

103RD INDIAN SCIENCE CONGRESS : A BRIEF REPORT

The 103rd Indian Science Congress was inaugurated in the morning of January 3, 2016 at university of Mysore by Shri. Narendra Modi, Hon'ble Prime Minister of India, in the presence of Shri. Rudabhai Vajubhai Vala, Hon'ble Governor, Karnataka State; Dr. Harsh Vardhan, Union Minister of Science & Technology & Earth Sciences, Shri Y.S. Chowdhary, Union Minister of State (Science & Technology & Earth Sciences), Government of India; Prof. K.S. Rangappa, Hon'ble Vice Chancellor, Mysore University, Shri Siddaramaiah, Hon'ble Chief Minister, Karnataka, Prof. CNR Rao, Bharat Ratna and Dr. Ashok Kumar Saxena, General President, The Indian Science Congress Association.



Dr. Ashok Kumar Saxena, General President, Indian Science Congress Association welcomed the dignitaries and delivered his Presidential Address, on the focal theme “Science and Technology for Indigenous Development in India”. Then Dr. Harsh Vardhan, Hon'ble Union Minister of Science & Technology and Earth Sciences, Government of India gave his speech. Shri Siddaramaiah, Hon'ble Chief Minister, Karnataka State delivered his address.



The Hon'ble Prime Minister of India, Shri Narendra Modi released the 103rd ISC Plenary Proceedings and presented ISCA awards to scientists (including Award 2014-2015, Vikram Sarabhai Memorial Award to Dr. M.Y.S. Prasad, Sriharikota. He also felicitated and gave mementoes to Nobel Laureates Prof. John B. Gurdon, Prof. David J. Gross, Prof. Dan Shechtman, Israel, Prof. Serge Haroche, Prof. Arthur B. McDonald, and the winner of Field Medal Prof. Manjul Bhargava. He also presented special prize for scientific work done on addressing disabilities. He then delivered his inaugural address.



Prof. K.S. Rangappa, Vice Chancellor, University of Mysore gave vote of thanks.

The inaugural session was attended by a large number of foreign scientists, distinguished scientists, academicians, Vice Chancellors of various universities, Members of Parliament, senior functionaries from the State government, representatives from industry, students and scholars.

5TH WOMEN'S SCIENCE CONGRESS

The 5th Women's science congress was organized with the theme "Science & Technology for Indigenous development of Women in India".

Honorable Union HRD Minister Smt.Smriti Irani inaugurated the Women's Science Congress on 4th January 2016 and enumerated the contributions made by the leading past and present women scientists. In the keynote address Dr.Soumya Swaminathan, Secretary DHR, DG-ICMR, New Delhi, touched upon the role played by women in the areas of education, research, extension activities, management and policy making bodies.

The technical sessions were held on 5th and 6th January. Five plenary lectures were delivered by- Dr.Prema Ramachandran, Director, Nutrition Foundation of India, New Delhi, Dr.Kaiser Jamil, Head -Genetics Department, Hyderabad, Dr.Tessy Thomas, Project Director, DRDO, Hyderabad and Prof.Rajalakshmi Sriram, UGC-Emeritus Professor, MS university, Baroda. Eminent scientists from premier R&D institutes/Universities delivered lectures. Scientists from DST, New Delhi presented initiatives undertaken by Department of Science & Technology in promoting gender equality and empowering women to adopt Science & Technology.



During the event, women scientists discussed their scientific achievements on the following issues:-

- a) Improving health of the community particularly at the rural level
- b) Small scale entrepreneurship activities
- c) Research on new biomarkers for the diagnosis and prognosis of diseases such as Chickungunya, Filaria, Leishmeniasis etc
- d) Gender discrimination and gender bias aspects

Opportunities for women to overcome the trajectories and contribute to science & Technology were also covered. It is about time that women get support and recognition to pursue higher education and an environment for nurturing promoting women scientists in India.



Ms.Vasanthi Hariprakash, Former NDTV correspondent was the event anchor for the women's science congress. The women's science congress was sponsored by Department of Science & Technology, SEED division, Government of India.



The two day technical sessions were attended by more than 150 delegates including faculty, research scholars and students from various Universities/Institutions across the country. The event organization and quality of technical sessions was rated as excellent by the participants.

CHILDREN SCIENCE CONGRESS

The Inauguration was held at the Amphitheater, University of Mysore on 4th January 2016. After the invocation by the students of Fine Arts College, University of Mysore, Prof. Arun Kumar, General Secretary (Scientific Activities), ISCA welcomed the gathering. The Children Science Congress was formally inaugurated by lighting of the lamp by Nobel Laureate Prof. John Gurdon and other dignitaries on the dais. Vice Chancellor Prof. K S Rangappa, University of Mysore, delivered keynote address. On this occasion, He released 'Billion Beats' the Pulse of India (Vol.1, Jan 2016) published by the Dr. A. P. J. Abdul Kalam International Foundation (Hq Rameshwaram) featuring the science stories and the dreams of the youth of India. The abstract book containing the selected project reports of the children scientists participating in the children science congress was also released on this occasion.



Dr. Achytha Samantha, Founder, KIIT and KISS, Bhubaneswar, spoke on the occasion and emphasized the significant contribution of the country in the field of science from times going back to the Harappa and Mohenjadarro civilization. He also lauded that in Mathematics, the ancient India had given to the world the great numbers zero, pi and negative numbers and thus provided a strong foundation to the scientific edifice of all nations.

Dr Ashok Kumar Saxena, General President, ISCA, remembered the late president Dr A P J Kalam in his speech and said that he himself a scientist was dearest to the whole children community. The great man always intended that the children should get inspired by science and should develop a liking for science. He added that the ISCA is therefore not only trying to light

the lamp of science in every young mind but also striving to realize the dream of Dr A P J Kalam to make India a corruption-free nation.

Dr Amit Krishna De, Executive Secretary, ISCA conducted the Declaration of Infosys ISCA Travel Awards are given annually upto 12th standard students at the ISCA award session. Dr Ujjwala T. Tirkey, Coordinator, National Children Science and Technology Communication, DST, spoke on the occasion. The programme concluded with the vote of thanks by Dr .N B..Basu, General Secretary, ISCA. Prof C Naganna was the master of ceremony for this inaugural function.

All in all, the children science congress was a very successful event with 58 entries under NCSTC from 30 states participating in this national mega event. Besides, there were 14 NCERT entries from 10 states, 4 entries from Kendriya Vidyalaya and 2 entries from Jawahara Navodaya Vidyalaya.

The valedictory marking the end of the event was held at Senate Bhavan Auditorium, University of Mysore on 6th January 2016 at 2.30 pm. The dignitaries for the valedictory were, Prof K S Rangappa, honorable Vice Chancellor of University of Mysore, Dr. Ashok K. Saxena, General President, ISCA, Prof. Arun Kumar, General Secretary, ISCA and Dr. Ujjwala Tirkey, Scientist F, DST. Prof. K. S. Mallesh, Convener, RKVS subcommittee proposed the vote of thanks. Madam Sreemathi Hariprasad, member of the subcommittee compered the valedictory programme.



9TH SCIENCE COMMUNICATORS' MEET

The 9th Science Communicators' Meet was inaugurated on 5th January 2016 by Prof Dan Shechtman, Nobel Laureate, Israel Institute of technology, Haifa, Israel, in presence of Dr. Prabhat Ranjan, Department of Science and Technology, New Delhi, Prof Rangappa, Vice

Chancellor of Mysore University, Dr Ashok Kumar, General President of ISCA, and Prof Arun Kumar, General Secretary (Scientific Activities), ISCA.



Defence Research Development Organization (DRDO), New Delhi, Director General (Life Sciences) Dr. Manas K Mandal delivered a talk on 'Opportunities and Challenges of Science Communication in India' and Professor in Forestry and Environmental Sciences K N Ganeshiah delivered a talk on 'Role of Scientists in Extracting and Communicating Science from Traditional Beliefs and Practices'. On 6th January 2016, former vice chancellor of Manipal University B M Hedge spoke on 'Science, Business and the Reality' and Scientist at Head Science Communication Through Multimedia, New Delhi, Gauhar Raza delivered a lecture on 'Scientific Temper a Necessity for Indigenous Development'. In the afternoon session, Vigyan Prasar, New Delhi, Director R Gopichandran spoke on 'Is Science Popularisation in India Oversimplified?: Provide Strategically Important Support to Missions for Better Engagement', former VC of University of Mysore S N Hegde addressed on 'Science and Technology for Enhancing the Quality of Life' and Vinod Kumar of University of Delhi threw light on 'Communicating Basic Life Science Research to Stakeholders: A need for the Paradigm Shift'. Former VC J Shahshidhar Prasad, University of Mysore and R K Sharma of DRDO and Prof Raja Sabh Tumkur University and Prof Mewa Singh chaired the sessions.



Former University of Mysore VC Prof S N Hedge delivered an address at the valedictory function. Dr. Gopichandran, Director, Vigyan Prasar, University Registrar Prof C Basavaraju and the science communicator's meet convener Prof Ravishankar Rai were present. Vote of Thanks was presented by Dr Arun Kumar Pandey, Assistant Executive Secretary, ISCA.

Pride of India Expo

The Pride of India (PoI) Expo, was inaugurated by Dr. Harsh Vardhan, Hon'ble Union Minister of Science and Technology and Earth Sciences in the presence of Dr. Ashok K Saxena, General President, Indian Science Congress Association and other dignitaries.



Special Pavilions at PoI Expo were “Hall of Pride” (HoP), dedicated to the life and works of Former President Dr. APJ Abdul Kalam - *The Missile Man* and “Edu Vision”. A one day symposium “Genesis”

with theme "Realizing the Make In India Mission through Indigenous Development - Role of MSME" was organized .

Vigyan Jyot (VJ) – *Flame of Knowledge* was flagged off ceremoniously, mounted on a float on 01 January 2016 from Bengaluru and received at the University of Mysore in a glittering function. The VJ was relit at the site of PoI Expo by Dr. Harsh Vardhan and other dignitaries. During the valedictory function, the VJ Torch was handed over to Prof D. Narayana Rao, General President Elect 104th ISC by Dr. Ashok Saxena, General President ISCA.

Spread over an area of approx. 20,000 sqm, the PoI Expo received tremendous response with the participation of over 150 organizations. The expo depicted confluence of new ideas, innovations and products covering the entire canvas of scientific world. It was a splendid display of cutting-edge technologies, leading scientific products and services, path breaking R&D initiatives and achievements of India's foremost and leading public and private sectors, government departments, research labs, educational institutions, corporate, defence etc. The PoI Expo was visited by over 5 lakhs visitors.





VALEDICTORY FUNCTION

The 103rd session of the Indian science congress concluded on January 7, 2016. Welcome address was delivered by Prof. K.S. Rangappa, Vice-Chancellor, University of Mysore followed by Report by Dr. Ashok Kumar Saxena, General President, ISCA. On the occasion, the General President (Elect) Dr. D Narayana Rao announced that the 104th Indian Science Congress would be held at SRM University, Chennai from January 3 to 7, 2017.

Shri. T.B. Jayachandra, Pro-Chancellor, Hon'ble Minister for Higher Education, Law and Parliamentary Affairs, Government of Karnataka delivered his address. On this occasion the Young Scientist Awards and Best Poster Awards were also presented.



Valedictory address was delivered by Shri. H.D. Deve Gowda, Hon'ble Former Prime Minister and Member of Parliament and Presidential address by His Excellency Shri. Vajubhai Rudabhai Vala, Governor and Chancellor, Karnataka

Prof. C. Basavaraju, Registrar, University of Mysore presented the formal vote of thanks'





Public and Plenary Programme Schedule

Sl. No.	Special Session	Name of Chair Person/ Speakers
1.	Special Session I: Panel discussion with Nobel Laureates – Science and Technology: Present and Future	<p>Chair: Bharatha Rathna Prof. C.N.R. Rao, Bengaluru</p> <p>Co-Chair 1. Prof. K. S. Rangappa, Vice-Chancellor, University of Mysore, Mysuru 2. Dr. Ashok Kumar Saxena, General president, ISCA, Kolkata</p> <p>Speakers: 1. Prof. Arthur B, McDonald, USA 2. Prof. Dan Schetman, Isreal 3. Sir Prof. John Gordan, UK 4. Prof. Serge Haroche, France 5. Prof. David J Gross, USA 6. Prof. ManjulBhargava, Fields Medallist, USA</p>
2.	Special Session II: “Value of Science for Society and Public”	<p>Chair: Prof. Ashutosh Sharma, Secretary, DST, Government of India, New Delhi</p> <p>Co-chair: Prof. K. S. Rangappa, Vice-Chancellor, University of Mysore, Mysuru</p> <p>Prof. C.N.R. Rao, Bengaluru Prof. Arthur B. McDonald, Nobel Laureate, USA Dr. K. Kasturirangan, Bengaluru Prof. Dan Shechtman, Nobel Laureate, Israel</p>
3.	Special Session III: STI Policy	<p>Chair: Dr. M. K. Bhan, Former DBT Secretary, New Delhi.</p> <p>Speakers:</p> <ol style="list-style-type: none"> 1. Prof. R. C. Solti, Vice-Chancellor, - Babasaheb Bhimrao Ambedkar University, Lucknow 2. Dr. Baldev Raj, Director, National Institute of Advanced Studies, Bengaluru 3. Prof. K. B. Akhilesh, Indian Institute of Science, Bengaluru 4. Prof. AmbujSagar, Indian Institute of Technology, New Delhi 5. Prof. R. Tewari, Punjab University, Chandigarh 6. Dr. Neeraj Sharma, Advisor & Head,

	Department of Science & Technology, New Delhi
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Sl. No.	Title	Name of the Chair Person/ Speakers
4.	“Session of Nanoscience”	Chair: Prof. A. K. Sood, Bangalore Speakers: 1-Prof. G. U. Kulkarni director, Bangalore 2- Dr. Ashok Ganguly, Mohali-
5.	“Space Science, Technology and Applications”	Chair: Dr. Kirankumar, ISRO, Bangalore Co-Chair: Prof. D N Rao, Chennai Speakers: 1.S. K. Shivakumar 2.V. Koteswararao 3.Vinay K. Dadhwal 4. S. Somanath 5.M. Annadurai
6.	Session on: Government’s view Points on Science and Technology	Speakers: Secretaries of DST, DBT, DSIR/CSIR, MOES, MOEF, MNRE, DEITY, ICAR, ICMR, DRDO, DOS, DAE, Dept. of Pharmaceuticals, S&T Wing of Niti Aayog (Dr. V.K. Saraswat, Sr. Adviser and Joint Adviser)
7.	Recent Advances Towards Cellular Basis for Clinical Disorder	Chair: Prof. S.S.Parmar, Speakers: 1-Professor Andrew J. Greenshaw, Canada

		<p>2- Professor Jonathan D. Geiger, USA</p> <p>3- Professor Anil Kumar, USA</p> <p>4- Professor S. Jamal Mustafa, USA</p> <p>5- Professor Madhavan Nair, USA</p> <p>6- Professor Othman Ghribi, USA</p> <p>7- Professor Joyce Ellen Ohm, USA</p> <p>8- P.K. Seth, Lucknow</p>
8.	“Sustainability and Future Generation Wireless Networks”	<p>Chair: Navarati Saxena South Korea</p> <p>Co-Chair: Abhishek Roy South Korea</p> <p>Speakers:</p> <p>1byeungwoojeon South Korea</p> <p>2-Prof. Jung Hyun Jun IIT Ropar</p> <p>3-Prof. SnehanshUSAha, Bangalore</p> <p>4- Vaskar Ray Chaudhary IIT Roorkee</p> <p>5- Hye Young Kim, South Korea</p> <p>6-Ashishsrivastava- USA</p>
9.	Session of Diabetes	<p>Chair: Prof. D. Shantaram Chennai</p> <p>Speakers:</p> <p>1-Dr. V.Seshiah, Chennai.</p> <p>2-Dr. V. Mohan, Chennai</p> <p>3- Dr. Prasanna Kumar, Bangalore</p> <p>4- Dr.S.R. Aravind, Bengaluru</p>
10.	“Evolution: The Frontiers”	<p>Chair- Prof. H.A. Ranganath Bangalore</p> <p>Speakers:</p> <p>1-Prof. Raghavendragadagkar, Bangalore</p> <p>2-Prof. Rama Shankar Singh, Canada</p> <p>3-Prof.Radhey S. Gupta. Canada</p>
11.	Novel Mechanisms Underlying Allergic Airway Inflammation And Bronchial Asthma	<p>Chair: Devendra K. Agrawal, USA</p>

		<p>Co-Chair: Prof. H.P.Tiwari, Allahabad</p> <p>Speakers: 1-Dr.Rajkumar, New Delhi 2-Dr.P.A.Mahesh, Mysore 3- Dr.A.Sanjiv Sur, USA</p>
12.	<p>“Discovery & Development of Novel Drugs Make in India: Challenges and Avenues.”</p>	<p>Chair: Prof. S Rajarajan, Sonipat</p> <p>Co-Chair Prof. S B Mahato Kolkata</p> <p>Speakers: 1-Dr. V.K. Subburaj, IAS, New Delhi 2-Dr. Simon Craft, London 3-Tom Blundell, Cambridge 4-Alan P. Kozikowski, USA 5-Dr. G.S .Samathanam, Sonipat</p>
13.	<p>“Bigdata Biotechnology : Challenges and Opportunities for India”</p>	<p>Chair Prof. Madan Mohan, Delhi</p> <p>Speakers: 1-Dr. Vinay Panda, Bangalore 2-Dr. A.K. Mishra, New Delhi 3-Dr. Dinesh Gupta, New Delhi 4-Dr. M. Michael Gromiha, Chennai</p>
14.	<p>“Atomic Energy.”</p>	<p>Chair: Dr. R.K. Sinha, Mumbai</p> <p>Speakers: 1-Dr.S.F.D’souza,Mumbai 2-Dr.K.B.Sainis,Mumbai 3-Dr.P.K.Tewari,Mumbai 4-Dr.S.Banerjee</p>
15.	<p>“Biodiversity Conservation: Current Status and Road Map for the Future”</p>	<p>Chair: Prof. R. Ramamurthi, Tirupati</p> <p>Speakers: 1-- Dr. M.S. Nagar, New Delhi 2-Dr. R.S.Rana, New Delhi 3-Dr.Giridhar A. Kilhal, Bhopal 4-Dr. S. Subramoniyam, New Delhi</p>
16.	<p>“Molecular Targets and Cancer Therapeutics.”</p>	<p>Chair: Prof. Sir Tom Blundell</p>

		<p>FRS, Cambridge</p> <p>Speakers: 1- Prof. Peter E Lobie, Singapore 2-Prof. Peter J. Houghton-USA 3-Prof. Alan Fersht, Cambridge 4-Prof. Mary- Ann Bjornsti, USA5-Prof. Shin-Ichiro Nishimura, Japan</p>
17.	“Safe Water and Sanitation”	<p>Chair : Prof K.J.Nath Co-Chair:Dr.N.B.Basu, Kolkata</p> <p>Speakers: 1-Dr.Bindeswarpathak, New Delhi 2-Dr.Sunita Narayan, New Delhi 3- Dr.Pradeep P, Chennai 4-Dr.V.S.Chari- India</p>
18..	“A Frontier in Science and Human Benefit.”	<p>Chair: Prof. B.P.Chatterjee Co-Chair: Prof. Abhijeet Banerjee, Kolkata</p> <p>speakers: 1-Dr. Hafiz Ahmed,USA 2-Prof. Jan Johansson, Sweden 3-Prof. G.V. Maksimov, Russia 4-Prof. S.Mukhopadayay, Kolkata 5-Prof.Kasturidatta, New Delhi 6-Asim K.Dattaroy,Norway</p>
19.	“Recent Advances in Male Reproduction.”	<p>Chair: Prof. P.P.Mathurbhubaneshwar Co-Chair: Manu Saxena, USA</p> <p>Speakers: 1-Prof.Manuela Simoni-Italy 2-Prof.C.V.Rao. USA 3-Dr.Vassilios Papadopoulos. Canada 4-Dr.Dianne Creasy.USA 5-Dr.Martine Culty. Montreal</p>
20.	“Preparing the Bioscience Workforce for Emerging Technologies”	<p>Chair: Prof Sulathadwarakanath USA</p>

		<p>Speakers: 1-Dr. Russ H Read USA 2-Dr.Linnea Fletcher USA 3- Dr.Soniawallman USA 4-Dr.Elaine Johnson, USA</p>
21.	<p>“Novel Translational Targets in Cancer and Other diseases.”</p>	<p>Chair: Prof. Shrikantanant,USA Co-Chair: V.L. Saxena Kanpur</p> <p>Speakers: 1-Prof. George Weiner, USA 2- Prof. Roy Jensen, Kansas, USA 3- Prof. Victoria L. Seewaldt, USA 4- Prof. Vinata B. Lokeswar, USA</p>
22.	<p>“Biodiversity Database Integration for the Benefit of Human Kind.”</p>	<p>Chair: Prof. Sudarshan Kumar, Lucknow Co-Chair: Prof S.P. Singh Kurukshetra</p> <p>Speakers: 1-Dr. RC Agarwal, New Delhi 2-Dr. G.P.S RAGHAVA, Chandigarh. 3-Dr. Anil Rai, New Delhi 4-Dr.Munazza Yousra-Pakistan</p>
23.	<p>“Genetic Dissection of Complex Diseases.”</p>	<p>Chair- Prof. H.S. Sharat Chandra Bangalore</p> <p>Speakers: 1-Prof. R.N.K. Bamezai, Delhi. 2-Prof. Aravinda Chakravarti, USA 3-Dr. Sathees C Raghavan, Bangalore</p>
24.	<p>“Insect Biology”</p>	<p>Chair- Prof. L.S. Shashidhara, Pune</p> <p>Speakers: 1-Prof. Volker Hartenstein, USA 2- Prof. D. Channegowda-USA 3-Prof. L.S. Shashidhara, Pune</p>

25.	“Prevention and Therapeutic Approaches in Cancer and Other Diseases.”	Chair: Prof. Animeshdhar, USA Co-Chair: Dr. Manoj Chakraborti, Kolkata Speakers: 1-Dr.Chendildamodaran, USA 2-Dr.Prajna Dhar, USA 3-Dr.Balkrishnalokeshwar, USA
26.	“Biogas Production, Power Generation and Purification of Vehicullar Applications.”	Chair: Prof. Virendra K. Vijay, Delhi Speakers: 1-Dr.Varsha Joshi - Delhi 2- Dr.Hoysall N Chanakya, Bangalore 2-Dr.Deepak Sharma, Udaipur 3-Dr. Deben C Baruah, Tezpur
27.	“Recent Advances In Medical And New Biology.”	Chair: Dr. R. Ravi Kumar, USA Speakers: 1-Dr. R.Lalitha, USA 2-Dr. Prasad Dhulipala, USA 3-Dr. Rohinidhulipala, USA 4-Dr. Krishna Dronamraju, USA 5-Dr. Arunaloke Chakravorti, Chandigarh
28.	“Panel Discussion on Skill Development in Engineering Manufacture for Make in India Initiatives.”	Chair: Prof. N.K. Aatre Co-Chair -Prof. L.S. Satya Murthy Speakers: 1-Col. H.S. Shankar, Bangalore 2- Dr. R.M. Vasagam ,Chennai 3-Dr. H. Maheshappa, Belgaum 4-Dr. G. Raj Narayan, Bangalore
29.	Diseases and Drug Development	Chair: Prof. Tej Pal Singh Speakers: 1-M.R.S.Rao 2-Tapas K. Kundu 3-Prof. Tej Pal Singh

		4-Manju Nathakini
30.	Nano Materials and Biotechnology	Chair:K.N.Thimmaiah Speakers: 1-K.J.Rao, Bangalore 2-K.Byppa, Mangalore 3-V.S.Chauhan, New Delhi
31.	Public –Private Partnership for the Swachh Bharat Mission Initiative	Chair: Prof. Indira Chakravarty Speakers: 1-Mrs. Santhasheela Nair 2-Mr. Nitish Kapoor 3-Mr. Sanjiv Mehta 4-Mr. Siraj Chaudhry 5- Dr.Saraswati Prasad



BRIEF REPORTS OF PLENARY SESSIONS

NANOSCIENCE

The plenary session on Nanoscience was organized and co-ordinated by Prof. A.K. Sood. The speakers were Prof. A.K. Sood, Prof. G.U. Kulkarni and Prof. Ashok Ganguli. Prof. Sood's talk covered the basic aspects of Nanoscience which exemplified the excitements in this field over the last 25 years. He presented his work on carbon nanotubes and graphene, which included a new understanding of flow induced voltage generation in carbon nanotubes and graphene based nano-devices. Prof. Kulkarni focused his talk on the gold nano particles with BCC structure. He showed how this rare form of gold can be created in the nano form as compared to the conventional FCC structure. He outlined various properties of this new form of gold such as catalysis. Prof. Ashok Ganguli's talk covered novel synthesis strategies for nano materials and their applications in water splitting, energy sector and biosensors.

The recommendations include: 1) The funding in the field of nanoscience and nanotechnology should be enhanced to be competitive internationally. 2) Efforts should be made to introduce new experiments related to nanoscience in the curriculum of Bachelor's and Master's programs.

SPACE SCIENCE, TECHNOLOGY AND APPLICATIONS

The Session was chaired by Prof. D. Narayana Rao, Director (Research), SRM University. The Session was co-chaired by Shri V. Koteswara Rao, Prof. Vikram Sarabhai Distinguished Professor, ISRO.

There were 6 presentations in total by the panel members as given below

Topic	Speaker
1.Indian Space Programme	Dr. V K Dadhwal, Director, NRSC
2.Mars Orbiter Mission	Dr. S. K. Shivakumar, Prof. Vikram Sarabhai Distinguished Professor, ISRO
3.ASTROSAT	Shri. V. Koteswara Rao, Prof. Vikram Sarabhai Distinguished Professor, ISRO
4.Applications of space Programmes	Dr. V. K. Dadhwal, Director, NRSC, ISRO
5.Future Launch Vehicle Programme	Shri. S. Somanath, Director, LPSC, ISRO
6.Future Satellite Programme	Dr. M. Annadurai, Director, ISAC, ISRO

Recommendations

1. Climate monitoring and improvements in weather forecast
2. Next step in planetary exploration as a sequel to the grand success of Mars Orbiter Mission
3. Marking the ASTROSAT science data available to Indian University students and faculty
4. Policies for making higher resolution remote sensing data available to civilian users
5. Development of heavy lift launch vehicles with capability to place 6 Ton satellites in GTO orbit
6. Geo- imaging satellites with higher resolution
7. Encouragement for University satellites
- 8.
- 9.

Recent Advances Towards Cellular Basis for Clinical Disorders

The Session was conceived by **Prof. S.S. Parmar**, former Chairman Deptt. Of Physiology, University of North Dakota, and included 8 distinguished speakers, seven from abroad and one from India. Prof. Parmar due to some unavoidable reasons could not participate in the session and it was chaired by **Prof. P.K. Seth** Former Director Industrial Toxicology Research Centre, Lucknow & Senior Advisor Biotech Park, Lucknow. The session was held on January 4, 2016 in a

beautiful new hall. The topic attracted several people which included a large number of students and young researchers. The hall was full as soon as the symposium started. The organizers had to put additional chairs to accommodate the participants.

Prof. P.K. Seth, in his opening remarks said that understanding of the mechanism of diseases at cellular and molecular level is extremely important as it helps in identifying the key genes and proteins responsible for the disease and identification of biomarkers which can lead to monitoring and better management of diseases and finally development of strategies for prevention and cure.

The tone of the session was set by **Prof. Andrew J Greenshaw** who highlighted that in determining overall health of adults, mental health is a significant factor. He pointed out that exposure in early development stage leads to increase in incidence of mental illness along with increases in the incidence of cardiovascular disease, cancer and diabetes. Further, early use drug of abuse, and adverse early childhood exposure, significantly impact the brain development. Using Canadian examples, he pointed out the usefulness of such research finding in developing health policy.

Dr. Jonathan Geiger, in his talk entitled **Aging and Alzheimer's disease in the HIV-1 infected population** provided evidence for the functional existence of store of calcium endolysosomes, from which calcium can be released readily. He discussed the mechanisms that regulate intracellular calcium. Dr. Geiger suggested a central role of endolysosomes in the pathogenesis of HIV-1 associated neurocognitive disorder (HAND). He showed that endosomes and lysosomes play a critical role in HAND and endolysosomes may provide therapeutic targets for prevention and treatment of HAND and Alzheimer's Disease..

Dr. Anil Kumar, in his talk entitled **HIV-1 gp 120 and methamphetamine-Mediated Toxicity in the Brain**, discussed results on understanding that how some drug of abuse enhances the HIV associated neuro-cognitive disorder

(HAND) using astrocytes and methamphetamine (MA) as a drug of abuse. MA and gp120 were found to act synergistically to enhance expression of IL-6 and further showed that both drugs involved PK13/Akt pathways. He showed that both MA and gp 120 independently and in combination increased the production of pro-inflammatory cytokine/chemokines via a different pathway. The functional consequences for the interaction between gp 120 and MA led to oxidative stress and ER stress, which resulted in apoptotic cell death in astrocytes.

Dr. Madhavan Nair, highlighted the application of of Nanotechnology for Neuro-Drug delivery in his talk and entitled **Getting in to the Brain: Potential of Nanotachnology to manage Neuro- AIDS and Drug addictions**, reported the development of a Magneto- Electric Nanocarrier (MEN) to deliver and release on demand HIV drugs and opiate antagonist, which otherwise are not penetrable to brain themselves. MEN enabled the drugs to reach in the brain and inhibit HIV as well reverse opiate mediated adverse neurological effects. This new technology is expected to have universal applicability against a variety of other CNS diseases such as Parkinson's, Alzheimer's, Brain tumors etc.

Dr. Othman Ghribi, discussed that how cholesterol oxidation products impact health and disease in his talk entitled **The Multi – Faceted Action of the Cholesterol Oxidation Products in Health and Disease**. He demonstrated that cholesterol oxidation products, oxysterols have a role in the pathogenesis of macular degeneration and breast cancer. Oxidized cholesterol may potentially be involved in several diseases, and possibly maintenance of adequate level of cholesterol may prevent occurrence of deleterious effect of oxysterols. Further increased plasma level of 2-hydroxy cholesterol may serve as the biomarker for neurodegenerative diseases and cancers.

Dr. S. Jamal Mustafa, in his talk and entitled **coronary flow regulation by Adenosine and its signaling** discussed about the possible role various adenosine receptors in the modulation of coronary flow He showed that all adenosine receptors have important role in regulation of coronary blood. These studies besides providing a better understanding of role of adenosine receptors in

coronary flow may lead to better therapeutic approaches.

Dr. Joyce Ohm, in her talk entitled **Genetic and Environmental Reprogramming of the Cancer Epigenome**, explained that chemical exposures in utero is of great concern, as exposures during this time can have a long lasting effect and outcome. She demonstrated that epigenetic remodeling program can be influenced both by genetic and environmental factors and lead to alterations in DNA methylation, abnormal enrichment of covalent histone modifications, and activation of pro-survival stem cell. Her group is actively working to identify key molecular mechanism for such changes and these findings have relevance to both the cancer research community in India as well as to those studying epigenetic changes linked to neurodegenerative and developmental disorders, believed to be due to environmental exposures.

Prof P.K.Seth, in his talk entitled **Alteration in selected Biochemical Parameters in Platelets and Polymorphonuclear Leucocytes (PMNs) in Depression and Schizophrenia**, demonstrated using both experimental and clinical studies, the usefulness of platelets and PMNs as a model for studying selected neurological disorders. Both. Based on his results, he suggested that platelets and PMNs can be considered as multi neurotransmitter site, similar to neuron for clinical conditions for parameters which exhibit responses similar to brain.

The presentation were followed by lively discussions In concluding remarks, Professor Seth said the session has been very exciting as lot of new information has been presented and discussed by the experts. It emerged out that early exposure to drugs of abuse and adverse conditions severely impact the nervous system development and the outcome of such exposures can be extremely serious as epigenetic remodeling can be impacted. The session also provided new insights in mechanism of Alzheimer's disease in HIV infection, adverse impact of oxidation products of cholesterol; mechanism by which drugs of abuse can enhance the HIV associated cognitive disorders and regulatory role of adenosine receptors in coronary blood flow. A magneto electric nanocarrier enabling drugs to reach the brain and inhibit HIV as well reverse opiate mediated adverse neurological effects and blood platelets and PMNs as peripheral model for selected CNS disorder were proposed.

ENERGY AND SUSTAINABILITY FOR A GREENER TOMORROW

Prof. Navrati Saxena, who Chaired the session is an associate professor in the College of Information and Communication Engineering, Sungkyunkwan University, South Korea . Envisioning one of the prime global concern, energy and sustainability, Prof. Saxena commenced the talk by introducing the speakers, invited from four different countries. To spread the awareness and to motivate the audience, speakers were invited from academia as well as industry, for detailed discussion of practices and proposals of various research institutes and companies for greener tomorrow.

Dr. Abhishek Roy, senior manager at Samsung Electronics, South Korea gave a talk on ‘Traffic aware energy optimization in green wireless networks’. He talked from industrial perspective giving a picture to the audience about the optimal traffic awareness techniques required for designing a green LTE networks.

Prof. Vaskar Raychoudhury, who works as an assistant professor in Indian Institute of Technology (IIT) Roorkee talked on “NDN Enabled Energy-aware Remote Elderly Health Monitoring”. He introduced Named Data Networking (NDN) based on Information Centric Networking as an optimal solution for vulnerabilities in healthcare IoT exchanges data over the IP-centric Internet. He focused on NDN-enabled smart healthcare system that promises to provide higher robustness while incurring less energy.

Prof. Jung Hyun Jun, whose talk was based on “Integrating heterogeneous sensor networks and other ubiquitous wireless networks for greener future generation wireless networks”, is an assistant professor at IIT Ropar. He discussed effective energy sharing between heterogeneous sensor networks, cross-technology communication, and strategies for making the evolving heterogeneous sensor network green

Prof. Snehanshu Saha working as a professor at PES Institute of Technology, Bangalore delivered a talk on “A Novel Revenue Optimization Model to address the operation and maintenance cost of a Data Centre”. He discussed about various enterprises, which are enhancing investments in cloud services, setting up data centres to meet growing demands. He further explained a novel algorithmic/analytical approach to address the issues of optimal utilization of the resources towards a feasible and profitable model.

Ashish Srivastava is currently working at Marlabs Inc., New Jersey, USA since 2012. His exciting talk entitled “Context Aware Techniques for a Greener Tomorrow” put forward the Network society’s goal of lowering energy consumption and wide deployment of ICT. He further explained the need of enhanced network level intelligence and presented context awareness techniques as an optimal solution. He explained various context awareness techniques to enhance the network level intelligence, which can control the energy

consumption to make future networks green

NOVEL MECHANISMS UNDERLYING ALLERGIC AIRWAY INFLAMMATION AND BRONCHIAL ASTHMA

The Session was chaired by Dr. Devendra K. Agrawal, Professor and Chairman, Department of Clinical & Translational Science Creighton University School of Medicine, Omaha, NE, USA, and Co – Chaired by Professor H. P. Tiwari, Allahabad University, UP, India. Dr Agrawal who started the session with an introductory information on the underlying cellular and molecular mechanisms of allergic airway inflammation and bronchial asthma, followed by specific information on the role of dendritic cells in the induction of allergic immune response. The lecture ended with potential novel target sites for intervention to prevent and treat asthma.

The second lecture was delivered by Professor Mahesh PA, Professor of Respiratory Medicine, JSS Medical College, Mysore, India. Dr. Mahesh gave a brief overview of difficult-to-treat asthma patients, followed by specific role of ADAM33 and matrix metalloproteinases (MMPs) in airway wall fibrosis and thickening of the basement membrane and thus in the pathogenesis of chronic asthma.

The third lecture was delivered by Professor Sanjiv Sur, M.D., Department of Internal Medicine, Division of Allergy & Immunology, University of Texas Medical Branch, Galveston, Texas, USA. Dr. Sur discussed several clinical cases of complex mast cell disorders and their management by mast cell degranulation inhibitor, LTD4 inhibitor, steroids, monoclonal anti-IgE, specific immunotherapy. The specific cases on Kounis syndrome: coronary spasm associated with mast cell degranulation, cutaneous mastocytosis with anaphylaxis to bee and wasp venom sting, and urticaria associated with shortness of breath during carboplat in infusion for ovarian cancer. Thus, successful management strategies were presented using a wide range of therapeutic measures to either prevent or treat complex mast cell disorders.

The last talk was delivered by Dr.Surya Kant Tripathi, MD,Professor and Head of Pulmonary Medicine at King George's Medical University, Lucknow, India, and delivered lecture on smoking cessation and its effect on lung function.

DISCOVERY & DEVELOPMENT OF NOVEL DRUGS MAKE IN INDIA: CHALLENGES & AVENUES:

The session was organized by Prof. S. Rajarajan, Vice Chancellor, SRM University Delhi-NCR, Sonapat (Haryana), the Chairman, gave an overview of the current scenario of Drug Discovery and Development in the country viz-a-viz around the globe. He informed the audience there has been new thrust for developing molecules from natural products apart the novel chemical entities. Considering enormous resource requirement, knowledge intensive and high risk in this sector, even developed nations find it hard for investment. He was happy to introduce the reputed scientists associated in novel drug discovery and development from the developed nations and India could come for the plenary session.

With these introductory remarks Dr. Rajarajan shared his plenary session his presentation titled “*Novel Drug Development – Make India Opportunities and Challenges*”. His emphasis highlighted the present limitations of lack of Scientific validation and standardization of Traditional Systems of Medicine in the Country. This needs greater emphasis and it is rather more important for enabling India as a platform for Make in India products. If India provides sufficient R&D enabled safety and other toxicological data of Indian products, there are immense opportunity for Make in India by attracting several investors of Pharma Sector to establish their production units. It is possible to convert the dream of Hon’ble Prime Minister of Make in India as a reality. Also, the Chairman conveyed the focus point of the Secretary to Government of India for chemicals and fertilizers, that the risk factor of 4% success involved pharma-industries, need for innovative drugs for neurological and oncological -complications and creation of more skilled manpower through existing and new institutes of NIPER.

Sir Tom Blundell, Dept. of Biochemistry, University of Cambridge, UK, in his presentation on “*Genomics, Structural Biology and Making New Medicines: Understanding the Role of Mutations in Genetic Disease and Drug Resistance*” shared his experience on Drug Discovery & Development which has been a rewarding one. The Laboratory Research could facilitate for developing product in market place and the assimilation of the technology by the industry and the due rewarding of innovators. He emphasized from his experience, the knowledge of architecture of protein molecules becoming the targets of new medicines and revolutionizing the current drug discovery to re-visit libraries of very small molecules,

chemical fragments using structure guided approaches in particular for Cancer & Infectious Disease Drugs. He also explained how the current drug resistance to the known drugs are throwing great challenges for drug development and the gene sequencing knowledge helps in handling this difficult problem.

Dr. Simon L. Croft, Faculty of Infections & Tropical Diseases, London School of Hygiene & Tropical Medicine, UK spoke on *Developing Drugs for Neglected Tropical Diseases*. He being a scientist worked in all sectors of Drug Discovery & Development both in Industry, Institution as well as in WHO, expressed his concern for developing new drugs for neglected tropical diseases like Dengue, Leishmaniases, Trypanosomyases, Malaria, T.B. etc. He was emphasizing Public Private Partnership should focus towards product development partnership. There are number of Philanthropic organizations around the world do support liberally this area. Its time that many more initiatives should be taken towards this end to add new battery of drugs.

Prof. Alan P. Kozikowski, Drug Discovery Programme, University of Illinois at Chicago, USA spoke on *“Identification of Indoleamides Targeting the MmpL3 Transporter for the Possible Treatment of Tuberculosis”*. He emphasized the Global Health Challenge of T.B. which is emerging as multi-drug, extensively drug resistant strains throwing challenges for new drug development. From his rich experience he opined Indoleamides as potential drug for the management of Tuberculosis. He has identified a mycolic acid transporter, as the putative target for these compounds. He shared the various strategies developed in his group to screen a potent compound for the management of T.B.

Dr. G.J. Samathanam, Former Advisor & Head, DST, New Delhi, conveyed his views through his presentation titled *“Prospective & Opportunities on Novel Drug Development – Make in India: Role of R&D”*. In his presentation he shared the various stages of development of anti-infectives in 20th century and the limitations associated with the novel drugs. He also informed the Indian Scenario of resources invested for Drug Discovery from the Government vis-à-vis industry. He commended the Indian drug industry for making excellent progress in the generic drug market making the cost of domestic drugs affordable and also make its presence in

more than 200 countries. He informed considering the immense potential available in this country through rich biodiversity and series of laboratories and Universities for contributing novel drugs. He opined that government sector needs to show more proactive, facilitating role with pharma industry and the regulatory bodies. As it is shown in the mission scientific departments like Space, Atomic Energy, DRDO, country should set goal and the timeframe for bringing one or two drugs of global presence in five years time from now onwards.

Dr. S.B. Mahato, Ex-Deputy Director & Emeritus Scientist (CSIR), IICB, Kolkata Co-Chaired the session. The session ended with vote of thanks to the Chair and the speakers by Organising Committee.

Recommendations:

1. Need for national level coordination to integrate the research activities happening in Govt., public undertakings, National research institutes & reputed private research institutes on drug discovery and development to consolidate the multi-disciplinary contribution to expedite drug development.
2. Promotion of scientific validation of the potential sources for therapeutic efficacy and safety are necessary in order to utilize the advantage of first-hand information on drug source from traditional systems of medicine.
3. Immediate collaborative effort with global institution to avail their strength in drug DEVELOPMENT like molecular level studies on pharmacokinetics, pharmacovigilance and modification of molecules etc. for compliance of regulatory standards.
4. The department of Pharmaceuticals, Ministry of chemicals and fertilizers, Govt. of India could make a time bound initiative to coordinate the activities listed above with a clear road map in bringing out the first Indian made drug in 3-5 years.

"Atomic Energy"

103rd Indian Science Congress, Mysuru

January 5, 2016

The five speakers in the Session focused on various societal applications of atomic energy and associated scientific research and development activities. The presentations were followed by a brief question and answer session. Main highlights of the session are given below. All recommendations are sequentially numbered from (A) to (M).

1. Nuclear Power - The Way Forward

Dr. Ratan Kumar Sinha, DAE Homi Bhabha Chair, Bhabha Atomic Research Centre, Mumbai spoke on the topic. He explained how with negligible carbon footprint, smallest land requirements per TWh, and practically zero number of accidental fatalities per TWh, nuclear power is eminently suited for serving as a major component of energy mix for a densely populated country like India. Nuclear power not only provides energy security but also addresses the concerns of the global warming and bio-diversity conservation.

India has mastered practically all aspects of the nuclear power generation and nuclear fuel cycle technologies. Its advanced status in the domains of spent nuclear fuel reprocessing - with attendant redressal of the nuclear waste issues, the fast breeder reactor technology that addresses the uranium resource constraints and energy security issues., and thorium deployment related research and deployment that would lead to practically unlimited source of clean energy to India, have been internationally well recognized. With the opening up of the international civil nuclear cooperation, the consequent availability of imported uranium supply, a large ramp up of nuclear power programme is technically feasible, and has been planned, in the short term time horizon itself.

The completion of some additional scientific and technological developments, included in the recommendations below, will help in accelerating the needed large scale deployment of nuclear power.

Recommendations:

A) Address irrational fear of low level ionizing radiation through establishment of science based radiation protection guidelines, on the basis of already available scientific knowledge and additional on-going research.

B) Develop and introduce advanced passive safety features for next generation reactors that practically eliminate the possibility of severe accidents, thereby not only offering a higher level of investment protection, but also, along with measure (A) above, eliminate the possibility of any emergency evacuation planning in the public domain, and

C) Develop and deploy high efficiency dry cooling towers, to facilitate availability of adequate number of nuclear power plant sites in water scarce low population areas.

2, Human health and Ionizing Radiations: Benefits Outweigh perception of risk

Dr. K.B. Sainis, Raja Ramana Fellow, Bhabha Atomic Research Centre, Mumbai highlighted that the increasing use of ionizing radiation and radiostopes in radiation sterilization of medical products, radioimmunoassay, diagnostic and interventional radiology, nuclear medicine employing radiopharmaceuticals for functional imaging by scintigraphy, single photon emission computed tomography (SPECT) and positron emission and the treatment of tumors by teletherapy,

brachytherapy, radionuclide therapy, accelerate electrons and protons have made a very profound positive impact on human healthcare.

He discussed how our understanding of the biological effects of ionizing radiation and their mechanisms at the cellular and molecular level has also kept pace with this increasing use. DNA is the prime target of ionizing radiation. DNA damage may cause cell death and deterministic effects, or if erroneously repaired, it may lead to mutations and stochastic effects, most fearsome of which are cancer and hereditary effects. Though exposure to high doses of radiation, such as in accidents, generally causes deleterious effects, it is increasingly appreciated that low doses and low dose rates of radiation are not damaging as one may aver by extrapolation from damage at high doses. Up to a dose of 100 mSv there may not be a significant increase in incidence of cancer. There is no evidence so far radiation induced hereditary effects in human population or accidental exposure situations.

The existence of high level natural radiation areas in the world provides a situation analogous to continuous exposure in contaminated areas after an accident. In this context, Dr. Sainis brought out the key features of the very extensive studies of incidence of cancer and genetic effects like birth defects in new born in populations continuously exposed to high level natural radiation in China and especially in Kerala in India. These studies have not documented any adverse effects in the children or adults though the dose received is much more than that internationally permitted for the populations living around nuclear plants.

With the availability of advanced research tools it has become possible to study the kinetics of DNA damage and its repair, and other molecular phenomena related to exposure of cells to ionizing radiation. Advanced research in these directions has been pursued in India and also internationally and the outcome of these assessments so far firmly indicates that on balance the benefits of ionizing radiation to humanity far outweigh the perceived health hazards due to nuclear power plants.

Recommendations:

D) Continuously educate general public as well as opinion makers on the dose response profiles of radiation effects and about the low dose and the low dose rate effects.

E) Increase efforts to harness ionizing radiation and radionuclides for enhancing the quality of human life.

3. Radiation technology in Agriculture and Food Processing

Dr. S.F. D' Souza, Raja Ramanna Fellow, Bhabha Atomic Research Centre, highlighted the role of radiation induced mutation and recombination breeding in the development of new improved crop varieties. He highlighted the features of different varieties in oilseeds and pulses developed using this approach especially at BARC and their societal impact. Several of these varieties, particularly of groundnut, greengram (mung), blackgram (urid) and pigeonpea (tur) have high patronage from farming community and are grown extensively across the country. Some of desirable traits which have been bred though induced mutations in these crops include higher yields, improved quality traits, early maturity and resistance to biotic and abiotic stress and suitability for rice fallow cultivation where large rice fallow area is available in India. These traits are considered of prime importance under crop diversity programme.

He also highlighted BARC efforts in the area of radiation processing of various foods and food products to reduce post harvest losses and enhance safety and shelf life. The globalization of trade in food and agricultural commodities has been on the rise. The international Plant Protection Convention recognizes radiation processing as a quarantine measure, enabling export of agro products such as mangoes that meet quarantine standards of importing country. He informed that the volume of food irradiated in India

steadily increasing and 12 food irradiation plants have been commissioned in the private sector.

Recommendations :

F) Explore use of radiation induced mutation along with cross breeding for developing crops which can withstand vagaries of climate change.

G) To enable large scale production of quality seeds to meet the farmers demands, further strengthen the mechanisms of dissemination of research efforts of Department of Atomic Energy to the farmers, augmenting effective linkages that have been already established with ICAR, State Agriculture Universities, National and State Seed Corporations, NGO's, Krishi Vigyan Kendras, progressive farmers etc.

H) Commensurate with the Indian position as the second largest producer of fruits and vegetables extend radiation processing to additional varieties of fruits, vegetables and food products. Encourage private entrepreneurs to establish more irradiation facilities to ensure large scale availability of radiated food in the market so that the consumer has an option.

I) Expand and strengthen collaborations with Food Corporation of India, Ministry of Food Processing Industries, National Disaster Management Authority, Defense authorities, hospitals, commercial as well as institutional food suppliers. This will ensure the eventual adoption and integration of irradiated foods into supply chains and will help promote commercialization and wide spread use of this technology.

4. Nuclear Technology for Water Security:

Dr. P.K. Tewari, Raja Ramanna Fellow, Bhabha Atomic Research Centre, in his presentation, informed that the Department of Atomic Energy (DAE) has developed several indigenous water technologies for enhancing water availability

And improving water quality. An indigenously developed hybrid nuclear desalination plant is operational at Kalpakkam (Tamilnadu). It is the largest capacity (6.300 Million Litres per Day (MLD) operating sea water desalination plant attached to a nuclear power plant in the world. It produces two qualities of desalinated water: distilled water for high end applications and potable water for drinking / other uses. Co- location of desalination and power plants has the benefit of sharing the resources and infrastructural facilities. Another indigenous seawater desalination plant based on hybrid technology (Reverse Osmosis- Multi- Effect Distillation (RO- MED) is being set up in OSCOM (Chatrapur, Orissa). A low temperature evaporation (LTE) seawater desalination plant utilizing waste heat of nuclear research reactor was set up in BARC (Trombay).

Department has developed and patented several types of indigenous desalination and water purification technologies addressing the unique challenges faced by the country. The knowhow of the technologies have been transferred to many entrepreneurs for wider deployment in a commercially viable manner providing an opportunity for 'Make in India' as well as helping in local employment generation. Rural adaptability of the technologies has been demonstrated with bacteria, virus, fluoride, arsenic, iron, uranium and other contaminants has been carried out in different parts of the country.

Membrane technologies along with conventional technologies play an important role in cleaning of water bodies. Department in providing technical support and guidance to clean and develop water bodies. An MOU has been signed between District Administration of Deoghar Government of Jharkhand and DAE for technical support and guidance to clean and develop the Shiv Ganga pond near Baidyanath temple. Indigenous membrane based water/ effluent treatment systems have potential to play a vital role in clean Ganga Mission.

Recommendation:

(J) Encourage the corporate entities to distribute the low cost indigenous water purification units for clean drinking water, developed by DAE, to household in rural and remote areas through CSR schemes. This will help in accelerating the pace of spreading the outreach of these very effective technology solutions for providing good quality drinking water to society.

5. Promoting Science and Technology through DAE Programmes:

In his presentation, Dr. Srikumar Banerjee, DAE Homi Bhabha Chair Professor, Bhabha Atomic Research Centre, Mumbai highlighted that a large number of scientific facilities have been set up in R&D institutions of Department of Atomic Energy which are extensively being used by researchers from academic and other research institutions.

Research reactor Dhruva has several neutron beamlines dedicated for diffraction, spectroscopy and small angle scattering experiments. Studies related to hydrogen bonding, protein crystallography, magnetic structure and phase distribution in multi-phase systems have yielded many important findings. Similarly the intense photon beams from INDUS-2 are being used for structural investigations on a wide variety of materials. Nuclear physics work is primarily conducted in the pelletron accelerator at

TIFR and Cyclotron in VECC. Several engineering experiments, for example, non-destructive testing by using neutrons and fabrications of nanostructures by intense photon beam in INDUS-2 synchrotron are being conducted in DAE facilities.

Apart from the utilization of large facilities, scientific collaborations between scientists in DAE institutions and academia have resulted in impressive scientific achievements.

Recommendations:

(K) Comprehensive research facilities for structural investigations in different length and time scales are available in DAE laboratories. These should be utilized by researchers from universities and research centre's in the country on a large scale.

(L) Researchers should also get involved in some of the areas of contemporary interest such as environmental protection, health care technologies, desalination and water purification, energy conversion, advanced materials, radiation biology and nuclear agriculture.

(M) DAE encourages collaborative research with universities and research institutes outside DAE. Board of Research in Nuclear Sciences also provides support for such collaborative work. These opportunities should be exploited to the maximum possible extent.

“Big Data Biotechnology: Challenges and opportunities For India”

The plenary session started with a talk on overview of the topic by Dr. T. Madhan Mohan (Adviser, Department of Biotechnology, Govt. of India) the session Chairman. He kick started the session by emphasizing the role of Big Data in current Biotechnology research. The session had four speakers namely- Dr. Binay Panda (IBAB, Bangalore), Dr. Dinesh Gupta (ICGEB, New Delhi), Dr. M. Michael Gromiha (IIT, Chennai) and Dr. A.K. Mishra (IARI, New Delhi). Dr. Binay Panda, in his talk “Big Data and Personalized Medicine: Opportunities and Gaps”, elaborated on the recent advancements in the field of genome sequencing which have aided our understanding on many human diseases, especially cancer. He highlighted the role of computational biologists and bioinformatics specialists, who use various tools to discover, analyze and interpret molecular changes from terabytes of data generated from cancer sequencing studies. He also spoke about various opportunities that Big Data presents in personalized medicine and how a young and vibrant India can take advantage of the time in leveraging the skills in Information Technology to solve problems in biology in general and in the practice of precision and personalized medicine in particular.

The talk was followed by Dr. A.K. Mishra’s talk on “Big Data and Cloud Computing in Agri-bioinformatics”. He highlighted the role of Biological data analytics in agriculture, especially related to climate condition, crop cultivation, crop diseases, weather forecast and irrigation related data. He pointed out that Big data in agriculture needs to be analyzed on cloud based networks to reduce costs and improve efficiency. The next talk was delivered by Dr. Dinesh Gupta, who spoke on “Big data analysis in Biotechnology: applications of machine learning and challenges towards clinical applications”. He reviewed the applications of machine learning for analysis of high throughput data, especially related to oncology. He illustrated this

by citing his research work to develop a machine learning method for classification of early stages of ccRcc from late stages, using transcriptional gene expression data. He concluded that the machine learning algorithms are potentially quite useful in the analysis of clinical Big Data, however he highlighted the gap areas, which need to be addressed urgently in order to translate Big Data analysis for clinical use.

The last talk of the session was delivered by Dr. M. Michael Gromiha. His talk, entitled “Algorithms and Applications of Bioinformatics in Bigdata analysis”, was focused on big data analysis challenges emerging due to advancement of sequencing technologies, analysis of sequences for disease causing mutations. He highlighted the use of algorithms to identify protein-protein interactions based on proteins structures and function.

While highlighting the importance of Big Data analysis for India, the speakers and audience made certain recommendations:-

1. Big Data collection should be done systematically, keeping in view its future applications.
2. Due importance should be given to quality of data so that it is reliable and reproducible.
3. For machine learning methods, a formal repository that sets minimal guidelines for machine learning investigation with potential clinical implementation could be developed
4. There is a need for national genome sequence database meant for clinical diagnostics and personalized medicine.
5. Health care data should be collected for transforming diagnosis and improvement of treatment outcomes.
6. Cloud is a good option for connecting several Agricultural institutions across the country; therefore development of user friendly computational algorithms and tools is needed.
7. With over 2.5 quintillion bytes created every day, data storage and analysis has become a great challenge. Cloud computing can be the solution to Big data problem.
8. Along with Biological data analytics, weather forecast and irrigation related data is also crucial for agricultural development and needs to be stored and analyzed.
9. Technologies like, Agro-Mobile and Agro-Cloud should be made accessible to all as they provide assistance to researchers and farmers for analyzing soil and climate condition, crop cultivation, crop diseases etc.
10. Considering various bottlenecks in drug discovery and development one should see a new data driven research and technology (DDRT) as highly promising approach in genomics to ease the pain.
11. The large data generated with personalized diagnostics and therapy requires usage of sophisticated and multi-dimensional data analysis tools and platforms. This data deluge in modern biology also requires effective data storage, analyses, interpretation, sharing

- and archival policy.
12. The use of machine learning approach for analysis of high throughput data especially related to oncology needs to be focused.
 13. The prospective applications of Big Data Analytics in different spheres of biotechnology, clinical research and gap areas need to be addressed urgently in order to get ready for real Big Data analysis for true applications for human welfare and science.
 14. Bioinformatics algorithms developed should be implicated usefully in analyzing the high throughput data and high level machine learning approaches including mathematical, statistical and computational methods need to be used for various features identification and validation procedures.
 15. Young India should take advantage of the time in leveraging the skills in Data Science and related areas to solve problems in biology and biotechnology. The generation and availability of Big Data, along with a push for Open Data, presents an attractive opportunity to contribute to and get benefited from.

BIODIVERSITY CONSERVATION: CURRENT STATUS AND ROAD MAP FOR THE FUTURE

	Invited Speaker	Topic
1.	Prof. Ramamurthi, Council Member & Convenor of Session	Education for Sustainable Development of Biodiversity
2.	Dr.R.S.Rana, Member, NBA	Nagoya protocol on Access and Benefit Sharing
3.	Dr.S.Subramaniyan, Convenor of NBA	Integration of Agro forestry System for promotion of Biodiversity Conservation
4.	Dr.G.A.Kinhal Director, IIFM	Medicinal Plant Diversity in India: A Bio cultural Wealth for Conservation and sustainable use
5.	Shri M S Nagar Invited Speaker, ISC- 2016	Biodiversity Conservation: Challenges and opportunities in the mining areas

Recommendations:

1. In the syllabus of schools and colleges aspects of mapping and monitoring of Biodiversity should be included.
2. Ministry of Science and Technology, UGC, ICAR, Ministry of Environment and Forests and climate change should not only encourage projects on Conservation but also promote conduct of workshops in taxonomy of various groups in different parts of the country.
3. Special focus is to be provided by HRD, UGC and DONvCC for encouraging school and college students to visit Nature parks and study plants and animals under the guidance of teachers.
4. Every school have Eco club and project report should be mandatory

MOLECULAR TARGETS AND CANCER THERAPEUTICS

In this session a number of distinguished speakers including Prof Peter Houghton and Prof Mary-Ann Bjornsti from USA, Prof Alan Fersht from Cambridge UK, Prof Shin-Ichiro Nishimura from Japan and Prof. Peter E Lobie, from Singapore delivered lectures. The talks, which were clear and concise, introduced different aspects of understanding molecular targets and developing cancer therapeutics. Prof Sir Tom Blundell, University of Cambridge, Chaired the session.

SAFE WATER AND SANITATION

The plenary session was chaired by Prof. K J Nath, President, Institution of Public Health Engineers, India, Former Director, All India Institute of Hygiene & Public Health, the Co-Chairman being Dr. N B Basu, Principal Chief Engineer (Civil), The Kolkata Municipal Corporation and General Secretary (Membership Affairs) ISCA.

Initiating the session, Prof. K J Nath mentioned that access to safe water & sanitation is now a basic human right. He referred to the enormous health outcome of the lack of safe water & sanitation – globally 62.5 million disability adjusted life years (DALYS). He also mentioned that this year's plenary session on safe water & sanitation has a special significance in the context of Govt. of India's Swachh Bharat Mission and the priority programme on supplying safe water to the community. He further added that the success of the programme would largely depend on the mobilization of resources and total participation of the people. Equally important is science and technology inputs. Triggering behavior change in the community and creation of an enabling environment need to be supported by appropriate and sustainable technology for safe water and sanitation, - emphasized Prof. Nath.

Gist of the presentations made

Promoting Community Sanitation in the country: Problems and Prospects by Dr. Bindeshwar Pathak, , Founder, Sulabh International Social Service Organization (SISSO), New Delhi. Dr. Pathak emphasized the need for sanitation in the community as a social and health parameter. He remarked that behind the wholesale loss of life and potential in our country, there is the absence of something basic, unremarkable and common place: toilets and other forms of improved sanitation. He described his experience during the last four decades for eradicating manual scavenging and untouchability from the society and eliminating open defecation. For this, he developed an appropriate technology for onsite sanitation – two pit pour flush toilets. Sulabh International Social Service Organization has constructed more than 1.3 million such toilets in the country and the Govt. and other organizations have built near about 60 million such toilets across the country. Dr. Pathak also mentioned about 8000 pay and use public toilet systems across the country installed by SISSO. Of these about 800 are connected to bio-gas plants and effluent treatment system. This is a decentralized option for waste water disposal and could be a cost effective alternative to the costly sewerage system, which needs huge water for flushing.

Emerging technologies for water purification with particular reference to application of nanotechnology by Prof. T. Pradeep, Institute Professor and Professor of Chemistry Department of Chemistry Indian Institute of Technology Madras . Access to clean water is one of the most important indicators of development. This water has to be affordable to make a meaningful impact to the society. Creation of affordable materials for constant release of silver ions in water is one of the most promising ways to provide microbially safe drinking water for all. Combining the capacity of diverse nanocomposites to scavenge toxic species such as arsenic, lead, and other contaminants along with the above capability can result in affordable, all-inclusive drinking water purifiers that can function without electricity. The critical problem in achieving this is the synthesis of stable materials that can release or adsorb

ions continuously in the presence of complex species usually present in drinking water that deposit and cause scaling on nanomaterial surfaces. It has been shown that such constant release/adsorbing materials can be synthesized in a simple and effective fashion in water itself without the use of electrical power. These materials have been used to develop an affordable water purifier to deliver clean drinking water at US \$2.5/y per family.

Urban and Rural Solid Waste Management in India: Problems, Prospects and Challenges by Prof. Arunabha Majumdar, Emeritus Professor School of Water Resource Engineering Jadavpur University. Cities and towns in India generate 150000 MT of solids waste daily whereas, in the rural areas of the country it is estimated that around 168000 MT of village solid waste is generated per day. Urban Local Bodies (ULBs) provide services for solid waste management but Panchayati Raj Institutions (PRI) have no infrastructure to provide services for managing solid waste in the villages. Solid wastes need segregation at source as organic and inorganic. There must be containerized collection and transportation system facilitating no accumulation of solid waste at any sources of generation. Inorganic recyclable waste can be segregated either at source or at centralized locations to facilitate waste recycling and to earn revenue. Organic waste may be converted to manure by windrow process or by vermin-composting. Non-recyclable inorganic solid waste may be disposed at engineered landfill sites for land reclamation. Calorific value of municipal solid waste in India is low (800-1200 K cal/kg) and accordingly it is not appropriate for incineration. But possibility needs to be explored to generate energy from the municipal solid waste by adding auxiliary fuel with a minimum cost. Electricity can be generated by increasing the calorific value of the waste and accordingly tipping fees per ton basis need to be considered to make the process economically viable.

RECOMMENDATIONS

1. For the success of Swachh Bharat Mission, it is necessary to trigger behavior change in the community and to create an enabling environment. Sanitation movement in the country needs to be supported by appropriate and sustainable technology, for which science and technology input is a key component.
2. Sustainable, affordable and user friendly technology for water purification is a key component of inclusive development. Nanotechnology holds great promise for reduction of cost of water treatment and land and energy requirement. Application of nanotechnology for purifying chemically and microbially contaminated water should be promoted at all levels.
3. The Key challenges for sustainable solid waste management must include source segregation, door to door collection, salvaging and selling of inorganic –recyclables, composting through business mode, waste-to-energy through commercial model and engineered land-filling for land reclamation. Apart from the said challenges and problems, peoples' awareness, motivation and sensitization including environmental discipline are also equally important in achieving sustainable solid waste management system.

A FRONTIER IN SCIENCE AND HUMAN BENEFIT

The plenary session on “A Frontier in Science and Human Benefit” discussed the development and application of glycoproteomics and glycomics in clinical biomarker research. Currently developed lectin microarray has drawn increasing attention to glycoscientists and researchers in other fields. A major thrust in glycoproteomics and glycomics in clinical research is the application of several analytical tools to various diseases like liver diseases, autoimmune diseases and specially cancer with a view to discovery of glycan-based biomarkers for diagnosis, monitoring disease progression measuring therapy response and detecting recurrence.

Discussion was also made on the involvement of galectin-3, a beta galactoside-binding lectin in the progression of many cancers specially prostate cancer. In prostate cancer galectin-3 promotes tumor angiogenesis, tumor endothelial cell adhesion and metastasis. Cod glycopeptide TFD 100 blocks galectin-3 mediated angiogenesis, tumor endothelial cell interactions and metastasis of prostate cancers in mice. As the galectin-3 TFD interactions is a key factor driving metastasis in most epithelial cancers, this high affinity TFD 100 should be a promising anti-metastatic agent for the treatment of various cancers including prostate adenocarcinoma.

“Metabolomics in Diabetes-Clinical Implications” was also a part of discussion in this session. Studies have linked alterations in metabolomic profiles with obesity, glucose intolerations and prevalent diabetes. The most prominent metabolomic shift involve hepatokines (Fetuin A), adipokines (adiponectin, leptin), blood acylcarnitines, branched chain amino acids and keto acids. High circulating fetuin A levels were shown to be strongly predictive of incident T2DM. Fetuin A strongly promotes inflammatory cytokines expression in monocytes and adipocytes and represses adiponectin. Vitamin-D insufficiency is common among individuals with prediabetes and is also associated with insulin resistance, systemic inflammation and HBA1c in patients of T2DM. Vitamin D supplementation has been shown to prevent progression to T2DM and increase the chance of reversal to normoglycemia in prediabetic individuals. Metformin therapy reduces hepatic glucose output by suppressing acyl-alkyl-phosphatidylcholines. Metformin induced activation of AMPK and the consequent suppression of SREBP1c and FADS leads to reduced levels of PUFA and LDL-C. Study of metabolomics not only provides tools to screen population at risk for T2DM but opens up possibilities for development of newer antihyperglycemic agents.

Spiders make different types of protein based silks with remarkable biochemical and mechanical properties and artificial spidersilk could be an ideal source for generation of novel biomaterials. Spider silk fibres contain crystalline beta-sheet regions, which mediate mechanical stability and are formed within fractions of a second in the end of the spinning duct, but the soluble silk proteins (spidroins) can be stored at huge concentrations in the silk gland without aggregating prematurely. Spidroins contain unique repetitive segments, which determine the mechanical properties of the silk as well as non-repetitive N- and C-terminal domains (NT and CT), which regulate conversion of the dope into fibres, NT ensures raised beta -sheet aggregation and prevents premature silk assembly. CT converts into amyloid like fibrils in apH and Co2 dependent manner. Following this mechanism, it is suggested to be an important for nucleating the formation of sheets in the silk fibres. The present research aims to develop minispidroins that can convert into fibres using a biomimetic spinning

procedure, which allow manufacture of biomimetic silk.

Hyaluronan-binding protein1 (HABP1) is differently localized and expressed in skin papilloma progression and hyperphosphorylated in cancer cells. Upon treatment with HABPI, melanoma induce cell migration and tumor growth by NF κ B dependent MMP-2 activation through integrin, α v β 3 interaction which can be blocked with anti-HABP 1 antibody, integrin binding peptides as well as with curcumin. These observations suggest its functionality in cellular signalling during cancer progression. Upon overexpression in HepG2 cells HABP 1 augments tumor potency by increased HA levels and HA cable formation and cyclin D1 dependent cellular proliferation. It is suggested from cumulative research that interaction of HA and HABP1 regulates tumor formation and may act as a biomarker for tumor promotion. From many reports so far collected it indicates that elevated levels of HABPI to be correlated with advanced stages of various cancers demanding a widespread commercial use of this protein in different tumor tissues as a tumor biomarker.

A challenge to integrated placental omic research is the generation of holistic perspective rather than a reductionist approach that integrates the “omic” technologies to describe the “molecular fingerprint” of the placenta and to assess its usefulness in predicting fetal health outcomes. In this regard, metabolic profiling is a powerful strategy for investigating the low molecular weight metabolites present in a cell, tissue, or organism. These metabolomic and proteomic-based approaches have been successfully applied to the development of robust early prediction of later pre-eclampsia. The adoption of similar approaches using metabolic and proteomic profiling of the placenta, integrated with transcriptomic and epigenomic profiling would allow the generation of a holistic molecular perspective of the placenta at birth. An important factor of placental development and function is epigenomic regulation governing the control of gene expression. Multimodal assessment of these alterations using integrated “omic” approaches will allow to determine the placental molecular architecture at birth, which may help to identify infants most at risk for poor health and cognitive performance.

Recommendations

Research for discovery of glycan- based noninvasive biomarkers for diagnosis of liver diseases, autoimmune diseases, and cancer should be encouraged. Impetus is to be given to hyluronan- binding protein 1 as biomarker of cancer progression. Study on Galectin-3., a lectin with beta galactoside specificity for prostate cancer therapy should be started. Study of metabolomics for development of antihyperglycemic drug should be opened up. Research on spider protein for manufacture of biomimetic silk should be encouraged. Newborn' s placental omic research to predict health architecture at birth for further consequences in adult life should come in front.

RECENT ADVANCES IN MALE REPRODUCTION

The Chairperson, Prof. P. P. Mathur Vice Chancellor, KIIT University, Bhubaneswar introduced the theme of the topic and emphasized the relevance of the topic in the present context due to the

presence of a large number of contaminants in the environment and observed harmful effects on male reproduction. All the speakers presented their seminal work which has great clinical significance.

The first speaker Dr. Manuela Simoni, Department of Medicine, Endocrinology, Metabolism and Geriatrics, University of Modena and Reggio Emilia, Italy extensively reviewed the pharmacogenetic potential of FSH for female and male and demonstrated the molecular mechanism of the different activity of the FSHR p.N680S polymorphism in. The first pharmacogenetic trial was performed with FSH for male idiopathic infertility in men with FSHR p.N680S homozygous genotype. In a multicenter, longitudinal, prospective, open-label, two-arms clinical trial, idiopathic infertile men received 150 IU of recombinant FSH (Gonal f®) every other day for 12 weeks and were then followed-up for further 12 weeks after FSH-withdrawal. Patients were evaluated at baseline and at the end of the two phases. Primary end point was sperm DNA fragmentation (sDF), centrally evaluated by TUNEL/PI assay coupled to flow cytometry, resolving two different sperm populations, namely: PIbrighter and PIdimmer. This was the first study demonstrating that FSH treatment induces a significant improvement of total sDF in men carriers of the p.N680S homozygous N allele, suggesting that the FSHR genotype may be a predictive marker of FSH response in male infertility.

Dr. C. V. Rao, Professor at Herbert Wertheim College of Medicine, Florida International University, Miami, Florida USA made an elaborate presentation on Dichotomous dependence of male and female reproductive competence on luteinizing hormone signaling. He illustrated dichotomous dependence of female versus male fertility on LH signaling. Comparison of these findings with follicle stimulating hormone (FSH) receptor knockout animals revealed that while homozygous females are infertile, males are only subfertile. Thus, it appears that male reproductive competence evolved differently from females. Thus, while males can bypass LH and FSH signaling to remain sexually competent, females are absolutely dependent on both of them. These findings could have an evolutionary significance. For example, evolution may have favored males to maintain their reproductive competence under the adverse conditions under which LH and FSH may not be available. Interestingly, LH can directly regulate male reproductive tract function, including spermatogenesis, sperm functions and even the phallus. Their LH dependence can also be bypassed by androgens. In contrast, female nongonadal LH actions cannot be completely rescued by ovarian steroid hormones and the treated animals cannot initiate pregnancy even with donor embryos.

Dr. Dianne M. Creasy of Huntingdon Life Science, New Jersey, USA extensively reviewed the effects of environmental toxicants on male reproductive function by extrapolating from animal data to man. She presented that in recent years there has also been growing concern regarding progressively declining sperm counts in the general population from a number of western countries. Low sperm count also appears to be associated with increased incidences of developmental defects in the male reproductive tract at birth and the development of testicular cancer in young men. Research in animal models has led to the hypothesis that this syndrome of changes (testicular dysgenesis syndrome) may result from hormonal disturbances in the developing fetus during organogenesis of the reproductive tract. Endocrine disrupting chemicals, particularly those with estrogenic and anti-androgenic properties (e.g. phthalates), have been implicated as possible causative agents. Although there is evidence in the rat, that maternal exposure to high doses of these chemicals can produce developmental abnormalities in the reproductive organs of male offspring, the dose levels required are many fold higher than humans

are generally exposed to.

Dr. Martine Culty, Professor, Department of Medicine, McGill University, Montreal, Canada, spoke on the Impact of Endocrine Disruptor Mixtures on Testis Development and Function. Dr. Culty presented her work on the experiments comparing the effects of genistein (GEN) and DEHP, alone or mixed, used at doses relevant to human exposure. These studies revealed that in utero exposure to GEN and DEHP combinations induced effects in adult rat testes different from those induced by single compounds, identifying Leydig, Sertoli and germ cell as adult target cells, and the involvement of inflammatory testicular cells. The studies also showed differential effects of the compounds in neonatal rat testes, including the normalizing effects of genistein on DEHP-induced oxidative stress responses, which were not observed in adult testes. These studies demonstrated that one cannot extrapolate effects of chemical mixtures on male reproductive system from the effects of single compounds, and highlighted the need of assessing the risks associated with mixtures at environmentally relevant doses at different ages.

Dr. Vassilios Papadopoulos, Executive Director & Chief Scientist Officer of The Research Institute of the McGill University Health Centre and the Department of Medicine, McGill University, Montreal, Quebec, Canada presented the pharmacology of the mitochondrial cholesterol transport and steroidogenesis. In his elegant presentation he explained that steroidogenesis begins with the transfer of cholesterol from intracellular stores into mitochondria through a complex formed of cytosolic proteins, such as the steroidogenesis acute regulatory protein and 14-3-3 adaptor, and outer mitochondrial membrane proteins Translocator Protein (TSPO) and Voltage Dependent Anion Channel (VDAC). TSPO and VDAC have been associated with multiple cellular mitochondria-dependent functions. Aberrant expression of TSPO has been linked to cancer, neurodegeneration, neuropsychiatric disorders and primary hypogonadism. TSPO drug ligands have been proposed as therapeutic and monitoring agents for these diseases. There is a clear need for developing repair therapies that restore the brain's and testis' abilities to make steroids. In vitro and in vivo studies, using animal models of disease, demonstrated that TSPO drug ligands increased neurosteroid production in neuropsychiatric disorders and testosterone formation in hypogonadism. Moreover, peptides conjugated to 14-3-3 site of interaction with VDAC1 blocked 14-3-3-VDAC1 and increased VDAC1-TSPO interactions in testis inducing testosterone formation. In contrast, in constitutively steroid producing Leydig and adrenal cell tumors blocking TSPO function inhibits excessive steroid synthesis. TSPO and VDAC were identified as valid drug targets that control steroid formation both in vitro and in vivo.

Co Chair: Dr. Manu Saxena, Coordinator for Monitoring Bluebirds Nest Boxes, New Jersey Audubon Plainsboro Preserve, USA.

TRANSLATIONAL TARGETS IN CANCER AND OTHER DISEASES

The session was co-chaired by Professor Shrikant Anant of Kansas University Medical Center, USA and Professor Vijaya Lakshmi Saxena, Kanpur. Dr. Anant first introduced the speakers and some introductory lecture about the topic.

First speaker was Professor Roy Jensen, Director of The University of Kansas Cancer Center and Kansas Masonic Professor of Pathology and Laboratory Medicine, presented breast

cancer genes, BRCA and how it could affect the triple negative breast cancer patients. Dr. Jensen described how it could be targeted in those patients.

Next talk was given by Professor George Weiner, Director, Holden Comprehensive Cancer Center, Professor of Internal Medicine, University of Iowa Medical Center, USA. Dr. Weiner talked about the new immunological approaches in leukemia and hematological disorders. Dr. Weiner talked about adoptive cell therapy particularly chimeric antigen receptor (CAR) T cell therapy. In CAR T cell therapy, T cells from a patient are removed and then genetically modified to express a protein receptor that recognizes a particular antigen found on leukemia cells. Dr. Weiner also described blocking of CTLA-4 involved in curtailing anti-cancer immune response and restore anti-cancer activity.

Finally, Professor Vinata Lokeshwar, Chair, Biochemistry and Molecular biology, Medical College of Georgia, Georgia Regents University, talked about the diagnostic and prognostic markers in Kidney and Prostate Cancer, Dr. Lokeshwar mostly talked about the metastasis of prostate, bladder, and kidney cancer with the goal of better diagnosis and treatment.

BIODIVERSITY DATABASE INTEGRATION FOR THE BENEFIT OF HUMAN KIND

At the outset Dr. Ashok K. Saxena, General President launched the pamphlet containing the information of the session and also a feed back form inside it.

Dr. S. Kumar, Chairman, Senior Principal Scientist & Head, Bioinformatics Division, CSIR - National Botanical Research Institute, Lucknow gave the presentation on " Web Enable Database on Plants of India and Integration of Associated Knowledge from other Domains" and "Species Diversity Management In Smart Cities of India". He emphasized on digitization of plant diversity of information stored in Herbarium databases, botanical gardens, monographs, herbaria, genomic information for the management of a web portal on 100 smart cities of India. Dr. S. Kumar started his presentation about the elements of infrastructure required in the development of smart cities of Govt. of India. He presented the detailed account of biodiversity databases and global need of development of the same. He presented a model on development of a Web Portal containing Digital accounts of Biodiversity i.e. total species of plants, animals and other organisms in smart cities of India. Dr. S. Kumar explained the use of information stored on Herbarium collections for several purposes like Basic Functions & Research, Related Research - Collections are the lynchpin of biological research, Education & Training, Outreach & Money Making ventures. He emphasized the importance and integration of database on information stored in Herbarium specimens, botanical gardens, germ plasm centres, monographic databases and traditional knowledge databases for the management of plant diversity and environment related issues in development of smart cities.

Linkage of knowledge on herbal products like Neem based products in controlling the Malaria disease in smart cities was also explained.

Dr. G.P.S. Raghava, Head, Bioinformatics Centre, CSIR - Institute of Microbial Technology, Chandigarh, India, gave detailed talk on genomics in relation to human diseases. Dr. Raghava started his presentation on various queries on Personalized Medicines and

hierarchy in biology i.e. from Atoms to Biosphere, Animal cell structure, human chromosomes & Hierarchical shotgun sequencing, genome annotation. He presented and elaborate account CancerDR Drug Cell Lines etc. and Cancer Drug Resistance Database, HerceptinR Resistance Database, Pancreatic Cancer Methylation Database (PCMdb), Structurally annotated therapeutic peptides database (SATPdb) and several web servers including Proteins Structure Prediction, Chemoinformatics and Pharmacoinformatics, Molecular interactions, Biological database, Genome annotations, Immunoinformatics or vaccine informatics, Functional annotation of Proteins, GPSR (A resource for genomics, proteomics and system biology) and OSDDLlinux.

Dr. R.C. Agarwal, Registrar General, PPV & FRA, Govt. of India, New Delhi. presented that biological diversity is fundamental to Agriculture and food production and India is amongst 12 centres of origin of cultivated plants. He emphasized the need and importance of information system for Plant Genetic Resource (PGR). During presentation a brief of some important PGR databases like PGR Informatics at International Level, WISH-GPA, DivSeek, Global Biodiversity Information Facility (GBIF), International Multicrop Databases, GBIMS, IINDUS, NORV, NISM etc. were explained. The details of various data sharing agreements, protocols in GBIF, ITIS, SINGER, GENESYS were explained. The need for data integration and various legislations were explained.

Dr. Anil Rai, Head & Professor, Centre for Agricultural Bioinformatics, ICAR - Indian Agricultural Statistics Research Institute, Library Avenue, New Delhi spoke on "Genomic Databases & Molecular Prediction to Accelerate Agriculture Germplasm Improvement." He emphasized need of food & nutrition & genomic selection, requirements of genomic selection and advantages of genomic selection. He mention about the flood of data due to outcome of rapid research technologies & developments. He explained about three central biological processes viz. a) DNA sequence determines protein sequence; b) Protein sequence determines protein structure; c) Protein structure determines protein function; and ICAR initiatives in this area including account of Advanced Supercomputing Hub for Omics Knowledge in Agriculture (ASHOKA). During presentation a brief of some important databases like Pigeonpea Microsatellite Database, Buffalo Microsatellite Database, First Whole Genome Based Microsatellite DNA Marker Database of Tomato (TOMsatdb), Goat Microsatellite Database, World's First Web Based Server for Goat Breed Identification using microsatellite DNA marker (GOMI), Breed Identification Server for Cattle (BIS-Cattle), Breed Identification Server for Goat (BIS-Goat), Halophile Protein Database (HProtDB), SBMDb: First Whole genome putative microsatellite DNA marker database of sugar beet for bioenergy and industrial applications, Buffalo Genome Information Resource, Fish Barcode Information System (FBIS) were presented.

Recommendations :

Development of web portal on plant diversity of smart cities of India by integrating various knowledge resources on plant specimens, live collections in gardens, germplasm, PGRs, traditional knowledge and databases from other domains.

INSECT BIOLOGY

Dr. L. S. Shashidhara, Professor and chair of biology programme in IISER Pune, chaired the session.

Research in the frontiers of molecular biology using Insect as a model helps in understanding key molecular mechanisms and also offers newer strategies to tackle various fatal diseases. One of the key speakers of the session Dr. Volker Hartenstein who is a Professor of molecular, cell and developmental biology in University of Los Angeles, delivered a lecture on the topic “From Gene to neuron to brain function: A lineage based analysis of *Drosophila* brain development and circuitry.” The focus was on the importance of *Drosophila* brain in context of studying neuronal circuitry due to its manageable number of stereotyped neuronal lineages, groups of neurons descended from individual stem cells born in the embryo. The lecture was an update of state of knowledge of lineage based *Drosophila* neuroanatomy at different stages of development with an introduction to the large dataset of several thousand contiguous electron microscopic sections in conjunction with a specially developed software package that assigns all synapse specific neurons, thereby assigning neuronal wiring properties to specific lineages. He summarised with the new findings that begin to elucidate how the anterior visual pathway circuit is assembled during brain development. This talk was followed by Dr. D. Channe Gowda, Professor at the Department of Biochemistry and Molecular Biology, Penn State University College of medicine, Hershey on “Understanding malaria Immuno-pathophysiology for developing treatment strategies.” Professor Gowda’s talk was focussed on two predominant species of *Plasmodium* family protozoan parasites that cause malaria- *P.falciparum* and *P.vivax* which are the most virulent and fatal disease causing-frequently in children and pregnant women. The widespread resistance of the parasites today is emerging to the new frontline drug, artemisinin and its derivatives and Professor Gowda laid focus on the parasite factors, host receptors and signalling events involved in immune responses and pathogenesis that will help in the field of drug discovery.

The session concluded with a brief talk by the session chair Dr. L.S. Shashidhara on evolution of Insect hind wing morphology: A comparative genomic analysis of targets of HOX protein Ultrabithorax. His talk provided new insights into evolution of Hox function, which are implicated in the evolution of body plan in the animal kingdom.

PREVENTION AND THERAPEUTIC APPROACHES IN CANCER AND OTHER DISEASES

Dr. Animesh Dhar, Chairman from Kansas University, Medical center, USA, talked about

small molecule inhibitor targeting epigenetic in pancreatic cancer. In this talk, Dr. Dhar talked about the development of novel drug derived from saffron as crocetin acid that affected epigenetic marks, histone demethylases in particular KDM1A and KDM3A, in turn, suppresses pancreatic cancer tumorigenesis through inhibition of cancer stem cells.

Dr. Chendil Damodaran of Department of Urology, University of Louisville, Louisville, Kentucky, USA, delivered his lecture on developing and designing novel molecules for breast cancer. In his talk, Dr. Damodaran concluded that Psoralidin, a non-toxic compound, suppressed breast cancer growth of breast cancer stem cells through inhibition of NOTCH and epithelial-mesenchymal transition (EMT). In conclusion, Psoralidin appears to be novel agent targeting breast cancer.

Dr. Balkrishna Lokeshwar of Department of Medicine, Medical College of Georgia, Augusta, Georgia, USA talked about the diet modification for prevention of malignant cancer in adding more spice. Dr. Lokeshwar presented data on preventive effect of all spice in different cancer in particular, prostate cancer.

At the end, Dr. Manoj Kumar Chakrabarti, one of the chairs of the session, concluded the session.

BIOGAS PRODUCTION, POWER GENERATION AND PURIFICATION OF VEHICULAR APPLICATIONS

Prof Virendra Kumar Vijay, the Session Chair, head, Centre for Rural Development & Technology, IIT Delhi gave presentation on : Prospects of Biogas Upgradation and Bottling for Cooking and Green Transport System in India

Dr H N Chanakya, IISC Bangalore spoke on Biogas from Biomass - the innovation path for sustainable and indigenous endogenous development of rural and peri-urban India

Ms Varsha Joshi, Joint Secretary, MNRE, Govt of India, spoke on Development of Biogas as Sustainable Decentralized Power Generation Option in India

Prof Deepak Sharma, Head, Renewable Energy Department, Maharana Pratap University of Agri. & Technology, Udaipur (Raj) presented on Domestic Biogas Plants for Energy Security and Bio-manure Production: A Green Fuel

Prof Deben C Baruha, Tezpur University, Assam, spoke on Biogas technology for rural development of Northeast India

Recommendations:

1. There is need to launch for a national mission on Biogas Technologies for cooking,

power generation and transport application.

2. One stop shop for providing all information on biogas production.
3. Incentive based approach for mission
4. 3 types of plants required- domestic, large and commercial plants for urban and village clusters.
5. Integrated efforts of Ministry of Agriculture, Rural Development and MNRE to expedite the Biogas Mission.
6. Revise BDTC mandate and ask for user feedback and operate as a solution center.
7. Biogas should be included under agricultural activities to target 10 million by 2022.
8. Distribution pattern for 10 million biogas plants as 70% in rural and 30% in urban areas.
9. Revive State missions and strengthen State renewable energy agencies.
10. Better marketing and dissemination strategies using various mass communication resources.
11. Develop maintenance and service sector for sustaining the existing and future biogas plants.
12. Emphasis on innovation, R&D and technology dissemination.
13. Multi-feed Biogas plants for economy and sustainability.
14. Effective legislations keeping in mind the new challenges like slurry fertilizer, urban wastes, multi-feed substrates, etc.
15. 1. There lies a huge potential for family size biogas plants installation in our country from the animal waste, which will generate local employment besides disposing large quantity in an eco-friendly manner.
16. 2. The organic manure thus produced in small quantity will be easily manageable and will serve the requirements of fragmented agricultural land holdings in remote rural areas.
17. 3. The government intervention in terms of policy framework, financial incentives, employment generation and skill development courses for unemployed masses should be formulated.
18. 4. It should be mandatory to utilise organic bio-slurry in conjunction with chemical fertiliser for the farmers in 50:50 ratio to maintain soil health and reduce irrigation water requirements with increased productivity.
19. 5. The health hazards due to indoor air pollution by way of burning firewood/dung cakes/loose biomass in traditional cook stoves are tremendous and needs to be highlighted giving alternate solution of bio-methanation.
20. 6. Multi-design and multi feed stock utilisation could be promoted so as to give choice

- of technology in conjunction with the economic status of individual beneficiary'
21. 7. The energy yield ratio, cost of installation, annual operational cost and annual income from small capacity biogas plants is also very attractive and need to be highlighted.
 22. Despite of the critical demand for cooking fuel, particularly in the rural households of northeastern region, and assured supply of feasible feedstocks (crop residue and animal dung), use of biogas technology has been very limited in NE region. For example, as against the 72% fuel wood user households in Assam, only 0.1% use biogas where as LPG users are limited to 19%. Thus, all round efforts for promotion of biogas technology with an aim to substitute traditional inefficient fuel system are required.
 23. Introduction of appropriate technology packages for application of gas as well as handling and management/value addition of digestate (without loss or leaching of nutrients) shall be emphasized in order to derive full benefits of the technology under typical rural/farming ambiance.
 24. Demonstration of community scale AD plants in certain selected rural clusters addressing (i) social, (ii) cultural and (iii) technical factors is expected to help promotion of this technology further.
 25. Rural technician in NE region (including existing By-Cycle repairing shop etc) shall be trained (skill development) for AD technology including installation and up to after installation repairing issues.
 26. R&D effort shall be directed to make AD technology as "commercially driven" rather than "subsidy driven".
 27. Demonstration of AD based Hybrid Renewable (Solar without storage) Energy in certain isolated areas of NE region are required. The integration of solar thermal in/during cold regions/seasons of NE is expected to ensure uninterrupted gas generation. This is also assist to tackle on-going deforestation of NE forest through supply of alternative thermal energy for domestic uses.

SKILL SET AND KNOWLEDGE DEVELOPMENT FOR AEROSPACE AND DEFENSE TECHNOLOGY SECTOR FOR THE MAKE IN INDIA INITIATIVE

In this plenary session the Public and Private sector enterprise views for a specific area of the high technology Aerospace and Defence equipment manufacture was the focused for panel discussion and following are the highlights of the discussions and recommendations.

Panellists: Padma Vibhushan Dr.V.K.Aatre, Former Director General DRDO]
 Co Chair
 Prof .L.S.Satyamurthy. CEO Medetel Health and Former Director, ISRO]
 Co Chair
 Dr.R.M.Vasaqgam, Former Director ISRO and VC Anna University,
 Chennai
 Col.H.Shankar CEO, Alfa systems and former Director BEL, Bangalore

Prof.Maheshappa, VC , Vishweshvaraiiah Technological University of
Karnataka
Bangalore
Shri. G.Rajnarayan, MD, Radel Systems Private Ltd and formerly at HAL

Summary of Presentations:

India is poised for manifold growth in Defence and Aerospace systems, civil aviation, military aviation and missile systems in coming years. The space launches will touch more than 10 per year from now onwards. Civil aviation in India is growing at the fastest pace in India with 100's of aircraft from reputed manufacturers across the world with 30% offset component. Similar is the scenario for the combat aircraft, helicopters, and military transport aircraft with 30 % offset opportunities. Private players are now forthcoming to exploit this lucrative opportunity along with state owned HAL.

Our programmes for Indigenous missile systems are aiming at producing the needed numbers with major role being assigned to Indian industries. There is also an emerging requirement for Maintenance and Repairs Operations (MRO) activities for civil and military aircraft systems .India will also can get a share of the world market in MRO activities .

The availability of well trained and highly skilled workforce is a major requirement for realisation of the above programmes. Trained manpower in excess of 100000 is the need of the hour. They will be working at component, subsystem and system integration level tasks in industries spanning from Medium and Small Scale Manufacturing Enterprise (MSME) sectors to the end product delivering entities. Handling cutting edge technologies, meticulous adherence to inspection, quality control and certification needs specialised training programmes for the workforce. Some initiatives have already been taken to offer training in manufacturing aerospace products including avionics, composite parts and integration and testing of mechanical, electro mechanical, electrical and electronic subsystems and assemblies. The facilities and work force have to be certified by national and international agencies like DGCA, CEMILAC,FAA and European agencies.

Recommendations for Action by Ministry of Skill Development , Ministry of Defence - PSUs, DRDO Laboratories./Organizations, ISRO-Department of Space, Union HR Ministry-IIT, NIT, UGC AICTE, State Directorates etc

General Aerospace Systems Perspective

Recommendations 1 The projected work force demand of 100000+ has to be met by specialised training and certification .The programmes launched by HAL , members of SCIATI will come handy for meeting this need. ISRO plans to move the work to Indian industries for producing high technology launch vehicle and satellite systems through effective technology transfer has already started paying dividends.Similar efforts have to be made by industry bodies like CII and ASSOCHAM. The trained manpower can find lucrative employment outside India as well. Thus these efforts will pave the way for realising "Make in India" goal in high technology area like Aerospace and Defence Technology systems .

Defence Technology Area-Public and Private Sector Industry Perspective Recommendation 2

“Make in India” initiative by Government of India has invigorated Indian Private Sector Industry, particularly, with respect to Defence Equipments/ Systems manufacture.

There are stringent design, development, production, testing and qualification requirements for defence equipment. Unlike civilian equipment, defence equipments have to function and operate in adverse climatic and terrain conditions.

Military standards-MILStd Ruggedisation is the Buzz word. MIL STANDARDS-JSS55555-lays down the standards. There is specific qualification Standards for land based, ship borne and airborne defence Avionics equipment and systems, which are to be followed meticulously at all levels.

The above requires skill sets and knowledge base for manufacture of equipment and systems at all levels – starting from skilled workers, technicians, supervisors, engineers, senior Executives and whose skills / knowledge base updated continuously and at regular intervals.

Hence there is a need of reviewing and amending curriculums starting at ITIs, Diploma/Engineering colleges, conduct of specialist courses at various Institutions, such as Institution of Engineers/Telecom Engineers/SIATI/Private Training Institutes. In addition, there has to be one-to-one interaction and Project based association including on job training between training/educational institutions with defence R&D and Manufacturing units, both in Public and Private Sectors. Above are essential particularly in Defence sector to ensure success of “MAKE IN INDIA” concept and to make it a reality.

Medium and Small Scale Enterprise (MSME) Perspective Recommendation 3

The ‘Make in India’ is a paradigm shift from the past two decades about the benefits of manufacturing products in India for home consumption rather than import them. However, ‘Make in India’ goes beyond just manufacturing, to design, innovate, manufacture and support in India.

Viewed holistically, this has profound implications across a wide section of businesses. It involves huge numbers of creative engineers, technicians, professors, research scholars, sales, marketing and support staff, etc. all of whom need to possess specialized skills.

Medium and Small scale Enterprises (MSMEs) in India contribute more than 45% of the industrial output of the country and hence constitute a large section of the manufacturing chains of almost all products. ‘Make in India’ opens up far more opportunities of raising their value proposition than being mere vendors to the large and established manufacturers.

MSMEs will now have to scale up their capabilities to design and manufacture parts, sub-assemblies

Technological University Perspective Recommendation 4

“Make in India” aimed at reviving the job-creating manufacturing sector is a key to taking Indian economy on a sustainable high growth path. The “Make in India” campaign has provided the umbrella for the policies and initiatives to accelerate manufacturing and job creation in India. Manufacturing is needed to develop the technological and engineering provision skills that balanced and sustainable economic growth requires. Manufacturing has to become the next big wave for India. India has all the ingredients in place to become a manufacturing hub- talent, entrepreneurship, raw materials, a large domestic market and the opportunity to reap economies of scale.

The major effort from the Technological university like the VTU in Karnataka will be to drive this concept to the select Engineering Institutions all over the country through the States Technical Education Boards to sensitize the Students, Teachers and managements to adopt sustainable knowledge and skill sets through training, Industry interaction, Seminars and symposia periodically for the Make in India transformation. The universities can evolve a Institutional frame work for Make in India through the State and central Government support including UGC and AICTE.

PUBLIC – PRIVATE PARTNERSHIP FOR THE SWACHH BHARAT INITIATIVE

The session was chaired by Prof (Dr) Indira Chakravarty, Padmashri Awardee, Chief Adviser, Public Health Engineering Department, Govt. of West Bengal, and co- chaired by Dr. (Er) Nilangshu Basu, Principal Chief Engineer, The Kolkata Municipal Corporation, Kolkata.

Prof. Indira Chakravarty gave an over view on the role of Public – Private Partnership in Swachh Bharat Mission and initiated the session.

The Key note address was given by Mr. Nipun Vinayek, IAS, Director, Ministry of Drinking Water and Sanitation, Govt. of India, on behalf of Dr Saraswati Prasad, IAS, Additional Secretary, Ministry of Drinking Water and Sanitation, Govt. of India

The next Key Speaker was Mr. Sugato Dutt, IAS, HOD (LU), State Planning Commission, Govt. of Tamil Nadu on behalf of Ms Shanta Sheela Nair, Vice Chairman, State Planning Commission, Govt. of Tamil Nadu and Former Secretary, Govt. of India

Ms. Priya Nair, Executive Director, Home care, Hindustan Unilever spoke on behalf of Mr. Sanjiv Mehta MD and CEO, Hindustan Unilever

Mr. Ravi Bhatnagar, Manager External Affairs, Reckitt Benckiser spoke on behalf of Mr. Nitish Kapoor MD and CEO, Reckitt Benckiser

The last key speaker was Mr. Siraj A Chaudhry, Chairman, Cargill India, who gave an

overview by linking Swachh Bharat Mission to food security initiatives.

Recommendations:

1. The importance of Cleanliness and Hygiene and its impact on the Health as well as the Nutritional status of the people, needs to be given due recognition.
2. This not only needs the support of the government but also of the industry, as well as other independent or non-government organisations, to ensure community reach.
3. To ensure this, formation of a Joint Public – Private forum by all partners – Government (Ministry of Drinking Water and Sanitation, represented here by Mr. Nipun Vinayek, IAS, Director, Ministry of Drinking Water and Sanitation, Govt. of India; State Planning Boards – represented here by Mr. Sugato Dutt, IFS, HOD (LU), State Planning Commission, Govt. of Tamil Nadu and others), Industry (represented by Mr. Siraj A Chaudhry, Chairman, Cargill, India; Ms. Priya Nair, Executive Director, Home care, Hindustan Unilever, India; Mr. Ravi Bhatnagar, Manager External Affairs , Reckitt Benckiser and others), Experts (represented here by Prof (Dr.) Indira Chakravarty, Chief Advisor, PHED and Mr. Nilangshu Basu, Engineer-in-Chief, KMC and others); Civil Society Organisations(represented here by the Foundation for Community Support and Development)was recommended.
4. It was recommended that a meeting of representative partners of this session may be held with Mr. Nipun Vinayek, IAS, Director, Ministry of Drinking Water and Sanitation, Govt. of India Swachh Bharat Mission to plan a way forward in consultation with Dr. Saraswati Prasad, IAS, Additional Secretary, Ministry of Drinking Water and Sanitation, Govt. of India.
5. Electronic media may also be used to form a group right awayeg. Formation of Whatsapp Group, Group Mails etc.
6. It was suggested that the chair of this session Dr. Indira Chakravarty, should discuss and take this forward with the Secretary, Ministry of Drinking Water and Sanitation, Govt. of India and other concerned Ministries with help of Dr. Saraswati Prasad, IAS, Additional Secretary and Mr. Nipun Vinayek, Director, Ministry of Drinking Water and Sanitation, Govt. of India.

RECOMMENDATIONS RECEIVED FROM SECTIONS

AGRICULTURE AND FORESTRY SCIENCES SECTION

- Imbalanced and inadequate plant nutrient application is a major reason for low crop productivity, low farm profitability and low nutrient use efficiency in Indian farms. Precision nutrient management based on the 4R Nutrient Stewardship principles is required for optimizing nutrient use in farm fields.
- Precision nutrient decision support tools such as Nutrient Expert, Green Seeker, GIS-based fertility maps, STCR etc. that help wide-scale dissemination of improved nutrient management tools must be up-scaled.
- Water scarcity is one of the biggest challenges that may compromise our food security. Participatory development of water conservation structures to store and use rainwater and excess canal water, and precision water management strategies that supply water near crop root zone will improve water use efficiency. In this regard, the quality of irrigation water (such as waste water, contaminated surface and groundwater, untreated sewage, industrial effluents, etc.) needs to be considered to address the bio-safety issues.
- Adoption of conservation agriculture and recycling of organic residues is essential for improving the soil organic carbon stock and soil health in general. Development of a national strategy on '*Waste to Wealth*' for providing potential and practical solutions to reduce residue burning and proper handling and recycling of rural and urban wastes is required. The latter may be linked with the *National Skill Development Mission* for recycling of organic residues back to fields for improving soil health.
- Implementation of Land Resource Inventory at 1:10000 scale is necessary to catch the micro-specificities of agricultural production systems and propose the appropriate Land Use Planning, with special emphasis on land degradation and the corrective measures.
- Climate change will strongly affect our agricultural production systems. Research for development of heat, drought and other biotic and abiotic stress tolerant cultivars through public-private partnership, and easy access of quality seed for farmers remain critical for adaptation and mitigation of climate change impacts.
- The need for data acquisition from the ICAR and the Central Government- funded long-term multi-location research projects and their proper storage was strongly recommended. The access to data for analysis by multiple agencies should be ensured for agricultural policy guidance.
- Strong emphasis is needed on extension to harness the large-scale impact of improved technologies in farmers' fields. Synergy of technologies and target groups, use of modern audio-visual aids, as well as ICT-based decision support tools like Nutrient Expert in conjunction with the Soil Health Card Program is desirable.
- Popularization of Non-Tree Forest Products is necessary to help ensure livelihood security and women empowerment in tribal areas.
- The wastelands along canal bunds and coastal belts can be put to productive use by raising high oil yielding trees for promoting biofuel production, thereby reducing environmental footprint of commercial fuel use.

ANIMAL, VETERINARY AND FISHERY SCIENCES

1. Animal behavioral studies pertaining to climate changes and natural disaster need to be taken as an area for potential research.
2. Bioresources are the wonderful gift of nature to the mankind whose sustainability can be effectively linked to rural livelihood and economic development, so science education should aim at attracting students for proper management and sustainable utilization of bioresources.
3. The assemblage of species with we share the planet represents a vast untapped genetic library, with undiscovered pharmaceutical and beneficial substances. So programme needed to be initiated for the exploration of other less known potential varieties of life forms with a view to ensure rural livelihood, food, health and financial security.
4. Promotion of Public awareness on biodiversity conservation role of individuals for minimizing ecological footprint and maintaining health and hygiene in the vicinity should be made.
5. Documentation of traditional technical knowledge (TTK) and indigenous technology, its revival and strengthening for sustainable development in the area of bioresources and adaptation to climate change should be made.
6. Public participation in decision-making should be ensured and integration of environmental, economic and social sustainability with food, health and livelihood security of the people.
7. Basic biology should be made integral part of undergraduate and post-graduate studies in biotechnology, microbiology, bio-informatics and modern disciplines.
8. Programme needs to be initiated for exploration of other less known varieties of life forms with a view to ensure livelihood and food security.
9. Application of molecular tools for wildlife conservation, especially of endangered species may be given greater importance.
10. Multivoltine race of silkworm (*Bombyx mori*) should be tested under different agro-climatic zones of India for proper evaluation of their improvement efficiency.
11. Bio-economic modeling of different ponds and reservoir management with view to increase fish production should be carried out.
12. Various disease problems (in aquaculture and animals' husbandry etc.) and their management can be worked out in details.

13. Public-private partnership (PPP) should be encouraged to solve the environmental problems and conservation and proper exploitation of all such life forms, which ensure food, health and livelihood.
14. With a view to check population growth, amalgamation of both indigenous and recent innovative research of male reproduction should be encouraged.

ANTHROPOLOGICAL & BEHAVIORAL SCIENCES

1. Social harmony is a prerequisite to both national development and integration. Social harmony is disturbed by three Ps—Poverty, Prejudices and Politicization. Therefore, efforts should be made for eradicating poverty, deescalating inter-group prejudices and discouraging politicization which lead to vote bank politics.
2. Indigenous knowledge of the country should be enriched particularly in the areas of health sector, agriculture, art, crafts and handicraft, indigenous skill development, sanitation and cleanliness and economic activities.
3. Indigenous development of armaments on the lines of indigenous subsonic missile (Nirbhaya in Oct 2014) should be further encouraged. DRDO had developed many more armaments and missiles and greater need has arisen to develop new armaments in this direction.
4. Policy makers should implement 'Ayush' vehemently, particularly in the areas of 'Ayurveda' and 'Yoga'. Benefits of Yoga have been proved scientifically. There has been acceptance of Yoga but greater efforts are needed to prevent many physical and mental ailments. Promotion of mental health may be facilitated by Yoga.
5. Stress and depression are increasing in our country. This is resulting in the increase of suicide rates of farmers, students and other sections of people. It is recommended that proactive policies be implemented by promoting mental health. Suicide has three phases: Ideation, Attempt and Commitment, by identifying the indicators through tests like 'Suicide Ideation Scale'. The number of attempters and committers may be reduced.
6. Counseling should become a regular routine in our school system.
7. Development of men should be based on the lines given by the then behaviorist (Vedic Philosophers) from individual to universe: Yatpinde-tat-Brahmande.

CHEMICAL SCIENCES

1. Emphasis should be on the development of technology for cheap diagnostic kits for diagnosis of diseases at an early stage.
2. Research should be encouraged for the development of chemical and bio-sensors for various bio markers.
3. Research should be conducted in the field of nanomaterials to be used in display, imaging and lighting applications.
4. Green synthesis and electro organic synthesis should be adapted for the rapid and efficient synthesis of various heterocycles and heterocyclic scaffolds.
5. Graphene quantum dot conducting polymer for opto electronic and photovoltaic applications are the need of the hour.
6. Application of electrochemical and photocatalytic technology should be expanded for the mineralisation of various environmental organic pollutants.
7. Research on Photogalvanic cells for sustainable approach to harvest solar power should be in the priority area of research.

EARTH SCIENCES

1. Recent geoscientific research and development shall be incorporated and amalgamated with the mineral and mining based industries for the National development.
2. With the increase in demand of Energy and Water there is an urgent need to formulate strategies and modalities through geoscientific investigations for their proper management and utilization.
3. To enhance mineral and energy resources ongoing studies in Bay of Bengal, Arabian Sea and Indian oceans be rigorously taken up. Regions such as Antarctica and Arctic be continued with reference to better understanding of Climate Change studies.
4. There is an urgent need to look into mitigation and management of Natural Hazards (frequent earthquakes, floods, cyclones and storms, tsunamis, mass movements, ground level fluctuations etc.) including Climate Change from geoscientific perspective.

5. Geoscientific concerns is necessary in planning of Smart Cities.
6. Geology be included as one of the optional Science subject in High and Higher secondary level School Curriculum to be taught by trained postgraduate's.

ENGINEERING SCIENCES

- Recent advances in Nano technology offer oportunities to devolope next generation water treatement and supply system. There should be a coordinated effort between the government, University and research organizations to suuport and highlight projects on nano-technology enabeled water and wastewater treatement.
- Convetional proven technology needs to be improved and utilized in colaboration with modern techniques for costeffective solutions of drinking water supply for rural community particularly in the arsenic and fluoride affected areas.
- River rehabilaton and training structures are nowdayas one of the most important aspects of river engineering which contains all the hydro-enviormentals features such as river grade control, bank protection, water quality and aquatic habitat and these are needed to be employed for a sustainable environment. Serveral eco friendly hydraulic structures like W-weir, cross vane, J-Hook and log deflectors are being employed to attain this objective.
- The research on finding the potential of both cotton and coal ash as water holding materials was experimented with sandy loams in the difficult terrain of inner Mongolia and this can evaluated in Indian senerio to assess the positive effect of increase of water holding capacity. In addition the potential of coal ash, the effect of artifitial geolite as particle film sparayed over plant-leafs can also be evaluted to further diversify its potential use for salinity mitigation in arid soil.

ENVIRONMENTAL SCIENCES

1. It is recommended to create “smart green belts” model for promoting conservation of biodiversity in a sustainable way so that this new concept will promote the growth of

indigenous industries harnessing the local resources and will provide various livelihood materials such as timber, firewood, fruits, vegetables, animal foods, silk, lac, honey, electricity, fertilizer and medicine for consumption as well as for generating incomes.

2. It is recommended to explore, document and reclamation of wasteland and conservation of wetlands for better livelihood and for maintaining sustainable ecosystem in a cost effective and implementable manner.
3. It is recommended to set up an all India co-ordinated Project on assessment and mitigation of air quality (indoor and outdoor air quality) in major cities of India in terms of inorganic (NO_x, SO_x, SPM, etc.,) and organic (pollen and spore causing allergy) pollutants.

MATHEMATICAL SCIENCES (INCLUDING STATISTICS) :

1. Applicable mathematics should be given more stress.
2. Data analytics, coding theory, soft computing and machine intelligence may also be included in the mathematics section
3. There should be collaboration among mathematics, engineering and other science subjects.
4. The above is due to the fact that mathematical modeling and simulation of physical problems save time and cost of repeated experiments to succeed the 'Make in India' slogan.
5. Mathematicians (pure, applied, statistics) need to think a bit application with their research outcomes as per the need.
6. Technical (educational and research) institutes should keep the mathematics subject and related facilities in the forefront because this may be the only subject without which no other subjects may grow for breakthrough results.
7. Provide quality mathematics education for all.
8. Provide opportunities to all teachers, for continued professional growth in their mathematical knowledge.
9. Mathematicians should recognize the need for improving mathematics teaching at all levels.
10. A coherent professional development program for mathematics should be developed.
11. The teaching and learning of mathematics should keep pace with the needs of modern societies

MATERIALS SCIENCE

1. Attention required for the Ganga river cleaning and to be encouraged by DST for research and development in the following thrust areas:
 - i. Developing simple techniques for the removal of above named chemical moieties from effluents from tanneries and other industries, so that the Ganga river turns clean.
 - ii. Research work for developing low-cost, eco-friendly alternate materials for substituting basic chromium sulphate for the tanning of leather without compromising the eventual quality.
 - iii. Portable test kits (conventional chemical sensors and sensors based on nano materials) for detection of chromium from the industrial effluents.
 - iv. Nano filters, dispersed with functionalized CNT to be developed.

MEDICAL SCIENCES (INCLUDING PHYSIOLOGY)

A) There must be improvement of health, hygiene, Nutrition and life style process in our country. Therefore topics are to be elaborately discussed and taken care of by the section also.

B) Proper hygiene is to be maintained echoing the prime Minister's slogan ie. "Swachh Bharat" meaning cleanliness and proper sanitation of our country.

C) Nutrition: India having one hundred thirty core populations, out of which more than 60% are suffering from under nutrition both from calorie point of view as well as formulation of diet including the micro nutrition. They are not having the proper kinds of foods. These eventually results in poor immune response to different infection diseases. Rather on the other hand invites diseases. Further, poor nutrition or over nutrition creates different types of non communicable diseases. This burden our society with i) Cardiovascular accident ii) cerebral vascular accident iii) Cancer iv) diabetes. These should be properly addressed.

D) Population of our environment are leading to may human diseases of COPD, different cardiovascular diseases, hypertension, cancer, diabetes, infertility etc.

Not only the modern medical sciences, we should also given equal stress of the study on our indigenous medical practices, including Ayurvedic, Homeopathy, tradition medicinal practices

and medicine. In connection to this, our folk medicines which also come to the center of these points are also need to be addressed.

Now a days, as for example, in rural area about 50,000 people are dying per year due to the poisons snake bite so it has been addressed by WHO that this is the most neglected diseases to Tropics. So this needs to be taken care of.

NEW BIOLOGY

1. Area of Microbiome received much attention as it has many applications in the years to come. It was felt that this area should be encouraged.
2. Cell Biology and signalling mechanisms were an area of interest to many.
3. Presentations on diabetes were well appreciated starting from insights into molecular aspects.
4. Area of proteins and enzymes in relation to snake venom was an area of interest and needs to be encouraged.
5. Cell communication including glycosaminoglycans was an area of interest.

PLANT SCIENCES

1. Since plant-microbe beneath the earth's surface have been found to confer beneficial attributes, more research should be carried out on plant-microbial root system in relation to crop protection from plant diseases and enhancement of productivity.
2. In order to develop and standardize microbial inoculants preparations and mass production for their application in farmer's field; Indigenous microbial strains may be screened and promoted at different agro-climatic conditions of specific region of country.
3. Indigenous knowledge available should be considered for blending with modern scientific knowledge, so as to apply its practical application in increasing farmer's economy in terms of average yield of the crop plants.
4. Efforts may be made at the Govt. level to devise ways for skill development in this area through educational and implementing agencies.

5. Efforts should be made to make use of plant resource based technology for the benefits of rural communities, primarily in agriculture and handicraft industry.

6. There is need to impart skill based teaching-learning in the area of Plant Sciences through revision of curricula including environmental concern through introduction of 4-year Bachelors programme.

7. Research in the area of scientific validation of traditional knowledge related to medicinal plants and formulations should encouraged and indigenous development and standardization of herbal remedies be enhanced.

8. The depletion of biodiversity caused by anthropogenic stresses and luxuriant growth of invasive alien plants needs to be significantly reduced in order to maintain the ecosystem stability.

