World Tea Science Congress

“World Tea Science Congress”- an international event, perhaps the biggest ever get together of the tea scientists, cultivators and traders was held on 22-24 November, 2011, at Tocklai, Jorhat, Assam, India to mark the centenary celebration of ‘Tocklai Experimental Station’- the oldest and largest Tea Research Institute of the world.

This three-day long event was inaugurated by Dr. A. P. J. Abdul Kalam, former President of India amidst a large gathering which includes Chief Minister of Assam Shri Tarun Gogoi, Chairmen of Tea Board (India and Bangladesh), Indian Tea Association, Tea Research Association and hundreds of tea scientists, tea growers and tea traders across the world.

Eight technical sessions, two poster sessions and one panel discussion were organized in this conference where altogether 114 research papers were presented. Along with the Indian delegates 28 foreign scientists from 9 countries attended this conference and took part in the technical sessions.

Several publications in the form of books, souvenir, documentary, cinema and a special issue of the Journal ‘Science and Culture’ were released in the inaugural session by the former President of India Dr. A. P. J. Abdul Kalam and the Chief Minister of Assam Shri Tarun Gogoi to commemorate the centenary celebration.

Tea based soft drink developed by Tocklai was released for commercial use by Dr. A. P. J. Abdul Kalam during the congress.

B. Barthakur, TRA

The Third Way to Produce Electricity from Sunlight Using Thermoelectric Effect

We are aware of the two known ways to make electricity from sunlight. One is to produce electricity directly from sunlight from a semiconducting material by producing electrons—the phenomenon known as photovoltaic effect for which the Nobel Prize was awarded to Albert Einstein. This method of producing.
electricity is known as photovoltaic (PV) method and has been used widely by using solar panels containing solar cells. The second method is to concentrate the sun’s rays using mirrors and use the solar heat to boil water and use the steam thus produced to drive a generator—the method known as concentrated solar power (CSP) (see editorial for details).

The other method recently proposed by Gang Chen of MIT and Zhifeng Ren of Boston College is to use the thermoelectric effect to produce electricity. Certain materials, such as bismuth telluride, are known to produce electricity when one part of the material is hotter than the other and this phenomenon is known as thermoelectric effect. Application of thermoelectric effect to produce electricity is nothing new. However, attempt to produce electricity from sun’s rays using thermoelectric effect has not been used in the past because in order to produce reasonable current the temperature difference required is more than 200°C. Taking the trouble in building mirrors to concentrate solar rays in order to achieve this is not worth attempt due to its poor efficiency compared to CSP.

The two researchers have made a prototype to demonstrate that their idea is worth attempting. In their view, three things are needed to create a workable solar-thermoelectric device. The first is to make sure that most of the sunlight which falls on it is absorbed, rather than being reflected. The second is to choose a thermoelectric material which conducts heat badly (so that different parts remain at different temperatures) but conducts electricity well. The third is to be certain that the temperature gradient which badly conducting material creates is not frittered away by poor design.

They succeeded in fulfilling these requirements by first coating the top of the device with oxides of hafnium, molybdenum and titanium, in layers about 100 nanometres thick. These layers acted like the anti-reflective coatings on spectacle lenses and caused almost all the sunlight falling on the device to be absorbed. The second condition, of low thermal and high electrical conductivity, was achieved by dividing the bismuth telluride into pellets a few nanometres across. That does not affect their electrical conductivity, but nanoscale particles like this are known to scatter and obstruct the passage of heat through imperfectly understood quantum-mechanical processes. The third objective, efficient design, involved sandwiching the nanostructured bismuth telluride between two copper plates and then enclosing the upper plate (the one coated with the light-absorbing oxides) and the bismuth telluride in a vacuum. The copper plates conducted heat rapidly to and from the bismuth telluride, thus maintaining the temperature difference. The vacuum stopped the apparatus losing heat by convection.

The efficiency of electricity production by this method is less (about 5%) compared to 40% from the well managed concentrated solar power and about 20% obtained from recently produced cheap thin film solar cells. However, both CSP and PV are expensive while the cost of producing such a kit is inexpensive and Dr Chen reckons the process to be worth considering for mass production.

He sees it, in particular, as something that could be built into the solar water-heaters that adorn the roofs of an increasing number of houses. If such heaters were covered with thermoelectric generators the sun’s rays could be put to sequential use. First, electric power would be extracted from them. Then, the exhaust heat from the bottom plate of the thermoelectric device would be used in the traditional way to warm water up. Two-for-one has always been an attractive proposition for the consumer. This kind of combined heat and power might enable more people to declare independence from the grid.

National Seminar on History and Philosophy of Science

M. C. Chaki Centre for Mathematics and Mathematical Sciences organized a National Seminar in memory of 99th Birth Anniversary of Late Professor M. C. Chaki on History and Philosophy of Science which was held on 2nd and 3rd July, 2011, at Calcutta Mathematical Society at A.E. 374, Salt Lake, Sector 1, Kolkata – 700 064. The object of the seminar is to give importance to the study of the History of Science. The discipline of History and Philosophy of Science is a major faculty in most of the developed countries, but in India, it plays a marginal role in the universities.

The history of science is not only a record of the heritage of science showing our past achievement in the scientific field, it provides clues to modern scientific enquiries and experiments for further discoveries and inventions. India for long has pursued religion and culture for which material development has taken a backseat. As a result, poverty remains as a fester in the bodypolitik.
Globalization has sharpened competition and now is the time for hammering out and having technical skill.

Philosophy of science records the evolution of scientific thought which helps to build up scientific temper and rationalism which serve against superstitions and obscurantism. That is also the need of the hour. Both history and philosophy of science must be highlighted and underscored at this critical juncture of transition in the 21st Century. We must go to the top in 2020.

The seminar was inaugurated by Professor Amita Chatterjee, Vice-Chancellor, Presidency University, Kolkata the Key-note Address was given by Professor Pradip Narayan Ghosh, Vice-Chancellor, Jadavpur University and Professor Bimal Roy, Director, Indian Statistical Institute, Kolkata addressed the gathering as Guest of Honour. It is to be mentioned in the inaugural session Professor N. C. Datta and Dr. Amit Krishna De both are the member of Indian Science News Association (ISNA) attended the seminar. There were more than 100 participants and 23 research papers were presented.

Balai Chaki
M. C. Chaki Centre

DNA Barcoding in Marine Fishes – Discussion in CMFRI Winter School 2010

All organisms are naturally subjected to mutations due to normal cellular operations or interactions with the environment, leading to genetic variation. A gene mutation is understood as a permanent change in the nucleotide sequence that makes up a gene. DNA in eukaryotic cells resides within the nucleus, however, about 1% of it resides in specialized cell organelle called mitochondria. Mitochondrial DNA (mtDNA) is considered to be a powerful molecular genetic marker for quantifying genetic variations between species. Vertebrate mtDNA genome is a covalently closed haploid circular molecule of 16000-17000 base pairs (bp) in length and is maternally inherited. Structurally it contain many genes (37nos., importantly 13 genes coding for proteins and two genes coding for small and large ribosomal RNA) vital for cell respiration and other functions. Some important mitochondrial genes include 16SrRNA, 12SrRNA, Cytochrome oxidase (CO) subunit I or Cytochrome c, CO subunit II, CO subunit III, Cytochrome b, ATPase subunit 8, ATPase subunit 6, NADH dehydrogenase subunit 4, NADH dehydrogenase subunit 5.

In many organisms, some genes in mtDNA seem to accumulate mutations more rapidly than do genes in nuclear DNA. For this reason mtDNA provide markers which are more likely to show differences between populations or species at genetic level. Many researchers in population genetics prefer to detect genetic differences in mtDNA rather than in nuclear DNA. Since the time of Carolus Linnaeus, founder of modern systematic biology, biologists have used distinguishing features in taxonomic keys (general morphomeristic body characters) for species identification and to apply binomial species scientific names. Since recent past it has been shown that in vertebrates and even in insects, short DNA sequences from a uniform locality on genomes can also be a distinguishing feature. A very short stretch of chromosome, i.e., structure of a partial DNA sequence of a particular gene can be a useful genetic marker. This is molecular taxonomy (Polymerase Chain Reaction and Gene Sequencer-based), which is a supporting tool to the morphology-based conventional/classical taxonomy. Molecular taxonomy allows identification of larval and tiny fry stages (about 3cm) of many commercially-important species of finfishes and molluscs in natural water bodies, which will be very difficult based on classical taxonomy.

During October 9-26, 2010, an ICAR-sponsored Winter School on ‘Vistas in Marine Biotechnology’ was organized at Marine Biotechnology Division of Central Marine Fisheries Research Institute (ICAR), Ernakulam, Kerala. The programme was particularly meant for upgradation of knowledge and laboratory skill of Young Scientists and University Lecturers in disciplines like Fish Genomics and Genetics, Fish Health, Fish Nutrition and Marine Bioprospecting. Present author was a participant in it. In the programme, Dr A. Gopalakrishnan, Principal Scientist and Officer-in-Charge, National Bureau of Fish Genetic Resources (NBFGR Cochin Unit) comprehensively explained the principles of DNA barcoding of finfishes. Author also personally communicated with Dr V. Srinivasa Raghavan, Scientist (SS), Marine Biotechnology Division, CMFRI and gained knowledge. According to them, DNA barcoding may be defined as a method of identification of a species based on DNA sequencing and analysis/characterization of a particular single gene (or its part) of its genome, preferably mitochondrial genome, i.e., DNA of a mitochondrial gene. In DNA barcoding, appropriate region of mitochondrial DNA must be selected which can differentiate species and which does not show variation (or showing very little insignificant variation) among/within species. Gene chosen and rigorously standardized for this
technology is the mtDNA gene ‘cytochrome c oxidase subunit I’ (CO subunit I or COI). Selection of COI as a uniform target gene for DNA barcoding is widely accepted and supported by published and ongoing work, which demonstrates that barcoding via COI will help in discrimination and identification of species as well as discovery of new and cryptic species (species appearing identical but genetically quite distinct) is possible in a wide diversity of aquatic and terrestrial vertebrates and invertebrates.

In the 16000 bp long mtDNA, the total length of COI gene is 1545 bp; for DNA barcoding a partial sequence of 655 bp is used. It is a conserved region of mtDNA sequence and species-specific molecular signatures can be produced through PCR. The 655 bp sequence of COI will not show any variation in sequence structure for Chinese, Mongoloids and Indians since all are ‘Homo sapiens’. But it will show variation between two species like human and chimpanzee, domestic cat and tiger, silver pomfret fish *Pampus argenteus* and Chinese pomfret *Pampus chinensis*, *Penaeus monodon* and another shrimp, and so on. Scientists have revealed 5% difference in structure of this 655 bp COI sequence in human and chimpanzee; i.e., nucleotide/base difference (one particular base (adenine, guanine, cytosine or thymine) substituted by either one of rest three bases in second species) at 32-33 positions. This partial sequence of COI gene is considered as a potential “barcode”. Partial sequences of other mtDNA genes cytochrome b (641 bp) and 16SrRNA (601 bp) are also recommended for the purpose. The main steps involved in DNA barcoding of fish samples are: i) Tissue sample collection (preferably fin tissue) from field in frozen or ethanol-preserved condition (for a species, minimum 5 different individuals to be collected from 5 different regions), ii) Labelling and preservation of fish specimen from which tissue was collected, iii) Isolation of DNA from tissue samples, iv) Amplification of COI gene by PCR method using specifically designed forward and reverse primers, v) Qualification and quantification of PCR products through agarose gel electrophoresis, vi) Sequencing of PCR products, vii) Editing, aligning and analysis of DNA sequence data (its comparison can additionally be done in different species of same fish), viii) Submission of DNA sequence information and specimen voucher data to newly created FISH BOL (Biology Of Life) database.

Hundreds of different ongoing barcoding projects around the world are contributing to a barcode library that contains a very high magnitude of specimen barcodes from around 70,000 species. In search of interspecific variation, total 207 species of Australian marine finfish have been sequenced (barcoded) for the 655 bp region of COI gene using two specific sets of primers (Ref: Ward, R. D., T. S. Zemlak and P. D. Hebert, 2005. DNA Barcoding of Australia’s fish species. Philosophical Transactions of the Royal Society of London B. doi: 10.1098/rstb.2005). Variation at the mtDNA COI gene has been examined in 15 species of cartilaginous fish North Pacific skate (Ref: Spies, I. B., S. Gaichas and M. F. Canino, 2006. DNA-based identification of Alaska skates (Amblyraja, Bathyraja and Raja) using COI variation. Journal of Fish Biology, 69B: 283-292). A mega-programme on DNA barcoding of Indian marine and inland fishes was initiated at NBGR (ICAR), Lucknow during 2006; DNA isolation and PCR amplification have been done for 1998nos. samples of 517 species; out of this, furthermore, DNA sequence profile of the 655 bp fragment of COI gene has been generated for 890nos. samples of 282 species. A total 115 species of marine finfish from the Indian Ocean covering different groups like carangids, clupeids, scombrids, groupers, sciaenids, silverbellies, mullids, polynemids and silurids have been barcoded for the first time using COI gene of the mtDNA (Ref: Lakra, W. S., M. S. Verma, M. Goswami, K. K. Lal, V. Mohindra, P. Punia, A. Gopalakrishnan, K. V. Singh, R. D. Ward and P. D. Hebert, 2011. DNA barcoding of Indian marine fishes. Molecular Ecology Resources, 11: 60–71. doi: 10.1111/j.1755-0998). It is expected that such research outcome will be of great utility in sustainable exploitation and management of Indian finfishes with an increased understanding of biodiversity.

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**Autonomous Underwater Vehicle (AUV)**

Researchers at Central Mechanical Engineering Research Institute (CMERI) – the apex R&D institute for mechanical engineering under the Council of Scientific and Industrial Research (CSIR) – have developed India’s first indigenous Autonomous Wireless Robotic Sea-Vehicle, that can map the seafloor.

The mega system can fulfil tasks such as seafloor mapping, coastal surveillance, mine countermeasure, and oceanographic measurements during adverse weather conditions.
Sponsored by the Ministry of Earth Sciences (MES), the AUV has been built to operate 150 feet under the sea to map the seafloor and collect sensor-based data. With no physical cable connection to the surface control station and possessing on-board intelligence and energy supply, the vehicle, designated as AUV-150, has much to boast about.

Autonomous underwater technology and underwater robotics are being vigorously pursued in many technologically advanced countries such as the U.S., Australia, Germany, Russia, Korea, and Japan. According to Gautam Biswas, director, CMERI, “The AUV technology will be an essential technology of the future as our dependence on ocean resources increases. The need for autonomous underwater vehicles in already being felt for activities such as inspection, location of objects, survey on the ocean floor, and surveillance.”

“AUV-150 will be tested in sea for seafloor mapping and monitoring of environmental parameters such as current, temperature, depth, and salinity. Once the technology is proven through extensive trial, the same vehicle with required customization may be used for other future applications, such as coastal monitoring, military reconnaissance, mine counter measuring, cable and pipeline surveys, littoral zone sensing, and more,” says Biswas.

Features AUV-150 is a cylindrical-shaped carrier with streamlined fairing to reduce hydrodynamic drag. It is embedded with advanced-power, propulsion, navigation, and control systems. The propulsion system comprises thrusters for generating motion in different directions to control surge, sway, heave, pitch, and yaw, while preventing the vehicle from rolling. Two arrays of crossfins have also been fixed at the two ends to provide additional stability to the AUV.

A lithium polymer battery powers the vehicle and a pressure hull contains its electronics and energy system. The vehicle is programmed to carry out an underwater mission without assistance from an operator on the surface. For autonomous free movement under water, with no wires attached to the station on the surface, the vehicle determines its own geographical position with the help of navigational sensors. Its forward looking sonar system and navigational algorithm help the vehicle in avoiding collision with obstacles. The autonomous vehicle is equipped with a number of navigational systems such as inertial navigation system, depth sensor, altimeter, doppler velocity log, forward looking sonar, global positioning system through ultra-short baseline system, which is a method of underwater acoustic positioning and payload sensors (side scan sonar, camera, and CTD or conductivity-temperature-depth recorder). For smooth communication and distant intervention, the vehicle is equipped with hybrid communication system: its radio frequency on surface and acoustic under water. The final prototype of the 4.8 meterlong AUV-150, with all its on-board subsystems, weighs approximately 490 kg. The vehicle also has positive buoyancy of approximately 30 newton to facilitate its retrieval in case of a power failure. However, the payload and configuration of the AUV will always be dictated by the mission requirements such as the one provided by the Ministry of Earth Sciences (MoES).

In September 2009, the prototype was tested for a week at the Idukki lake in Kerala. Both pre-launch and post-launch checks were committed. During all trials, the mission was carried out with the help of a precompiled mission file which was stored in the memory of the on-board computational unit.

Developed under the supervision of Sankar Nath Shome, group head – robotics and automation and Dean of School of Mechatronics, CMERI, AUV-150 is second only to Maya, a small autonomous underwater vehicle developed by the National Institute of Oceanography (NIO), Goa in September 2009 to sense physical, biological, and chemical properties of the ocean and collect relevant scientific data. The working prototype of AUV-150 was developed by the Mechatronics group of CMERI in collaboration with IIT, Kharagpur.

The final prototype is capable of exploring the seafloor for example, minerals (metals, oil, natural gas, and chemicals), medicines, and food,” says Shome. The vehicle is also expected to be used for search and rescue operations as well as for military reconnaissance. It is capable of conducting various kinds of surveys such as the bridge scour which is a process of removing sediments of sand and rocks around bridge piers; channel conditioning and clearance survey, which is a hydrographic survey involving determination of size, location, and sedimentation for a channel and requirements for dredging towards flood control measurements; and cable and pipeline surveys for monitoring and repair operations. Long-term monitoring of seafloor for prediction of weather, habitat mapping, archaeological survey and monitoring of boundary limitations and route survey are other tasks that AUV-150 is expected to perform. Following AUV-150’s successful completion, CMERI and the Naval Science and Technology Laboratory are now planning to launch a mega AUV project under the umbrella of CSIR and DRDO India.

SK

Adopted from the article of Vantika Dixit