Notes and News

Felicitation of Mrs. Maya Natarajan who donated Rupees Twenty five lakhs to ISNA

Mrs. Maya Natarajan of Chennai was felicitated in a solemn event organized by the Indian Science News Association (ISNA) which was held in the seminar room of Bose Institute on 16th of November. Prof. P.K. Ray, President of ISNA, presided over the ceremony. A cheque of **Rupees Twentyfive lakhs (Rs. 25,00,000)** was handed over by Mrs. Natarajan to Prof. P.K. Ray, President of ISNA with the following citation "*These funds have been donated to theIndian Science News Association by N Meenakshi of Nemam village to be placed in a corpus fund to be used for publication of Science and Culture*". Prof. S.C. Roy, Editor-in-Chief, Science and Culture narrated how a series of events made Mrs. Maya Natarajan decide on donating the sum to ISNA. Incidentally, Maya Natarajan is the grand-daughter of the sister of N. Meenakshi in whose name the donation has been made. In a freak accident Meenakshi lost her husband and the then British Government compensated her monetarily. While the money was wisely invested by Mrs. Meenakshi for the family, it was her desire that a portion of it should go to charitable organizations. It was Vasant Natarajan, Professor of Physics at the Indian Institute of Science, Bengaluru, also a Life Member of ISNA,who convinced Maya Natarajan (Vasant's mother) to donate a part of the sum to ISNA for publication of Science and Culture. Prof. P.K. Ray presented a silver plaque to Mrs. Maya Natarajan in appreciation of her generous donation for the cause of science and culture which, he hoped, will inspire many others to follow suit. Mrs. Maya Natarajan in her speech expressed her satisfaction in donating to an organization which is selflessly devoted to public understanding of science. Prof. P.C. Sen, Honorary Secretary of ISNA welcomed the audience and Prof. Sudhendu Mandal, another Honorary Secretary of ISNA offered the Vote of Thanks. ❐

Editor

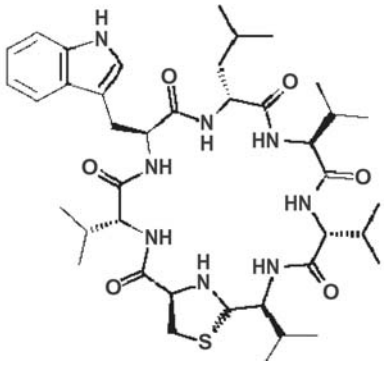
Prof. P.K. Ray, President of ISNA presenting the memento to Mrs. Maya Natarajan, while Prof. P.C. Sen, Prof. Sudhendu Mandal and Prof. S.C. Roy (from left to right) look on.

Scientific Titbits

(1) Human Nasal Mucus: A New Source of a Novel Peptide Antibiotic – Scientists at the University of Tübingen and the German Center for Infection Research (DZIF) have recently discovered that *Staphylococcus lugdunensis*, colonizing in the human nasal fluid called 'snot', produces a previously unknown antibiotic, named lugdunin which completely inhibits the growth of *Staphylococcus aureus*. This finding is immensely important because the drug-resistant form of *S. aureus*, viz., MRSA (methicillin-resistant *S. a.*) is a major public health problem, killing more than 10,000 people annually in USA alone.

These scientists analysed the microbial populations of snots from 187 hospitalised patients. They found that 32% of the patients carried *S. aureus*, 9% of the patients contained *S. lugdunensis* and only one patient carried both. This hinted at *S. lugdunensis* to be an enemy of *S. aureus*. Being curious, they tested the effect, if any, of *S. lugdunensis*

on *S. aureus* and found that the former was highly effective in preventing the growth of the latter in the skin of mice infected with *S. a*. They identified the antibiotic responsible for this inhibition, named it *lugdunin*, characterised it as a cyclic peptide made up of a thiazolidine heterocycle and amino acids and also synthesised it. Gratifyingly, when exposed to low levels of lugdunin over a period of 30 days, *S. aureus* did not evolve any resistance to the antibiotic, although development of resistance to lugdunin in future may not be ruled out. The possible use of *S. lugdunensis* as a probiotics treatment for the nose is, however, problematic since this bacterium itself is associated with a range of infections of the heart, joint, skin and eyes.



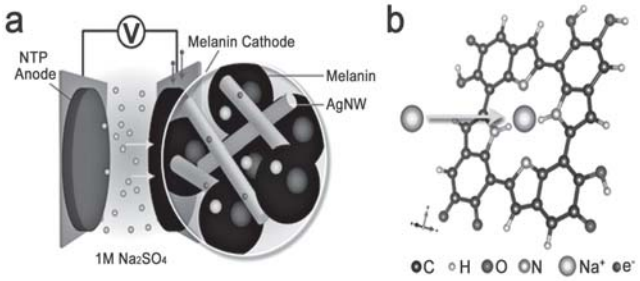
Lugdunin

Since soil has been the richest source of useful bacteria so far, the present finding makes us hopeful that in near future our specific body parts could turn out to be new sources of commensal bacteria, hence new antibiotics.

(2) Edible Batteries: Knocking at the Door – In modern medical system, ingestible, battery-operated electronic devices such as stimulators, biosensors and controlled-release devices are used for the diagnosis and/or treatment of diseases. Indeed, a battery-operated ingestible camera was developed nearly two decades ago as a complementary tool to endoscopy. This device containing a conventional battery was designed to pass through the gastrointestinal (GI) tract and eventually excreted. The risk of this device getting stuck in the GI tract is small. But for repeat applications in a single patient, e.g. in the case of drug deliveries, the risk becomes unacceptably greater especially because of the toxic materials contained with the batteries. A degradable, non-toxic battery is, therefore, the need of the hour.

A group of scientists, led by Christopher Bettinger, of the Carnegie Mellon University, Pittsburgh, USA have reported in the 252nd National Meeting and Exposition of the American Chemical Society at Philadelphia that they have developed a low-power battery made from melanin, isolated from the ink sacks of cuttlefish, a marine species. Melanin is found in skin, hair and eye and is degradable. They found that melanin-based batteries could power a 5 milliWatt device for up to 18 hours using 600 mg of active melanin as the cathode, but it could be upgraded to power a 20 mW device. This capacity was good enough for use of melanin-based batteries in ingestible devices since such devices are expected to pass through the digestive tract in 10-20 hours. Basically, the team has replaced the potentially toxic components of a battery with that of a benign endogenous material within the body, i.e. melanin. The battery was encapsulated in a 3D-printed capsule made of polylactic acid, a gelatine material often used in vitamins.

Melanin on a macromolecular scale exhibits different structures, hence different chemistries. They found out that melanin bearing a tertrameric structure (a four-membered ring) (see Figure) could be used as the cathode in a battery since this tetrameric structure had the right number of exposed nitrogens to bind with sodium and it generated a voltage output consistent with the tetrameric structure.



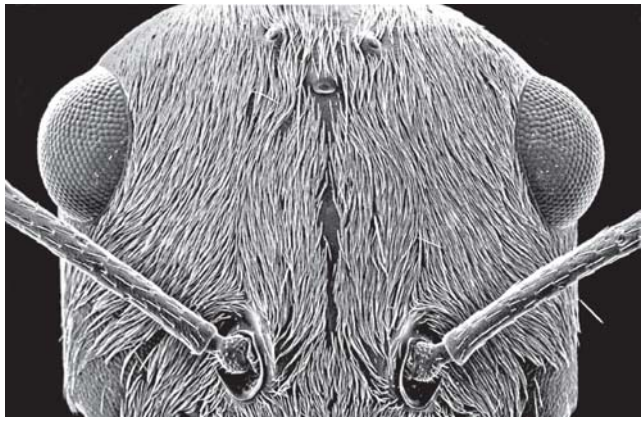
Melanin battery & Tetrameric Structure

They claim to have developed a method to synthesise tetrameric melanins, and they are trying to scale it up in a cost-effective and sustainable way. Bettinger's vision is to use melanin-based batteries for sensing certain diseases and for drug delivery purposes. They are also trying to make batteries developed from other naturally occurring biomaterials, e.g. pectin and also to develop packaging materials that will deliver such a battery safely to the stomach. We just have to wait.

(3) Cool Fabrics: A Beginning Has Been Made – To keep us warm in cold environments, we use apparels made from far, feathers and woollen fabrics because their air pockets reduce thermal conduction and keep warmth inside. But to keep us cool in hot environments, we need to use fan, air conditioner or wearable thermoelectric coolers. Even in wicking technology employed in modern athletic apparels, convecting cooling becomes operative only when there is perspiration. A solution to this problem has recently been reported by Hsu *et al.* (*Science*, **353**, 1019, 2016). They have experimentally demonstrated that

radiative cooling by a few degrees Celsius can be achieved using commercially available nanoporous polyethylene (nanoPE) which has interconnected pores of 50-1000 nm diameter.

Human body emits thermal radiation in the mid-infrared (IR) spectral range (7-14 μ). Conventional fabrics block mid-IR waves by partially reflecting them and by absorbing the rest. If fabrics can be engineered such that they are transparent in the mid-IR region, thermal energy emitted by skin can be shed off. Such fabrics, however, also need to be opaque in the visible wavelength range (400-700 nm) to make the dresses visible to human eyes. Hsu *et al.* have demonstrated that nano-PE exhibits more than 90% total IR transmittance (longer than 2 μ) and is completely opaque in the visible spectral range because of strong scattering off the nanopores. Scientists have chemically modified nano-PE to improve its breathability and to add to it water-wicking functionality (make it more hydrophilic) in order to make a comfortable fabric. Although much work needs to be done before cool fabrics and apparels made thereof come into the market, the scientists are surely one step closer to the goal.



Pertinently, a striking example of nanotechnology cooling is already there in the animal kingdom. The skin hairs of Saharan silver ant (see Figure) are fine enough to scatter and reflect sunlight, thus avoiding overheating of their body by sunlight, but the hairs are transparent in the IR range so that body heat is partly shed off. Alas, we, the human beings, are trailing! ❐

Professor Manas Chakrabarty, FRSC
Formerly, Department of Chemistry
Bose Institute, Kolkata

Genomics: Molecular to Ecosystem Level

"There is excitement blowing in the wind. The eye of this storm is Genomics, which is really the study of a genome as a whole; that is the study of all the genetic material in the chromosomes of a particular organism, as opposed to studying only selected parts of a genome. Studying a genome as a whole permits, among other things, the identification of patterns that have been conserved over the course of evolution and interactions among various regions of a genome". With these words, Dr Partha P. Majumdar, Director, National Institute of Biomedical Genomics and concurrently Professor of Indian Statistical Institute, Kolkata begun his article which was published in Science and Culture 'Special Issue on Genomics' July-August 2001.

In the Seminar on 'Genomics: Molecular to Ecosystem Level', recently organized at the prestigious Asiatic Society, Kolkata on 9th December, 2016, Dr Majumdar presented a audio-visual talk as the Key-note speaker on 'Our footprints on the sands of time', where, besides elaborating on the afore-mentioned statements comprehensively described the structure, origin and evolution of human populations, characteristic features of *Homo erectus* and *Homo heidelbergensis*, analysis of raw genome data and very minute difference in DNA sequences of this present generation, our fathers and forefathers, their comparison and prediction of a common ancestor/origin, exchange of genes in modern humans from the Neanderthal and Denisovian population, ethnic composition of India in terms of numbers of tribal groups, castes, sub-castes, religions and migrant groups, explained about localization of genetic/genomic variations within particular 'groups' of individuals, who remain clustered socially in geographically proximal regions.

Dr Majumdar mentioned that with the help of recent advances in molecular and statistical genetics, now we can sequence and study DNA of living humans and estimate the rate of accumulation of changes with evolutionary time, finally draw strong inferences about how humans have evolved. Dr Majumdar presented salient features of his research work on population structure and analysis of whole genome sequences of Andamanese individuals and their comparison with sequences of individuals from mainland India belonging to different groups. A distinct ancestry of the population of Andaman archipelago could be identified. Analyses of genome-wide data of unrelated individuals drawn from different mainland and island populations and of individuals from populations represented in the Human Genome Diversity Panel have revealed four major ancestries in mainland India.

Dr Majumdar begun his talk with the efforts of Late Prof. P. C. Mahalanobis in recording body dimensions of individuals and a published article entitled 'Bengal

Anthropometric Survey – a statistical study', published in Vol. 9 of the Journal Sankhya in 1949. In the 1st technical session of the Seminar, Prof. Chandrasekhar Chakraborti, Former Vice Chancellor, WB University of Animal and Fishery Sciences while speaking on the topic 'Gene concept to DNA deciphering' described the birth and development of genomics' science and biotechnology, concept of heredity, explained how the four letters A, T, G and C constitute the genetic information and control the biological system of all organisms through synthesizing various kinds of proteins. He described the genetic basis of cause of abnormalities like albinism, incidences of urine turning black in contact with air and sickle-cell anaemia and the intrinsic enzyme actions involved. He explained hypotheses like 'one gene – one enzyme', 'one gene – one polypeptide' and 'one cistron – one polypeptide', fondly narrated the epoch-making contributions of pioneers in genetics and Nobel Laureate molecular biologists chronologically, works of Dr Ananda Mohan Chakraborty, birth of Human Genome Project in 1985, emphasized on application of genomics to produce better food crops, improved foodfishes, use of biotechnological tools like gene manipulation for human health and welfare.

Dr Subrata Kr. Dey, Vice Chancellor, Maulana Abul Kalam Azad Institute of Technology, Kolkata spoke on the topic 'Impact of genomics on human health: Down Syndrome as a model for investigation of some common diseases'. He comprehensively discussed about basic concepts of human molecular genetics, emphasizing on genetic disorders especially on Down Syndrome. We were informed that frequency of birth defect Down Syndrome is 1 in 700 live births; whose genetic basis is the trisomy of chromosome no. 21, and can be caused by abnormalities, which are free trisomy 21, translocation and mosaicism. Majority of this birth defect is caused by trisomy 21 due to nondisjunction, *i.e.,* failure of chromosomes to separate properly during meiosis. Pathogenesis of neurological abnormalities like mental retardation, early manifestation of Alzeimer's disease, elevated risk of leukemia, congenital heart disease is attributed to excessive synthesis of multiple products derived from over-expression of genes located on chromosome 21. Over 90% of nondisjunction errors leading to trisomy 21 arise in the oocyte; advanced maternal age has been identified as risk for Down Syndrome.

In the 2nd technical session, Dr Parthadeb Ghosh, Emeritus Professor, Department of Botany, Kalyani University gave a comprehensive idea on structural genomics, functional genomics, metagenomics, comparative genomics and pharmacogenomics to the learned audience. He further discussed about chromosome mapping by FISH technique, cloning and sequencing of individual parts of chromosome, sequencing technique of metagenomic DNA samples of typical soil sample, genome size of certain organisms, whole genome shot-gun sequencing; Prof Ghosh opined that a new kind of holistic ecosystem study will emerge if the results of metagenomic data obtained are combined with data generated from 16S rRNA gene amplicon sequencing and *in situ* expression data generated via metaproteomics and metatranscriptomics. Dr Sucheta Tripathy, Principal Scientist at CSIR-IICB, Kolkata while speaking on the topic 'Ecological genome plasticity: a new age science in making' focused on computational genomics, bioinformatics, her research work on genomics and functional genomics aspects of several microbial species from different ecological niches, newer tools developed in analysis of genomic information, blue-green bacteria, 2nd and 3rd generation sequencing techniques, large-scale gene discovery and genome deciphering *via* whole genome *de novo* sequencing (draft) of several indigenous cyanobacterial and economically-important fungal species.

Valedictory session of the Seminar was enlightened with the august presence and presentation of Prof. Dhrubajyoti Chattopadhyay, Hon'ble VC, Amity University and formerly Professor of Biochemistry, University of Calcutta. Dr. Chattopadhyay spoke on 'Metagenomic attributes of bacterial response to petroleum hydrocarbon contamination of environment as revealed by bioinformatic approaches'. A broad spectrum of microorganisms degrade and use a variety of hydrocarbons as sources of carbon and/or energy in oil-polluted habitats for their survival, and thereby act beneficially in restoration/remediation of affected environments. Prof. Chattopadhyay described the newly-developed gene sequencing techniques that have facilitated advancement in studies on ecology of microorganisms in oil-polluted environments and understanding of resident microbiome. We were informed about an integrated bioinformatic pipeline that have been implemented by Sir and his research students for analysis of 65 publicly available 16S rRNA datasets (pyrosequencing technique was used to generate it) from 12 diverse petroleum hydrocarbon-polluted habitats/sites, with an intention to infer about taxonomic and functional characteristics of bacterial communities present therein. Phylogenetic and metabolic characterization of the habitats had been studied comprehensively; bacterial species/communities belonging to 255 taxa and 414 functional modules could be identified, which can be used as metagenomic biomarkers to differentiate between the studied polluted (hydrocarbon-contaminated) habitats. Different taxa were found to be involved in accomplishing

important functions in the studied habitats, and important difference has been observed to exist between the habitats. Dr Chattopadhyay highlighted some aspects of ongoing studies on draft genome sequence preparation of some hydrocarbon-degrading bacterial strain isolated from crude oil-contaminated soil from the Noonmati Oil Refinery, Guwahati, Assam.

Prof. Nimai Chandra Saha, Hon'ble VC, Burdwan University and Prof. R. N. Chatterjee, Emeritus Professor, Department of Zoology, University of Calcutta chaired the 1st and 2nd technical sessions respectively and made their thought-provoking deliberation on the prospects and opportunities lying in genomics, often connoted as revolutionary science of the century. Prof. Chatterjee emphasized on expression of genes, gene regulation, protein regulatory sequences and importance of epigenetic modulation. Dr A. K. Sanyal, Secretary, Biological Science Division, Asiatic Society and Chairman, WB Biodiversity Board nicely coordinated the entire programme. He lucidly spoke on 'Origin of Species' written by Charles Darwin, contributions of Gregor Mendel as founder of modern science of heredity, diversity of life forms existing on mother earth, Shakespeare's writing in Hamlet and Gurudev Rabindranath Tagore's '*Bishwobhora pran*', establishment of molecular basis of life in 2001 as completion of draft preparation of human genome map, introduction of human insulin gene and its production in *Escherichia coli* by recombinant DNA technology, concept of agricultural genomics, UN Convention on biological diversity in 1992, significance of ecosystem service on survival of human on earth, gene expression in community structure and in ecosystem function, genomics in conservation biology.

Dr Sanyal further gave an account on identification of very immature and early stages of diverse species of finfishes and shrimps occurring in rivers and creeks of Indian Sundarbans by DNA barcoding technology, which are destroyed during the incessant commercial practice of seed collection of tiger shrimp *Penaeus monodon* from those places for their supply to culture farms. In addition to above-mentioned dignitaries, eminent zoologists like Prof. Amalesh Chowdhury, Dr Asish Ghosh, Dr J. R. B. Alfred, Dr Samiran Chakraborti, Prof. S. G. Pal and others expressed their viewpoints during discussion session; retired and in-service Lecturers/Asst. Professors in Zoology and Biotechnology and 30-35 PG students and researchers participated in the programme. ❐

Subrato Ghosh

122/1V, Monohar Pukur Road,
Kolkata - 700026

Diversification in Freshwater Aquaculture *wrt* Both Coldwater and Warmwater Sectors

During 2013-2014, Indian fisheries and aquaculture production amount reached to the mark of 9.58 million tonnes, of which, inland fisheries sector contributes almost 65% of the total fish production; rest is the contribution of marine capture fisheries. Fish production from freshwater aquaculture sector stands at about 4.80 million tonnes during 2013-2014. During 2015-2016, total fish production amount in India has exceeded 10 million tonnes but still it has been felt that it is not enough. In order to feed our country's growing population with this nutritious food item, cater to the demand and sustain national nutritional security, by the year 2025, our country's fish requirement has been estimated and expected to be about 16 million tonnes, of which aquaculture is expected to provide over 10 million tonnes; it includes cultured fish production from freshwater (warmwater and coldwater), brackishwater and marine environments. With this responsibility of enhancing productivity and fish production level lies the relevance of development of newer ways of scientific fish culture practices in terms of diversification and introduction of new fish species in culture systems in all kinds of environments, and introduction of newer production/culture systems in indoors and outdoors in addition to pond-based aquaculture.

In such a background, National Seminar on "Aquaculture Diversification - A step forward towards Blue Revolution" was organized at ICAR-Central Institute of Freshwater Aquaculture, Bhubaneswar, Odisha during December 1-3, 2016. In this programme, Dr P. Jayasankar, Director, ICAR-CIFA discussed about fish as health food, some new fish species that have been successfully bred in captive conditions at ICAR-CIFA in recent years, like Mahanadi rita *Rita chrysea*, giant snakehead *Channa marulius*, long-whiskered catfish *Mystus gulio* and peninsular carp *Puntius pulchellus*, development of selectively-bred freshwater prawn having high growth rate, progress and prospect of fish farming in cages installed in reservoirs of Jharkhand and other places, success stories of pond aquaculture in Punjab and other places, the gaining popularity and improved growth performance of genetically-improved 'Jayanti Rohu' in different parts of India, seed production and culture/farming of *Anabas testudineus*, *Clarias batrachus*, murrels and other non-conventional fishes and most importantly mentioned about dissemination of newer technologies to fish farmers, those must reach to them and importance of analysis of their cost-benefit ratio/ particulars.

Dr Jayasankar emphasized on cluster farming-based seed rearing of new fish species, production of stunted fingerlings, *i.e.* yearlings of major carps in shallow ponds, wastewater aquaculture system, fish farming in rice fields, integrated fish farming system in homestead ponds, All-male Tilapia culture, Aqua Field School model, farm-made fish feed and establishment of low-cost feed production plants in regions where freshwater aquaculture is prospering, carp broodstock diet 'CIFABROOD' and portable FRP carp and catfish hatcheries developed and commercialized by ICAR-CIFA. He mentioned about need of packaging the technologies and we must never get disconnected from the fish farmers; he emphasized on five salient aspects: fish seed, fish feed, human health, pond environment and proper market channel and infrastructure.

Respected Dr S. D. Tripathi, Former Director, ICAR-CIFA and ICAR-CIFE (Deemed University) while speaking on the topic 'Diversification of freshwater aquaculture in India: nationally and regionally' gave a comprehensive account on species diversification in Indian freshwater aquaculture, discussed on the possibility of introduction of some species of medium carps, minor carps, medium-sized catfishes, murrels in freshwater (warmwater) culture systems, foodfishes with potential culture value and regional significance, that include *Labeo calbasu*, *Labeo bata*, *Labeo dyocheilus, Cirrhinus reba*, *Puntius sarana*, *Osteobrama belangiri*, *Amblypharyngodon mola*, *Heteropneustes fossilis*, *Ompak pabda*, highlighted their merits and characteristic features, discussed the seed production and propagation techniques of many of them, nicely narrated his experiences about submerged-type cages established in some places in India and abroad for fish farming in the context of reducing land and water area and less water availability.

Dr Tripathi emphasized on farming of small indigenous fishes along with major carps in polyculture system and region-specific aquaculture practices, mentioned that it is urgently necessary to utilize all available and amenable resources for fish culture that are lying unused so far, besides going in for species and systems diversification. Indigenous catfishes, murrels, medium carps, barbs can be raised in submerged-type cages in reservoirs, their broodstock in pen enclosures in beels with support of balanced supplementary feed. He also discussed about possibilities of adoption of newer technologies like running water aquaculture, recirculatory aquaculture system (RAS), indigenous periphyton-based aquaculture, wastewater treatment system 'Biofloc' and the Aquaponics system, which is a combination of RAS and hydroponics and a triangular system of fishes under culture, plants and beneficial bacteria, and is prevalent in commercial fish farms of Kerala.

Dr A. K. Singh, Director, ICAR-Directorate of Coldwater Fisheries Research, Bhimtal in his speech on 'Prospects and Potential in Coldwater Fisheries and Aquaculture' mentioned that 203 finfish species have been recorded from Indian Himalayas of which schizothoracids and mahaseer support sizable capture and sport fishery in rivers and lakes. Coldwater fishery sector significantly contribute to the livelihood for a large section of economically-underprivileged hill population of the country. Important fish species of coldwater region are the snow trouts, mahseer, exotic trouts, exotic carps, minor carps *Labeo dero* and *Garra gotyla*, barils, minnows, loaches, coldwater catfishes; in addition to farming of these, propagation and culture of *Labeo pangusia*, *Neossocheilus hexagonolepis*, *O. belangiri* and *Semiplotus semiplotus* have also been initiated. In mountains, fish production through culture fisheries is gaining momentum. We were informed about ICAR-DCFR initiatives like culture of three Chinese carps *Cyprinus carpio var communis*, *Ctenopharyngodon idella* and *Hypophthalmichthys molitrix* in ponds of 0.01-0.03ha in size, experimental farming of improved Hungarian strain of mirror carp and scale carp that gave 35-40% better growth than normal common carp, plastic film-lined ponds meant for rainwater harvesting, subsequently fish culture with vegetable farming; fish farmers of Champawat and Almora districts of Uttarakhand have adopted such a farming system. Farming of commercially-important fish species brown trout and rainbow trout has spread from Jammu and Kashmir and Himachal Pradesh to Arunachal Pradesh, Sikkim and Uttarakhand, new raceways have been constructed for this purpose.

Dr S. Felix, Dean, Fisheries College and Research Institute, Tamil Nadu Fisheries University spoke on newer warmwater aquaculture technologies like super-intensive raceways, open water IMTA (Integrated Multi-Trophic Aquaculture); he described the features of enclosed channel systems as traditional raceways, raceways constructed of plywood and plastic sheets in ponds and provided with airlift system, greenhouse raceways with minimal water exchange facility thus reducing environmental impact, inland raceways with adoption of greenhouse system and bio-secured raceways like treatment of incoming water, zero water exchange, bioremediation in culture system. We were informed about system design for Aquaponics, which is a closed-loop ecological system combining fish farming and hydroponics, *i.e.,* soilless plant culture. In aquaponics, nutrient-rich water that results from raising fish serves as

natural fertilizer for growing plants (foodcrops). Water circulates through the fish tanks, filter structures and plant grow beds and flows back to the fish tanks completing the loop. Fish wastes in water provide the nutrients that plants need and the natural microbial process keeps both fish and plants healthy.

Water has become a limited resource in many areas, thus limited amount of water used in recirculation-based fish farming system is very beneficial; where volume of discharged water is much lower than discharged from a traditional fish farm. In super-intensive RAS-based fish farming systems, as little as 300lits of new water is used to produce one kg of fish in a year. Dr Felix mentioned that in traditional flow-through system, $30m^3$ volume of new water is consumed to produce one kg fish per year, and in intensive RAS, $1m^3$ volume of new water is consumed to produce one kg fish in a year. In addition to RAS, duckweed-based water treatment system and fish culture, pen culture in floodplain wetlands in Eastern India offer enormous possibilities in enhancement of freshwater fish production.

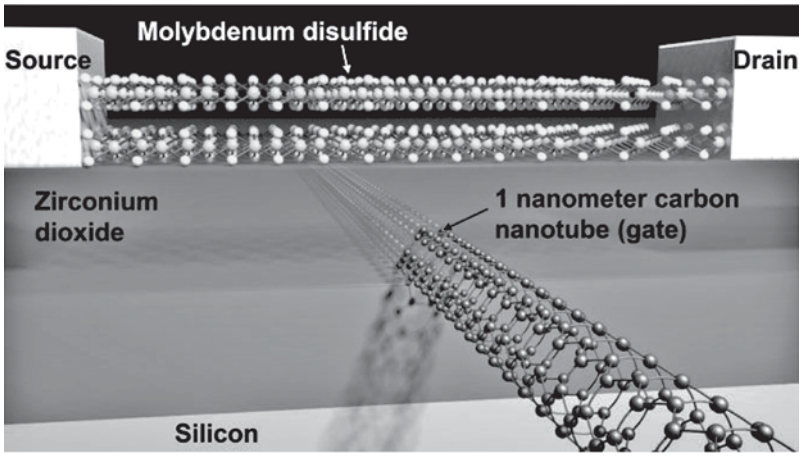
Dignitaries in the programme recommended and emphasized on the need of production of diverse spectrum of cultivable fish species, utilization of different kinds of water bodies/water resource (natural and artificially-constructed) for fish culture, development and refinement of mass-scale seed production and rearing technologies of new fish species, strengthening the conventional major carp production technologies so that it becomes more remunerative to fish farmers. ❐

Subrato Ghosh

122/1V, Monohar Pukur Road,
Kolkata - 700026

World's Smallest Transistor Created

A research team at the US Department of Energy's Lawrence Berkeley National Laboratory has created the world's smallest transistor with a working one-nanometre gate. For comparison, a strand of human hair is between 80,000 and 100,000 nanometres thick. The researchers achieved this feat by using a class of semiconductor materials called transition metal dichalcogenides, or TMDs, instead of silicon conventionally used in making chips (Science, 7 Oct 2016 | DOI: 10.1126/science.aah4698).



MoS_2 transistor with 1-nanometre carbon nanotube gate. (Credit: Sujay Desai)

Field-effect transistors consist of three terminals: a source, a drain, and a gate. Current flows from the source to the drain, and that flow is controlled by the gate, which switches on and off in response to the voltage applied. In an integrated circuit (IC), the transistor gate length is the minimum feature size of a transistor on which the flow of current through the junction depends. If the minimum feature size can be reduced, it would mean the transistor gate length can be reduced effectively making the transistor smaller with the same electrical properties. This would allow for lower current flow for the same purpose and lesser heat dissipation.

An integrated circuit is a set of electronic circuits created on one small wafer of silicon, often containing several billion transistors and other electronic components packed in an area the size of a human fingernail. In conventional silicon-based ICs, the minimum gate length hitherto achieved was around 5 nanometres. One reason why 5-nanometre transistors were considered to be the theoretical limit was because, with silicon, if size is reduced further, a phenomenon called quantum 'tunnelling effect' comes into play, making electrons start leaping from one transistor to another and signals going haywire and the circuit breaks down.

The Berkeley researchers, led by Ali Javey, graduate student Sujay B. Desai and their colleagues succeeded in overcoming the size barrier by replacing silicon with a combination of carbon nanotubes and molybdenum disulphide (MoS_2), which is sometimes used as an engine lubricant. MoS_2 belongs to a family of materials with immense potential for applications in LEDs, lasers, nanoscale transistors, solar cells, and more.

According to the researchers, because electrons flowing through MoS2 face higher resistance, their flow can be controlled with smaller gate lengths. MoS2 can also be scaled down to atomically thin sheets, about 0.65 nanometres thick, with a lower dielectric constant, a measure reflecting the ability of a material to store energy in an electric field. Both of these properties help improve the control of the flow of current inside the transistor when the gate length is reduced to 1 nanometre. In testing, the researchers' prototype device – which combines MoS_2 with a 1-nanometre-wide carbon nanotube – showed that the transistor effectively controlled the flow of electrons without being diverted due to tunnelling effect.

According to the researchers, the development could be key to keeping alive Intel co-founder Gordon Moore's prediction that the density of transistors on integrated circuits would double every two years, enabling the increased performance of our laptops, mobile phones, televisions, and other electronics. However, the researchers caution, "It's only a proof of concept. It may take some time to develop large-scale fabrication techniques for commercial manufacture and applications of the new device to become practical." ❐

Biman Basu
Dream 2047
December 2016, Vol. 19 No. 3

Microplastic Pollution is Devastating Our Oceans

The harmful impact of plastics on environment is well known. Plastic pollution involves the accumulation of plastic products in the environment that adversely affects wildlife, wildlife habitat, and humans. The main problem with plastics is that they are non-biodegradable; that is, they are not decomposed easily and remain intact for years (see *Dream 2047*, June 2016). Till recently it was presumed that damage due to plastic waste was limited to only rivers, water bodies, and coastal waters. But now it appears that no environment on Earth has escaped plastic pollution. Recent studies by researchers from the universities of Bristol and Oxford in UK, working on the Royal Research Ship (RRS) *James Cook* at two sites have revealed that plastic waste in the form of microplastics is already threatening deep oceanic life.

Microplastics are defined as small particles that are less than five millimetres long, and include both microfibres

Toothpaste containing microbeads. Small plastic particles such as these are used in many cosmetic products. (Credit: Georg Mayer/Greenpeace)

and microbeads found in many cosmetic and cleaning products. According to the scientists, microplastics including polyester, nylon and acrylic waste can enter the sea via the washing of clothes made from synthetic fabrics. In studies at two sites in the mid-Atlantic and south-west Indian Ocean, the researchers found plastic microfibres inside a wide range of deep-sea creatures, including hermit crabs, lobsters, and sea cucumbers at depths of 300-1,800 metres (Scientific Reports, 30 September 2016 | doi:10.1038/srep33997). The animals were collected using a remotely operated underwater vehicle. The finding marks the first evidence of ingestion of microplastics by animals at such depths. According to Michelle Taylor, lead author of the study, "What's particularly alarming is that these microplastics were found in the deep ocean, thousands of miles away from land-based sources of pollution."

Microplastics are roughly the same size as 'marine snow' – the shower of organic material that falls from upper layers of water to the deep ocean and which many deep-sea creatures feed on. A recent study by scientists of Plymouth University in UK has shown that more than 7,00,000 microscopic fibres could be released into waste water during each use of a domestic washing machine, many of which are likely to pass through sewage treatment and into the environment (Marine Pollution Bulletin, September 2016 | DOI: 10.1016/j.marpolbul. 2016.09.025). Their studies showed that plastic waste could find its way deep into the ocean through the faeces of plankton. Studies have shown that laundering an average washing load of 6 kilograms could release an estimated 1,37,951 fibres from polyester-cotton blend fabric, 4,96,030 fibres from polyester and 7,28,789 from acrylic.

Plastics are enormously beneficial materials, but if marine plastic pollution, especially microplastic pollution in deep sea waters continues to increase, its impact on

marine life could be grave. It is important that the accumulation of plastic and microplastic debris in marine habitats is prevented through better waste-handling practices and smarter choices in the materials we use.

The UK Government has recently announced that it would ban plastic microbeads, found in many cosmetic and cleaning products, by the end of 2017. The move followed reports by the House of Commons Environmental Audit Committee about the environmental damage caused by plastics. Late last year US president Barack Obama signed a bill outlawing the sale and distribution of toothpaste and exfoliating or cleansing products containing plastic microbeads. It is time that the Indian Government takes notice of the problem and brings in suitable legislation to counter the growing menace. ❐

Biman Basu
Dream 2047
December 2016, Vol. 19 No. 3

malaria. Most mosquitoes – including certain species

Indian Science News Association
ESTD.-1935

SCIENCE AND CULTURE

Published by Indian Science News Association
Phone : (033) 2350-2224 ● E. Mail: scie2224@dataone.in
Website: www.scienceandculture-isna.org

Science and Culture is a multidisciplinary journal which focuses on research and development in science, society and culture, national issues and events. This is a unique journal connecting the reflection of the community of scientists and thinkers on the public understanding of science and culture together.

SUBSCRIPTION ORDER FORM

Date:

To
The Editor-in-Chief
Indian Science News Association
92, Acharya Prafulla Chandra Road
Kolkata – 700 009

Dear Sir,

Our institution is interested to subscribe the journal ***SCIENCE AND CULTURE***, for the year……(January to December).

A cheque/ draft for Rs/ US$…….....…drawn in favour of **INDIAN SCIENCE NEWS ASSOCIATION** is enclosed towards the subscription. Subscription has been sent by bank transfer to the following account.

Yours faithfully,

(Authorized signatory with seal)

Bank Name and Branch: **State Bank of India**, Manicktala Branch
Account No.**11152795977** IFSC Code: **SBIN0001715** SWIFTCode: **SBININBB492**
Annual Subscription: **Rs. 2,500.00 (India), US$ 125.00 (Foreign)**

Mailing address in which the journal is to be sent :

.....
.....
.....
.....
.....
.....