Notes and News

M.N. Saha Memorial Lecture

M.N. Saha Memorial Lecture is a regular lecture series organized by the Indian Science News Association (ISNA). This year's M.N. Saha Memorial Lecture was held jointly with the Presidency University on 27th November 2018 at the Lecture Hall of the Physics Department of the Presidency University. The lecture was delivered by Professor Arnab Rai Chaudhuri of the Department of Physics, Indian Institute of Science, Bangalore and Professor Amitava Raychaudhuri, Palit Professor of Physics, Calcutta University was the Chief Guest. Dr. K. Muraleedharan, President of ISNA and Director, Central Glass and Ceramic Research Institute, Kolkata presided over the programme.

Professor Sudhendu Mandal, Secretary, ISNA welcomed the audience and made some introductory remarks about ISNA and reminded the audience that ISNA was established primarily by the effort of Meghnad Saha, Prafulla Chandra Ray, P.C. Mahalanabis, U.N. Brahmachari and other stalwarts of that time. Meghnad Saha was the first Secretary and first editor of the journal Science and Culture which has been publishing since 1935. As a result, M.N. Saha Memorial Lecture has a special meaning to us and very prominent personalities are usually selected as the speakers. He mentioned names of few of the past speakers. Professor Arabinda Nayak, Dean of Faculty of Natural and Mathematical Sciences of the Presidency University hailed the effort made by the Physics Department to hold this prestigious lecture at the Physics Department.

Professor S.C. Roy, Editor-in-Chief of the journal Science and Culture introduced Prof. Arnab Rai Choudhuri who is a reputed astrophysicist internationally. He did his graduation from Presidency College and did his Ph.D. from the University of Chicago in 1985 under the supervision of another well-known astrophysicist Eugene Parker. Prof. Rai Choudhuri is the fellow of all the three National Academies of India and as well as TWAS. Prof. Roy also mentioned some of his valuable traits he noted during his involvement with him during the National Seminar on History of Science held in Delhi and as well as during the publication of a Special Issue of Science and Culture of which Arnab is the Guest Editor.

In his lecture titled "How the Saha Ionization Equation was Discovered", Prof. Rai Chaudhuri in his inimitable way emphasized the exact nature of Meghnad Saha's contributions on this subject analyzing Saha's original papers and other relevant papers by scientists of that time, as well as other historic materials such as letters exchanged between scientists. The lecture also pointed out how Saha's thermal ionization equation paved the way to the development of modern astrophysics.

A section of audience at the physics auditorium of Presidency University during the interactive session after the M.N. Saha Memorial Lecture delivered by Prof. Arnab Rai Choudhuri held on 27th November 2018.

The Special Issue of Science and Culture published to mark the 125th birth anniversary of Meghnad Saha was released by the Chief Guest Prof. Amitava Raychaudhuri. Prof. Roy explained the special significance of the Special Issue and presented a brief history of the

Release of Special Issue of *Science and Culture* published on the occasion 125th birth anniversary of Meghnad Saha at Presidency University, Kolkata on 27th November 2018 by Prof. Amitabha Raychaudhuri, Palit Professor of Physics, Calcutta University. Seen in the picture are (from left); Prof. S.C. Roy, Editor-in-Chief, Science and Culture, Prof. Amitabha Roychaudhuri, Prof. Sudhendu Mandal, Secretary, ISNA and Dr. K. Muraleedharan, President, ISNA and Director of CGCRI.

journal and requested the audience to be associated with the journal.

The issue has been sponsored in part by the Department of Science and Technology, Govt. of India through a J.C. Bose Fellowship awarded to Prof. Rai Choudhuri.

Dr. K. Muraleedharan expressed his immense satisfaction on the way the lecture was delivered. He presented the memento and the M.N. Saha Memorial Lecture Medal to Prof. Arnab Rai Chaudhuri.

The vote of thanks was offered by Prof. Suchetana Chatterjee of Presidency University.

The lecture was well attended by students, faculty, and other distinguished scientists. ❐

Research on Breeding and Seed Rearing of *Tenualosa ilisha* in freshwater

Kalyani Regional Centre (RC) of ICAR-Central Institute of Freshwater Aquaculture, West Bengal has obtained landmark success in experiments on artificial breeding and larval rearing of the high-priced fish *Tenualosa ilisha* in freshwater conditions. Larvae and advanced larvae could be produced both in normal carp hatchery and modified hatchery in the institute; those could be successfully reared upto fry, fingerling and yearling stages later on in experimental ponds.

During February 2016, *T. ilisha* was successfully bred in river Hooghly at Godakhali near Budge Budge, Dist. South 24 Parganas WB by a team of scientists of ICAR-CIFA Kalyani RC. Male and female broodfishes were collected from fishermen and breeding operation was conducted on boat itself by stripping method. Drinking water was used for egg fertilization. Fertilized eggs were transported to the institute in oxygen-filled plastic packets and hatched in trays. Trial for incubation of eggs was also done in Fibre-glass Reinforced Plastic hatchery after suitable modification of the operational procedure. In hatchery, larval survivability was considerable. Four-day old *T. ilisha* larvae have been reared in FRP tanks and nursery ponds for one month and their survival and growth performance were assessed.

Experiments on hatching rates of fertilized eggs of *T. ilisha* after transportation were carried out using different freshwater sources at field camp of the institute near Diamond Harbour, at laboratory of the institute and in pond water of institute with different salinity level. One-day old larvae were kept in different water systems. *T. ilisha* fry produced from breeding trials were reared in rectangular FRP tank for one month. Protocols for mass production of certain species of phytoplankton and zooplankton meant to be fed to *T. ilisha* larvae and broodstock in controlled condition have been developed by ICAR-CIFA scientists. Artificial fecundation of wild caught *T. ilisha* was conducted in river Hooghly during February 2017 also. Fry could be weaned to accept artificial feed under pond culture condition and its growth rate assessed in ten-month culture period.

In March 2018, on-board/on-boat breeding of *T. ilisha* was done at aforesaid region of Hooghly river. Matured males and females caught from river Hooghly were stripped and fertilized eggs were produced by scientists on-board. Fertilized eggs of *T. ilisha* were supplied to M/s Chatterjee Brothers Fish Farm at Mogra, Dist. Hooghly, WB to ascertain whether it is possible to maintain these fertilized eggs successfully and reared upto larval stages in farmers' hatchery, although it has been tested at hatchery of ICAR-CIFA Kalyani RC. Fry and yearlings of *T. ilisha* were also supplied to this fish farm to note its growth and development in freshwater and to ascertain whether these

can be developed into broodstock at farmers' freshwater pond. For the first time in the world, experiments on incubation of *T. ilisha* eggs and larval rearing in farmers' hatchery at farmers' field were undertaken. Research is in progress and it cannot be conclusively stated right now that *T. ilisha* will not attain maturity in confinement. The fish has established itself significantly in freshwaters of Ukai/Vallabh Sagar reservoir in Gujarat, mature stocks have been observed.

Research and trials are on-going and further research is required so that *T. ilisha* can attain maturity in confinement and in pond condition and it is a great challenge. It holds prospect and in future, fry and fingerlings of *T. ilisha* may be supplied to fish farmers. It may be possible through hormonal manipulation and environmental simulation. Larval feed of *T. ilisha* has been supplied to Chatterjee Brothers' Fish Farm for rearing the fish in nursery ponds. Much dedication and devotion is required in such a kind of research, which is remarkable and prospectful. At ICAR-CIFA Kalyani RC, this sophisticated marine fish could be acclimatized in captivity and *T. ilisha* larvae could be weaned to artificial diet successfully. Ponds with much longer length help the fish to swim fast and grow. Research on *T. ilisha* will gain momentum if more fish farmers come forward for seed production, there exist opportunities; technologies from laboratory to farm conditions can be transferred effectively. ICAR-CIFA has taken initiatives which will help other farmers also. Fishery scientists are conducting research intensively in this regard; it is hoped that demand of seed of *T. ilisha* can be met and pond-cultured *T. ilisha* of marketable size will be available in city markets in near future. ❐

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Ebola: An New Vaccine Will Soon Be Available

What is Ebola Virus? : Ebola virus disease, formerly known as Ebola hemorrhagic fever, is one of the deadliest viral diseases known to man. The disease is caused by the Ebola virus, which belongs to the genus *Ebolavirus* within the family *Filoviridae.*The virus is transmitted from animals to humans and since it is highly contagious, it spreads rapidly among the human population through infected blood and other body fluids. The case-fatality rate of Ebola virus disease is extremely high, with an average of 50%, which can reach as high as 90%, meaning that up to 90% of infected persons will die.

The disease was first reported in 1976 in the Democratic Republic of Congo (then Zaire) in a village near the Ebola river. That's how the name originated. Since its discovery in 1976, the majority of outbreaks occurred in Africa. In 2014-2016, an explosive Ebola outbreak occurred in West Africa in rural Guinea, which spread to urban areas, and then across borders to Liberia and Sierra-Leone. There were 28,610 cases in these three countries with a staggering death toll of 11,308! This was the largest and most complex outbreak of Ebola since its discovery in 1976. The severity of this outbreak necessitated the development of a vaccine to prevent the disease.

Ebola Vaccines Under Development : Currently 12 Ebola vaccine candidates (including monovalent, bivalent and multivalent vaccine candidates) are under various stages of clinical development. Among these, the front-runner is a recombinant Ebola vaccine candidate called rVSV-ZEBOV. The vaccine is based upon vesicular stomatitis virus (VSV), which has been genetically engineered to contain a protein from Zaire strain of Ebola virus (ZEBOV) so that it can elicit an immune response against the virus.

Clinical Trials of the New rVSV-ZEBOV Ebola Vaccine Candidate : The Phase-III clinical trial of the rVSV-ZEBOV vaccine candidate, carried out in Guinea in 2015, is the only vaccine that has shown clinical efficacy in humans. This trial included 11,841 people. A total of 5,837 people were vaccinated with rVSV-ZEBOV, while the remaining were non-vaccinated. No Ebola cases were reported in the vaccinated group, while 23 cases were reported in the non-vaccinated group. The trial was led by WHO, Guinea's Ministry of Health, Médecins sans Frontieres (MSF) and the Norwegian Institute of Public Health. Since then, the rVSV-ZEBOV vaccine candidate has been evaluated in several clinical trials in over 16,000 people across Africa, Europe and USA. The vaccine trial results unequivocally established that the vaccine candidate was safe and protective against Ebola virus.

Use of rVSV-ZEBOV in the Current Ebola Outbreak : A severe Ebola outbreak is currently ongoing in the Democratic Republic of Congo (DRC), which has been predicted to be the worst Ebola outbreak to occur in East Africa. The DRC outbreak started in early, May 2018.

It had been recommended by the WHO Strategic Advisory Group of Experts on immunization (SAGE) in 2017, that in the event of an Ebola outbreak, rVSV-ZEBOV should be deployed. Accordingly, this new vaccine is currently being used in the DRC Ebola outbreak. The Ministry of Health of DRC is being supported by WHO, GAVI (Global Alliance for Vaccines and Immunization), MSF, UNICEF (United Nations Children's Fund) and other partners in this vaccination effort. Till date, a total of 7,560 doses of rVSV-ZEBOV manufactured by Merck, have been sent by WHO to DRC to stop the outbreak. Another 8,000 doses will be sent shortly. This vaccination campaign is not a general mass vaccination drive where the entire population of the affected region is vaccinated. Rather, it is a targeted vaccination strategy that is used to protect the affected population by vaccinating the people at highest risk of being infected with the Ebola virus.

Conclusion : In the current Ebola outbreak in DRC, as of 30th August, 2018, 118 cases and 77 deaths have been reported so far. This new investigational vaccine has been instrumental in keeping down the mortality rate. Due to the superior performance of this new vaccine in the current Ebola outbreak, it is hoped that it will soon become licensed by WHO and made available for vaccination of the general population in Ebola endemic parts of the globe.

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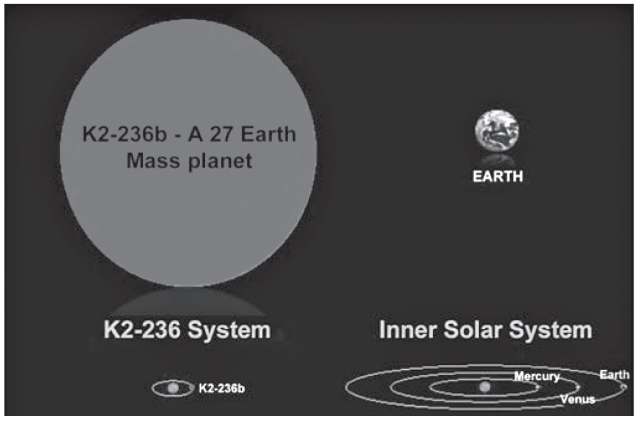
Indian Scientists Discover an Exoplanet

In an exciting first, an Indian team of scientists have discovered a large exoplanet orbiting a Sun-like star around 600 lightyears away. The team from the Physical Research Laboratory (PRL), Ahmedabad made the discovery using the indigenously designed 'PRL Advance Radial-velocity Abu-sky Search' (PARAS) spectrograph to measure and confirm the mass of the new planet. This is the first of its kind spectrograph in the country, which can measure the mass of a planet going around a star. Only a few spectrographs that can do such precise measurements exist around the world and most are found in the USA and in the Europe. The precise and stabilised high-resolution spectrograph PARAS was integrated with the 1.2 m telescope at PRL's Gurushikhar Observatory in Mount Abu, Rajasthan for making the observations.

The team led by PRL's Abhijit Chakraborty observed the target for about 18 months and made calculations that suggested the planet to be smaller in size than Saturn but bigger than Neptune. By measuring the amplitude of wobbling of the host star, the mass of the planet was found to be about 27 Earth masses and the radius six times that of Earth. Only 23 such systems (including the present one) are known with such precise measurement of mass and radii to this date.



Planet size comparison of K2-236b and Earth

The scientists estimate that 60% to 70% of its mass could be made up of heavy elements like ice, silicates and iron. With a surface temperature of 600°C, the new exoplanet has been named EPIC 211945201b (or K2-236b). The host star has been named EPIC 211945201 or K2-236. The planet was found take only 19.5 Earth days to go around the star. The scientists did not directly observe the planet but monitored the changes in the wavelength of light emitting from the star using PARAS to deduce the

The PARAS spectrograph was designed and developed by the members of the Astronomy and Astrophysics Division of PRL. The primary aim of PARAS is to search for planets around dwarf mainsequence stars. It has wavelength coverage *of 400 nm to 680 nm. (Credit: PRL)*

presence of another body in its star system. According to the scientists, being seven times nearer its star in comparison with the Earth-Sun distance and being extremely hot, K2-236b would certainly be uninhabitable (*Astronomical Journal*, 8 June 2018 | DOI 10.3847/1538-3881/aac436).

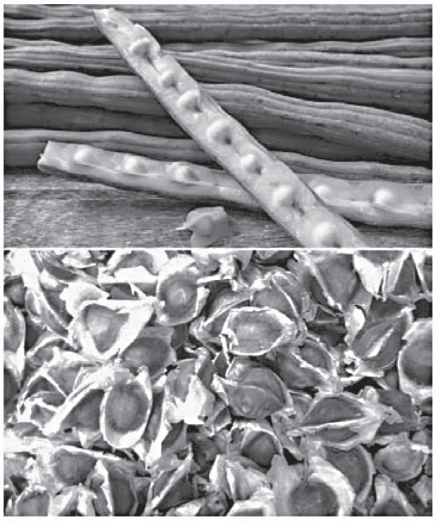
Exoplanet discovery is nothing new. In fact, it has become a hot area for research in recent years. NASA's *Kepler* satellite has already discovered 3,786 confirmed exoplanets in 2,834 exoplanetary systems.But this is the first discovery of an exoplanet made by Indian scientists, and with this discovery India has joined a handful of countries, which have discovered planets outside our solar system. The PRL scientists actually worked on a planetary candidate based on data from NASA's *Kepler*-2 mission. However, the key part of exoplanet discovery is confirming its planetary nature for which an independent measurement of the mass of the body was required, which the PRL team managed to achieve to clinch the discovery. According to the scientists, this discovery is of importance for understanding the formation mechanism of such large planets that are too close to the host star. ❐

Biman Basu
Dream 2047, August 2018, Vol 20 No.11

A Seed that could Bring Clean Water to Millions

Scarcity of drinking water is a major problem in most countries today. According to figures released by the United Nations, 2.1 billion people lack access to safe drinking water, the majority of whom live in developing countries. In most countries purifying water is an expensive proposition. Now scientists have developed a cheap alternative that uses a widely available natural plant material. Researchers at Carnegie Mellon University and Pennsylvania State University in USA have developed a refining process using extracts of seeds of *Moringa oleifera* that could soon help provide clean water to many in water-scarce regions. The method uses sand and proteins from the *M. oleifera* plant to create a cheap and effective water filtration medium, termed "f-sand" (*Langmuir*, 22 March 2018 | DOI: 10.1021/acs.langmuir.8b00191).

Moringa oleifera is a fast-growing, drought-resistant tree, native to the southern foothills of the Himalayas in north-western India It is widely cultivated in tropical and subtropical areas where its young seed pods (commonly known as drumsticks) and leaves are used as vegetables, and many parts of the tree are used in traditional herbal medicine.



Moringa oleifera fruits (top), seeds (bottom)

M. oleifera seeds contain a natural protein called *M. oleifera* cationic protein (MOCP) that can be used as an antimicrobial flocculent material for water clarification. However, the seeds also release other watersoluble proteins and organic carbon, which increase the concentration of dissolved organic matter in the water. The presence of this dissolved organic carbon supports the regrowth of pathogens in the treated water, allowing bacteria to regrow after just 24 hours. This puts a great limitation on the availability of safe drinkable water.

To get over this limitation, Stephanie Velegol of Pennsylvania State University had the idea of combining the use of Moringa protein with sand filtration methods common in developing countries. By extracting the seed proteins and adsorbing them on the surface of silica particles (the principal component of sand), she created the antimicrobial functionalised sand, or 'f-sand', which both kills microorganisms adhering to particulate and organic matter and reduces turbidity. These undesirable contaminants and dissolved organic carbon can then be washed out, leaving the water clean for longer and the f-sand ready for reuse.

While the basic process was proven and effective, there were still many questions surrounding creation and use of f-sand. For example, would isolating certain proteins from the *M. oleifera* seeds increase f-sand's effectiveness? Are the fatty acids and oils found in the seeds important to the adsorption process? What effect would water conditions have? What concentration of proteins is necessary to create an effective product? Bob Tilton and Todd Przybycien of Carnegie Mellon University decided

to find the answers as they could have big implications on the future of f-sand.

After exploring all possibilities of enhancing the effectiveness of using *M. oleifera* extracts for water purification, including effects of water hardness, fractionation of the seed proteins, and fatty acid extraction, the researchers were able to arrive at conclusions that could have major benefits for those in developing countries looking for a cheap and easily accessible form of water purification.

Tilton and Przybycien found that fractionating the proteins had little discernible effect on the proteins' ability to adsorb to the silica particles, meaning this step was unnecessary to the f-sand creation process. They also found that much like fractionation, removing the fatty acids had little effect on the ability of the proteins to adsorb. This is significant because people in the region can remove and sell the commercially valuable oil and still be able to extract the proteins from the remaining seeds for water filtration. The researchers further found that proteins were able to adsorb well to the silica particles, and to coagulate suspended contaminants, in both soft and hard water conditions. This means that the process could potentially be viable across a wide array of regions, regardless of water hardness.

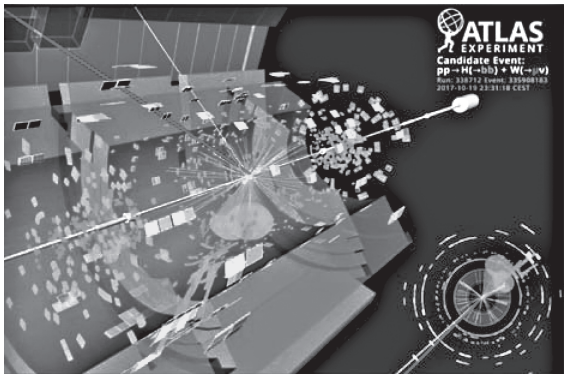
The new research thus suggests that sands can be effectively modified with *M. oleifera* proteins using small amounts of seed extract under various local water hardness conditions and that the modified sand would be stable on repeated use for water filtration. The work of these researchers puts this novel innovation one step closer to the field, helping to forge the path that may one day see f-sand deployed in communities across the developing world. ❐

Biman Basu
Dream 2047, August 2018, Vol 20 No.11

Decay of Higgs Boson Observed

Six years after discovering the Higgs boson, physicists have observed how the particle decays. This is considered as a monumental contribution to our understanding of the Standard Model of particle physics and the universe at large.

There was lot of excitement when the elusive Higgs boson, predicted in 1964, was discovered by scientists at the Large Hadron Collider (LHC) of the European Organisation for Nuclear Research (CERN) in 2012. Higgs boson is an elementary particle predicted by the Standard Model of particle physics that relates to how objects have mass.The Standard Model also predicted that 60 percent of the time, a Higgs boson will decay into smaller fundamental particles called bottom quarks (b quarks), which has now been observed. The results were presented at CERN on 28 August 2018 by the ATLAS and CMS collaborations at the LHC. According to physicists, the finding provides major support for the Standard Model, which has many implications for how we understand the world and the universe. The finding is consistent with the hypothesis that the all-pervading quantum field behind the Higgs boson also endows the bottom quark with mass.



An ATLAS candidate event for the Higgs boson particle decaying into two bottom quarks. Physicists at CERN recently observed this process, which further confirms the Standard Model of particle physics. (Credit: ATLAS/CERN)

Although observing the Higgs boson decay may not be as astounding as the discovery of the particle itself, which was awarded the 2013 Nobel Prize in physics, it is a colossal victory, the researchers said. Spotting the Higgs-boson decay channel was anything but easy, as the six-year period since the discovery of the boson has shown. The reason for the difficulty is that there are many other ways of producing bottom quarks in proton–proton collisions, which were used to create the Higgs boson. This makes it hard to isolate the Higgs-boson decay signal from the background "noise" associated with such processes.

Another problem is that ATLAS and CMS are separate detectors, so the collaborations working on each one must make and confirm these observations separately for it to "count". So the findings may be considered another big step along the journey to better understand the Higgs boson and our universe. And each new discovery or observation, like the discovery of the Higgs boson, has the potential to give way to new questions and experiments. In confirming that this particle does, in fact, decay into b quarks, the physicists have shown that the Higgs field, the field behind Higgs boson particles " the "invisible jelly that permeates

all of space"– gives b quarks mass. The Higgs field uses the Higgs boson to interact with other particles, like the b quark, and give them mass. ❐

Biman Basu
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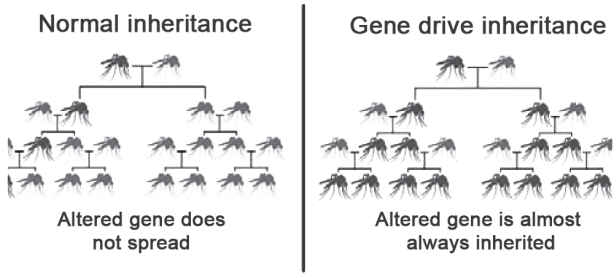
New Technique for Genetic Control of Mosquitoes

Gene-editing techniques involve cutting genes at specific sites in the DNA of an embryo in order to disrupt those genes' function or insert other genes. The CRISPR-Cas9 makes artificial gene-editing much easier and cheaper, enabling scientist to target specific bits of DNA. As a result, CRISPR gene-editing is widely used, heralding advances in biomedicine such as cancer treatments and protecting individuals from infections. The CRISPR-Cas9 system uses enzymes that can cut specific gene sequences from DNA, guided by a similar molecule known as RNA. Natural gene repair mechanisms then take over and can be used to disrupt the function of the original gene or replace it with a completely different one.

In the latest study, CRISPR methods have been used to make mosquitoes resistant to malaria infections and coupled with a "chain reaction" to drive this gene modification (the resistance to malaria parasite) through the population. This process is referred to as a "gene drive", which may be used to ensure that a specific genotype (a certain version of a gene) is passed on to the descendants of modified individuals. Gene drive has now been successfully used to decimate a population of malariacarrying mosquito in the lab. This is the first time the technique has been used make a population of mosquitoes to self-destruct, a result that holds promise for combating malaria(*Nature Biotechnology*, 24 September 2018 | doi: 10.1038/nbt.4245).

The study, led by molecular biologist Tony Nolan and vector biologist Andrea Crisanti, both at Imperial College London, identified three genes in *Anopheles gambiae* that, when mutated, lead to infertility in females. The team targeted a region of a gene called 'doublesex' that is responsible for female development. Female *Anopheles gambiae* mosquitoes with two copies of the altered doublesex gene did not lay eggs. After eight generations, the drive had spread through the entire population, such that no eggs were laid, effectively leading to the decimation of the entire population.

"This breakthrough shows that gene drive can work, providing hope in the fight against a disease that has plagued mankind for centuries," saysco-author Crisanti, a molecular parasitologist at Imperial College London.



Mosquitoes and other organisms normally have a 50 percent chance of passing along a gene to an offspring (left). A gene drive copies and pastes itself into chromosomes from both parents, ensuring it gets passed *on more often (right). (Credit; Science News)*

A sexually reproducing organism usually has a 50% chance of inheriting a specific genotype (genetic constitution) from one of its parents. Using a gene drive can cause the inheritance pattern to increase that chance to nearly 100%, ensuring almost all descendants possess the genotype. As those descendants mate and produce their own offspring, the proportion of organisms with the genotype increases until it can be found in the entire population.

The idea that a population's genotype can be "replaced" is particularly appealing when that population is responsible for spreading disease, as mosquitoes are with malaria. Malaria is preventable and curable but still kills over 400,000 people worldwide each year.

The potential for using a gene drive to engineer insects (particularly mosquitoes) was discovered in the 1960s. But the advent of CRISPR's cheap and easy gene-editing puts this research onto a whole new footing. According to the researchers, the longer term aim of using this method might be to release persistent, modified mosquitoes into the environment to assist in controlling a public health problem. ❐

Biman Basu
Dream 2047, November 2018, Vol 21 No.2

Evolution and Propagation of Antimicrobial Resistance and Prospective Therapeutics – Discussion in ICCAR 2018

In India, antimicrobial resistance (AMR) is a major public healthcare concern where easy availability and higher

consumption of medicines have led to disproportionately higher incidence of inappropriate use of antibiotics and greater levels of resistance. It is a severe threat to community, health and environment surrounding us. In the Technical Session entitled 'Evolution and Propagation of AMR' held on the 2nd day of International Conference on Contemporary Antimicrobial Research, organized by Department of Biotechnology, Indian Institute of Technology, Kharagpur during 15-17th December 2018, Prof. R. Chakraborty from North Bengal University spoke on 'Molecular association among genes involved and between genes and the phenotypes under selection determines the course of evolution of AMR'. He spoke on characteristics of two kind of bacteria lover of poor nutrient condition and high nutrient condition in polluted river water, bacterial isolates bearing gene cassettes related to AMR, thermostability of *E. coli* in pigeon faeces resistant to Trimethoprim, diverse gene cassettes in Cl-I integrons in facultative bacteria of river Mahananda, distribution of resistant and sensitive bacteria in pristine river Dima towards Chloramphenicol (Clr), amendment of Dima water with Clr directing the evolution of resistance under oligotrophic condition during incubation, oligotrophs becoming more sensitive towards sub-inhibitory concentration of Clr added to water, *Klebsiella pneumonae* from river Mahananda as a multiple antibiotic resistant (AR) bacteria, 'superbug' *Pseudomonas pyomelanin* resistant to all available antibiotics.

Dr A. K. Mukhopadhyay from NICED, Kolkata spoke on 'Non-antibiotic therapeutic regimens for *Helicobacter pylori* in an era of increasing AR'. He described the epidemiology of *H. pylori* infection, its survival in highly acidic stomach and adaptation to chronic infection, Metronidazole is a drug of choice for *H. pylori* treatment but not in India, curcumin and ellagic acid (present in Haritaki, black berry) showing immense therapeutic potential against *H. pylori* and highly effective in inhibiting its growth, functional rdx-A nitroreductase gene responsible for *H. pylori* infection and AR, emergence of Clarithromycin resistant *H. pylori*, anti-ulcer potential of curcumin, its effect on the viability of *H. pylori* in experimentally-infected mouse. Dr H. K. Tiwari from Sikkim University spoke on 'Glimpse of AMR in Sikkim hills with regard to extended spectrum β-lactamase (ELBS) producing bacteria' and reported the evolution and prevalence of ESBL-producing uropathogens in the area. He discussed about urinary tract infection, pattern of AR in uropathogens *Klebsiella pneumonae*, *E. coli*, *Proteus mirabilis*; *P. aeruginosa* showing 100% resistance to Ampicillin followed by *K. pneumonae* (88%), Imipenem as an effective antibiotic, detection of ELBS, ELBS-resistant genes and distribution of ELBS-resistant genes among uropathogens. Dr S. R. Joshi from North Eastern Hill University spoke on '*Enterococcus* sp in traditional products – a paradox in probiotic lactic acid bacterial research'. He discussed about method of cleaning, fermentation in earthen pots, marketing and preservation of small fishes *Puntius ticto* and *P. sophore* followed by tribals in NE India, fermentation microbe *Enterococcus* sp (having antimicrobial activity and inhibit food-borne pathogens) present in raw fish results in fermented food products, stability and minimum inhibitory concentration of bacteriocin from purified *Enterococcus* sp against *E. coli* and *P. aeruginosa*. On the other hand, Vancomycin resistant *Enterococcus* has come up, different virulent strain found in *E. faecalis*, molecular profiling of pathogenic traits of *E. faecalis*, it showed high levels of resistance to Kanamycin and Gentamycin. *E. faecalis* present in traditional fish product are probiotics, but it should be regarded with caution since it may be a reservoir of AR and virulent genes enabling the propagation of those genes to human biota.

In the Technical Session entitled 'New Target Identification', Dr J. Gowrishankar from Centre for DNA Fingerprinting and Diagnostics, Hyderabad spoke on 'Rho inhibition leads to death of *E. coli* from antisense transcript-generated R-loops'. He stated that proteins Rho and Nus-G are important for viability of *E. coli* and Rho is a known antibiotic target. Absence of these proteins kills the bacterium because of excessive accumulation of R-loops in cells. The proteins actively target for termination of those transcripts that are not being simultaneously translated. High levels of antisense transcription do not kill *E. coli* cells as long as R-loop formation from the antisense RNAs is curtailed. Lethality comes from R-loops that are formed in them and Rho deficiency provokes the increased formation of R-loops; it's essential role is in curtailing such transcription and the consequential R-loop formation from a subset of RNAs.

Prof. (Ms) M. Kundu from Bose Institute spoke on 'Two component systems (TCS) of *Mycobacterium tuberculosis* (Mtb) as potential drug targets'. She mentioned that there are 11 known paired TCSs in Mtb genome, it responds to various stresses (low pH, low oxygen, low nutrients) encountered within the host and help the bacterium to survive. She spoke about TCS of ompR family in Mtb, gene expression analyses of the response regulators RegX3 and MprA (both responsible for virulence) targets using genetically manipulated strains, targeting the LRXK motif at the C-terminal DNA binding domain inhibits Mtb growth and targeting with inhibitors. If production and

release of ESAT-6 from Mtb is down-regulated, it will inhibit the virulence factor. The sensor kinase MtrB in Mtb, which is required for the survival of Mtb under hypoxia, is a potential drug target. It is required for establishment of infection *in vivo*. Dr Kundu explained inactivation of MtrB and genome-wide transcriptional profiling using microarrays. Her research findings underscore the novel function of MtrB as a global regulator controlling the transcription of genes involved in the adaptation of Mtb to hypoxia and to the host environment.

In the Technical Session entitled 'Prospective Therapeutics', Dr M. Dutta Chowdhury from Assam University spoke on 'Natural products and derivatives as RND efflux pump (EP) inhibitors – *in silico* and *in vitro* appraisal'. He spoke about the 34 different EPs in the opportunistic pathogen *P. aeruginosa*, downregulation of EPs, multidrug resistant EPs in bacteria, EPs of RND superfamily in *P. aeruginosa*, assembly of MexAb-OprM EP that consists of three proteins, EP inhibition in combination with antibiotic as a strategy for overcoming resistance, *in silico* screening of plant-based antimicrobials for their inhibitory activity against MexB protein of MexAb-OprM EP, preparation of MexB (receptor), preparation of ligand and molecular docking studies using software. The compound P-coumaric acid was found to potentiate the activity of Ciprofloxacin for EP inhibitory activities. Dr S. K. Ghosh from IIT, Kharagpur spoke on 'Drug resistance to parasitic diseases'. He opined that drug resistant pathogens emerge faster than new drugs come out of drug discovery pipelines, and discussed the basic mechanism and difference in drug resistance in protozoan parasites and bacteria, many antibiotics are not effective against parasites, monitoring clinical drug efficacy against parasites. High dosage was used to kill parasite *Entamoeba histolytica* (causing diarrhoea) and such dosage also increases the selective pressure of antibiotics and parasites become AR. No *Plasmodium falciparum* strain has so far been found to be insensitive to artemisinin in *in vitro* model. Treatment of parasitic diseases relies on only few old drugs. Dr Ghosh feels that Consortium for parasitic drug development is required. Prof. S. Rimmer from University of Bradford, UK spoke on 'Detection and treatment of bacterial and fungal disease using smart polymers'. He spoke about *Staphylococcus aureus* responsive polymers, features of branched polymers, development of highly-branched poly (N-isopropyl acrylamide) that bind to bacteria and then respond by desolvation of polymer segments in outer domains of polymer coil. Dr Rimmer developed an improved diagnostic device that carries three such polymers functionalized with ligands for Gm-positive, Gm-negative or fungal infections. ❐

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