience through the journey of Man & Space. The other topics covered were Journalist Cooperation for Better Science Communication, Outreach of Indian Space Program, Public Communication of Scientific Research, Role of Institutions & their applications in Public Domain, How Does the Indian Media Cover

brought forth the objectives of the Meet.

The other speakers during the Inaugural Ceremony were Dr K K Dwivedi, Advisor & Head, NCSTC, DST; Prof. K. C. Pandey, General President, 98th ISC; Dr (Mrs.) Vijay Laxmi Saxena, General Secretary, (Scientific Activities) ISCA; Dr Amit Krishna De, Executive Secretary, ISCA &



Change?, Health Mix Derived from some common Indian Medicinal Plants as Herbal Remedies for Malnourishment and Anti-obesity, Role of media in Science Communication, Methods of communicating communicable diseases, Emphasis on fresh water resources, etc.

The three days event had the valedictory session screening the movie 'Truth About Tigers' by Mr Shekar Dattatri, the renowned wildlife filmmaker which covered a tiger's life in detail and also enlightened the audience about the colossal damage brought by poaching on the national animal's population. He urged the gathering to form watchdog groups and use the Right To Information (RTI) Act , to influence tiger protection measures at policy level.

The Vote of Thanks was delivered by Dr A S Padmavathy, Convener of the 3rd Rashtriya Vigyan Sancharak Sammelan on the deliberations of the technical sessions & their proceedings for all the three days.

5.0 RASHTRIYA VIGYAN CHALCHITRA MELA AND COMPETITION (RVCM) -2011

During the 98th Indian Science Congress, Vigyan Prasar organized the India's First Science Film Festival at SRM University, Chennai. The festival was from 04 to 07 January 2011. The festival was known by the Rashtriya Vigyan Chalchitra Mela and Competition. It was organized to facilitate, nurture, recognize and encourage outstanding science film producers. Jangirabad Media Institute, Barabanki, UP and Tamil Nadu Science Forum, Chennai were the partners who provided the technical and event support respectively. Competition had the three categories; (a) Popular Science Programme (duration more than 20 mts), (b) Short Film on Science and Technology (duration less than 20 mts) and (c) Animation and Graphic film/video on Science and Technology .

This competition had attracted outstanding science and technology video films produced in the country and set new bench marks for excellence. There were 58 entries received in different categories. Out of these, 11 films in the 'Popular Science Programme', 09 in the 'Short film on science and technology' and 02 in the 'Animation and Graphics film on science and technology' were shortlisted.



Inaugural programme of RVCM

During the first three days shortlisted science films were screened which were well received by the viewers. The films under different categories for awards were selected by a national jury. Jury members were well known and prominent personalities of science communication. The team was lead by Mr Kiran Karnik while Er

Gauhar Raza, Mr Amar Kanwar, Mr U. Radhakrishnan and Mrs Saba Dewan were the members of the jury.

The Science Film Festival was inaugurated on 4th January 2011 by Er Gauhar Raza, Eminent Science Film Maker, and Scientist & Jury Member. Er Anuj Sinha, Director, Vigyan Prasar, gave the opening remark and welcomed the participants. The festival was well attended by enthusiast film makers, producers, delegates and science communicators.

Award presentation ceremony was at T. Ganeshan Auditorium Hall of SRM University. Guest of Honour was the Prominent Film Maker Dr Adoor Gopalakrishnan and Chief Guest was Prof. K. C. Pandey, General President of 98th ISC. Awards were presented by the Dr Adoor Gopalakrishnan and Er Gauhar Raza national Jury member of the competition.

6.0 PRIDE OF INDIA EXPO - 98th ISC

One of the most sought after and exciting part of the congress, the “Pride of India ISC Expo-2011”, showcasing India’s tremendous development and advancement in the field of science and technology in different fields was held at the sprawling campus of SRM University from 03 to 07 January 2011.

The POI expo was inaugurated by Hon'ble Union Minister of Science and Technology, Shri Kapil Sibal in the presence of Dr. M. S Swaminathan, Member of Parliament, Rajaya Sabha & Chairman MSSRF, Chennai, Dr. T. Ramasami, Secretary, Science and Technology, Dr Vijay Kumar Saraswat, SA to RM, DG DRDO & Secretary Defence R&D,



Dr. V. M. Katoch, Secretary , Department of Health and Director General ICMR, Dr. T. R. Pachamuthu, Chancellor, SRM University and other eminent scientists and personalities.

The prestigious “Hall of Pride” (HoP) this year showcased the life and achievements of two greatest sons of Tamilnadu; the natural mathematical genius, late S. Ramanujan and the distinguished businessman and philanthropist, Padmabhushan Alagappa Chettiyar. Well compiled and informative, HoP was highly appreciated by all the dignitaries.



Sri. Kapil Sibal, Hon'ble Union Minister of Science & Technology, inaugurating the exhibition

The special pavilion “EDU Vision” was created on the lines of this year’s ISC theme “Quality Education and Excellence in Scientific Research in Indian Universities”. This pavilion had the participation from prestigious institutions, universities and publishing houses showcasing their achievements and strengths.

The one day symposium “Genesis” with theme “Innovative PPP models to foster excellence in R&D in Indian Institutions” was organised on 4th January, 2011 with an idea to accentuate how crucial is Industry-Institution partnerships to encourage research which is beneficial for society, industry and economy. Prominent speakers like Prof. Samir Brahmachari, DG CSIR and Secretary DSIR, Prof. P Sathyanarayanan, Vice Chancellor, SRM University & Chairman Organizing Committee, Dr. K.K. Narayanan, Managing Director, Metahelix, Shri K. Vijayaraghavan, Chairman and CEO, Sathguru Management Consultants, Prof. K. C. Pandey, General President, 98th ISC addressed the august gathering.

“Vigyan Jyot” a new initiative introduced by MMActiv last year with the objective to popularize science and technology among masses, particularly students gained momentum this year by traveling across the nation from Delhi to Chennai, the venue of 98th ISC. Vigyan Jyot was supported by the Ministry of Youth Affairs & Sports, National Service Scheme (NSS), Nehru Yuva Kendra Sangathan (NYKS) and their



Stalls in the exhibition

centres across India. During its journey Vigyan Jyot covered a distance of over 3000 kms and touched various universities, institutions and research centers and lakhs of people and students.

True to its image, the Pride of India Expo attracted over 150 exhibitors from diverse sectors like PSU's, R&D Institutes, Innovators, States, Corporate, Central Government, Academia,

Universities etc. The exhibition was visited by large number of eminent scientists, VIP's and dignitaries apart from lakhs of enthusiastic students and general public.

7.0 VALEDICTORY FUNCTION

The Valedictory Session of the 98th Indian Science Congress was held on January 7, 2011 at SRM University, Chennai. Prof P Satyanarayanan, Vice Chancellor, SRM University welcomed the delegates.

Presentation of Best Poster Awards were announced by Dr. (Mrs.) Vijay Laxmi Saxena, General Secretary (Scientific Activities) and Dr Manoj Kumar Chakrabarti General Secretary (Membership Affairs), ISCA. Prof. K. C. Pandey, General President, presented Best Poster Presentation Awards (Certificate and a cash of ₹5,000/-) to the selected scientists in recognition of their contribution in their respective fields.



Prof. K. C. Pandey, General President, delivering speech at the Valedictory session of 98th ISC



Exhibitors were presented with excellence awards in various categories at the hands of Prof. K. C. Pandey, General President 98th ISC, Dr. P. Sathyanarayan, Vice-Chancellor, SRM and Prof. Geetha Bali, General President Elect 99th ISC. Chief Guest delivered address and Dr. T. R. Pachamuthu, Chancellor, SRM University, presented Mementos to the dignitaries.



Prof. K. C. Pandey, General President and Dr. T. R. Pachamuthu, Chancellor, SRM University, presenting Best Poster Awards

In the concluding part, Prof. K. C. Pandey, General President, handed over the Vigyan Jyot to Prof. Geetha Bali, General President Elect, with the message of further spreading the awareness of science amongst the students and taking the Jyot to Bhubaneswar, the venue of 99th ISC.

The formal vote of thanks was proposed by Prof. D. Narayana Rao, Local Secretary, 98th ISC.



Valedictory session of 98th ISC concluding with National Anthem



8.0 MAJOR RECOMMENDATIONS : EMANATING FROM THE 98th INDIAN SCIENCE CONGRESS

8.1 Recommendations from the Address of the Hon'ble Prime Minister of India Dr. Manmohan Singh

- Need to create an innovation eco- system so that innovation becomes a way of life in our knowledge institutions.
- Special attention is to be given to the growth and development of university system. Funds have sanctioned for the creation of new universities and to increase the capacity of existing ones. An Academy of Scientific and Innovative Research which seeks to produce more than 1,000 doctoral and post graduate fellows every year is being established.
- Universities have to be more hospitable to creativity and genius, and less captive to bureaucracy and procedure. They should be more open to talent and to the challenge of established ideas.
- The question is whether scientists should step beyond their discipline and at least guide the social discourse on the use of scientific knowledge. Should they develop a code of conduct that defines the limits within which they will work on the application of their discoveries? Should there be a collegial process for deciding difficult cases? The products of science have been put to illiberal uses. It is necessary to guard against such tendencies, especially in our own country.
- The Science Advisory Council to the Prime Minister prepared a report setting out a vision and a roadmap for India to become a global leader in science. The council has *inter alia* recommended measures to attract the best of talent for science. The Ministries of Human Resource Development and of Science & Technology to jointly mount efforts to attract more young people to the study of science.



- The year 2012-2013 will be centenary year of the Indian Science Congress. The Ministry of Science and Technology should designate 2012-13 as the 'Year of Science in India'.
- Modern cyber technology now allows trans-continental collaborative research. More joint research projects between Indians in India and those abroad is needed so that the global talent pool can be drawn and teaching and research base can be strengthened. The high speed National Knowledge Network will greatly facilitate such collaborations.
- It is hoped that the "Year of Science in India" will unleash the energies of our young scientists and inspire a new generation of Indians to enter the world of science, cross new horizons, explore new possibilities.

8.2 Recommendations from the Address of Sri Kapil Sibal , Hon'ble Minister of State (Independent charge) for Science and Technology and Earth Sciences

As declared by Hon`ble Prime Minister during 97th ISC, the year 2010-2020 was to be the decade of innovation. The National Innovation Council (NIC) was set up accordingly to prepare a road map for the Decade of Innovation.

- In higher education scenario the Gross Enrolment Ratio is today around a mere 15%. Changing labour markets and demographics are driving a "new" demand for higher education. This will necessitate many more universities and colleges to be opened in the years to come.
- In myriads of private and foreign education providers imparting education through conventional, distance learning and online programmes. Most of the providers are in the areas which cater to human resource needs for the growth of the industries in India. We have over 3000 engineering institutions and colleges across the country that produce aggregately nearly 5 lakh engineering graduates. The quality of education imparted is a matter of concern.
- Need for better quality education, as also new courses, new content, and new delivery standards. This is exactly what we are seeking to incorporate in



the thirty new Central Universities that we are setting up. Our vision for these universities is that they should become symbols of excellence, models of efficiency, and examples in terms of academic standards and university governance for other state and deemed universities to emulate.

- The Gross Enrolment in higher education should be doubled to at least 30% by the end of 2020, means tripling of enrolments in the tertiary sector from around 13 million to 40 million. This will entail massive capacity building, both institutional as well as human. Besides enhancing the quantum of teachers and faculty in colleges and universities quality to be improved.
- To put in place an effective quality assurance system and provide a common frame of reference for students and others to obtain credible information on academic quality across institutions, domestic as well as international. The National Accreditation Regulatory Authority for Higher Educational Institutions Bill, 2010 has been introduced in Parliament to provide for mandatory accreditation and creation of an institutional structure for the purpose.
- Plan to set up a National Commission for Higher education and Research (NCHER) for regulating higher education.
- To set up an Education Finance Corporation which will refinance educational loans to students, especially from lower income families seeking to pursue professional courses, at much more favorable terms than available presently and also provide not-for-profit educational institutions access to low cost funds.
- Need to focus on improving the quality of teaching-learning processes in our institutions of higher learning. To set up the National Mission on Education through ICT to link thousands of degree colleges and departments within universities, with a view to facilitate teaching sharing and providing access to open educational resources. The private sector is also contributing in this effort.
- Embarking on a joint initiative of the Ministry of Human Resource



Development and Ministry of Science & Technology for 'Building Educator for Science Teaching (BEST)' in mission mode.

- Need a renewal of the missions and methods of existing institutions of higher education.
- Concept of having Navratna Universities or an Indian Ivy League. Intend to nurture these select universities, like the public sector Navratnas, by generous financial support, freedom in accessing external funding and total autonomy so as to free them from shackles of government control.
- Better utilisation of the assets of publicly funded academic institutions. We believe these assets could be a catalyst for developing several forms of Public Private Partnerships.
- To set up fourteen 'Innovation Universities'. These will be unique Institutions which will set benchmarks, in academics and more importantly, in research, comparable to the best in the world in the context of problems of hunger, water, poverty and diseases through cutting edge science and technology. These Innovation Universities would be innovative in their governance, in their financial structure, in their academic and research structure, in their content and in every other way.
- To realize the Vision of India as an Innovation Hot Spot? Strategy is:
 - First, realize long term academia-industry collaborative relationships with open access to and resources free of intellectual property (IP) entanglements;
 - Second, put in place better integration of corporates with higher educational and research institutions to create a pipeline for skills that will support growth industries. This I believe will help to reduce the training costs and learning time not only for corporates but also help to develop skilled human resource.
 - Third, encourage multidisciplinary collaboration among business government, academia and R & D thereby creating an environment that



supports technological development which is aligned with and driven by industry needs.

- Fourth, recognizing the contribution of young researchers to the vitality and quality of the research system put in place more programmes for support of young researchers.
- Fifth, enhance significantly publicly funded research that reaches out to the market by engaging corporate executives as champions.
- Sixth, take up in collaboration with concerned government economic Ministries the modernisation and upgradation of technology in use by the small and medium enterprises.
- Seventh, encourage the formation of international R&D, technology and innovation consortia between Indian and foreign entities and last, provide tax incentives to businesses that collaborate with academia and R & D researchers.

8.3 Recommendations from the Presidential Address of Prof. K. C. Pandey, General President, ISCA on the Focal Theme - Quality Education and Excellence in Scientific Research in Indian Universities

- India lags behind key countries and some BRIC partners in research investment and output, particularly in the industrial sector.
- Non availability of suitable researchers in required numbers.
- India has systematically failed to capitalize on its basic research output. There is disconnect between research laboratories and industry.
- The output of research papers was practically constant from 1981 to 2000, when it started to go up, since 2004 the gradient is steep and our growth factor (vis a vis 1981) will catch up with UK, Germany, France and Japan in a few years.
- The number of papers published jointly with collaborators, abroad is about



20 percent of the total published by Indians; it has doubled in the period 1999-2003 to 2004-08.

- Our research profile is evenly balanced between physical and life sciences.
- Nonprofit research laboratories, the “ request for proposal’ system giving due support to theoretical research and support for research without strings for eminent scientists will be overall helpful to the scientific research effort.
- There are only few universities in India, known for good standards in research and teaching. Star researchers getting more salary than normal is step, helpful to quality.
- The recommendations of the three academies of science should be seriously considered for implementation. The main suggestion are:
 - Four year BS program.
 - Integrated program up to Ph.D.
 - Introduction of post doctoral programs.
 - Networking is the key to relevance and excellence.
 - Foreign universities should be welcomed to have their own campuses or to collaborate with existing institution.
 - Good teachers/researchers should be recognized and rewarded on the basis of evaluation.
 - The universities should make the management supportive of research projects rather than making it an undesirable experience for researchers.
 - Services of retired teachers should be utilized with suitable honoraria.
 - In order to attract young talent a new scheme YTS for post graduate science student with guaranteed research job should be implemented.
 - Serious consideration should be given to encourage private investment in



higher education by lifting restrictions on fees and enabling profit. This will enable the development of world class institutions.

- Special educational zones on the lines of special economic zones may be established.
- Quality Institutions, run by private corporations for profit should be encouraged.

8.4 Recommendations of Sectional Committees (as received from Sectional Presidents)

8.4.1 Agriculture and Forestry Sciences

- Cultivation of not only wheat and rice but also minor millets like Jowar, bajra and finger millet should be encouraged.

- Development of climate resilient agriculture to strengthen food security of the country.

- State government should pay more attention to farmers by implementing the national policy for farmers including proper sanitation, supply of drinking water, good delivery system and infrastructure development of storage.

- There is a general lack of excellence in the agricultural education and listed several options to improve it further which included up gradation of skill of the faculty including bringing fresh blood from outside the parent university. New initiatives taken by ICAR including modernization and renovation of class rooms, e-resources, faculty development etc. ICAR Model Act- 2009 will also be implemented to reform the agriculture education in the country.

- It is observed that universities are starved of operational funds, which affect the quality of academics and the research and development. There is need for plan allocation for agriculture education and research needs substantial enhancement in term of investment to make India a first rate country in agricultural research and education. Among the different interventions,



well- trained faculty, incentives for the faculty, International and national collaborations in research and education, National Agricultural Education Project on the lines of NATP and NAIP with support from Govt. of India are important to improve the stakes of higher agricultural education.

8.4.2 Animal, Veterinary and Fishery Sciences

- Creativity is needed for which teachers and students should be curious and there should be scientific discussions, dialogue and criticism.
- There should be inter-disciplinary attitude of teaching and research.
- Basic research should be encouraged and teachers should generate interest in the young minds to come forward to accept the challenges of the emerging trends in animal sciences.

8.4.3 Anthropological and Behavioural Sciences (including Archaeology, Psychology, Educational Sciences and Military Sciences)

- In the light of the theme of the 98th Science Congress, i.e. “Quality Education and Excellence in Science Research in Indian Universities”, the existing curricula of all the disciplines under the section should be revised and updated as far as possible and see that a parity should be maintained in the Indian Universities and also ensure quality discourses.
- The present teaching and research programme on human sciences, such as Bio-Archaeology, evolution and human migration, DNA mappings, Socio-cultural conflicts etc. should be strengthened.
- Different sub-committees may be constituted at the national level in order to examine and carry out necessary ground works and make proper recommendations.
- As has been felt that a comprehensive survey on food and nutritional status of the people of India, specially the children is necessary and for that, services of the Anthropologists who are trained in the techniques of



nutritional assessment and nutritional ecology may be utilized.

8.4.4 Earth System Sciences

- A new strategic international and interdisciplinary approach to science is necessary to exploit fully the existing knowledge to identify and address the geo hazards.
- A key role of ESS in natural hazards / Risk and Mitigations, water management, interfacing of geology and agricultural sciences and climate change.
- To develop manpower in mathematical modeling and computer simulations for better understanding of processes and phenomena of ESS, which can fill up the present and future needs of the country.
- Research & explorations in gas hydrates and nuclear mineral resources as an alternating energy resources.
- The Earth system Science is for the integrated study of the Earth System, the changes that are occurring to the system and the implications of these changes for global sustainability.

8.4.5 Engineering Sciences

- There is a strong need of promoting ethical conduct in science education and research.
- Every researcher should swear an ethical oath of science.
- Scientific knowledge should be used for sustainable development.
- Science and engineering education should provide skills and tools to deal with sustainable development process with 'Holistic Approach'. The current decision making process needs to shift from cost benefit analysis into 'Multi-criteria Decision Making' in the face of uncertainty.
- There is need to include in modern teaching and research the concept of



Green, Clean Closed Cycle operational CSR, Ecological foot prints and Security.

- Multi-disciplinary stake holder approach must find place in research and teaching to ensure sustainable development.
- To boost research, a parallel cadre of Research Professors, Research Associate Professors, Research Assistant Professors, and Research Lecturers etc. is required.
- Basic research should be encouraged in the universities.
- For economic benefits of research being carried out at various universities in addition to R & D, training in delivering aspects of research projects is very much required.
- Civil conscience is required to stop upward trend of environmental pollution.
- Need to increase awareness of importance of science and technology in daily life of Indians.
- Environmentally sound technologies should be promoted.
- Ways should be found to empower women as a resource for science and technology.
- Need to remove social obstacles and barriers that continue to exclude girl children and women from the study of science and technology.
- Energy should be saved through proper energy management techniques and conservation measure.
- Use of Biomass fuels should be promoted for sustainable development.
- Green technology should be adopted.
- Use of Ethanol may be promoted for sustainable development as alternate fuel.



- Continuous energy audit along with environmental audit is required for sustainable development of the technologies.

8.4.6 Environmental Sciences

- Appropriate Phytoremediation methods have to be initiated to combat various environmental problems.
- For clean, Ecofriendly and Green Technology there is a need of integrated management strategies involving different sections of the societies viz. Govt. Organization, NGO, Scientists, Researchers, common Public.
- Awareness on Environmental issues need of the hour, emphasis must be given on this field.
- Plastic below 40 Microns should be banned instead 20 microns to combat its ill impact.
- Climate Change: Case studies in Central Himalayas and Gangetic plains are shown that there are already adverse affect of climate change. There are certain adaptation Technologies that should be practiced and incentives be provided to poor small farmers to adopt them. At the same time there is a need of furthers researches to develop new technologies to mitigate the adverse affects of climate change and global warming.
- For effective use of role of media in specific dissemination of News related to, environment, the journalists must be well educated, i.e. there is a need of Environmental Journalism.
- An urgent need of conservation of natural resources like Water, Biodiversity (Flora and Fauna)
- Need of Rehabilitation of degraded lands by eco restoration process.
- Need of Reclamation of abandoned mined area.
- Solar energy, wind energy used Biomass to be utilized as alternative sources



of energy. Extensive energy Plautatious should be taken up.

- Application of Biofertilizer, Biopesticides & Biotoxides should be enhanced for sustainable Environmental management.
- Need of Carbon trading / carbon reduction through carbon credit and CDM.
- It is important to insure safe and pure drinking water (Arsenic and Fluoride free) in several parts of India.

8.4.7 Information and Communication Science and Technology (including Computer Science)

- Factors that contribute to empower People & Society , Governments, regulators and operators should look for innovative ways of promoting community access to empower people in rural areas to join the rest of the virtual world. For example, community access points, such as rural Internet kiosks, can create a chain reaction, leading to demand for more connectivity throughout rural areas and hastening the development of local economies.
- Mobile phones have allowed farmers to sell their crops directly to the highest bidder & It is estimated that increasing broadband use by 10 per cent would increase Gross Domestic Product (GDP) by more than 1 per cent .
- Community access represents a huge opportunity in changing lives, especially in the rural areas of developing country like India.
- The example of a solar-powered, self-contained, Internet rural kiosk cited during the various discussion why the Internet, and more broadly ICT, is in such high demand by people who in many cases do not have enough to eat or safe water to drink.
- The kiosk can operate in any environment and can bring the power of Internet access to any village.
- In the present era of globalization of education and research, quick access to information and widespread dissemination of knowledge has become very



important. On the research front, sharing of scientific knowledge through journals, conferences and other means is mired in many problems. Journal costs are escalating and conferences have their own inherent problem of high costs involved in organizing or attending. Further, everyone interested cannot attend all conferences.

- Improving ICT legislation, regulations, and enforcement are high priorities because most of the states lacks laws and regulations protecting researchers & consumers “confidential information and privacy”, national copyright and intellectual property laws are poorly enforced, and inadequate regulatory structures govern the Internet and telecommunications.
- A viable and enforced legal regime must be in place to accelerate technology development and e-commerce. Governments should share legal research and analysis to speed promulgating laws and Regulations to:
 - Protect personal data and information privacy;
 - Protect Internet-related intellectual property, publishing rights, & software applications and accelerate the introduction of e-commerce legislation
 - Green technology: Using ICTs to tackle climate > change and environmental challenges.
 - National & State Level Initiatives Programmes in Environmental Protection/CO₂ Pollution Awareness in Schools, Colleges and Universities. National Awareness Programme dedicated to help save the planet from global warming.
 - The whole society benefits of this action due to a reduced environmental impact. Energy, Education, Governance and Schools.
 - Schools need to give consideration to environmental education, not just within the curriculum but across all areas of school life. A positive attitude towards the environment should be reflected in the aims of the school and



consideration needs to be given to waste issues when developing policies for purchasing, efficient use of resources, waste collection, maintenance of the school and its' grounds and other aspects of school life.

- In order for today's students to function in the 21st century, they must be able to acquire, evaluate, and use information technology tools effectively. Today's students must become information literate workers, teachers, facilitators and coaches. Designing technological solutions and pondering benefits and risks should be an integral part of the middle school science experience. As students take the initiative to learn science and technology, they will learn about themselves, their community and potential career paths. The confidence to pursue such personal goals can be instilled through successful science experience.
- Children can act as a powerful lever and positive force for change, both at school and at home. School, college & universities should have programme to encourage students/children to recycle, most considered that information and advertising were paramount, but sadly lacking.

8.4.8 Mathematical Sciences (including Statistics)

- It is strongly reiterated that the birth day of Legendry Indian Mathematician Srinivasa Ramanujan, which is December 22, should be declared by the MHRD, Government of India as National Mathematics Day. By doing so we will not only remember the great Indian genius, but also will succeed in making mathematics a popular subject by organizing various events for schools / colleges / university students. Moreover, such an attempt shall inspire both our students and teachers towards mathematics.
- In order to ensure the quality of research, for any person it should be compulsory before he or she can submit his/her Ph.D. / D. Phil. thesis that two of his/ her research papers must have been accepted/ published in a refereed journal of mathematics. A research announcement in good journal of mathematics can be taken as equivalent to research paper.



8.4.9 Medical Sciences (including Physiology)

- Iodine deficiency disorders (IDD) are major public health problem in India and supplementation of iodine through iodized salt has been taken as only measure to prevent and control IDD. However, inspite of iodine supplementation more than a decade IDD is still a moderate public health problem in many regions of the country. Therefore with successful iodization programme, identification of region specific environmental goitrogens / anti thyroidal factors and their possible amelioration are very important.
- Positive and strong infrastructure requires to be developed to ensure a self - enforcing industrial environment where assurance of occupational health and safety are the norms.
- Melatonin has therapeutic prospects as a free radical scavenger in the reduction of oxidative stress in humans and economically important animals.
- Proteins promoting sperm motility and immortality factors in sperm head and epididymis has therapenstio prospects in the manipulation of fertility control/family planning.
- Adult brain stem cells may be used to control Alzheimer's and Parkinson's diseases.
- Polyunsaturated fatty acid in diet influences embryo survival in farm animals.
- An intronic polymorphism of Adiponectin gene and lower adiponectin levels associated with rapid growth of economy with changes in eating habits and marked decrease in physical activity are the possible factors for diabetic epidemic in India.

8.4.10 New Biology (including Biochemistry, Biophysics & Molecular biology and Biotechnology)

- The quality of scientific presentations both by invited speakers (including



oral presentations) and posters are becoming of high standard day by day.

- More than two prizes should be kept for the poster presentations in this Section.
- It was also proposed that one special prize may be kept for the undergraduate students.
- More abstract books should be published and distributed in the venue to the participants.

8.411 Plant Sciences

- India being one of the 12 mega diversity centres is very important for biodiversity. During the past several decades, biodiversity has been considerably explored all over the world But still there is greater scope and need to continuously explore and update the biodiversity base of all the groups of plants. In the recent years the lower plants seems to have received little attention unfortunately. These groups of plants need greater attention, support and encouragement as they are even more important ecologically and biologically.
- Equally and even more important is the *ex situ* and *in situ* preservation of the known biodiversity.
- *Ex situ* for both wild and cultivated plants by using modern techniques like cryopreservation, tissue culture and micro propagation
- Major and small biodiversity spots require immediate attention for conservation as they are rich in numbers as well as populations.
- Greater emphasis should be laid on biodiversity based and supported biotechnology by making biotechnology more relevant to human welfare and at the same time providing broader and stronger base to biotechnology. Therefore studies on ethno botany should be earnestly undertaken as many areas are still unexplored from ethno botanical point of view, more

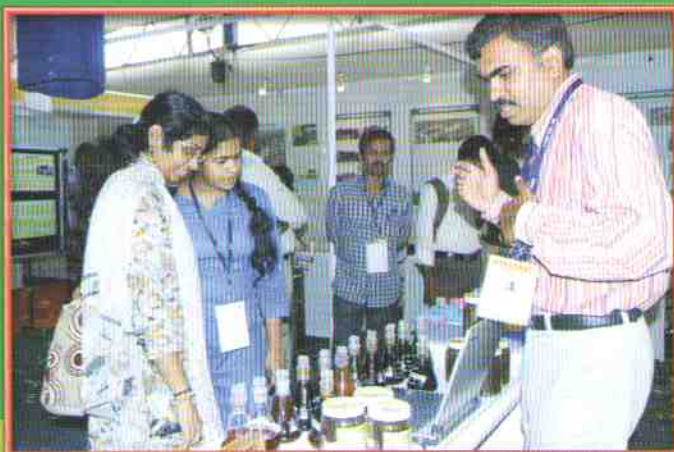


importantly such important areas are gradually and at times suddenly shrinking because of cultural invasions.

- Exploration of endophytes, secondary metabolites, nutraceutical potential of medicinal plants, mushrooms and lichens etc. and studies on nanomaterial's need to be undertaken with greater emphasis and direction so that the recorded biodiversity is put to greater use for the welfare of the society.
- More grants for Botanical Gardens, Herbaria and museum, should be provided. More centres for conservation of biodiversity should be established in different regions in addition to those already in place so that every bit of biodiversity wealth is recorded. More jobs for maintaining such centres should be provided with proper promotional avenues so that young people are attracted and play their role efficiently in the conservation of this national wealth which is extremely valuable for all future ventures.



Pre Conference Press Meeting



Visitors at Science Exhibition



School students attending Children Science Congress inauguration



Inaugural programme of Science Communicators Meet



Dr. Kapil Sibal, Union Minister of Science & Technology with other dignitaries



Prof. C. N. R. Rao delivering lecture



Prof. P. Satyanarayana, Vice Chancellor, SRM University, delivering address



View of Science Exhibition



Dr. R. Chidambaran, Principal Scientific Advisor to Govt. of India, at Children Science Exhibition



Dr. Martin Chalfie, NL, delivering lecture



Cultural Programme



Prof. K. C. Pandey, General President, 98th ISC handing over Vigyan Jyot to Prof. Geetha Bali, General President Elect