

Bhatnagar Prize Winners For 2020

The Shanti Swarup Bhatnagar Prize for Science and Technology is the highest award in India for scientists below the age of 45 years. The award was instituted by the Council of Scientific and Industrial Research (CSIR) in 1958 in honour of Sir Shanti Swarup Bhatnagar, the founder Director-General of CSIR. This annual award recognizes the excellence and outstanding contributions of Indian scientists in the area of science and technology, both fundamental and applied. This award carries a cash prize of Rs. 5 lakhs, as well as other incentives for encouraging further research. The award is given for research work carried out, primarily in India, during the five-years preceding the year of the prize.

This multi-disciplinary award is given in the following seven disciplines:

- Biological Sciences
- Chemical Sciences
- Earth, Atmosphere, Ocean and Planetary Sciences
- Engineering Sciences
- Mathematical Sciences
- Medical Sciences
- Physical Sciences

Sir Shanti Swarup Bhatnagar (1894-1955) is considered to be the Father of Research Laboratories in India. As a scientist, he worked in the area of colloidal chemistry. Besides his scientific excellence, he was also an efficient scientific administrator. He was not only the first Director-General of CSIR, but also the first Chairman of the University Grants Commission (UGC) of India. In recognition of his scientific attainments, he was elected as a Fellow of the National Institute of Sciences of India (FNI), which is now known as the Indian National Science Academy. He was also a Fellow of the Academy of Sciences (FASc), Fellow of the Royal Institute of Chemistry (FRIC), Fellow of the Institute of Physics (FInstP), and a Fellow of the Royal Society (FRS).

He received many accolades during his lifetime, the most notable of which are the Padma Bhushan, Order of

the British Empire (OBE), and Knighthood, bestowed by Queen Elizabeth II in 1941.

In recognition of his exemplary scientific achievements and administrative brilliance, and to honour his legacy, the CSIR instituted the Shanti Swarup Bhatnagar Prize in his name.

The first recipients of this prestigious prize were:

- Toppur Seethapathy Sadasivan (1960) in Biological Sciences
- Tuticorin Raghavachari Govindachari (1960) in Chemical Sciences
- Kshitindramohan Naha (1972) in Earth, Atmosphere, Ocean and Planetary Sciences
- Homi Nusserwanji Sethna (1960) in Engineering Sciences
- Komaravolu Chandrasekharan (1959) in Mathematical Sciences
- Ram Behari Arora (1961) in Medical Sciences
- Kariamackam Srinivasa Krishnan (1958) in Physical Sciences

BHATNAGAR PRIZE WINNERS FOR 2020

This year, fourteen scientists were awarded this coveted prize. The names of the awardees were announced by Dr. Harsh Vardhan, the Minister of Science and Technology, Minister of Health and Family Welfare, and the Minister of Earth Sciences on 26 September 2020. Incidentally, the date coincided with the 79th Foundation Day of CSIR. This special day also celebrated the contributions of CSIR scientists to the COVID-19 pandemic response.

The contributions of these fourteen scientists are briefly discussed below.

BIOLOGICAL SCIENCES

Dr. Shubhadeep Chatterjee

Laboratory of Plant-Microbe Interactions, Centre for DNA Fingerprinting and Diagnostics (CDFD), Hyderabad

Dr. Chatterjee received the prize for his work on quorum sensing (QS), a phenomenon exhibited by bacteria

to check their population growth. This seminal discovery has sparked interest among scientists to conduct theoretical modeling studies on bacterial QS. His research has improved our understanding of the plant pathogenic bacterium *Xanthomonas*, in the context of QS. The research has also shed new light on other phenomena exhibited by bacteria, such as iron metabolism, cell-to-cell communication, and other metabolic regulatory pathways.

Dr. Vatsala Thirumalai

Neural Circuits and Development Laboratory, National Centre for Biological Sciences (NCBS), Bengaluru

Dr. Thirumalai's discovery has helped to improve our understanding of the mechanisms involved in the development of neural circuitry responsible for generating movement. Her research used zebrafish – a small freshwater fish native to South Asia – as the model organism to study neural development. A major advantage of using zebrafish is that their embryo and larvae are transparent, which makes it easy to observe internal organs. This allowed Thirumalai to closely study the brain of zebrafish, which helped to decipher the underlying mechanisms involved in neural development.

CHEMICAL SCIENCES

Dr. Jyotirmayee Dash

School of Chemical Sciences, Indian Association for the Cultivation of Science (IACS), Kolkata

Dr. Dash is the first Odia woman to be awarded this prestigious prize. Her major area of study is cancer. She has substantially contributed to the area chemical biology in order to better understand how nucleic acids, such as DNA and RNA, act as cancer targets. These studies have helped to find new molecular structures, specific to cancer, that could be targeted by potential anticancer drugs.

Dr. Subi Jacob George

New Chemistry Unit, Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bengaluru

Dr. George's area of research spans across several disciplines, including polymer chemistry, supramolecular chemistry and materials chemistry. His research touches upon both organic and inorganic chemistry. His studies provided proof-of-concept evidence that the growth and organization of polymeric structures can be modulated using molecular cues. His research group were able to control the length and dispersity of these polymers, which is a major breakthrough in supramolecular polymerization chemistry.

EARTH, ATMOSPHERE, OCEAN AND PLANETARY SCIENCES

Dr. Abhijit Mukherjee

Department of Geology and Geophysics, Indian Institute of Technology (IIT) Kharagpur

Dr. Mukherjee received the prize for developing strategies for the detection of potential sources of groundwater that could provide a safe and sustainable supply of drinking water for Indians. He used artificial intelligence (AI) technology to predict the availability of groundwater in various parts of the country. Dr. Mukherjee also developed a model for groundwater flow in the Gangetic delta of West Bengal. He also explored arsenic-safe aquifers at various points along the route of the Ganges river.

Dr. Suryendu Dutta

Department of Earth Sciences, IIT Bombay, Mumbai

Dr. Dutta received the prize for his innovations in the area of plant-derived organic chemicals, in particular, terpenoids, which are an important source of liquid hydrocarbons in areas where petroleum is excavated. Importantly, data on the presence of plant-derived hydrocarbons at fuel exploration sites in India is very scarce. This underscores the importance of the study.

His research on the evolutionary history of plant-derived terpenoids spans over a period of 300 million years, starting from the Permian Period and ending in the Eocene Epoch of the Paleogene Period. His findings suggest that the western part of India was once covered by dense rainforests that included trees belonging to the family *Dipterocarpaceae* that thrived in the tropical climate of the Indian subcontinent.

ENGINEERING SCIENCES

Dr. Amol Arvindrao Kulkarni

Chemical Engineering and Process Development Department, National Chemical Laboratory (NCL), Pune

Dr. Kulkarni received the prize for his innovations in designing microreactors and flow reactors. The microreactors have been instrumental in producing pharmaceutical compounds, various types of dyes, chemical constituents of perfumes, as well as nanoparticles. The flow reactors have been successful in converting complex batch processes into continuous processes, which are far more energy-efficient. Several of his flow reactors have been licensed for use by various industries in India.

Notably, Dr. Kulkarni is credited for establishing a microreactor lab, which is the first of its kind in India. Another important contribution is the development of the first scalable continuous process for nanowires made of silver.

Dr. Kinshuk Dasgupta

Materials Group, Bhabha Atomic Research Centre (BARC), Mumbai

Dr. Dasgupta received the prize for his groundbreaking work on carbon nanomaterials, including their synthesis and potential applications. He has utilized these nanomaterials to develop a new type of bulletproof jacket, nicknamed 'Bhabha Kavach', as it was developed at the 'Bhabha' Atomic Research Centre. This jacket is being used by the Indian Army. This indigenously developed bulletproof jacket consists of armored panels, made of boron carbide and carbon nanotubes, combined with a special type of polymer that gives it flexibility. This bulletproof jacket has been rigorously tested to assess its ability to confer protection against bullets. A major advantage of the 'Bhabha Kavach' over conventional bulletproof jackets is that it is much lighter, and therefore, more comfortable to wear in the battlefield. It is also much cheaper than conventional bulletproof jackets, which have to be imported, resulting in increased costs.

MATHEMATICAL SCIENCES

Dr. U.K. Anandavardhanan

Department of Mathematics, IIT Bombay, Mumbai

Dr. Anandavardhanan received the prize for his work in the area of Langlands program, which is named after Robert Langlands, the renowned American-Canadian mathematician. Anandavardhanan's research revolved around algebraic groups involved in number theory, in the context of Langlands program. He specifically focused on automorphic forms and representation theory.

Dr. Rajat Subhra Hazra

Theoretical Statistics and Mathematics Unit, Indian Statistical Institute (ISI), Kolkata

Dr. Hazra, who is an Associate Professor at ISI, received the prize for his work in the area of probability theory in the context of mathematical limits of semiflexible polymers. His research also encompasses the areas of random matrices, extreme value theory, regular variation, Gaussian free fields, branching random walks, and membrane models, among others.

MEDICAL SCIENCES

Dr. Bushra Ateeq

Department of Biological Sciences and Bioengineering, IIT Kanpur

Dr. Ateeq, an alumnus of Aligarh Muslim University, received the prize for her work on cancer biomarkers and the molecular mechanisms involved in the development of prostate and breast cancer. She is also trying to elucidate the genetic, as well as the epigenetic mutations that stimulate carcinogenesis and progression to metastatic spread throughout the body. Her eventual goal is to develop effective therapies targeting key molecular pathways involved in the pathogenesis of prostate and breast cancer.

Dr. Ritesh Agarwal

Department of Pulmonary Medicine, Postgraduate Institute of Medical Education and Research (PGIMER), Chandigarh

Dr. Agarwal received the prize for his research on allergic bronchopulmonary aspergillosis (ABPA), which is a fungal disease of the lungs that occurs due to hypersensitivity reactions against the surface antigens of the fungus *Aspergillus fumigatus*. His pioneering research, spanning over a decade, has investigated the pathogenesis, epidemiology, diagnostic approaches and therapeutic strategies against ABPA. Over the past several years, he has validated many existing diagnostic tests that are now used to diagnose ABPA across the globe. He has also made significant contributions in the area of ABPA therapy. He has developed protocols for standardization of the dosage of oral glucocorticoids and antifungal drugs for the treatment of ABPA.

PHYSICAL SCIENCES

Dr. Rajesh Ganapathy

International Centre for Materials Science, JNCASR, Bengaluru

Dr. Ganapathy received the prize for his exemplary research in the area of soft condensed matter physics. The major focus of his research is on glass-liquid transition. This investigates the transition of hard and brittle glass to a viscous and liquid state, brought about by exposure of the material to very high temperatures. This phenomenon presents one of the greatest challenges in modern condensed matter physics.

Dr. Surajit Dhara

School of Physics, University of Hyderabad, Hyderabad

Dr. Dhara received the prize for his outstanding work on colloidal physics. He has substantially contributed in the area of liquid crystal science and technology. Some of his exceptional contributions include the development of colloids and liquid crystal droplets using tunable microresonators and microlasers, as well as movement and controlled assembly, among others.

It is hoped that the seminal discoveries of the Bhatnagar awardees will go a long way towards strengthening the scientific base, promoting scientific temper and inspiring youngsters to pursue a career in science. □

Dr. Kaushik Bharati, PhD, MIPHA, FRSPH (London)
*Former Senior Program Officer
Translational Health Science and
Technology Institute (THSTI)
NCR Biotech Science Cluster, Faridabad,
Haryana, India*

International Webinar on Food and Nutrition vs COVID-19

The One-day International Webinar on 'Food and Nutrition vs COVID-19' was organized by Department of Food and Nutrition, Kalyani University, Kalyani, WB on 24th July 2020. In introductory remarks, Dr J. N. Bhakta, Coordinator of this webinar spoke about importance of self- health consciousness, knowing how to enhance immunity in ongoing 'new life' period and maintaining COVID-19 prevention protocol. As 1st speaker, Dr (Mrs) M. Dasgupta, Dietician at American Dietetic Association, Texas, USA spoke on 'Impact of diet and nutrition for general population and renal patients during COVID-19'. She discussed about eating more fresh fruits, legumes, lentils, bean, oats, unsaturated fat, canola oil and avoiding saturated fat, cookies, cakes, sweetened yogurt drinks, processed meat to fight COVID-19; focusing on foods rich in Vit-D like marine fishes tuna, mackerel, salmon and Vit-E (egg yolk, sunflower and soyabean oil); eating less salt and sugar and no eating out. Each patient must maintain good nutritional status; oral zinc supplementation reduces incidence rate of acute respiratory infection by 35%, increases rate of recovery. People with kidney disease especially dialysis and post-transplant patients are at high risk to severe cases of COVID-19, it is causing acute kidney injuries and kidney failure to 25% of patients. In

some COVID-19 patients, complications like fluid and toxin build-up in blood were observed. Dr Dasgupta developed need assessment tools at her clinic for each patient focusing on COVID-19 to identify risk areas and establish interventions for each. She educates patients on renal-friendly food sources and those rich in protein, zinc, Vit-A and C, viz., meat, shellfish, beans, whole grains, carrots, broccoli, cauliflower, cabbage, fortified breakfast cereals.

Dr (Ms) R. Roy Chowdhury from Reshmi's Wellness, Kolkata spoke on 'New normal food and nutrition' as 2nd speaker. She mentioned that 70% of body immunity required to fight COVID-19 is produced from diet and rest through exercise and physical activity; advised eating more brinjal, pumpkin, papaya, water melon, carrots having antioxidant properties; intaking 3lit water, 400gm fibre, 200gm fruits, not more than one tea-spoon salt and 6gm sugar /adult/day; avoiding baked foods and overeating; controlling BMR and blood parameters including cholesterol; keeping protein level high in body; washing raw vegetables, fruits and fishes with vinegar @ 2 tea-spoon/2lit water before use; black cumin powder and smell of garlic paste having anti-viral effect; cooking veg and non-veg items in sunflower/soyabean and mustard oils respectively; vegetable *chacchori, sukto, chhenchki* as immunity boosters (3-4 *bati*/adult/day). Dr Roy Chowdhury emphasized on proper sleep cycle; handling cooked and uncooked foods separately; eating more citrus fruits, yogurt as probiotic, spinach, turmeric and ginger; maintaining proper timings daily for breakfast, lunch and dinner.

As 3rd speaker, Dr. S. Ray at Dept of Systems Pharmacology and Translational Therapeutics, University of Pennsylvania, USA spoke on 'COVID-19 management: need to understand how our circadian clock is tickling in terms of immunity, metabolism and nutrition'. Dr. Ray discussed about how aberration of healthy circadian clock of ours lead to cardiovascular and infectious diseases, risk of cancer and diabetes-II; possible interplays between circadian clocks and SARS-CoV-2 infection; maintenance of immunity clock, metabolic clock in proper fashion to prevent infection; susceptibility to influenza and herpes infection in early morning when our immune system is not very strong; dosing time of medicines to improve their action; morning vaccination (Vacc) against influenza H1N1A and -B enhances Ab responses over afternoon Vacc as time of day influences magnitude of Ab response generated in our body post-Vacc; importance of early time-restricted feeding; druggable host factors that interact with SARS-CoV-2 proteins; effects of chrononutrition (meal timing and

dietary components) on circadian rhythmicity. Dr. Ray mentioned that our immune system and metabolic activity show robust 24-hours rhythm and boosting circadian host factors is additional mechanism to manage COVID-19 as disruption of our circadian timekeeping favours rapid virus replication. Circadian rhythms should be considered when designing and dosing candidate drugs and Vacc against SARS-CoV-2 and it is important to eat within 8- to 10-hour window of time each day and boost our body clock and health.

Dr S. Chatterjee, Sr. Scientist at CSIR-Indian Institute of Chemical Biology, Kolkata was 4th speaker who spoke on 'Immunological interpretations of COVID-19'. Emphasizing on COVID-19 as virus-triggered inflammatory disorder, he stated that hyperinflammation is main causal factor of its pathogenesis, which disrupts body immunity and not SARS-CoV-2. He explained viral infection (Stage-I), progression (St-II; very less involvement of virus) and inflammation & disease sensitivity stages (St-III; virus doing nothing, inflammatory process triggered, inflammatory cytokines secreted by macrophages and immune cells) of COVID-19; blocking of protective immunity by hyper-inflammatory stage with patients in critical situation; immune dysregulation due to acute inflammation, cytokine storm (Cs), acute lung injury, multi-organ failure; defective T-cell response and disease severity in COVID-19. He compared levels of B-cell frequency, Cs, blood lymphocyte %, immunosuppression and effector CD4⁺ (including T-follicular helper cell) and CD8⁺ T-cell responses in mild and severe diseases upon SARS-CoV-2 infection; magnitude of early innate immune and virus-specific adaptive immune responses generated with progress of days after infection; function of four subsets of CD4⁺ T-cell; magnitudes of SARS-CoV-2 RNA and antigen, specific IgA, IgG and IgM produced in incubation (asymptomatic stage), disease and convalescence periods.

Type-I interferon controls viral diseases in early phase but Dr Chatterjee observed diminished Type-I INF mediated signaling and anti-viral response in SARS-CoV-2. Finally he described plasma collection from recovered patients and delivering into newly-infected ones, presence of neutralizing high-titre anti-SARS-CoV-2 Ab in it and hoped that our improved understanding of convalescent plasma will be valuable for controlling pandemics in future. □

Subrato Ghosh
122/IV, Monohar Pukur Road,
Kolkata - 700026
Email: subratoffa@gmail.com

Expert Consultation Webinar on Role of Women in Environmental Sustainability

The ENVIS Resource Partner of ICMR-National Institute of Occupational Health, Ahmedabad organized an Expert Consultation Webinar on Role of Women in Environmental Sustainability on 28/7/2020. As 1st eminent speaker in this programme, Dr (Mrs) A. Kapley, Principal Scientist, CSIR-NEERI, Nagpur spoke on 'Developing leadership roles in women: environmental sustainability'. She discussed about environment (Env), economy and social as pillars of sustainability; responsible interaction with Env needed to avoid depletion of natural resources and allow long-term Env sustainability (ES); avoiding excess pollution, protecting health ecosystems, targeting welfare not GDP, shifting to renewable resources as facets of ES and women to be included under its pillars and goals. According to Dr Kapley, women play critical role in decision-making processes at household level, manage natural resources on family & community levels and are most-affected by Env degradation. They earn 50-66% of what men earn, are more exposed to indoor air pollution and more likely to die than men during disasters. These inequalities to be understood; ensure women's effective participation and equal opportunities for leadership at all decision-making levels; enhance use of information and communication tech to promote their empowerment; adopt and strengthen policies and enforceable legislation for promotion of gender equality. She discussed about features of Chandi P. Bhatt-led Chipko movement, Green Belt movement by W. Maathai in Kenya, works of Greta Thunberg, of May Boeve against climate change, movement by Gambian activist I. Ceesay, importance of creating possibility for participation of women in India in Env management in scientists groups and unorganized community groups as partners in Government.

Prof. (Mrs) S. Singh from Maharana Pratap University of Agriculture and Technology, Udaipur spoke on 'Role of Indian agricultural women in environment conservation'. She informed that women make up 33 and 47% of cultivators and agricultural labourers respectively in India; 84% of rural women depend on agriculture for livelihood, have active and extensive involvement in livestock production, fish processing and forest resource use; their work as field operations in crop production, agro-processing activities, tea plucking, lac cultivation, tobacco leaf harvesting, animal upkeeping and dairy activities. She discussed about women having skills for natural resource management, sensitiveness towards Env; have high ecological consciousness and manages natural resources

better; impact of Env degradation and climate change on women; promoting agri-preneurship, microenterprises, integrated and organic farming, smart horticulture; ITKs held by women farmers must be scientifically validated and their role as decision makers, planners and advisors related to Env management should be increased. In the end, Prof. Singh discussed about women as champions of Env conservation and restoration, *viz.*, movement led by Amrita Devi Bishnoi in Khejarli village, Rajasthan (1730); Chipko movement in Uttarakhand (1973); Appiko movement in Karnataka (1983); Silent valley movement in Kerala (1976); Narmada Bachhao Aandolan (1985); Navdanya movement (1984); Uttarakhand Nadi Bachhao Aviyani (2008); Deccan Development Society in Telangana (1983); works of conservationists Seed mother Rahibai and Salumarada Thimakka, Solar Mamas in Jaipur, 700nos Jal Saheli in Bundelkhand (2005); women as protectors of *Jal, Jangal* and *Jamin*.

Dr (Mrs) S. Vardhan, Deputy Director, Centre for Disease Control, New Delhi spoke on 'Psycho-physiological challenges and sustaining health of women in agriculture and allied fields'. She discussed about women-specific challenges (WSC) in agriculture, *viz.*, increase in workload at workplace and household due to male out-migration, less access to ownership of land, training on new technologies, agriculture resources & modern inputs; facets of WSC in sustaining health (discrimination for seeking healthcare and for nutrition, gender violence and abuse, etc); psycho-physiological challenges *viz.*, long irregular working hours, mental anxiety, depression, hypertension, gender-based work and wage discrimination, insecurity & poor inter-personal relationships, etc; protecting women health against risk factors, means of avoiding injuries and extreme weather events, zoonotic and vector-borne diseases; mental health response strategies provided through Ayushman Bharat Health & Wellness Centres, psycho-social support and mental health services in disasters; useful measures to manage stress.

As the 4th speaker, Dr (Mrs) L. Joseph, Quality Manager, Christian Medical College, Vellore spoke on 'Women in healthcare: challenges and opportunities'. She discussed about strength, resilience and care exhibited by women in Indian healthcare system; 240 lakh of the 285 lakh nurses and midwives globally are women and are 70% of global health workforce; underutilized potential of women in health undermines the contribution they could make to effective leadership for health systems. Dr Joseph mentioned that gender bias (as a challenge) impacts negatively on women and psychologically lowering their

self-confidence and work performance. Strong measures taken to protect women employees from gender harassments. Occupational health hazards are a major challenge of healthcare workers which is particularly true during COVID-19 pandemic situation. Women face unbalanced family and work responsibilities, exposed to blood-borne and air-borne infections from patients. Other challenges include extended work hours, limited representation at higher levels and child bearing, *i.e.*, no ideal time for a woman healthcare worker to have a child. As 'In middle of difficulty lies opportunity', she said that women excel at soft skills needed for healthcare leadership. They find opportunities aligned with their passions; feel better career prospects compared to women in other professions. Dr J. Majumdar, ENVIS Coordinator, ICMR-NIOH anchored this programme. □

Subrato Ghosh
122/IV, Monohar Pukur Road,
Kolkata – 700026
Email: subratoffa@gmail.com

RNA Virus Invasion Strategies: COVID-19 the New Challenge

The 3-days International Virtual Workshop on 'COVID-19: RT-PCR Diagnostics and Therapeutics' was presented by DST PURSE-II, Kalyani University, West Bengal in association with COVID-19 Testing Laboratory, CoM-Jawaharlal Nehru Memorial Hospital, Kalyani during August 5-7, 2020. In this programme, Prof. S. Das, Director, National Institute of Biomedical Genomics and Professor of Microbiology and Cell Biology, Indian Institute of Science, Bangalore presented the Keynote Lecture on 'RNA virus invasion strategies: COVID-19 the new challenge'.

Dr Das mentioned that we are learning particularly from notorious RNA viruses in harder way. He discussed about making RNA from RNA using RdRP that we learnt from different viruses; they are difficult to handle due to high mutation rate and lack of proof reading in RdRP and absence of exonuclease activity; principle in usage of drugs Remdesivir, Ribavirin is that they cross mutation threshold (tolerability) level and virus cannot survive; virus vaccines are changed and designed appropriately every year to be effective after analyzing virus strain (due to frequent mutation). He highlighted his efforts in preparing Hepatitis-C vaccine using genotype 3A and virus-like particle (VLP); surface protein when injected into mice produce antibodies (Abs) that can neutralize cell culture strain. Immunogenicity

testing was done in pigs with VLP and DNA vaccine for eliciting humoral and cell-mediated immunity respectively. RNA viruses mutate in 4 strategies, *i.e.*, reassortment, genetic drift (as evolution of Dengue serotypes), antigenic shift causing change in virus antigenicity and recombination (Orthomyxoviruses interchanging their genetic material). Newly produced virus with different surface protein as antigen can escape vaccine challenge.

Dr Das discussed about how viruses get away and survive happily in host hijacking host factors (HF)/cellular machinery, importance of understanding viral and host proteins in viral replication complexes when dealing with new viruses. Every virus uses different HF in RNA replication helping them in tissue tropism, presence of HF in a particular organ will help them to replicate effectively, productive RNA virus infection depends upon it. Dr Das is studying how virus manipulates HF and exploits it. In polio virus, viral RNA (uncapped RNA) shuts down host cell protein synthesis but can synthesize its own protein. He further discussed about RNA scaffold, internal ribosome entry site and how viruses bypass lot of requirements of HF and begin transcription; La protein moving out of infected cells help Hep-C viral RNA translation, replication and protein making. In targeting viruses to be advantageous to us, protein synthesis can be made translational from translation. Viral RNA translation of Hep-C can be inhibited without affecting the host. Small peptide from La protein can go inside liver cells and knock down the virus, monoclonal Abs from persons who recovered from Hep-C infection can be used to inhibit virus replication. In this context, natural plant-based compounds (molecules) can be hepatoprotective, inhibit viral protease and research is being done to make a stable derivative commercially, Dr Das stated.

He mentioned that SARS-CoV-2 does not have active adaptive immune response in population. It shuts down IFN secretory pathway thereby outcoming innate immune response. Late immunity is weakened in infected cells and thus can get away. While explaining life cycle of Coronavirus, he emphasized on formation of polyprotein 1A and polyprotein 2nd part, four structural proteins helping in RNA encasing, antigenic shift in ligand and receptor of SARS-CoV-2, mutation happening in intermediate host and is ready to infect human host, mice ACE-2 receptor different from human; also discussed about transmission cycle and interspecies transfer of SARS-CoV-2; beginning of its pandemicity in Wuhan, China; need to identify host genetic polymorphism that either confers susceptibility or protective from RNA virus; difference in sequence between SARS-CoV (2003) and SARS-CoV-2 (2019) and generation of Stem

Loop 4prime in latter. Five key amino acids are actually mutated in receptor-binding domain and are consistent in pangolin-CoV-2 and human SARS-CoV-2. He also informed that out of multiple lineages of SARS-CoV-2, A2a predominant haplotype with D614G mutation (centre of haplotype's transmissibility/virulence) has emerged in almost all regions in India by June 2020, which is associated with enhanced transmission efficiency.

Finally Dr Das stated that ongoing Consortium research on analysis of several SARS-CoV-2 virus mutations collected from all over India will be useful in vaccine design and effective in diagnostic strategies. Knowledge we are gaining now must be translated for our future preparedness to overcome future pandemics. With advancement of knowledge and technology, we should prepare ourselves collectively to handle menace from RNA viruses in future, which must not overpower us. Researchers should get updated and be aware of new technologies and practice it in real life, which will be real learning. □

Subrato Ghosh
122/IV, Monohar Pukur Road,
Kolkata – 700026
Email: subratoffa@gmail.com

International Webinar on Chemical and Clinical Prelude in Pandemic Situation

The one-day International Webinar on Chemical and Clinical Prelude in Pandemic Situation was organized by Department of Chemistry, Barasat Government College, North 24 Parganas, West Bengal in collaboration with IQA Cell of this college on 18th July 2020. Dr P. Dutta, Associate Professor in Chemistry at Ananda Mohan College, Kolkata was the first invited speaker. Dr Dutta compared title of this webinar with A Black Hole Title Song, which seems and sounds uncertain and ambiguous as like the present escalating pandemic time. We are full of uncertainties and questions arise in our mind like 'When will it end?' As learning from COVID-19, according to Dr Dutta, we can explore how one can learn more effectively in this pandemic situation. He focused on 'Learning itself' and 'Learning can be fun'. He lucidly explained different features with examples, *viz.*, solving puzzles for learning purpose, recognizing a false question, generalization from pattern, thinking out of box (going out of normal thinking), learning from mistakes, understanding illusions (visual illusions and audio illusions), resolving paradoxes, unlearning for proper learning, made visual and funny game.

As the second invited speaker, Dr. S. Bandyopadhyay, Speciality Doctor in Geriatrics, Surrey and Sussex Healthcare, National Health Services (NHS) Trust, London stated that there is lot to learn from success and failure of different medical systems in different countries. He discussed about technological advances foundation of modern medicine and evidenced-based medicine; we are experienced in managing Swine flu and influenza pandemics but nothing known earlier about Coronavirus twelve months ago; asymptomatic superspreaders as peculiarity of SARS-CoV-2; 'Test and track: isolate and support' as an approach of COVID-19 treatment; arrangements made at NHS for its treatment; non-suspected COVID-19 patients becoming symptomatic (even doctors); his experiences on struggling to maintain social distancing with patients with 2mt distance; lack of transparency leading to erosion of trust; accountability in making decisions; decisive leadership is vital as in New Zealand, Japan, Finland and moving at right time; importance of global cooperation to fight against pandemic.

Dr Bandyopadhyay further discussed about maintaining social distancing, staying at home, 'Do not go out unless you have to'; evidence-based medicine may delay our response to COVID-19; importance of lockdown as there is good evidence about difference in infection rate before and after lockdown; clothed mask for everyone; entry of SARS-CoV-2 through human mucous membrane and use of mask, gloves and eye glasses is very important to protect oneself; use of eyeglasses even while going out at night; lockdown as a correct policy to 'flatten the curve'; discarding all clothes for washing after returning back home and use of showering gel; the virus has greater chance of infecting in poorly-ventilated places in homes; it cannot be ruled out that SARS-CoV-2 is airborne. According to Dr Bandyopadhyay, we must check alcohol content of hand sanitizers (which must be $\leq 90\%$ to be effective) and oxygen saturation level does not reduce when one wears mask ('happy hypoxia' situation). It is better not to reuse three-layered surgical masks; the clothed masks can be washed and reused. He explained conditions of COVID-19 patients with pneumonia; swab test for reverse transcriptase PCR testing and possibility of false negative result in few cases; possibility of 1-2% false positive result in antibody-based testing; Dexamethasone as part of recovery trial and its 6mg dose to severe COVID-19 patients kept in ventilation, which checks in maturing immune response or 'Cytokine Storm'; the antiviral Remdicitvir as RNA polymerase inhibitor is not much effective in mild to moderate patients; convalescent plasma is a safe treatment; having enough Vitamin-D level in human body is a potential tool in

COVID-19 prevention.

Dr Bandyopadhyay mentioned that a COVID-19 vaccine is preliminary prepared for Ph-I, II and III trials, then will be manufactured and available in market after satisfying quality control aspects. He mentioned that first Chinese vaccine is now moving into Ph-III trial in Brazil, 2nd vaccine CanSino approved for Chinese military trial, the Oxford University vaccine completed Ph-I trial in UK, the mRNA vaccine Moderna of USA is promising, Bharat Biotech vaccine moving into Ph-I trial, Russian vaccine completed Ph-I trial on July 15, 2020. There is still no vaccine for Coronavirus diseases SARS and MERS. He emphasized on WHO-sponsored Epi-Brain as warning system to prevent future infection storm; need for development of artificial intelligence system; internet-based health care system where people can be monitored through machines from home; removing health inequality and making health care more affordable and cheaper; aiming for safer, cleaner and healthier life on planet earth. Old aged persons must take sufficient and proper food avoiding weight loss in this situation. Antibody levels tend to disappear from blood after three months of COVID-19 infection and thus the person may be prone to reinfection. We must respect SARS-CoV-2, continue to take all precautions even after recovery from COVID-19. □

*Subrato Ghosh
122/IV, Monohar Pukur Road,
Kolkata – 700026
Email: subratoffa@gmail.com*

Science, Biology and the World's Future

Department of Botany, Dinabandhu Andrews College, Kolkata and IQAC of this College organized an International Webinar on 25/8/2020 where Prof. Bruce Alberts, Chancellor's Leadership Chair in Biochemistry and Biophysics for Science and Education, University of California at San Francisco spoke on 'Science, Biology and the World's Future'. He was one of the original authors of influential, best-selling and pathfinder book 'Molecular Biology of the Cell' and was awarded US National Medal of Science in 2014 for his intellectual leadership, experimental innovation in the field of DNA replication and for unparalleled dedication to improving science education (SE) and promoting science-based public policy.

Prof. Alberts spoke about how we can make science more productive and collaborative in virtual meetings on Zoom platform; fundamental research on biological

mechanisms, molecular details of DNA replication and DNA repair pathways and underlying knowledge will be essential for improving human health, agriculture and in other applied fields; explorations on living cell biology to be done for better understanding. He was called by Nobel Laureate biologist Prof. J. D. Watson in early 1978 to join him as author of afore-mentioned new text book, whose 1st edition was published in 1983. He described protein machines (PM) that undergo ordered movements driven by proteins in the set that harness energy of ATP/GTP hydrolysis; recent breakthrough on description of reconstitution of budding yeast (eukaryotic) DNA replication initiation with 16 purified replication factors, made from 42 polypeptides; analysis of every individual person's tumour occurring by chance process of mutation, selective killing of tumour cells *via* PAR polymerase inhibitors and potential in exploiting each particular defect to eradicate a cancer (FDA-approved personalized medicine), need to understand the DNA repair or recombination process exactly causing hypermutability that is selected for by tumour progression.

According to him, it is a challenge for next generation biochemists to obtain information needed to accurately describe mechanism of every type of PM in a cell. Detailed chemistry of each machine can be deciphered *in vitro via* reconstitution of many hundreds of PM. Extensive sets of RNA scaffolds (long non-coding RNAs) and scaffold proteins produce biochemical sub-compartments in a cell without requiring a membrane and form different biochemical factories inside cell. They make cell chemistry very efficient and everything organized within. It is a new knowledge, so also is the 1994 research on presence of transcription and replication factories in stained cell nucleus while making RNA molecules and DNA replication respectively. As a result of complexities (like different filament dynamic molecules in actin-binding protein), life reflects the emergent properties that result from very complex networks of interactions. New quantitative methods like computer modeling and more biochemistry in purified systems needed to analyze and understand complexities of life's chemistry. We have to learn how cells work together and maintain tissues in *Drosophila* fruitfly; its brain with only 10⁵ neurons can be a foundation for better learning of human brain and consciousness. We have to understand most of functions of 29 proteins of new model organism SARS-CoV-2; understanding the fundamental biology of this single virus will lead to many new understandings of crucial importance to future of human health. Presently we understand only little about SARS-CoV-2 proteins which targets our immune mechanism and evolved ways to manipulate it, in order to help the virus

escape. More knowledge gained can be exploited to make effective drugs.

Prof. Alberts has experienced that India has a lot to teach the world about spreading science. He discussed about power of science application and Indian scientists in improving lives and livelihood of even underprivileged part of society, his conversation with Prof. M. S. Swaminathan and Village Knowledge Workers in Information Villages at Pondicherry, efforts of MSSRF in connecting scientists by wireless internet to women in groups of farming villages, supplying knowledge about farming practices, people can hold up their diseased crop plants on computer screen and get help from scientists, funding mechanism to women SHGs by MSSRF, possibility of groups of women making a business by making bio-pesticides with *Trichogramma* sp. He also spoke about Science for All, introduction and prioritization on the word 'scientific temper' (ST) by Pandit Jawaharlal Nehru during 1950s, spreading of ST throughout society will be essential and that requires a change and redefinition in SE, means by which major ITs and universities spreading science throughout India, vision for inquiry-based SE, formation of Young Academies as a critical tool for strengthening science both in each nation and across the globe. Best way to really improve humanity is advancement of fundamental knowledge that will improve our health, environment and food production. Prof. Alberts ended by saying that challenges ahead for scientists are enormous in creating a ST for the world but we shall find a way by working together across the globe. □

Subrato Ghosh
122/IV, Monohar Pukur Road,
Kolkata – 700026
Email: subratoffa@gmail.com

Evolution and Spread of SARS-CoV-2

The Bilateral INDO-US Webinar on COVID Biology was organized by Indian Institute of Science Education and Research, Kolkata in collaboration with Indian Institute of Science, Bangalore; University of Pennsylvania and University of Colorado School of Medicine during August 16-19, 2020. As one of the distinguished speakers in this Webinar, in Session-1 on first day, Prof. P. P. Majumder, eminent scientist and Founding Director, National Institute of Biomedical Genomics and President, Indian Academy of Sciences, Bangalore spoke on the topic 'Going viral: Evolution and spread of SARS-CoV-2'. The phrase 'going

viral' is brought about by the virus as it is spreading very fast.

Dr Majumder mentioned that 30000 nucleotides of SARS-CoV-2 are wrapped in protein coat which is essentially lipid, that is why we wash our hands often so that it breaks down the lipid layer and exposes the RNA sequence which is not so stable and thus virus dies. SARS-CoV-2 proteins are ready to be translated just like mRNA, it can manufacture its proteins very fast and can hijack host cell machinery much more efficiently to reproduce. Coronavirus from bats was sequenced, its comparison was made with human SARS-CoV-2 isolated from individual working in seafood market in Wuhan in December 2019 - two sequences found to be identical to 97%. Coronavirus was isolated from lungs of two dead pangolins 200km away from Wuhan, it was identical to both bat and human Coronavirus and this virus most likely came into human from bats *via* pangolin. It is usually handled in seafood market in Wuhan. As Coronavirus was spreading rapidly to other parts of world, it was diversifying the original virus found in Wuhan and also accumulated mutations (though not so much), which resulted in diversity of the virus. Prof. Majumder studied on phylodynamic analysis of Coronavirus; identifying dynamic evolution of it together rooting it with original ancestral Coronavirus of China, which is the 'O' subtype. After sequencing lots of Coronavirus isolates, 11 different subtypes of it were observed by March 2020. Explaining the term 'subtype', he said that it was tried to find out whether there are certain subsets of RNA sequences which are more similar to each other in contrast to RNA sequences that belong to different subsets. These RNA sequences could be grouped into 11 different clusters.

Initially 5-6 subtypes were spreading to different geographical regions of world but the A2A subtype was found to dominate almost throughout the world and out-compete others within a month. Prof. Majumder tried to find out the kind of Darwinian selective advantage of it. One of the key mutations of A2A subtype was D614G, amino acid change very close to spike protein. While explaining features of attacking and cracking host cell membrane by SARS-CoV-2, he said that ACE-2 is expressed in plenty in cell surface of lungs (type-2 pneumocytes) with which spike protein can anchor very well. Change from aspartic acid to glycine in A2A subtype/mutant enables it to anchor far better to host cells that express ACE-2. Human ACE-2 gene has certain kind of mutations that enables some virus subtypes (like A2A) to anchor better. This gene does have many mutations but mutation across human populations is very rare (non-polymorphic

mutations), Prof. Majumder stated. Human gut enterocytes also express ACE-2 in large quantity, so 30% of COVID-19 patients found to get diarrhea as clinical symptom. This virus infects when uninfected people does not have appropriate immune repertoire to ward off SARS-CoV-2. Vaccine as surrogate of original virus elicits immune response/immunity in body similar to natural infection; we can get immunity only after getting infected as SARS-CoV-2 vaccine is absent right now.

Prof. Majumder also mentioned that getting infection is in some way good as population/community immunity is raised and virus will die its natural death. For the spike protein to work, cleavage must take place between its S1 and S2 domains and virus can crack open cell membrane. It is done by human protein TMPRSS-2. He explained that unlike in Europe, USA and most parts of world, A2A subtype could not be dominant in east and south Asia where other subtypes were also high in prevalence. According to him, both TMPRSS-2 gene and MX-1 gene, located close to each other and oriented in opposite direction, have genic region or controlling set of nucleotides and mutations were observed in that particular genic region that have huge differences between the Caucasians and non-Caucasians. Huge allele frequency differences for these particular mutations or polymorphisms that lie in between these two genes controls both of them. Inability of A2A D614G mutant to establish itself as dominant in east and south Asia is most likely because host genomic polymorphism that controls cleavage of the particular site between afore-mentioned two domains. Once cleavage occurs, spike protein become functional and enables SARS-CoV-2 to enter into host cell. In addition to SARS-CoV-2 subtype and entry of SARS-CoV-2 into cell cytoplasm, Prof. Majumder in his talk elaborated on other concepts/terms like positively stranded RNA virus, tracing Coronavirus back to bats, two sequences identical to 97%, mutation at amino acid position number 614, concepts $R_0 = 3$, $R_0 = 1$ and $R_0 < 1$, SARS-CoV-2 as 'kind' virus. □

Subrato Ghosh
122/IV, Monohar Pukur Road,
Kolkata - 700026
Email: subratoffa@gmail.com

Brown Manuring: A Novel Practice for Weed Management in Maize

Brown manuring (BM) is a practice of growing *Sesbania bispinosa* / *Croialaria juncea* as co-culture with a

crop for a short period of 25-30 days after sowing (DAS), and then killing by the application of post-emergence herbicides selective to the crop of prime interest. In addition to weed management, BM offers multiple benefits such as improving organic matter, C and N reserves, and soil physical and biological properties. A BM option, *Sesbania* + *Crotalaria* (12.5 + 12.5 kg/ha) mixture applied with 2, 4-D at 25 DAS resulted in 65.4% higher grain yield (5.8 t/ha) over the unweeded control (3.5 t/ha) with a reduction of 86.2% in weed density (at 60 DAS), thus, giving a net return of 48,900 Rs/ha. Besides, it resulted in production of 1.69 t/ha brown manure biomass and addition of 52.6 kg N/ha into soil. Therefore, a combination of 1 : 1 mixture of *S. bispinosa* and *C. juncea* (12.5 + 12.5 kg/ha) and 2,4-D applied at 25 DAS would be an effective weed management practice in maize for higher productivity and profitability. □

*Adapted from IARI News,
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Mechanisms of Odour and Chemo- Sensation by the Plant and Insect-Parasitic Nematodes

Nematodes locate their hosts in soil by sensing the chemicals emitted/ secreted by plants. The expression of nematode genes involved in odour sensing was investigated and characterised in the entomopathogenic nematode *Heterorhabditis bacteriophora*. The fluorescence in-situ hybridisation assays revealed that *Hb-odr-2mRNA* expression was localised at the nerve ring region while that of *Hb-odr-3* in the pharyngo-intestinal valve and anterior esophageal region of the IJs. This is the second such investigation on the characterisation of *odr* genes in a parasitic nematode in world. □

*Adapted from IARI News,
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New Yellow Mutant Variety of Chrysanthemum

Irradiation with gamma rays (10, 15 and 20 Gy) of 14 cultivars viz. Star Yellow, Star White, Pusa Anmol (yellow), Pusa Kesari, Vjay Kiran, Himanshu, Pusa Sona, Sadbhavana, White Prolific, Ajay, Datymed, Mother Teresa and Liliput were done with 30 uniform rooted cutting for each treatment during August 2017.

A yellow coloured mutant of white coloured spray type cultivar Himanshu have been identified and developed after irradiation of 15 Gy. This identified plant attains similar attributes of their parent except having yellow colour and best suited for pot cultivation. □

*Adapted from IARI News,
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Men's best friend is a friend in need

Scientists at the University of Adelaide in Australia are training dogs to detect coronavirus to detect coronavirus affected persons by sniffing sweat. The research is part of an international effort to train sniffer dogs to rapidly screen people for COVID-19. The name of the dog under training in Australia is Floki. The trick in training the dog to detect the correct sample is through the reward given the canine by allowing to play with his favourite toy when they pick a sweat sample from someone infected with the disease out of a lined up subjects. Preliminary studies show that dogs trained in this way are able to identify people who are infected with the coronavirus before they develop symptoms. A pilot scheme involving 4 sniffer dogs at Helsinki airport indicated that dogs can detect the presence of the virus in less than 10 seconds with nearly 100% accuracy. □

*S.C. Roy
From Nature Briefing and The Times of India*