

# **SECURING CYBER SPACE**

With our digital life becoming as seminal as the physical one, cyber security assumes unprecedented importance, highlighting the need for upgrading our laws as also enhancing common public awareness to deal with sophisticated cyber crimes









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# What's Inside



# **18** WHY WE NEED TO PROTECT OUR DIGITAL LIVES

#### 6 Nobel Prize 2023

This winners of the Nobel Prize in science disciplines push the frontiers of knowledge with their pathbreaking works

#### 8 Getting a Grip on Air Pollution in Delhi

It's the annual season of 'very poor quality' air in Delhi-NCR but are our measures to tackle it enough?

#### 11 Tribute: Dr MS Swaminathan

Remembering the Father of Green Revolution in India, Dr Swaminathan, who passed away on September 28

#### 15 World Food Day: A Toast to Millets

The importance of high-on-health, low cost and environment friendly millets can never be overemphasised

#### 24 Who Was Dr Narayan Chandra Rana?

Focusing on the life of a genius astrophysicist of humble origins, who faded into oblivion due to early death

#### 28 Recap: India's COVID-19 Vaccine Story

The worst ever pandemic is behind us but we look back to celebrate the efficacy with which India handled the crisis

#### 32 Spotlight: Cheruvayal K Raman

An enterprising rice cultivator in Kerala is preserving indigenous and superior rice varieties through his ingenuity

#### 35 Science & Spirituality

The science behind the spiritual power of OM that has been acknowledged and utilised in India for centuries

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OCTOBER, 2023 | Soi SCIENCE INDIA | 3

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#### CSIR-IICT @csiriict iet SpokespersonNavy .... @indiannavy Happy to share the recent work of Dr @IN\_HQENC units recovered the crew module - path paved by extensive planning, training of Naval divers, formulation of SOPs and joint Arindam Chakrabarty and group on "Cellulose communication by combined teams of #IndianNavy & #ISRO. Nanofiber-incorporated High-Solid Siloxane .@IN\_HQSNC Acrylic Latex by Mini-emulsion Polymerization for Hydrophobic Coating and Wood Adhesive". #Gaganyaan DOI: doi.org/10.1002/pat.61... @CSIR\_IND @dgcsirIndia @AcSIR\_India Dr Jitendra Singh 🚭 8 @DrlitendraSir Kudos #ISRO, for successfully accomplishing maiden Test Vehicle Flight #WATCH | Bhavnagar, Gujarat: On heart attack cases during the Garba TV-D1. festival, Union Health Minister Mansukh Mandaviya says, "ICMR has This is the first step in the last leg of journey towards India's Crewed done a detailed study recently. The study says that those who have had Human Spacecraft mission #Gaganyaan. In the enabling milieu provided severe covid and enough amount of time has not passed, should avoid by PM Sh @narendra odi, @ISRO achieving one 1/2 overexertion, and overwork out, running or over-exercising for at least a year or two, to avoid heart attacks." (29.10) Dr Jitendra Singh 🔮 success after the other...and the next important one is the #Gaganyaan. ۰ 2/2 CSIR-NCL's Cell Systems for Stationary and Encimone details of the

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# Let's Connect

#### Dear Readers,

The auspicious times of festivities continue across the country and *Science India* takes this opportunity to wish its esteemed readers good wishes on all the major and minor festivals that fall this month — from Navratri and Durga Puja to Dusshera and Vijaya Dashami.

It's a time for euphoria, indeed, with a major part of the population in the country also relishing the ongoing ICC Men's Cricket World Cup 2023, following not only the home team's fortunes but also those of a few other favourites from a total of 10 sides in the fray.

However, enjoying in total abandon has its own pitfalls and one can lose, not just one's senses but also material valuables in the melee of celebrations. While remaining in total control of one's sanity is the key to keeping safe, in the digital age, that is not enough, as many of us are realising gradually, much to our chagrin. We are increasingly becoming aware of terms — phishing, vishing, spamming, phreaking — that have flummoxed us, robbed us of our digital identity or assets, and forced us to rethink on how to keep ourselves safe. A physical lock-and-key has ceased to be enough.

As October is globally observed as the Cyber Security Awareness month, *Science India* presents a comprehensive analysis of what, indeed, is cyber security, through this edition's cover story, and why we can remain oblivious of it at our own peril. Internet, as the authors of our cover story deduce, is as important as air, water and food and it is impossible to imagine our lives without Internet in it. Its importance gets underscored when we realise that India has the second largest population in the world that uses the Internet, at 692 million or 69.2 crore people, second only to China and almost double that of the United States.

While still on taking care of ourselves, here's another toast to millets, in honour of the World Food Day that is observed on October 16 annually. The bouquet of numerous varieties of small-seeded cereals for long provided nutritious, ecologically-friendly food to millions but in the past few centuries, got overshadowed by the fancy wheat, rice, and to some extent corn. Thanks to India's pioneering efforts, the power of millets in providing wholesome yet low-cost food to the world is being rediscovered. *Science India* presents a zillion reasons on why more and more millets should be incorporated in our daily diet.

Another level which we need to take urgent steps on, lest we lose our valuable years of life, is the quality of air we breathe. It is especially important for people living in Delhi-NCR, which will soon enter its annual phase of 'very poor quality air', irretrievably affecting people's health and hiving off quality from their lives, and even affecting lifespan.

The edition carries a host of other interesting stories, such as a heart-felt tribute to Dr MS Swaminathan, the Father of Green Revolution in India; spotlight on the Padma Shri rice cultivator Cheruvayal K Raman; remembering the forgotten astrophysicist Narayan Chandra Rana; and several other regular features.

As the earth turns towards the last lap of this year and the season changes, we hope that *Science India* has been able to satisfy the essential reading requirements of its readers across a range of topics.

Hope you all enjoy reading this edition till we meet again next month.

India has the second largest population in the world that uses the Internet, at 692 million or 69.2 crore people, second only to China and almost double that of USA



# Nobel Prize 2023 New Frontiers Breached by Science

A total of eight scientists with different specialisations carry home this year's Nobel Prize in Physics, Chemistry and Physiology/ Medicine

#### Science India Bureau

A lfred Nobel (1833-96), a Swedish chemist, engineer, businessman, and the creator of dynamite, left the majority of his wealth to a number of awards in the fields of physics, chemistry, physiology/ medicine, literature, and peace, collectively known as the Nobel Prizes in his last will and testament in 1895.

From October 2 through October 9, winners of Nobel Prize 2023 were revealed every day. The recipients of the 2023 Nobel Prize will be presented with their medals and certificates in Stockholm on December 10, the death anniversary of Alfred Nobel.

Here are this year's Nobel Prize winners:

#### **PHYSIOLOGY/ MEDICINE**

The 2023 Nobel Prize in Physiology or Medicine will be shared by Katalin Karikó and Drew Weissman for their understanding of nucleoside base alterations, which paved the way for the development of COVID-19 mRNA vaccines. The winners were chosen by the Nobel Assembly at Karolinska Institutet, mandated to select the awardees in this category as per Alfred Nobel's will, and have been doing so since 1901.

Hungarian-American biochemist Katalin Karikó was born in 1955. She earned her PhD from the University of Szeged in 1982, and from that year to 1985, she worked as a postdoctoral researcher at the Szeged branch

- 1. Pierre Agostini, Physics
- ↗ 2. Moungi G Bawendi, Chemistry
- 3. Katalin Karikó, Physiology/ Medicine
- 4. Drew Weissman, Physiology/ Medicine
- 5. Louis E Brus, Chemistry
- メ 6. Ferenc Krausz, Physics
- 7. Anne L'Huillier, Physics
- メ 8. Aleksey Yekimov, Chemistry

of the Hungarian Academy of Sciences. She then pursued postdoctoral research at Temple University in Philadelphia and the University of Health Sciences in Bethesda.

Later, in 1989, she was employed at the University of Pennsylvania as an assistant professor. She remained there until 2013. She then progressed to vice president and senior vice president of BioNTech RNA Pharmaceuticals. Since 2021, she has held the positions of Professor at Szeged University and Adjunct Professor at the Perelman School of Medicine at the University of Pennsylvania.

Drew Weissman, who will sharing the Nobel Prize for Medicine, was born in 1959 in Lexington, Massachusetts, United States. He earned both his MD and PhD from Boston University in 1987. After finishing his clinical training at Beth Israel Deaconess Medical Centre at Harvard Medical School, he finished his postdoctoral studies there. At the Perelman School of Medicine of the University of Pennsylvania, Weissman established his research group in 1997. He is the Roberts Family Professor in Vaccine Research and the Director of the Penn Institute for RNA Innovations.

#### PHYSICS

Pierre Agostini, Ferenc Krausz, and Anne L'Huillier have won the 2023 Nobel Prize in Physics for their groundbreaking experimental methods that produced attosecond light pulses, enabling in-depth research on electron dynamics in matter, particularly in atoms and molecules.

French-Swedish physicist Anne L'Huillier was born in Paris on 16 August 1958, and is a professor of atomic physics at Lund University, Sweden. French experimental physicist Pierre Agostini was born in Tunis on 23 July 1941, and is currently professor emeritus at Ohio State University, Columbus, USA. Hungarian-Austrian physicist Ferenc Krausz was born on 17 May 1962 at Mor, Hungary and is currently the director of the Max Planck Institute for Quantum Optics in Garching, Germany. He is also a professor of experimental physics at the Ludwig Maximilian University of Munich, Germany.

#### **CHEMISTRY**

The Nobel Prize in Chemistry 2023 has been given to Moungi G Bawendi, Louis E Brus, and Alexey Yekimov for their work on the discovery and development of quantum dots. These tiny particles, which have special qualities, emit light from LED lighting and television displays. They catalyse chemical reactions, and the surgeon can use their clear light to illuminate cancer tissue.

Every student of chemistry learns that an element's characteristics depend on the number of electrons it has. However, quantum phenomena appear when matter is reduced to nanoscales; these phenomena are controlled by the size of the matter. The 2023 Chemistry Nobel laureates have succeeded in creating particles with properties that are governed by quantum phenomena. These tiny objects, sometimes known as quantum dots, are increasingly crucial to nanotechnology.

Moungi G Bawendi, an American-Tunisian-French chemist, was born in 1961 in Paris. He is currently the Lester Wolfe Professor at the Massachusetts Institute of Technology, and is known for his advances in the chemical production of high-quality quantum dots. Louis E Brus, born in Cleveland, Ohio, United States on 10 August 1943, is an American chemist. He is currently the Samuel Latham Mitchell Professor of Chemistry at Columbia University, US. He is the co-discoverer of the colloidal semi-conductor nanocrystals known as quantum dots.

Alexey Yekimov, born on 28 February 1945, is a Russian solid state physicist and a pioneer in nanomaterials research. He discovered the semiconductor nanocrystals known as quantum dots in 1981, while working at the Vavilov State Optical Institute. He was successful in producing size-dependent quantum effects in coloured glass at the beginning. Copper chloride nanoparticles were responsible for the coloration, and Ekimov showed how quantum effects may change the colour of the glass depending on the particle size.

Louis Brus was the first scientist in the world to demonstrate size-dependent quantum effects in particles freely circling in fluid a few years later. Moungi Bawendi's 1993 revolution in the chemical synthesis of quantum dots produced nearly flawless particles. They had to possess this superior quality in order to be used in applications.

Using QLED technology, quantum dots are currently used to illuminate computer and television screens. Biochemists and clinicians utilise them to map biological tissue, and they also lend complexity to the light of some LED lamps.

Therefore, quantum dots are proving to be game changer in humanity's march towards further progress. We have only begun to explore the potential of these tiny particles, but researchers think they may one day help create flexible electronics, tiny sensors, thinner solar cells, and encrypted quantum communication.

Nobel Prize laureates will receive a Nobel Prize diploma, a Nobel Prize medal and a document detailing the Nobel Prize amount, which this year is 11 million Swedish krona, or about \$989,000 / approx. Rs 82 crore at current exchange rates.

# Delhi Air Pollution: Beyond the Blame Game

With winter knocking on its doors, Delhi's 'poor quality' air is back in focus, the solutions to tackle which, in the long run, would need more will than exhibited so far by politicians and citizens alike

ome winters in Delhi and pollution is a routine slugfest of claims and blames. Humble wind is the sole saviour that everyone looks forward to, to burst the choking bubble. In general, between June and September, conditions are categorised as 'moderate', September to October and then January to March as 'poor', October to January as 'very poor' as per Air Quality Index (AQI). The variation is also attributed to moderation during monsoon season between June and September and worsening during winter owing to low wind speed conditions and falling temperatures that stagnate toxic blanket over human activity.

#### **POLLUTION AND LOSS OF LIFE**

It is noteworthy that Delhi rarely experiences 'good' or 'satisfactory' AQI levels, and the consequent impact on the health of Delhiites is obvious. The burden of disease is reflected as disability affected life years (DALYs), which refers to the sum of years of potential life lost due to premature mortality and the years of productive life lost due to disability. In Delhi, total DALYs due



#### Prof (Dr) Virendra Kumar Paul

to particulate matter concentration were of the order of 300,000 in 1995, which increased to around 750,000 in 2015, consequently further stressing the already exasperated healthcare infrastructure. Delhi could see a rise in life expectancy by over nine years if the WHO standards of pollution were to be adopted. Therefore, the economics of mitigation measures must recognise health impacts, the loss of productivity to the nation and not be constrained due to limiting challenges of implementation.

Although construction activities, vehicles, industries, dust on roads, open waste burning, domestic cooking and captive power diesel generators and fires at landfills spew poison year round, stubble burning is a winter phenomenon in Delhi directly attributed to anthropogenic activities. Delhi being landlocked, is also impacted by adjacent areas owing to stubble burning during November-December, essentially from Haryana and Punjab as





Left: Delhi has been suffering from hazardous air pollution for years; Above: Burning of farm stubble or Parali releases gases like Carbon Dioxide and Carbon Monoxide

well as industrial clusters of Ghaziabad. As a result, areas with proximity to industry intensive Ghaziabad tend to be more polluted as against the areas closer to sparsely developed Faridabad, which experience marginally better



conditions. Similarly, while use of furnace oil and petroleum coke is banned in Delhi under the Supreme Court order since 2017, its continuance in neighbouring states impacts adjacent areas of Delhi.

#### **CHIEF CULPRITS**

Within Delhi, not all sources of pollution impact uniformly. Transport activity is the main contributor of PM 2.5 and contributes to almost 1/3rd of particulate matter and 80% of Nitrous Oxide pollution. Overall contribution of vehicular pollution is of the order of 40%. Irrespective of the weather conditions, the areas closer to high vehicular activity within Delhi have exposure year round. Since such areas are also high built-up density and congested, the effect of wind can also be expected to be much lower. While four-wheelers in general contribute between 20-40%, vehicles from other states come to Delhi in very large numbers that further adds to the worsening of conditions.

Delhi has one of the largest small scale industrial clusters in the country located at Anand Parbat, Wazirabad, Naraina and Okhla which are also the most polluted in terms of air and water, besides polluting soil which is categorised as 'critical'. This is a challenge for mitigation since it also has a social dimension of entrepreneurship on one side and economic impact on the other.

Construction is a perpetual activity in Delhi, contributing to almost 1/3rd of the total pollution. Delhi is surrounded by brick kilns in neighbouring Ghaziabad, Jhajjar and Faridabad where manufacturing also peaks around December. Although the use of clay fired bricks has been prohibited for a long time, the implementation is non-existent except in government projects. Delhi has a large stockpile of fly-ash, thanks to thermal plants that supply power, flyash utilisation as building materials is largely limited to Autoclaved Aerated Concrete (AAC) blocks produced by private manufacturing units. As regards construction activities on site, there are stringent compliance requirements to control dust, DG set emissions but their compliance is low at best, and their effectiveness remains unsubstantiated. There is practically no accountability of either the polluter or implantation agency in respect of construction activities that go on year round.

#### **ROADSIDE DUST**

Roadside dust PM10 pollution is a fait accompli situation. Construction trucks carrying debris, excavated matter and ferrying building materials are often dirt-laden, and uncovered load spills dust all over the road network. Construction sites, rampant roadside repairs, excavation left open for various utility works and flow of silt during rains bring large quantities of dust on the roads. Dust finds its way into the storm water drains leading to silt deposition in drain pipes. De-silting is a common activity which takes place in Delhi with contentious claims of effectiveness. Since the sources of roadside dust have no visible control strategy, the storm drains are the obvious victims. This cycle of reduced flow due to settlement of silt in pipes reduces the intake capacity causing ponding at the receiving point and reduced flow of stormwater. And, reduced flow further increases settlement of silt and impairs drain flow capacity. The conundrum is unending and dust on the road is a natural consequence. Silt receptor at the intake point is an obvious intervention that is missing in the system, there is no visible effort on the ground to control roadside dust.

#### **GAS COCKTAIL OVER DELHI**

A cocktail of toxic gases in Delhi's air has been recorded repeatedly in the past decades. These include Nitrous Oxide, Carbon Monoxide, Carbon Dioxide, Sulphur Dioxide, and Ground-Level Ozone. It can safely be said that the concentrations of these gases have never been observed to be lower than the safe limits in the past decades, except the lockdown duration when most vehicular movement and construction activities were halted.

Nitrous Oxide (N<sub>2</sub>O) pollution is

caused by industrial activity (over 50%) and vehicular emissions (over 30%). While developing countries are witnessing a decline in N<sub>2</sub>O, it continues to be a serious concern in Delhi. N<sub>2</sub>O adds to winter complications when it transforms to form nitrites as particulate pollution. Asthma, eye irritation and other respiratory health problems are associated with N<sub>2</sub>O. Nitrous Oxide, arising from high temperature combustion of fossil fuels and in combination with volatile organic compounds (VOCs), contributes to ground-level ozone, which is highly reactive. Ground-level O, can damage respiratory passages, and cause associ-



New Delhi, whose location is indicated on the image, is under a patch of especially thick haze on 5th November 2016



Farmers burn farm residue in Punjab that has an adverse impact on Delhi AQI

ated diseases like asthma and chronic obstructive pulmonary disease.

Carbon Monoxide, emanating from incomplete combustion of fossil fuels, impacts the human body's ability to absorb oxygen, thereby becoming highly detrimental to neurological health. The main sources of CO are vehicles, furnaces, and equipment placed in enclosed areas.

Sulphur Dioxide is consistently found higher than permissible limits. It is primarily a by-product of vehicular and industrial emissions. India being one of the most Sulphur Dioxide polluted nations in the world, reducing its emission within permissible limits is an uphill task in Delhi as well.

With Delhi having the highest annual carbon footprint in the country, higher  $CO_2$  concentrations lead to higher intensity of solar heat absorption, thereby leading to faster rise in temperature.  $CO_2$  is also an Indoor Air Quality concern leading to lack of concentration, dementia and respiratory illnesses and air purifiers are no solution to it. Ventilation is useful but if outside air is already polluted, then what is the

#### India being one of the most Sulphur Dioxide polluted nations in the world, reducing its emission within permissible limits is an uphill task in Delhi as well

way out?

Delhi also gets covered in a thick blanket of smog every winter season, putting the health of its citizens at severe risk. Smog forms when a thin layer of atmosphere near the earth's surface becomes cooler than the atmosphere above, causing pollutants to get trapped at ground level. Smog does not get dispersed in the cooler layer, until a change in weather causes shifts in air.

With the winter knocking at the doors, AQI in Delhi will begin to transition from poor to very poor range. And, customary interventions such as odd-even vehicle movement, banning construction, banning DG set operation, stringent vehicle pollution certificate checks, etc., may resurface but their effectiveness is far from being substantiated. Occasional 'good' or 'moderate' spells of over 200 days in Delhi, as reported on 11 October 2023, is an achievement only if it can be scientifically attributed to specific measures for targeted and sustained dividends. Sporadic actions taken during winters almost every year may appear effective but, the herculean challenge requires a consistent comprehensive strategy founded on political will, administrative commitments and resolve of citizens. Do we have the 'Trishul' attack against the 'Asur' of pollution?

\*The writer is Professor at the Department of Building Engineering and Management at School of Planning and Architecture, New Delhi.



#### TRIBUTE: DR MS SWAMINATHAN (7 AUGUST 1925 – 28 SEPTEMBER 2023)

# A Legendary Scientist who Sowed the Future of Prosperity

The Father of Green Revolution in India was a visionary who put science to work to ensure food security for millions of Indians, laying the foundations for making the country one of the top food exporters of the world

uring his tenure as Director General, International Rice Research Institute, Manila, the Philippines, in the 1980s, Dr MS Swaminathan used to work all seven days of the week including late evenings. When no staff was available during odd hours, his phone operator would be there to facilitate international and domestic calls. Interestingly, Dr Swaminathan would go to nearby restaurant to have tea or coffee himself and fetch some snacks and tea or coffee for the operator, as she could



#### Dr Manoj Kumar Patairiya

not leave her seat.

Many times, he was seen barefoot or with muddy shoes guiding and working with farm technicians and labourers in the farms at Indian Agriculture Research Institute (IARI), New Delhi. Lately, at MS Swaminathan Research Foundation (MSSRF), as early as he reached his office, he would remove his shoes and move around.

I visited MSSRF and stayed at their guest house during the 9th Indian Science Communication Congress held in Chennai in 2009. Dr Swaminathan took me around and explained the activities and research facilities at the foundation. The main attraction, amongst others, was scientific collection and preservation of precious seeds and germplasm of various food and plant varieties in appropriately refrigerated chambers developed for the purpose. He narrated the concept of Bio Villages and explained through posters and charts available on the walls of the foundation. Though he invited me to visit a Bio Village setup by MSSRF near Pondicherry, I did not have the fortune to visit. However, our Doordarshan team did visit and produce a good story on Bio Village which was telecast on DD Kisan Channel.

Once in an informal chat, his wife revealed to the Doordarshan crew that Dr Swaminathan was a very simple man. He would never complain about food, no matter what she cooked. Once, she deliberately prepared something not tasty but Dr Swaminathan not only ate it with pleasure but also appreciated.

#### THE GREEN REVOLUTION

When something like Green Revolution was brewing in his mind, Dr Swaminathan wanted to import seeds of high yielding dwarf variety of Mexican wheat for his experiments, but then ICAR authorities did not agree. He ventured to rush to Food & Agriculture Minister Chidambaram Subramaniam, who was eventually convinced. Dr Swaminathan was able to crossbreed this variety with Japanese and native Indian varieties and developed high yielding wheat variety resulting in India's Green Revolution of 1960s.

The experiments were replicated at Jyontika Village of Delhi with local farmers under the supervision of Dr Swaminathan. The Father of Green Revolution, Dr Norman Borlaug, also visited the place in 1967 and supported the work of Dr Swaminathan.

During his assignment as Director General, Indian Council of Agricultural Research, Dr Swaminathan came to know about a tribal woman Ms Kamla who was interested in crossbreeding of wild paddy varieties in Odisha to develop better ones. She had no idea of genetics and knew only Oriya language. Dr Swaminathan facilitated her to work in nearby Rice Research Institute at Cuttack with the help of scientists and got

encouraging results.

Dr Swaminathan was selected for Indian Police Service, and initially studied zoology to become a doctor to fulfil his family's wish, but he left both and preferred agriculture research to pursue his passion and meet the nation's challenge of food scarcity. He got an opportunity of UNESCO fellowship in the Netherlands, but he chose to work in India. Dr Swaminathan was uncomfortable with India importing food grains when 70% of the population was dependent on agriculture with forecasts of drought and famine like situations.

#### **KNOWING DR SWAMINATHAN**

Dr Swaminathan had direct access to visit then Prime Minister, Indira Gandhi, in her office. However, once he visited as usual, he found that the PM was not pleased, though she did the work for which Dr Swaminathan had gone.

While coming back, she asked him to seek prior appointment. Dr Swaminathan felt bad and after returning to his office, resigned from the position of DG ICAR.

Dr Swaminathan was known for his sharp memory. Once you met him, he was sure to call you by your name the next time you met. Dr Ramesh Datt Sharma, Director, ICAR-Directorate of Information & Publications in Agriculture (DIPA) introduced me to Dr Swaminathan in the mid-1980s. Since then, I had several occasions to meet and interact with him and visited his offices too. I also had opportunities to see him at his residence in New Delhi when he was a Member of Parliament (Rajya Sabha). It was mainly in connection with 'Krishi Darshan' (a weekly agriculture programme on Doordarshan), of which I have been a casual anchor and newsreader since the early 1980s.



Clockwise from top left: Dr MS Swaminathan with Dr Norman Borlaug, the Father of Green Revolution in the world; at the International Rice Research Institute in the Philippines; Swaminathan (in black coat, left) with Dr Borlaug (second from right) in the wheat fields of Indian Agricultural Research Institute, New Delhi, 1965; a young Swaminathan



Left: Then PM, Dr Manmohan Singh felicitating Dr MS Swaminathan, at the 57th Annual Convocation of Indian Institute of Technology Kharagpur, West Bengal, on August 22, 2011

Below: PM Narendra Modi releasing books on Dr MS Swaminathan, titled 'M.S. Swaminathan: The Quest for a World Without Hunger', in New Delhi on May 19, 2017

We were also fortunate to benefit from his vast knowledge and experience in putting together the full-fledged 24x7 satellite Kisan TV Channel of Doordarshan, as I was given the responsibility of setting up DD Kisan Channel as early as the new government took office in 2014. I was appointed as the first Additional Director General, Doordarshan to oversee and head DD Kisan Channel in July 2014.

He was so simple and polite as no one could guess, considering the towering personality that he was and the highest positions that he occupied. Whenever we approached him for a talk or interview, he would simply ask the topic and the duration and most importantly, would never say no. Although he was a scientist par excellence, he was a media savvy genius too. If we told him eight minutes, he would look at the camera and speak exactly for eight minutes without looking at the watch. In an interview, he would answer in crisp and concise manner, easy to understand by the lay audiences. The delivery, content and expression, all would be just excellent, in one go, as Dr Swaminathan disliked retakes. Normally, scientists are not considered good communicators, but Dr Swaminathan was a wonderful exception.

He was born on August 7, 1925, at Kumbakonam, Tamil Nadu, as the second son of MK Sambasivan, a surgeon, and Parvati Thangammal Sambasivan, a homemaker. When he was 11, his father passed away and his paternal uncle looked him after. He graduated from Chennai and did his post-graduation from IARI, New Delhi. He went on to obtain his PhD from the University



of Cambridge in 1952. He met Mina Swaminathan in 1951 during their studies at Cambridge and married eventually. After his highly illustrious life, he left for his heavenly adobe on September 28, 2023, at the age of 98, at his home in Chennai.

He served as Director General, Indian Council of Agricultural Research, during 1972-79. He was Principal Secretary to the Ministry of Agriculture & Irrigation during 1979-80. He also served as Director General, International Rice Research Institute, 1982-88, and as president of the International Union for Conservation of Nature and Natural Resources during 1984–90.

#### **TOWARDS FOOD SELF-SUFFICIENCY**

The Green Revolution brought about by Dr Norman Borlaug increased production of food grains, mainly wheat and rice, in large parts of developing countries, with new high yielding varieties, in the 1960s. Dr Swaminathan was instrumental in bringing about Green Revolution in India that helped extend the benefits to several developing countries in Asia. While Dr Borlaug was working with Mexican dwarfs, Dr Swaminathan crossbred Mexican dwarf and Japanese variety in India with better results.

New varieties required synthetic fertilizers and pesticides for higher yields, but more cost and harm to soils and biodiversity. It saw lower yields where chemical fertilizers and pesticides were unavailable. In fact, old indigenous strains were better adapted to native conditions and traditional agriculture with some natural resistance to pests and diseases. The efforts of Dr Swaminathan helped bring greater acceptance for modern farming methods. Many farmers in India and other countries felt the Green Revolution was a curse as it spoiled seeds, soil, water and biodiversity, causing long-term and irreversible impact.

Some argue that high yielding wheat and rice during the 1960s came to save millions from possible starvation and malnutrition when the country was likely to face a famine like situation. The Green Revolution was able to triple the wheat production in a few years and the country was declared selfsufficient in food grains in 1971 as a result. The United Nations Environment Programme credited Dr Swaminathan as 'The Father of Economic Ecology'.

Dr Swaminathan was appointed as the Director of Indian Agriculture Research Institute (IARI) in 1966. It is with his persuasion that the government of India imported 18,000 ton of Mexican wheat and with the application of genetics for crossbreeding, the crop production was increased three-fold. Dr Borlaug wrote to Dr Swaminathan before receiving the Nobel Peace Prize in 1970: "...to you, Dr Swaminathan, a great deal of the credit must go for first recognizing the potential value of the Mexican dwarfs. Had this not occurred, it is quite possible that there would not have been a Green Revolution in Asia".

#### **MODERN AGRICULTURE**

Dr Swaminathan became the Director General of Indian Council of Agricultural Research (ICAR) in 1972. He pushed the idea of technical literacy thereby setting up centres all over the country that eventually became Krishi Vigyan Kendras. He spread awareness amongst farmers on modern agriculture practices. He helped build many national and international institutions and provided research support in China, Vietnam, Myanmar, Thailand, Sri Lanka, Pakistan, Iran and Cambodia. He coined the phrase, 'Evergreen Revolution' in 1990 that described his vision of 'productivity in perpetuity without associated ecological harm'.

His basic research was on potato, wheat, and rice including cytogenetics, ionizing radiation, and radio sensitivity. His research on species differentiation and nature of polyploidy in Solanum



Dr Swaminathan accepting the first World Food Prize from James Ferguson, CEO of General Foods, at the Laureate Award Ceremony at the Smithsonian Institution in Washington, DC, 1987

tuberarium had greater ability to transfer genes from a wild species to cultivated potato. His postdoctoral work at Wisconsin helped develop a frost resistant potato. His research on mutagens and the world's first high yielding Basmati rice is significant. He also visited Hoshangabad, Madhya Pradesh, to bring to the world what came to be popularly known as 'Radio Rice'.

He founded the MS Swaminathan Research Foundation (MSSRF) in 1988 as nonprofit trust with proceeds of \$2,00,000 from the First World Food Prize 1987. The foundation aims at accelerating the use of modern science and technology for agriculture and rural development. The foundation has made a difference by improving lives and liveli-

Dr MS Swaminathan's contribution as the Father of India's Green Revolution at a time when the country needed it the most will remain undisputed in the annals of agriculture research hoods of millions of farming and fishing communities spread over 18 countries.

Dr MS Swaminathan's contribution as the Father of India's Green Revolution at a time when country needed it the most will remain undisputed in the annals of agriculture research. His groundbreaking work to boost Indian agriculture has ensured food security and has contributed to food prosperity of millions in India and many other countries in Asia. He left behind his legacy and an India with ample food security and food prosperity of his cherished dreams where organic and natural farming are now harnessed to overcome the perils of chemical based farming. Our heartfelt tributes!

\*The writer has pursued his studies and research in biosciences. He has authored award winning books on biotechnology, DIY science activities, environment, science communication, and has two patents to his credit. Currently, he is a New Delhi-based science writer and Adjunct Professor of Science Communication at the National Institute of Advanced Studies. He can be reached at manojpatairiya@yahoo.com.





Dr Rashmi Kulkarni

The challenges of feeding a growing global population in the face of climate change and diminishing resources have spurred an urgent search for sustainable, nutritious, and resilient crops. Millets, often overshadowed by their more widely cultivated counterparts, have emerged as silent champions in this quest. This comprehensive exploration delves deeper into the myriad advantages of millets, providing a robust case for their widespread promotion globally to combat the looming food crisis.

#### THE NUTRITIONAL BRILLIANCE OF MILLETS Rich in Nutrients

Millets, comprising varieties such as sorghum, finger millet, pearl millet, and foxtail millet, are not just dietary sta-

#### **WORLD FOOD DAY: OCTOBER 16**

# Millets: Unlocking the Nutritional Goldmine

The benefits of millets and their global role in combating food crisis are unprecedented

ples; they are nutritional powerhouses. These grains are dense with essential vitamins, including the B-complex group, and vital minerals like iron, magnesium, and phosphorus. Their nutrient density makes them instrumental in addressing malnutrition and ensuring dietary completeness.

#### **Nutritional Powerhouses**

In the world of nutrition, millets stand as hidden gems, waiting to be discovered for their unparalleled richness in essential nutrients. These ancient grains, including sorghum, finger millet, pearl millet, and foxtail millet, are nutritional powerhouses that offer a diverse array of health benefits.

**1. Fiber: The Digestive Guardian** 

One of the standout features of millets is their exceptional fiber content. Fiber, an indigestible carbohydrate, plays a pivotal role in digestive health. Millets, being rich in both soluble and insoluble fiber, contribute to a healthy digestive system by promoting regular bowel movements, preventing constipation, and supporting gut microbiota.

The soluble fiber in millets helps regulate blood sugar levels and lower cholesterol, reducing the risk of chronic diseases such as diabetes and cardiovascular conditions. Insoluble fiber, on the other hand, adds bulk to the stool, aiding in the prevention of digestive disorders and promoting overall gut health. **2. Protein: The Building** 

2. Protein: The Building Blocks of Life Millets are robust sources of plant-based proteins, making them an excellent addition to diets, especially for vegetarians and vegans. Proteins are essential for the growth, repair, and maintenance of tissues in the body. While millets may not match the protein content of certain animal-based sources, they offer a well-rounded amino acid profile crucial for overall health.

In a world where sustainable and diverse protein sources are becoming increasingly important, millets emerge as an eco-friendly alternative. Cultivating millets requires fewer resources compared to raising livestock, making them a more sustainable option for protein intake.

#### 3. Minerals: The Essential Supporters

Millets pack a mineral punch, providing essential nutrients like iron, magnesium, phos-

phorus, and zinc. Iron is crucial for the formation of red blood cells and the prevention of anemia, while magnesium plays a role in muscle function, nerve transmission, and bone health.

Phosphorus, abundant in millets, is vital for energy metabolism, kidney function, and the formation of DNA. Additionally, zinc, another mineral found in millets, supports immune function, wound healing, and DNA synthesis.

#### BALANCED MACRONUTRIENT PROFILE

What distinguishes millets is their balanced macronutrient profile. Comprising complex carbohydrates, proteins, and healthy fats, millets present a harmonious blend of nutrients crucial for sustained energy release, muscle development, and overall metabolic health.

#### **GLUTEN-FREE ALTERNATIVE**



A significant boon for those grappling with celiac disease or gluten sensitivity, millets present a gluten-free alternative that extends dietary choices. The burgeoning market for gluten-free products aligns seamlessly with millets, offering not just sustenance but also culinary diversity for those with gluten-related issues.

#### LOW GLYCEMIC INDEX

Beyond their nutrient richness, millets exhibit a low glycemic index, making them a favourable choice for individuals seeking to manage blood sugar levels. The gradual release of glucose into the bloodstream not only provides stable energy levels but also reduces the risk of developing type-2 diabetes.

#### ENVIRONMENTAL SUSTAINABILITY Drought Resistance

As the frequency and severity of

droughts increase due to climate change, the intrinsic drought resistance of millets becomes a crucial asset. These hardy crops can thrive in semi-arid conditions, providing a reliable source of sustenance in regions susceptible to water scarcity.

#### **Low Water Footprint**

The impact of agriculture on water resources is a growing concern. Millets, with their significantly lower water footprint compared to water-intensive crops like rice and wheat, present an eco-friendly alternative. Choosing millets is not just a nutritional decision but an environmentally responsible one, particularly in regions facing acute water shortages.

#### **Biodiversity Promotion**

The modern monoculture trend in agriculture poses risks of pest and disease

outbreaks. Millets, with their diverse varieties, contribute to biodiversity in agricultural landscapes. This inherent diversity acts as a natural defense mechanism, reducing the vulnerability of crops to large-scale failures.

#### GLOBAL FOOD SECURITY Cultivation Versatility

The versatility of millets in cultivation is a key factor in addressing global food security. From the arid landscapes of Africa to the mountainous terrains of Asia, millets can be cultivated in diverse conditions, expanding the range of cultivable land and contributing to food security.

#### **Small-Scale Farming Support**

Small-scale farmers, often marginalised in the agricultural landscape, find a dependable ally in millets. Requiring minimal inputs, these crops enable farmers with limited resources to diversify their crops. This diversification not only enhances economic resilience but also contributes to the sustainable development of rural communities.

#### **Climate-Resilient Agriculture**

The unpredictable nature of climate change demands adaptive agricultural practices. Millets, with their short growth cycles and ability to withstand temperature fluctuations, offer a climateresilient alternative to traditional crops. This adaptability mitigates the risks associated with changing weather patterns, providing a stable source of food.

#### CULINARY VERSATILITY AND PALATABILITY Diverse Culinary Applications

Millets are not just grains; they are culinary chameleons, adapting to a plethora of culinary applications. From hearty porridges and *pilafs* to crispy flatbreads and delectable desserts, the culinary possibilities of millets are vast. Their versatility in diverse cuisines makes them a delightful addition to culinary repertoires worldwide.

#### **Local and Global Cuisine Fusion**

The ability of millets to seamlessly integrate into both local and global cuisines is a testament to their adaptability. They bridge the gap between age-old culinary practices and modern gastronomic trends, offering a unique fusion of flavours that tantalises taste buds globally.

#### **Taste and Texture Appeal**

Beyond their nutritional and environmental attributes, millets bring a unique taste and texture to dishes. The nutty flavor, coupled with a satisfying crunch, adds a sensory dimension to meals. This not only enhances the eating experience but also makes millets an attractive component in a variety of culinary creations.

#### CHALLENGES AND SOLUTIONS Lack of Awareness: A Hindrance to Nutritional Empowerment

Despite their nutritional prowess, millets face a significant challenge — a lack of awareness among the general population. The modern diet, often dominated by refined grains and processed foods, has relegated millets to the sidelines. Many individuals remain unaware of the nutritional richness that millets bring to the table.

#### **1. Cultural Shift and Globalisation**

As societies undergo rapid cultural shifts and embrace globalisation, traditional and locally significant foods, including millets, are at risk of being overshadowed by more commercially promoted options. This shift not only affects dietary diversity but also disconnects people from the inherent nutritional wisdom present in local and ancient food traditions.

#### 2. Limited Marketing and Culinary Exposure

The lack of aggressive marketing and culinary exposure further compounds the issue. In the aisles of supermarkets, the spotlight often falls on familiar grains, leaving millets in the shadows. Culinary platforms and media channels, which play a pivotal role in shaping food trends, have not given millets the attention they deserve.

#### 3. Perceived Lack of Culinary Versatility

Another factor contributing to the lack of awareness is the perceived limitation in culinary versatility. Many people are unfamiliar with the diverse culinary applications of millets, assuming that their use is confined to specific regional dishes. This misconception limits the incorporation of millets into mainstream diets.

#### THE WAY FORWARD: ADVOCACY AND CULINARY EXPLORATION

Addressing the lack of awareness about millets requires a multifaceted approach that combines advocacy, education, and culinary exploration.

#### 1. Advocacy and Education Community Engagement: Grassroots-

level campaigns and community engagement can play a vital role in raising awareness. Workshops, seminars, and community-driven initiatives can educate individuals about the nutritional benefits of millets. **School Programmes:** Introducing educational programs in schools that focus on traditional and nutritious foods, including millets, can instill healthy dietary habits from a young age.

#### 2. Culinary Exploration

**Culinary Shows and Platforms:** Collaborating with popular culinary shows and platforms to showcase the versatility of millets in various cuisines can dispel the notion of limited culinary applications.

**Cookbooks and Food Blogs:** Promoting the creation of cookbooks and food blogs that highlight creative and delicious millet-based recipes can inspire individuals to incorporate millets into their daily meals.

#### 3. Government Initiatives and Policy Support

**Subsidies and Incentives:** Governments can provide subsidies and incentives to farmers cultivating millets, promoting their production and making them more economically viable.

**Inclusion in Food Programmes:** Integrating millets into government-led food programmes and schemes can encourage their consumption at a larger scale, especially in regions with malnutrition.

#### A CALL TO EMBRACE MILLETS

The nutritional richness of millets, with their abundance of fiber, proteins, and essential minerals, makes them a valuable asset in combating malnutrition and supporting overall health. However, their potential remains underutilised due to a lack of awareness. By advocating for millets, educating communities, and exploring their culinary possibilities, we can unlock a world of nutritional empowerment. It's time to celebrate millets not just as ancient grains but as modern solutions to the complex challenges of global nutrition and food security.

> \*The writer is Director and Co-founder, ARNA Genext Solutions Pvt. Ltd.



## COVER STORY: CYBER SECURITY AWARENESS MONTH DEFENDING YOUR DIGITAL LIFE: **THE POWER OF CYBERSECURITY AWARENESS**

With internet becoming as vital as air, water and food for the world, it's important that individuals arm themselves with information on protecting themselves against cyber crimes



Karthikeyan Subramanian,
 Dr Meher Wan

he Indian government has adopted the importance of cyber safety in the digital world and supported Cyber Security Awareness Month — October, along with the cyber safety community globally. In the US, the Cyber Security Awareness Month-October campaign was launched in 2004, and global security communities accepted it. The main aim of this campaign is to create awareness and spread scientific temper among individuals and organisations to disseminate the globally adopted best practices to the common public and entities.

Data and the internet are becoming an essential part of human life. As with a physical universe, the digital universe also coexists. The new cyberspace ecosystem has grown with advanced technological enhancement. As per the July 2023 Statista data, for the 8 billion people, globally 16.7 billion smart devices are present and active in the digital world. It is expected that in 2030, there will be 29.42 billion smart electronic devices will be interconnected. Among 141 crore of the Indian population, 69.2 crore people use the internet through smart devices. India is the second largest internet user after China in the world. In India, every person has started creating a digital trace before birth and after their existence.

#### **COVER STORY**

#### **INTERNET: A BASIC NEED**

Nowadays, the internet is also added after the food, water, air, and shelter in the list of basic needs. In the global village, every technology and new innovative products are easily spread across the globe in a short span. With the help of science, technology, and industries, humans started consuming more advanced technologies daily. To top it, internet is the primary source to all kind of communication. In the past ten years, internet has changed the human life drastically and is able to connect with all electronic devices. Human digital trace was marked on every smart device. In the 20th century, all the gadgets were merged into a single device in the form of smartphone. Almost all modern technologies - Internet of Things (IoT), Artificial Intelligence (AI), Machine Learning (ML), Cloud computing, Natural Language Processing (NLP), and Biometric Technologies are already interconnected. However, these modern technologies have more significant challenges and threats from cyber attackers. Our daily life majorly depends on the internet. Online shopping, mobile banking, street vegetable purchases, travel bookings, hotel bookings, food orderings, fund transfers, bill payments, social media gathering, movie watching, TV watching, online gaming and official work-from-home activities are migrated into online platforms.

#### **COLLATERAL DAMAGE**

When more positive things happen around, the same platform brings more negative things also. Cyber criminals play a crucial role in attacking cyberspace to steal valuable data and money. Phishing, Spam SMS, Ransomware attacks, Denial of service, SIM swap scams, Viruses, Worms, Trojan horses, online job fraud, cyberbullying, cyberstalking, cyber grooming, Automated Teller Machine (ATM) fraud, card/debit card fraud, website hacking, online drug trafficking are widespread cybercriminal activities happening in India. As per the State Application Security Q2 report, 97.1 crore cyber attacks have taken place in India compared to 110 crore cyber at-



tacks globally.

Since the range of internet users varies from six-month-old children to 80-plus-year-old elderly persons, criminals get more chances to use human weaknesses (technically called vulnerability) and easily attack with different methodologies. Online attacks, offline attacks, bot attacks, network attacks, and defame attacks on business organisations are very common in the internet world. Like trained armies, cyber criminals are also well-trained to strike an attack on the masses and organization to damage social life. Those trained cyber professonals work ethically and unethically.

Unethical hackers are also professionally trained in cyber skills but attack against the government, networks, and individuals to damage society, organisations, and individuals. Ethical hackers work for goodness to find the weaknesses in existing networks and regular behaviour and try to strengthen and increase cyberspace security.

#### WHAT IS CYBER SECURITY?

Cyber security is the process of detecting and protecting the digital environment by implementing up-to-date safety measures for digital devices and digital users. It has different nomenclatures like cybersecurity, cyber awareness, and cyber hygiene.

#### **Science Behind Cyber security**

Cyber security is a multidisciplinary domain that includes different scientific disciplines, frameworks, networks, geopolitical policies, national and international laws, and scientific temperaments. Cyber security involves preventing and protecting computers,







mobile phones, personal information, and organisation data from cyber attackers. Technologically, it is inclusive of computer science, cryptography, network security, information security, operating systems, machine learning, artificial intelligence, cyber threat intelligence, cyber physical systems, ethical hacking, digital forensics, security standards, and enforcement agencies. This cyber ecosystem is interconnected with different industries like healthcare, financial, industrial, telecommunication, transportation, education, media, hospitality, retail, and public sectors.

#### State of Cyber Security in India

India is the second largest internet consumer in the world. As Prime Minister Narendra Modi mentioned, in Digital India, cyber security becomes an integral part of the nation. The Indian government has built several strategies to protect the country's cyberspace ecosystem, including establishing a National Critical Information Infrastructure Protection Centre (NCIIPC), an Indian Computer Emergency Response Team (CERT-in), a National Cyber Coordination Centre (NCCC), a central cybercrime portal https://cybercrime.gov. in, incluing a financial fraud toll-free helpline '1930'. Protecting and creating awareness for 70 crore users from cyber attacks is a big challenging task for the Indian government.

Cyber security is not a seasonal affair like the Indian monsoon. It is an ongoing continuous task to be performed on a daily basis. As Home Minister Amit Shah said, on priority mode, India is creating an effective framework and ecosystem for the prevention, detection, investigation, and prosecution of cybercrime. To develop a sustainable cyberspace ecosystem, different stakeholders like government departments, public/ private organisations, domain experts, industrial experts, individuals, and research and development organisations are very important. It needs continuous learning and adaptation to address new challenges in the digital world.

#### **Online cyber crime**

Online cyber attacks are happening in the virtual world, where the internet is the primary medium to target the victims. Since mobile phones and laptops significantly influence our daily lives, most cyber attacks happen on these

platforms. Fraudsters approach masses using different methodologies such as phishing, Malware attack, online job fraud, website hacking, Ransomware attacks, viruses, worms, Trojan horse, Denial of Service (DoS), and social engineering.

In June 2023, there was Malware attack at All India Institute of Medical Sciences (AIIMS), New Delhi, by the suspected Chinese or Hong Kong-based cyber hackers. This threat was successfully neutralised by the deployed cybersecurity systems.

In October 2023, Indian Space Research Organisation (ISRO) chairman S Somanth mentioned at a cyber security conference that the country's space agency was facing more than 100 cyberattacks daily. He also mentioned that Indian satellites, which help the common people on a daily basis, are controlled by different types of software. In this context, cyber security systems play an important role to protect all these activites controlled by ISRO command and control centre.

#### **Offline cyber crime**

Offline cyber crime is happening in the physical world or has real-world consequences, in which attacks do not happen



#### **COVER STORY**

in the network or the internet. These types of crimes often exploit the human psychology weakness in security systems. Cyber criminals may initiate online financial fraud schemes, such as card skimming, where they capture card information from ATMs by faking the extra devices in card-swiping devices. Identity theft begins online by collecting personal information and ends in the physical world by using identities of others, opening bank accounts, applying for bank loans, and buying SIM cards in the names of others. In the name of the banker, cyber criminals call older adults (this is called vishing) who do not have exposure to the digital world and try to get One Time Password (OTP) pins for fraudulent financial transactions.

#### TYPES OF CYBER SECURITY THREATS IN INDIA

Along with many countries, India also faces multiple cyber security threats. These directly attack government organisations, businesses, healthcare centres, essential service centres, and individuals. Different types of cyberattacks are highlighted here.

**Phishing attacks** are most common in India, targeting individuals and organisations by sending deceptive emails with malicious software links to steal valuable data, like credit card information, Card Verification Value (CVV) numbers, date of birth, and net banking passwords.

**Vishing attacks** are through telephonic calls; attackers personally talk with the individuals by aiming to collect banking-related information like credit card numbers, ATM PINs, transaction passwords like one-time password (OTP) numbers, and CVVs.

**A ransomware attack** is hacking personal computers and organisation data centres and encrypting all the data the user cannot open. To access the data, a considerable amount (ransom) is demanded to decrypt the data.

**Smishing** is a fraud that uses mobile



Hackers often use online shopping sites to steal money from users

phone text messages to tempt victims to call back on a fraudulent phone number, visit fraudulent websites, or download malicious content via phone or the web.

**Spamming** is a type of fraud in which cyber criminals send unsolicited commercial messages via email, SMS, MMS, and other hyperlinks. They may try to impress the recipient to buy a product from the website where hackers can track all online translation data and credentials.

**Credit/Debit card fraud** involves an unauthorised use of another's credit or debit card information to purchase or withdraw funds from it.

**Website Defacement** is an attack intended to change the visual appearance of a website and/or make it dysfunctional. The attacker may post indecent, hostile, and obscene images, messages, and videos to spoil the organisation or individual fame.

#### CYBER SECURITY CHALLENGES IN INDIA

Is India's cyber security law strong enough to deal with the threats? Cybersecurity laws and regulations have been evolving as cyberspace technologies grow in India and across the globe. In the year 2000, the first Information Technology Act (IT Act 2000) was framed in India to address security issues in electronic communication and transactions. In 2008, additional sections were added to deal with unauthorised access, hacking-related offences, stolen devices, identity theft, and publishing and transmitting sexually explicit content online.

Previously, the IT Rules 2011 dealt with data protection standards and requirements for organisations that handle sensitive personal data or information. In 2013, the National Cyber Security Policy was established to promote research and development activities and create a workforce to meet the skilled cybersecurity professional requirements. Indian Computer Emergency Response Team (CERT-In) is the national agency responsible for responding to cybersecurity incidents and coordinating efforts to enhance cybersecurity in India. The Reserve Bank of India (RBI) has issued cyber security guidelines for banks and financial institutions to ensure the security of financial systems and customer data. Various sectors, such as telecommunications, space, healthcare, and critical infrastructure, have specific cybersecurity regulations and guidelines.

In August 2023, the government framed the enhanced Personal Data Protection bill in the Parliament session and published the Digital Personal Data Protection Act, 2023 (DPDP) in the *Gazette of India* notification. This new act 'provides for the processing of digital personal data in a manner that recognises both the right of individuals to protect their personal data and the need to process such personal data for lawful purposes and for matters connected therewith or incidental thereto.'

Indian government collaborates with various stakeholders, including state and central government agencies, law enforcement, industry associations, and international cyber security organisations, to strengthen cyber security in India. As like cyber criminals, general public may also knowingly or unknowingly get involved in cybercrime activities. Like cyber bullying, sharing copyright contents in social media, message against religion and government; defacement against any individual in social media also comes under cyber crime. In this context, general public also needs to remain aware about cyberspace rules and regulations. If common public is reluctant to learn cyberspace ethics, it may lead to enforcement of the IT Acts, which include hefty penalties and imprisonement.

#### **NEED FOR PUBLIC AWARENESS**

Since organisations are aware of cyber attacks, they are in a better position to prevent and fight against cybercriminals. However, in the case of an individual, they are the easy prey for cyberattackers. Smartphones are distributed across all age groups. Among them spreading cybersecurity awareness, threats, precautions, and mitigations, training sessions, media publicity and seeding the scientific temper are great challenges. At last, the end users who directly use the internet and online platforms, have more responsibility for enriching their cyber security awareness and make others aware of the dos and don'ts in the cyber world.

#### A few critical dos for cybersecurity:

Strong passwords with a minimum of 8 characters with upper case, lower case, number, and special characters (ULNS)
User Multifactor Authentication

(MFA)

• Keep updated with anti-virus software

• Keep offline backup data

• Use secured website links that start with "https://"

• Keep checking with mobile app permissions and give the permission when the app is in use mode only.

• Privacy settings to be controlled by who can see your posts and profile information

• Use the 'lock' option to protect your electronic devices

• Use biometric authentications where ver possible

• One can meet personal friends online but never attempt to meet online friends in the physical world.

#### A few critical don'ts for cyber security:

• Don't use free Wi-Fi internet; there is a chance for hackers present in network and waiting to steal your personal credentials and data.

• Don't share time-to-time updates on social media, which can be valuable information for criminals.

• Don't open emails from unknown sources, which were randomly distributed.

• Don't use unsecured websites starting with www or http:// for online transactions.

• Don't share One Time Password (OTP) with anybody unknown via calls, chat, or emails.

• Don't share mobile numbers in commercial establishments and malls.

#### CONCLUSION

Cybersecurity is not a product to fix at one-time. It is a process that needs to be adopted and practised on a daily basis in the digital world. In the case of organisations, several safety measures are taken care of and regular audit and mitigation activites performed against cyberattacks. But in case of public, they have to protect their digital world on their own. Digital world is common to all the age groups of people, professionals, and criminals. Here, cyber criminals are well-trained compared with the common public. So, cyber criminals are easily creating traps and victimising individuals and organisations.

In the physical world, the triangle of public-police-criminals system is well established in society. If any offence happens in the physical world, everyone knows where to complain and how to deal with it. However, in the digital world, the imaginary triangle connection is not yet established. In general, the public may not have proper knowledge and guidance to deal with cyberattack incidents. The lack of cyber security awareness makes them victims of cyberattacks. In India, trained cyber se-



curity professionals are small in number to deal with modernised cyber attacks and cyber criminals. It is essential to increase the skilled workforce to prevent and protect the cyberspace environment from cyber attacks.

In the meantime, cyber criminals have a clear agenda and sophisticated tools and advanced technologies to carry out cyber attacks. In this situation, adopting the 'prevention is better than cure' strategy will help, even in the digital world. Any cyber incident has two parts: before and after. Following safety measurements before an incident is much easier than adopting the same after a cyberattack has already taken place. The public will be in a safety shield when they follow cyber security best practices.

Cyber security is a process which has to be adopted in our daily lifestyle to be safe at all times in the digital world.

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#### **PROFILE OF THE MONTH: DR NARAYAN CHANDRA RANA**

# A Genius Astrophysicist Almost Forgotten

In his short life, Dr Narayan Chandra Rana shot for the stars but his scientific achievements remain rather relatively unknown



Kalyan Kumar Ganguli

During the full solar eclipse of 1995, Dr Narayan Chandra Rana, the famous astrophysicist, was a headliner for all media houses as he was the most sought after teacher on solar system to students and amateur astronomers throughout India and abroad. Now, 27 years after his sad demise at the young age of 42 in the year 1996, his low presence in internet and no news in media about any programme in academic, professional and amateur astronomy circles in his memory suggests that we have almost forgotten him.

#### THE BIRTH AND UPBRINGING OF A CHILD PRODIGY

Narayan Chandra Rana was born on 12 October 1954, to a very poor family in a remote village named Sauri in Midnapur district of West Bengal, India. He excelled not only in various branches of astrophysics, but also took a leading role in science popularisation, text book writing, etc. In addition to science, he took interest in history, literature,



philosophy also.

His mother's name was Nakfuri and father, Rajendra Rana, was a brass smith. After preliminary education at home, he was admitted to Sauri Bholanath Vidyamandir. While studying in class VII, his father died all on a sudden. The possibility of disruption of Narayan's education was looming large. But the school secretary and teachers

mage Courtesy: midnapore.in

S& SCIENCE INDIA | OCTOBER, 2023

came forward to his rescue in view of his proverbial learning capacity. His school fees were waived off and he was accommodated in the school boarding, free of cost. To support the rest of the family — comprising another son and a daughter — his mother used to take up the job of maid servant occasionally, but never asked Narayan to discontinue education to help her.

After coming over to the hostel, Rana became close to his teacher Manindra Narayan Lahiri. Incidentally, Lahiri was an amateur sky watcher. Rana was his regular companion during night sky observations. Despite living in a mud-walled, thatched roof hostel room in such a remote village, Lahiri was updated on modern scientific developments. He indigenously built planispheres, binoculars, telescopes. Lahiri was equally efficient in writing books and articles on popular science in periodicals. A novel technique he devised for integrated finderscope was published in Sky and Telescope magazine of USA. He was the guiding spirit to Rana throughout his life. Years later, as Guru Pranam, Rana presented a 10-inch telescope from Germany to Lahiri. When Lahiri was in death bed from cancer, Rana nursed him. In loving memory of his late teacher, he formed Manindra Narayan Lahiri Memorial Astronomical trust at Sauri of which he was the president.

As a student, Rana was exceptionally meritorious. In 1969, he stood second in the West Bengal School Final examination and was awarded National ScholAfter coming over to the hostel, young Rana became close to his teacher Mahindra Narayan Lahiri, who was an amateur sky watcher and instilled a fascination for astronomy in Rana. Years later, when Lahiri was dying of cancer, Rana nursed him and started an astronomical trust in his memory in his native village

arship. At the initiative of his teachers — Lahiri sir, Nanda sir and the school secretary Nemaibabu, he was admitted at Presidency College, Calcutta, and accommodated at Ramkrishna Mission Vidyarthi Ashram at Belgharia in the city under the care of monks. His scholarship money covered all his expenses. He passed MSc in Physics from Calcutta University, standing second. At the Presidency College, Narayan was a dear student of renowned physicist Prof Amal Kumar Raychaudhuri (internationally famous for the equation in cosmology which bears his name).

#### **RESEARCH CAREER**

In the year 1977, Rana appeared in the Entrance Examination of Tata Institute of Fundamental Research (TIFR) for

Image Courtesy: IUCAA



Prof Narayan Chandra Rana at Summer Programme for school children at Inter-University Centre for Astronomy and Astrophysics (IUCAA) research fellowship. Out of 256 candidates, 17 were selected. Rana stood first and joined there. Rana was suffering from heart disease, 'Idiopathic Hypertrophic Sub-aeortic Stenosis with Complete Left Bundle Branch Block'. On 22nd October 1978, pacemaker was planted in his heart and the entire expense was borne by the TIFR.

At TIFR, Rana started his research work under the supervision of famous cosmologist Prof Jayant Vishnu Narlikar. Rana's research topic was, 'Cosmic Microwave Radiation'. He completed his PhD in 1981. The title of his thesis was, 'An Investigation of the Properties of Inter-galactic Dust'. His thesis was selected for Geeta Udgaonkar Award from TIFR as the best thesis for the year 1983 and in the same year, Dr Rana received INSA Young Scientist Award. His high end research on distribution of chemical elements in universe started from here. In the Physical Review Letters journal, his research paper - 'Relative abundance of lighter elements of molecule billing in early parts of Big Bang' - was published as a special paper.

According to the Big Bang theory, our universe began with an explosion of space itself. Starting from extremely high density and temperature, space expanded, the universe cooled, and the simplest elements formed. Gravity gradually drew matter together to form the first stars and the first galaxies.

In that context, how Hydrogen and Helium were formed within seconds of creation of universe from the tremendous energy and how other elements got absorbed in stars was Dr Rana's dear subject. He dedicated his thesis to Lord Ramakrishna. He was a very spiritual person in private, and would recite Sanskrit *mantras* loudly everyday while taking bath. Moreover, applied astrology, such as the effect of planets and stars on human beings, particularly on the menstrual cycle of women, drew his attention.

After the completion of doctoral work, Dr Rana was appointed as a Permanent Research Fellow. In the same year, 1983, Dr Rana joined Durham University in England for post-doctoral research under the supervision of the famous astrophysicist Prof Arnold Wolfendale. The topic of his research was, 'Chemical Evolution of the Galaxy'. During his stay at Durham, Dr Rana published 10 research papers on that subject and received two international awards, viz. the Commonwealth Bursary Award and SAARC Fellowship. His conclusion from that research is narrated below in his own words:

"Though most astrophysicists though that much of the universe was made of exotic particles in the form invisible so-called 'dark matter', all of that in the immediate neighbourhood of the sun could be in the form of nonluminous stars."

Completing his post-doctoral research work, Dr Rana returned to India on 2nd October 1985 and joined TIFR. A Britisher named Wilson, a doctoral student of Dr Rana at Durham, completed his thesis in India.

In 1986, Narlikar left TIFR and established his own research institute — Inter University Centre for Astronomy and Astrophysics (IUCAA) at Pune. On invitation from Narlikar, Dr Rana joined IUCAA from TIFR as an Assistant Professor. In the year 1996, he was Associate Professor of Radio Astronomy and Astrophysics.

#### PUBLICATION OF RESEARCH PAPERS AND BOOKS

Narayan Chandra Rana was a theoretical astrophysicist. In his research career of seventeen years, he published as many as 58 research papers (single/joint).

Those papers can be broadly classified into six major areas, viz. Astrochemistry, Stellar Astrophysics, General Theory of Relativity and Cosmology, Celestial Mechanics, High Energy Astrophysics, and Semi-popular works. Total citation for these publications received was 497, out of which five publications received citation in the range 51 to 72.

### Some of his books are detailed below:

1. *Classical Mechanics* by NC Rana and PS Joga. Prescribed as text book in MSc



(Physics) in India and abroad such as at Oxford University, among others.

2. *Our Solar System* by AW Joshi and NC Rana, widely used as a text book at college and university level and is really 'classical'. Prof Rana dedicated this book to his respected teacher Prof AK Raychaudhuri.

3. *Night Fall on a Sunny Morning* by N Vayada and NC Rana, a must read for amateur astronomers.

4. *Myths and Legends Related to Eclipses* by NC Rana, it explores scientific reasoning of the eclipses to alleviate superstition from public mind.

5. *Observers' Planner* 97 by NC Rana Besides the above, he wrote a book

in Bengali, titled *Ebar Surya Grohon*. It is reported that the publication of the following more books was pending: *Introductory Course on Astronomy and*  During his stay at Durham University, England, for his post-doctoral research, Dr Rana published 10 research papers on the topic, 'Chemical evolution of galaxy', and received two international awards, viz., the Commonwealth Bursary Award and the SAARC Fellowship



Astrophysics, Total Solar Eclipse, Nokstrer jonmo mrityu in Bengali.

#### OUTREACH PROGRAMME FOR STUDENTS AND GENERAL PUBLIC

With the natural ability of reaching out to the common man, Dr Rana was a very famous figure among amateur astronomers all over India. Anybody whoever had an opportunity to talk to him or hear him became infused by his relentless inspirations. He wrote hundreds of articles in print media, to alleviate superstitions on eclipses and to know the solar system.

He was the main architect of popularisation of amateur astronomy in India and was the Indian representative at International Astronomical Union (Teaching of Astronomy). He was chairman and instrumental in the formation of 'Confederation of Indian Amateur Astronomers' (CIAA), a platform for interaction of amateur astronomers of India.

One of Dr Rana's very challenging projects was of measuring the radius of the Sun through appearance and disappearance of Bailey's bead (minute speck of sunlight passing through hilly areas of moon), during the total solar eclipse on 24 October 1995. He involved a large team of young students selected from all over India, on the Delhi-Jaipur highway in Rajasthan over a distance of 8 km employing 66000 electronic devices and 400 photo detectors. The value of the radius of the sun with this new method as National Science Popularisation Award (posthumously), which included a citation and a sum of Rs 1 lakh. Dr Rana's mother, Nakfuri Devi, accompanied by a well-wisher, went to Delhi to receive the prize on behalf of late Prof Rana.

#### **POSITION OF HONOUR**

Dr Rana was made a fellow of Royal Astronomical Society (FRAS) in England and member of the International Astronomical Union (IAU). He held different posts of various organisations. He was Chairman, Scientific Advisory Committee, CIAA; Member, Education Sub-Committee, IAU; Coordinator,

One of Dr Rana's very challenging projects was to measure the radius of the Sun through the appearance and disappearance of Bailey's bead (minute speck of sunlight passing through hilly areas of moon), during the total solar eclipse on 24 October 1995

he found is 696500 km. (The uncrewed SOHO spacecraft was used to measure the radius of the Sun by timing transits of Mercury across the surface. The result was a measured radius of 696,342 +- 65 km, during 2003 and 2006. This corresponds to the value determined by Dr Rana way back in 1995).

#### **MAN PROPOSES GOD DISPOSES**

Dr Rana himself was confident about himself. He reported to have said to his teachers from his school days, "If I am able to live a few more years, I would shake the thoughts of Nobel laureates."

But he did not get that time. Between 21 June and 21 July 1996, Dr Rana delivered lectures in Italy, Poland, England and other places abroad. Soon after coming back to India, he fell seriously ill. He was admitted to a nursing home in Pune. At 8 am, on 22nd August 1996, Prof Narayan Rana started his eternal journey.

#### **POSTHUMOUS RECOGNITION**

In 1997, the National Council for Science and Technology Communication honoured him by conferring on him the Popularisation of Astronomical Society of India during 1993-95; Head, Science Popularisation and Amateur Astronomy, IUCAA.

#### **OBITUARY**

In the monthly newsletter *Khagol* of IUCAA, Dr Rana's PhD supervisor Prof JV Narlikar wrote: "Perhaps 'striving' is not the right word to describe the dynamic personality of Rana. His small stature and outwardly sedate demeanour hid a highly motivated and restless human being. I discovered this, right from the times when Rana joined me as a PhD student more than sixteen years ago, when we were both at the Tata Institute of Fundamental Research (TIFR), Bombay."

#### LEGACY

The sky observation centre at Midnapore College is named after Dr Rana, while the perforated dome at IUCAA, Pune, for watching night stars, was his brainchild.

\*The writer is a Sr Scientist (Retired), CSIR-Central Institute of Mining & Fuel Research, Dhanbad.

# How India's COVID-19 Vaccination Mission Became a Success



With the COVID-19 pandemic behind us now, here's a recap of how India, with the second highest population in the world then, and fewer resources than the developed nations, pulled all stops to contain the virus and successfully beat it

#### Science India Bureau

Success of India's COVID-19 response has a background of multiple programmes that the government of India had undertaken during 2017-18 to improve healthcare. To make India's health sector robust, economically affordable, and accessible, the National Health Policy 2017 was rolled out. Ayushman Bharat Program (ABP), the flagship healthcare initiative, was launched in 2018 as a mission to expand universal health coverage, with a commitment to 'leave no one behind'.

One of the components of ABP, the Pradhan Mantri Jan Arogya Yojana (PMJAY) had begun to expand the footprint of healthcare coverage to rural and vulnerable populations, improving access to hospitalisation services at secondary and tertiary level health facilities for bottom 40% of the total population. The second component of ABP was Health and Wellness Centers (HWCs), launched on 14 April 2018, and by 31 March 2020, a total 38,595 Ayushman Bharat-HWCs were operational across India. Besides, digital health initiatives had begun to evolve simultaneously. These initiatives of the government, led by Prime Minister Narendra Modi, as chairman of NITI Aayog, were significant catalyst developments in fight against the pandemic. Thus, the apex level organisational setup existed wherein NITI Aayog was already actively engaging with the Ministries of Health and Family Welfare and AYUSH, the Department of Pharmaceuticals, the National Health Authority, state and local governments, in addition to international and national academic institutions and research organisations. Therefore, it is important to underline the fact that India's healthcare system was prepared to take on the challenge.

#### DISTURBING SIMMER OF MYSTERIOUS VIRUS

Earliest indications of an inexplicable pneumonia outbreak in Wuhan seafood market had alerted the Indian intelligence and the PMO in December 2019. On 31 December 2019, WHO got to



know of the cases of unknown cause and by 3 January 2020, 44 cases of hospitalization were reported in China. In parallel, PMO entrusted the responsibility to collate the information to Dr VK Paul, Member NITI Aayog, and Prof K Vijay Raghavan, Principal Scientific Advisor. As the first case of COVID-19 was reported outside China on 13 January 2020, India began thermal screening at airports for passengers coming from China on 17 January 2020.

By the first week of January 2020, the Chinese theory of animal-to-human transmission was being contested as the doubling rate of infection could not be explained and hence, the human-tohuman transmission became a cause of worry. This raised an intrigue that Wuhan Institute of Virology (WIV) was not far from the market. As the COV-ID-19 became national news in China on 20 January 2020, WHO declared it a Public Health Emergency of International Concern. Initial apprehension that WIV had connection with outbreak gained ground as the WIV lab had been engaged in research related to SARS coronavirus since 2005 and had isolated over 300 horseshoe bat coronavirus sequences. Later, it was found that the December 2019 coronavirus cases had 96% genetic similarity to RaTG13 virus found in horseshoe bats. Although the role of WIV continues to be controversial, the early belief on the animal-mantheory of spread had proven correct for India's science-based thinking. India reported Patient Zero on 23 January 2020 at Thrissur who had a history of train travel in China. The monster had made it to India.

India had already got its act together and by 27 January 2020, 30,000 incoming international passengers had been screened. Realising the magnitude staring at us, the government banned export of PPE kits on 31 January 2020. By late February, virus had spread and engulfed Italy, Asia and the Middle East.

#### **FIRST WAVE STRIKES**

On 4 March 2020, 15 Italian tourists tested positive in Delhi and were quarantined at ITBP camp. While the modelling of COVID-19 progression was being undertaken, on the same day, the government decided to upscale Virus Research and Diagnostic Labs (VRDLs) testing facilities from 14 labs in February to 106 in March 2020. VDRL platforms provided support in handholding new laboratories for testing. Fourteen Centers of Excellence mentored approximately 300 medical colleges and finally by August, the nation had 1596 labs in India. To further meet the needs of the country, indigenous point-of-care testing was developed such as TrueNat and CBNAAT. In parallel, over 1200 NABL accredited (under ISO 1515189) private sector laboratories were rolled out. This was further augmented by point-of-care antigen testing kits which could give results in 30 minutes. And hence, the 'test, track and treat' became a new strategy. To take the testing material to every nook and corner of the country, 'Mission Lifeline Udan' transported over 40 tons of load in 150 flights during lockdown. The nation was at work!

On the other hand, on 4 March 2020, India began to brace up its might from a stockpile of only 3.35 lac N95 masks, only 2.75 lac PPE kits and only 20000 ventilators. Needless to say, India had no manufacturing capability on 4 March!

On 13 March 2020, Tablighi Jammat held a gathering of 9000 missionaries at Nizamuddin Markaz in New Delhi. Around 800 of these had participated in the congregation at Malaysia which was known as 'super spreader event' and Malaysia had to close its borders after this event. While the government banned a gathering of more than 50 persons in religious places, Tablighi attendees stayed put and some made way to other parts of India. Tablighi Jammat event possibly was the first 'Super Spreader Event' in India.

On the same day, 13 March 2020, Prime Minister called upon the SAARC nations for a collective resolve and said, "I would like to propose that the leadership of SAARC nations chalk out a strong strategy to fight Coronavirus. Together, we can set an example to the world, and contribute to a healthier planet." Important point to note is that the call to SAARC leadership was in true spirit of Vasudhaiv Kutumbakam which India lived to its commitment when under Vaccine Maitri, doses were given to other developing countries even when we were ramping up supplies to India citizens. And, it was a foresight proven correct that COVID-19 fight is a global challenge and must be fought together. Most nations realised this approach much later, if they actually did.

India soon realised the need for strategic decision to control acceleration of case load and 'flatten the curve'. It was most essential to make lacs of hospital beds, ICU beds, stockpile ventilators and muster healthcare workers for the surging onslaught. The idea of locking down had germinated as the indications of imminent impact were clear. Dow Jones crashed, Sensex began to crumble and events began to be cancelled. On Sunday, 22 March 2020, the partial lockdown was declared by the Prime Minister in the spirit of Jan Bhagedari. The PM introduced 'Social Distancing', carefully nuanced in Hindi as 'Do Gaz ki Doori', to reflect positive connotation which became the norm later. Two days later, on 24 March 2020, at 8 pm, the Prime Minister called for a complete lockdown of the entire nation for 21 days. At that time, most nations were in a quandary and the world recognised this step taken by India as most appropriate and timely.

#### VACCINE DEVELOPMENT

Globally, it is a recognised fact that the development of a vaccine can take over 15 years. India took up the task of developing COVID-19 vaccine, standardise assays, trial designs, regulatory approaches, selection of vaccine candidates, manufacture, distribution and actual vaccination at the inception of the pandemic in the country. India was quick to realise the need for development of vaccine and had confidence of its robust capacity for vaccine development. India had a successful vaccine and vaccination legacy for polio, cholera, measles, diphtheria and meningitis. India had a pioneering record of firsts in vaccine manufacture. Serum Institute of India (SII) developed first meningitis vaccine, Bharat Biotech International had launched typhoid conjugate vaccine, multi-dose inactivated polio vac-

| VACCINE                        | COLLABORATION   | NATION               | TYPE OF VACCINE  |
|--------------------------------|---|----------------------|--|
| Sputnik V                      | Gamaleya Research<br>Institute of Epidemiology<br>and Microbiology along<br>with the Russian Direct<br>Investment Fund (RDIF) | Russia               | Adenovirus vector<br>vaccine   |
| PiCoVacc                       | Sinovac Biotech   | China                | Inactivated and mixed with adjuvant  |
| AD5-nCoV                       | CanSino Biologics   | China                | Adenovirus-based   |
| ChAdOx1-n<br>CoV-19/Covishield | AstraZeneca/Oxford<br>University produced by<br>Serum Institute of<br>India (SII)   | Britain and<br>India | Non-replicating<br>adenovirus type 5<br>vector vaccine   |
| BBV152/COVAXIN                 | Bharat Biotech in<br>collaboration with<br>ICMR and NIV (Pune)  | Hyderabad,<br>India  | Inactivated whole<br>virion candidate<br>vaccine   |
| ZyCoV-D                        | Zydus Cadila  | India                | DNA plasmid<br>vaccine   |
| NVX-CoV2373                    | Novavax vaccine<br>manufactured by SII,<br>India, with annual<br>production of a<br>billion doses                             | USA and<br>India     | Glycoprotein<br>sub-unit<br>(recombinant<br>protein)<br>nanoparticle<br>adjuvanted vaccine<br>(matrix M) |
| BNT162                         | Pfizer/BioNTech   | USA                  | Three lipid<br>nanoprotein mRNAs   |

cine launched by Bilthoven Biological, first fully liquid hexavalent vaccine based on whole cell pertussis developed by Panacea Biotech of India and so on. Besides, India was the only country to have over 23 pre-qualified vaccines! The 'Atmavishwas' had a reason to take lead.

As early as 19 March 2020, CO-VID-19 Research Consortium was announced jointly by the Department of Biotechnology and Biotechnology Industry Research Assistance Council (BIRAC). BIRAC eventually supported Mission COVID Suraksha and pledged Rs 900 crore for the programme. Proposals were invited for devices, diagnostics, vaccine candidates, therapeutics, and other interventions. In respect of vaccine development, three proposals were recommended for funding.

The proactive partnership in development of vaccine began to give dividends when DCGI granted first approval for Phase I and II Human Clinical Trials in July 2020, just within four months of the first wave. Compared to international vaccine development timelines, Moderna and Pfizer were marginally ahead of Indian candidates and published their Phase I and II trial results on 14 July and 12 August. It is pertinent to mention that Indian vaccine and vaccination programme was already in the very advanced stage before second wave struck in December 2020.

While vaccine was still about five

months into its vaccination phase, the aggressive planning for the vaccine administration was announced on 15 August 2020. By now, the leadership of the nation was confident and began preparation for taking Suraksha Kavach to the people. It is important to note that the nation was still fighting the surging COVID-19 cases, hospital capacities and the public pressure on its healthcare delivery capacity. It is only through the convergence efforts of the union and state governments, with the partnerships with private players, that the nation was saving its people. In fact, the entire nation was unified in its resolve.

On 29 September 2020, SII declared partnership with Gates Foundation and GAVI to deliver 200 million doses by 2021. On 15 October, the Prime Minister chaired a review meeting for vaccine research and development. When India released the COVID-19 Vaccine Communication strategy on 30 December 2020, US FDA had just authorized Pfizer for emergency use on 11 December and UK gave the same approval to AstraZeneca on 30 December 2020. For India, the big day came on 3 January 2021 when emergency use approval was granted to Covishield and COVAXIN. Finally, India rolled out two of its own vaccines in Vaccination Phase on 16 January 2023. Dr VK Paul, who was at the forefront of the COVID-19 crisis from day one, took the shot on the very first day and dispelled the apprehensions of 'vaccine hesitancy', displayed the confidence on the achievement of the nation. India rolled out its vaccination drive in a little over 10 months. To have four out of the top eight COVID-19 vaccines from India is the greatest contribution of Indian science community.

The Nobel Prize 2023 in Physiology or Medicine has been awarded to Kata-

To have four out of the top eight COVID-19 vaccines from India is the greatest contribution of the Indian science community



Source: https://ourworldindata.org/covid-vaccinations

lin Karikó and Drew Weissman for their discoveries concerning nucleoside base modifications that enabled the development of effective mRNA vaccines against COVID-19. However, Indian scientific, medicine, vaccine collaborations, vaccination programme leadership and participants in delivery system deserve greater recognition.

#### THE VACCINATION DRIVE

Vaccination in India was certainly not an easy task. The meticulous preparation to reach geographically diverse locations, inaccessible, challenging terrains had started as early as 15 August 2020 while the actual vaccination drive stated on 16 January 2021. Vaccination drive of India was the biggest, unparalleled and historic in the world and over 220 crore doses were administered, the fastest ever. Indian vaccination program saved 34,00,000 lives due to its vaccination programme as reported in an independent Lancet research on modelling by Stanford University and the Institute of Competitiveness. User interface, vaccination certificate and entire monitoring became possible in real time without digital support. To ensure that no one was left out, CoWIN digital platform was conceived as the robust backbone for India and offered to other

countries as well. Vaccine administration has been nearly equal by gender. Covishield was administered the most, followed by Covaxin and Corbevax in very limited doses.

India started to export vaccines as Vaccine Maitri initiative and delivered 16.29 crore doses to 96 different countries as humanitarian assistance. The cost of Indian vaccination was under 3 USD, lowest as compared to other developed nations with efficacy of Covishield as nearly 90%, Covaxin as 78% and Corbevax >90%. Adverse Events Following Immunisation (AEFI), the complications reported after receiving the vaccine in India, was around 0.006 per cent while in the US it was 0.2% and in UK it was 0.7% as per affidavit filed by the government in the Supreme Court of India.

Vaccine development and vaccination were the perfect examples of Atmanirbharta, executed with Atmavishwas and in the spirit of Vasudhaiv Kutumbakam.

\* This article is based on excerpts from the lecture, 'COVID-19 Vaccine Journey: Lessons in Science and Delivery', given by Dr VK Paul, Member, NITI Aayog, at INSA, New Delhi.



#### **SPOTLIGHT: PADMA SHRI CHERUVAYAL K RAMAN**

# **Nurturing the Legacy of Traditional Rice Varieties**

Cheruvayal K Raman, awarded the Padma Shri this year, has preserved 50 varieties of rice that were grown in the Wayanad region of Kerala, most of which have disappeared from cultivation



Clockwise from top left: Cheruvayal K Raman (second from left) with his wife and children; author with Cheruvayal K Raman at his house in Wayanad; Raman's son Ramesh involved in seed separation work; baskets made of Ochlandra sp. (a species of bamboo) used to store seeds before lack of space forced Raman to use gunny bags



#### Dr Biju Dharmapalan

heruvayal K Raman, a septuagenarian tribal farmer from the Wayanad district of Kerala, is fighting a oneman effort to conserve the remnants of traditional varieties of rice. Once, the region was a repository of rice and millet varieties. According to Raman, known locally as 'Vithachan' (father of seeds), there were more than 100 rice varieties in the region. Many varieties have been lost due to the Green Revolution, he says.

In the Green Revolution, scientists focussed only on hybrids, they totally neglected the traditional varieties of crops present in our country. Even the traditional rice varieties collected in the name of conservation by our scientists are deposited in gene banks abroad (at International Rice Research Institute, the Philippines). Local people don't have access to the varieties taken by our scientific community. If it is to be stored in seed banks, what is the purpose of conservation? Conservation will be meaningful only if conserved varieties are cultivated by the common man, says Raman. The seeds of rice varieties have a shelf life of about eight months only, after that germination quality deteriorates. If we want to conserve the germplasm we need to grow them every season. What is the use of keeping the seeds in seed banks and cryobanks, like keeping money in a bank locker? The custodian, the farmer, is not aware of where these seeds are kept and how they can retrieve them.

#### **CONSERVING LOST RICE VARIETIES**

Raman has developed a model for conserving the varieties he holds. He will give seeds free of cost to the local farmers on condition that they need to return the same amount once the plant is harvested. He has tried to save nearly 60 varieties in his lifetime through this practice, but today he has only 50 varieties in his custody. In earlier days, he used to store these seeds in baskets made of bamboo (Ochlandra sp.), but now he stores them in gunny bags, due to lack of space. According to Raman, the custodian of traditional varieties are the farmers and scientists have no right to that.

Even though he appreciates the advances in science and technology, he has a lot of apprehensions when it comes to the food sector. He attributes

the increasing incidence of diseases to our dependence on hybrid rice varieties. All these hybrid varieties focus on increasing the quantity and not the quality. The metabolites and the metabolic processes themselves get changed which is not good for human health, says Raman. Moreover, these hybrid varieties promote increased usage of fertilizers and pesticides which directly come to our food chain, making everyone in the diseased state lifelong, he adds. Not only that, it also badly affects our ecosystems destroying other useful life forms that are important in improving crop productivity. Chemical fertilisers kill all the fish, insects, earthworms, frogs, and reptiles found in our paddy fields. Not a single agriculture scientist has spoken a word against that. What is the use of increasing productivity by spilling toxins into our environment and our body?

#### SOCIAL RESPONSIBILITY OF SCIENTISTS

Also, the polished rice varieties that most people consume are not at all good for health. We need to eat unpolished rice with bran in it. He says that the youthfulness of today's generation is lost even before reaching middle age because of change in our dietary habits. Scientists should have social responsibility, but most of the time they forget that. Otherwise, how can one suggest toxic food items to the public? Scientists have created a scene where they make the public feel that without pesticides or hybrids, one could not increase the productivity of crops. This is utter nonsense, says Raman. Nature has answers to every problem, the only thing is we have to observe and feel the pulse of nature. Unfortunately, our scientists lack that skill.

If we manage the cultivation of traditional rice varieties systematically by rotating long and short-duration varieties, we can have a continuous supply of rice throughout the year. Also, there are traditional varieties like 'Navara' that are highly medicinal. Most of these rice

Di Tana In

THE REAL

varieties are flood and droughtresistant and have the strength to fight climate change adversities, says Raman.

#### FIGHTING FOR PRESERVATION

For Raman — popularly called Ramettan — who belongs to the Kurichya tribe, agriculture is in his blood. The historical figure Thalakkal Chanthu, an archer and commander-inchief of the Kurichya soldiers of the Pazhassi Raja who fought British forces in the Wayanad jungles during the first decade of the 19th century, was his maternal uncle. The Kurichivas still continue to uphold the practice of matriarchy, so neither his children nor his wife have inheritance rights for his property. Raman fears that after his demise, individuals residing outside the region of Wayanad, who lack any affinity for agri-

cultural practices and the conservation of seeds, will assume ownership of this land. He fears this may ultimately lead to losing the valuable resource he has preserved over the years.

A school dropout who studied up to Class 5, and who knows only Malayalam, Raman has travelled to different parts of the country and even a few foreign countries like Brazil, and Arab countries, as an invitee. He was an invited delegate to an international symposium organised by the Federal University of Parà, Brazil, in association with the Museum Paraense Emilio Goeldi and the International Society of Ethnobiology, on the challenges faced by indigenous people and the sustainable use of biodiversity. According to Raman, he has not seen any other country like India that maintains rich diversity in culture and that is secular to the core.

He has won several recognitions including the prestigious National Plant Genome Saviour Award instituted by the Protection of Plant Varieties and Farmers Right Authority in 2016, and the coveted Padma Shri in 2023. Even though he is thankful to authorities for

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From top: The list of rice varieties conserved by Raman; Receiving the Padma Shri from President of India Droupadi Murmu this year

bestowing these recognitions, these don't bring changes in society. "Every year, I suffer a loss in cultivating and preserving these seeds. My family even doesn't hold the right to the property or house. Even the traditional ancestral house I maintain needs huge effort in preservation. Nobody understands our pain and suffering. Even I don't have a good room to keep all these accolades you are conferring on me," reminds Raman.

Raman has a printed list of 50 varieties of seeds in Malayalam, that he has been preserving since 1962 for future generations to refer. Some rice varieties in his custody are more than 500 years old and have been inherited over generations. The list includes both long-duration like 'Veliyan', 'Chentadi',' Chembakom', etc., that give yield at 180 days and short-duration varieties like 'Karanthan', 'Navara', 'Punnadan Thodi', etc., which give yield within 90 days. He knows that his efforts would go in vain if government agencies don't take over his mission to conserve and propagate traditional varieties.

The tribal communities hold a repository of knowledge that has been gathered through generations, and no scientists can ever provide for humanity. Since most of this knowledge is inherited orally and within the community, it is challenging to document it completely. Raman wants the government to develop 'Heritage Villages' by providing incentives to the community, to protect and preserve this identity and culture. These villages can showcase the tribe's culture, knowledge, practices and even the products developed by them. Tourists can visit these villages as part of the ecotourism project by paying a fee. When science and scientists fail, nature will provide answers to problems humanity faces, that can be provided only by our tribal community. Raman practices the Gandhian principle: 'The world has enough for everyone's needs, but not everyone's greed' in his life.

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#### SCIENCE AND SPIRITUALITY

# The Mantra 'Om' Science, Spirituality and Philosophy in Vedas

Scientific studies have shown the immense power unleashed by the chanting of 'Om', which induces calm, a phenomenon that Indian seers had deduced centuries ago

Image Courtesy: Shutterstock



Prof VPN Nampoori

lbert Einstein once said, 'Everyone who is seriously involved in the pursuit of science becomes convinced that a Spirit is manifest in the Laws of the Universe — a Spirit vastly superior to that of man, and one in the face of which we, with our modest powers, must feel humble.'

Many thousands of years ago, our culture was not broken into fragments as it is now. At that time, science and spirituality were not separated as discussed by Indian rishis and knowledge developers. Modern physics really suggests that everything is thus internally related to everything else. We are internally related to the whole. It could be said that science, art, and spirituality are the principal content of culture. Mandukya Upanishad discusses the theory of four states of consciousness; and asserts that Aum is Brahman - and that Brahman is this self, Atman; Aham brahmasmi, one of the Maha Vakyas). The word 'Om' represents Brahma in the sabda form and is described as Barthrhari in his Vakyapadiya. The present article discusses the fusion of science, spirituality and philosophy as revealed in the mantra 'Om'.

#### INTRODUCTION

History of Indian knowledge generation as is known as from the written documents started from the 8th century BC with the *Sulbasutras* by a school of Sulbakaras like Katyayana and Apastambha. In contrast, the beginning of Science as knowledge generation started in the west during the 17th century with the works of Galileo and later on with those of Isaac Newton. For example, the west learnt of the seven colours of rainbow with Newton's famous demonstration of dispersion of sunlight by a triangular glass prism, whereas, Varahamihira in the 6th century AD described the formation of rainbow caused by dispersion of sunlight by water droplets present in air just after a rain (see below).

#### सूर्यस्य विवधवर्णाः पवनेन विघट्टिताः कराः साभ्रे । वियति धनुः संस्थानाः ये दृश्यन्ते तदिन्द्रधनुः ॥ — *Brihat Samhita*, Varahamihira, 6th

century AD Classical Physics in the west origi-

nated with Newton and it has two fundamental components, namely, the observer and the observed. For an observer, there is the world out there to be perceived and the act of observation will not disturb the observed. This led Newton to develop theoretical and experimental works based on the existence of absolute time and space. The situation did not change for the next two-and-ahalf centuries till Max Planck led a revolution by creating new physics through energy quantization while discussing the unsolved problem of black body radiation. This revolution caused a paradigm shift with the entry of Albert Einstein who published three papers in Annalen der Physik, namely, 'Theory of Brownian motion', 'Theory of photoelectric effect' and 'Special theory of relativity'.

Quantum theory, which was seeded by Max Planck and helped germinate by Einstein grew to a tree of different branches to be called Quantum Mechanics, or the Physics of the micro world. The arrival of quantum mechanics (QM) destroyed the dichotomy of the observer-observed system with the observer influencing the observed. This caused Heisenberg to introduce the famous uncertainty principle which be-

The west learnt of the seven colours of rainbow with Newton's demonstration of dispersion of sunlight by a prism, whereas Varahmihira had done the same earlier in the 6th century AD came the foundation of QM along with Schrödinger's wave equation. The foundation of QM rests on the concept of operator, state of the system defined with a function (called wave function), eigen value (probable result of the outcome of the observation). Prior to the actual performance of an experiment, observer can predict all the possible outcome of the experiment with specific probability of occurrence. However, once the experiment is performed, all the probable outcomes vanish except one, namely the result of the experiment and there is no longer any ambiguity. One can think of that as one system which has different manifestations and one can realise the reality once the observation is made.

#### **KNOWLEDGE OF DIFFERENT FORMS**

Ever since man appeared on the scene on the earth as a thinking specie ('I think, therefore I am' said René Descartes), many questions have arisen in his mind like who am I, whence I came, whence I go, what is death, who is the controller of this entire universe, is there something hidden behind the visible universe? He explores the universe to get answers using his five senses to get knowledge about what he observes directly - knowledge Prathyaksha. From Prathyaksha, he infers knowledge using his mind as instrument which is hidden knowledge - knowledge Paroksha. Conclusions drawn from the acquired knowledge result in what is called scientific reality based on which he judges the world. Better and better knowledge is obtained using better instruments. For example, X-ray machine will reveal the knowledge beneath the skin and getting the horizon of the knowledge expanded. Thus Prathyaksha together with Paroksha knowledge provide what forms scientific reality (SR).

Philosophers define another type of knowledge revealed instantly and immediately to a specially trained mind — knowledge Aparoksha of which scientific reality is a subset. For scientific reality, universe is not an open book, the more we uncover the secrets, horizon of knowledge recedes farther and farther. Man describes the universe through five



Varahamihira, the renowned mathematician/ astronomer who lived in Ujjain in the sixth century AD, described dispersion of sunlight in his treatise *Brihat Samhita* 

senses based on Panchabhuta — earth (Prithvi), water (Jal), fire (Agni), ether (Akash), and the fifth at a higher plane, namely Sat. Sat is the first cause of all evolution which is named in Indian philosophy as Parabrahma — the Absolute. It is through highly trained mind that the absolute reality is realised. It is the highest spiritual truth and in fact, is the TRUTH as it is. As Max Muller puts it, our inner life is more perfect, more comprehensive and more universal, in short, more human — a life transformed to eternal life. This is Brahma Bhava described by Shankaracharya.

According to Shankaracharya, Brahma is formless and we all are part of that infinite consciousness and our ultimate goal is to unite with that consciousness. Adi Shankracharya remarked that the ultimate truth is formless but various forms of gods are actually the expression of that formless energy and hence by worshipping our gods and deities, we are actually worshipping the infinite. Brahman, according to Shankaracharya, is the cause of the origination, subsistence and dissolution of the world which is extended in names and forms with characteristics: (1) This world must have been produced as the modification of something which is itself omnipresent and omnipotent. (2) The world is so orderly that it could not have come forth from a non-intelligent source. Brahman is the intelligent source. (3) This Brahman is the immediate consciousness which shines as the self and also through the objects of cognition which the self knows. The word OM represents Brahma in the sabda form and is described as such by Brathrihari in his Vakyapadiya (Vakyapadiya I,1; I, 20):

#### अनादिनिधन ब्रह्म शब्दतत्त्व यदक्षरम् । विवर्ततेऽर्थभावेन प्रक्रिया प्रक्रिया जगतो यत ॥

That beginningless and endless One, the imperishable Brahman of which the essential nature is the Word, which manifests itself into objects and from which is the concern of the Universe

#### यत्र वाचो निमित्तानि चिह्ननोवाक्षरस्मृतः । शब्दपूर्वेण योगेन भासन्ते प्रतिबिम्बवत् ॥

In which the symbols of speech, pointers as it were to the 'one letter scripture' (Om) shine forth like reflections in association with that (i.e., Om) which is antecedent to all (manifested) speech,

#### OM, THE MAHA MANTRA DESCRIBED IN MANDUKYA UPANISHAD

The Mandukya Upanishad is one of the several Upanishads that discusses the meaning and significance of the syllable Aum (Om). In the following sections, let us now explore OM as described in Mandukya Upanishad. The Mandukya Upanishad opens by declaring, 'Aum!, this syllable is this whole world'. With four fold structure derived from A + U + M + 'silence' (or without an element) in verses 3 to 6, the Mandukya Upanishad enumerates four states of consciousness: wakeful, dream, deep sleep and the state of ekatma (being one with Self, the oneness of Self) These four are A + U + M + 'without an element' respectively.

The verses 3 through 7 discuss four states of Atman, which can be summarized as these four states of Self, respectively, as seeking the physical, seeking inner thought, seeking the causes and spiritual consciousness, and the fourth state is realising oneness with the Self, the Eternal. The *Mandukya Upanishad* describes three states of consciousness, namely waking (*jagrat*), dreaming (*svapna*), and deep sleep (*sushupti*), and 'the fourth' (*turiya*) beyond and underlying these three states.

The Om mantra is a mahamantra with a single letter but is also labelled as the monosyllabic Brahman in the Shrimad Bhagvadgita. The sage of this mantra is Parabrahman, the deity Parmatma and the rhythm (chanda) Gayatri. The mahamantras from the Vedas, Upanishads, etc. and also the efficacious (siddha) mantras and names denoting 'the Lord' are the varied forms of this Omkar. When chanting every mantra, it is essential to start it with the Om mantra, also known as Omkar. 'The scriptures describe the *pranav*, that is, Om mantra as the 'monarch of mantras'. It is considered as the symbol or representation of the individual soul.

#### **OM: SCIENTIFIC STUDIES**

Scientific studies have shown that when OM is chanted, an alpha wave is produced within the brain. This wave produces a state of calm.

Let us look at the phonetics of the word OM. According to *Mandukya Upanishad* (Johnston, 1923), OM is the manifestation of all states of time, Atman, consciousness and knowledge. In Sanskrit, the sound "O" is a diphthong spelled "AU". A diphthong is a mixture of two vowel sounds and can be separately heard. This is why OM sounds "AUM", which represents the 3-folds division of time. The figures given above give a scientific analysis of the vibrations produced by the chanting of 'OM'.

#### CONCLUSION

In AUM, A (*apti*) represents the waking state (symbolises darkness, inertia,





Fig 1. Vibration representing syllables of OM; Fig 2 Spectral analysis of Vedic mantra OM (AUM) (Devi, HJ, Swamy, NVC, and Nagendra, HR (2004), 'Spectral analysis of Vedic mantra', *International Journal of Traditional Knowledge*, 3, p. 154–161

ignorance). U (*utkarsha*) represents the dream or creative state (symbolises passion, activity, dynamism). M (*miti*) represents the state of deep sleep or meditative state (symbolises purity, truth, light). Om is also called Pranava, meaning it sustains life and runs through the breath or Prana. The 'O' or 'AU' sound makes all the bones of

The 'O' or 'AU' sound in OM/ AUM makes all the bones of the thoracic cage vibrate, leading to the vibration of lungs and to the delicate membranes of the alveolus. This enables proper exchange of air in lungs the thoracic cage vibrate, which leads to the vibration of lungs and finally to the delicate membranes of the alveolus. This can stimulate pulmonary cells and enables a proper exchange of air in the lungs. These vibrations produce a much accentuated effect in the endocrine glands. This leads to the balance activation of several glands and organs. Besides this vibrational message, which results from the emission of the vowels 'AU', the latter acts especially in the abdominal and thoracic cage, whilst the vibration of 'M' in the skulls induces a vibration of the cranial nerves.

mage Courtesy: VPN Nampoori

\*The writer is visiting professor at the International School of Photonics, Cochin University of Science and Technology, Kochi; Kerala University, Thiruvananthapuram, and MG University, Kottayam. He can be reached at nampoori@gmail.com.

#### **BOOK REVIEW: THINKING OF CLIMATE CHANGE...**

# Decoupling Urban Construction and Carbon Emissions

Offering a fresh perspective on the ubiquitous topic of climate change, the book challenges readers to revaluate their understanding of construction practices and their consequences on the world we inhabit

The book, *Thinking of Climate Change...* by Prof Virendra Kumar Paul and Devika Nayal, ignites a thought-provoking debate on the pressing issues that shape our journey towards 'Amritkaal' and the foundation of 'Viksit Bharat @ 2047'. This book echoes the visionary spirit of Mission LiFE, introduced by Prime Minister Narendra Modi at the 26th UN Climate Change Conference of the Parties (COP26) in Glasgow in 2021.

In this vibrant discourse, the book raises crucial questions about our collective responsibility in the face of emerging global challenges, particularly the formidable issue of climate change. As we march forward, it beckons architects, planners, science educators, engineers, heritage and environmental conservationists, and climate change experts to contemplate their roles and responsibilities in this unfolding narrative. It is an invitation to consider the implications of climate change and to explore how we can collectively navigate this crucial juncture in our quest for a sustainable and resilient future.

The authors' writing is marked by a



Sanjay Bhandari

keen focus on the environmental impact of construction. They incisively point out that construction is an essential human activity, yet it is also an insatiable consumer of natural resources. The book draws attention to the fact that as long as human civilization exists, the need to build and expand will persist.

#### DECONSTRUCTING CONSTRUCTION INDUSTRY

The book commences with an exploration of the fundamental concepts of consumers and consumption within the construction industry. It underlines the importance of understanding that construction materials and practices are deeply interconnected with the consumer's needs and desires. The authors aptly question the prevalent disconnect



Thinking of Climate Change... Prof Virendra Kumar Paul and Ms Devika Nayal, Rs 200/-

between consumers and the design and construction process, where economic returns often take precedence over sustainability. This chapter serves as a foundation for the book's overarching theme of re-evaluating our approach to construction and consumption in light of climate change. By questioning the sustainability of the ongoing construction boom, the book encourages readers to reconsider the blind pursuit of territory expansion. It's an upsetting reminder that more isn't always better, especially when it comes to natural resources.

The chapter, 'Heritage of Jal-Jangal-Jamin' (water-forest-land) takes a step back to appreciate the invaluable contributions of indigenous Himalayan cultures and their deep-rooted respect for ecology. By highlighting the heritage of 'Jal-Jangal-Jamin', the book underscores the need to integrate traditional wisdom into contemporary practices. It emphasises that recognising the profound knowledge embedded in indigenous cultures can provide valuable insights for tackling modern climate challenges.

One of the book's key highlights is its detailed examination of construction

materials and practices, with a particular focus on the Himalayan region. The narrative highlights the prevailing practices of masonry and concrete hybrid buildings, which rely heavily on clay bricks, cement, sand, aggregate, and reinforcement steel. These are portrayed as the primary choices for construction, underscoring the inherent challenges of resource scarcity in certain regions. The construction industry is a major consumer of the Earth's natural resources. In the recent past, due to tourism development, infrastructure expansion, and haphazard construction in ecologically sensitive areas like the hilly towns of Himachal Pradesh and Uttarakhand, the negative consequences of disorganised building practices and reliance on global materials have become glaringly evident. This raises crucial questions about the availability and sustainability of these materials in the long run. This has shown the results during the recent monsoon seasons when heavy rains caused severe damage in Himachal Pradesh and Uttarakhand. Many new buildings couldn't withstand the heavy rainfall, while some old temples and houses, constructed using traditional methods, remained resilient.

#### CHALLENGES POSED BY URBANISATION

This book encourages a shift toward a more positive and proactive stance regarding climate change. It underscores the importance of validating demands for sustainable solutions and the necessity of addressing them. The book's discussion on the urban heat island effect highlights the environmental challenges posed by urbanisation. It explores the direct influence of technological advancements on local cultures and social values and emphasises the importance of efficient land use and public transport in decoupling urban development and carbon emissions. Through an analysis of historical trends and current urbanisation processes, the book explains the heat island effect's detrimental consequences. The author argues that as cities grow and urban landscapes expand, the urban 'hot spots' intensify, necessitating



A snapshot depicting the havoc wreaked by floods in Uttarakashi in 2013

increased air-conditioning use, which, in turn, exacerbates the heat problem a vicious cycle that is difficult to break.

Furthermore, the book delves into the potential of hydroelectric power in India. It acknowledges the promise of this alternative energy source but also explores the environmental issues that have arisen from large-scale dam construction, which includes submergence of areas and ecological degradation. The authors underscore the necessity of a comprehensive assessment that considers both economic and ecological impacts.

In summary, *Thinking of Climate Change...* provides a thought-provoking and optimistic perspective on climate change action and narrates how we can create a sustainable future by tapping into ancient Indian wisdom. Empha-

> During the recent heavy rains in Himachal Pradesh and Uttarakhand that caused severe damage, many new buildings couldn't withstand the rainfall while old temples and houses remained resilient

sising on need of incorporating lessons from traditional knowledge systems and promoting a more positive approach to sustainability, the book offers a valuable guide for individuals, communities, and organisations seeking to make a positive impact in the fight against climate change. It presents a holistic way forward that integrates traditional wisdom and modern knowledge to address one of the most pressing challenges of our time. The authors' focus on sustainability, resource scarcity, and the repercussions of urbanisation makes this book an essential read for anyone interested in environmental issues, sustainable construction, and the future of our planet. This work challenges readers to revaluate their understanding of construction practices and their consequences on the world we inhabit. It underscores the critical importance of judicious material choices in construction, which is fundamental not only for preserving traditional practices of construction but also for creating robust, disasterresistant structures. It reminds us that our Bhartiya heritage carries valuable lessons on how to coexist harmoniously with our environment. Therefore, it is imperative to regard these lessons as we work towards a more sustainable and resilient future.

> \*The writer is Assistant Professor, School of Planning and Architecture, Vijayawada.

#### YOUNG SCIENTIST: DR MADDIKA SUBBA REDDY/ SSB PRIZE FOR BIOLOGICAL SCIENCES, 2022

# **How Protein Talks Inside Cells**

Dr Maddika Subba Reddy and his team are researching on the communication between proteins that are most important to body's function

#### Science India Bureau

ell biologist Dr Maddika Subba Reddy studies how proteins interact in cells at the Centre for DNA Fingerprinting and Diagnostics in Hyderabad. He shared the prestigious Shanti Swarup Bhatnagar Prize in Biological Sciences for this year with Dr Ashwani Kumar of the Chandigarhbased CSIR-Institute of Microbial Technology.

Dr Reddy is the head of the Centre for DNA Fingerprinting and Diagnostics' Laboratory of Cell Death and Cell Survival (LCDCS). He received the National Bioscience Award for Career Development, one of the highest Indian science honours, from the Department of Biotechnology of the Indian Government in 2017–18 for his contributions to the biosciences.

The University of Manitoba awarded Dr Reddy a PhD in biochemistry and medical genetics in 2007. Junjie Chen's lab at Yale University served as the site of his post-doctoral studies. Upon his return to India in 2009, he joined the Centre for DNA Fingerprinting and Diagnostics (CDFD), where he now serves as the director of the Laboratory of Cell Death and Cell Survival (LCDCS). Dr. Reddy has been a senior fellow with the Wellcome Trust-DBT India Alliance since 2016. He is renowned for his research on cellular phosphatases and signalling pathways.

For each cell in our body to perform its job, proteins are necessary. Proteins work by "talking" to other proteins through the complexes they create after being synthesised in cells. In general, this is what Dr Reddy's lab at CDFD is attempting to comprehend.

Disease can result from any change in how proteins interact with one another. Therefore, it is crucial to comprehend the subtleties of various protein com-



plexes in cells in order to comprehend the causes of human illness development and progression.

Cellular homeostasis is the term for Dr Reddy's research on the systems that keep cells in a delicate balance. Proteins must be broken down in cells once they have served their purpose. Protein buildup or protein damage is bad for the health of the cell and causes sickness in humans.

As a result, the ubiquitin system has evolved in all cells. A tiny protein called ubiquitin attaches to other proteins and serves as a signal for the associated protein to be identified by the cell's machinery for protein breakdown. To comprehend the delicate balance of protein function in cells, Dr Reddy and his team work to comprehend how ubiquitin is connected to proteins.

The phosphatase system is yet another mechanism that cells have created. Inactive molecules are generally created during protein synthesis in cells. They must be altered after being synthesised in order to mediate their functions. To maintain the balance between active and inactive proteins, phosphatases and kinases are enzymes that add and remove phosphate groups from proteins, respectively. Any disruption in the equilibrium of phospho-proteins is harmful to cells and causes a number of illnesses, including cancer, neurological conditions, cardiovascular ailments, etc. In his laboratory, Dr Reddy studies how various phosphatases function in cells to keep this balance.

The NEDD4-like E3 ubiquitinprotein ligase WWP2, an E3 ligase, was discovered to be a regulator for the tumour suppressor gene PTEN by the team lead by Dr Reddy. This discovery is said to be important for regulating cell proliferation and, consequently, for preventing cancer.

Dr Reddy has written several publications, and 77 of them are included on ResearchGate, an online database of scientific literature.

Dr Reddy, a former young associate of the Indian Academy of Sciences and an elected member of the Guha Research Conference, was given the 2017 NASI-Scopus Young Scientist Award by Elsevier and the National Academy of Sciences, India.

### **Discovery of New Molecules That May Treat TB Faster**

Dr Ashwani Kumar's work shows that bacteria residing in biofilms are tolerant to all the first-line and second-line anti-TB drugs

#### Science India Bureau

r Ashwani Kumar, Senior Principal Scientist of the Chandigarh-based Institute of Microbial Technology (IMTECH), has been given the prestigious Shanti Swarup Bhatnagar Prize for Biological Sciences for the year 2022. His contributions to TB pathophysiology, particularly the part played by biofilm-induced infections, have earned him this honour.

Dr Kumar is an expert in infectious diseases and the intricate field of tuberculosis pathogenesis. His research is focused on elucidating the complex methods used by the bacteria that cause tuberculosis (TB), Mycobacterium, to display phenotypic treatment resistance.

Dr Kumar was born and raised in New Delhi and attended Delhi University for his undergraduate and graduate degrees. Under the guidance of Professors Vani Brahmachari and Mridula Bose, he completed his doctoral work before moving to the University of Alabama at Birmingham, USA, for his postdoctoral studies.

His research focuses on understanding the physiology of mycobacteria that live in biofilms and how they behave during non-replicating persistence. He explores the extracellular polysaccharides that are present in mycobacterial biofilms, illuminating their crucial contribution to the bacterium's treatment resistance.

Dr Kumar is active in creating stateof-the-art instruments for assessing the metabolic and redox states of mycobacteria during infection, hence his research





Dr Ashwani Kumar

goes beyond theoretical comprehension. This strategy promises to reveal important details about how the bacterium behaves inside the host. According to his laboratory's theory, tuberculosis is a biofilm infection,

necessitating multiple drug delivery for at least six months in order to treat it.

Dr Kumar also received a Swarnajayanti Fellowship from the Department of Science and Technology for the academic year 2016–2017. Additionally, he was also chosen for the DBT/Wellcome Trust India Alliance Senior Fellowship (2021–2026) . In 2022, he was chosen as a Fellow of the Indian National Academy of Sciences. He is regarded as one of India's top researchers on tuberculosis.

The goal of Dr Kumar's lab is to comprehend the processes by which Mycobacterium exhibits phenotypic drug resistance. He is working to understand the physiology of bacteria that are resident in biofilms and during non-replicating persistence in order to achieve this. More precisely, he wants to know how mycobacterial biofilms' extracellular polysaccharides are made and how the SenX-RegX3 two-component system controls virulence and mycobacterial reproduction.

The MDRIpred project, an opensource server for predicting inhibitors against drug-tolerant M.tb. H37Rv, has included Dr Kumar as a member. ResearchGate, an online database of scholarly literature, lists 31 of the works he has written. His research has shown that hosts, including humans, contain cellulose-encased biofilms. He also studies how signalling chemicals like carbon monoxide and hydrogen sulphide can control autophagy. He received the National Bioscience Award for Career Development, one of the highest Indian science honours, from the Department of Biotechnology in 2017-18, for his contributions to the biosciences.



# Pioneering Innovation in Mining and Fuel Sector



Dr JK Pandey

ining and energy are the bedrock of modern society, underpinning our daily lives and economic prosperity. India, with its rich heritage in minerals and mining, has played a significant role in shaping these critical sectors. At the heart of this transformative journey lies the CSIR-Central Institute of Mining and Fuel Research (CSIR-CIM-FR), an institution of excellence that has consistently pushed the boundaries of research and development in the fields of mining, energy, and environmental sustainability.

The CSIR-CIMFR Dhanbad, a constituent laboratory under the aegis of Council of Scientific and Industrial Research (CSIR), New Delhi, was formed on 2 April 2007 by integrating the core CSIR-CIMFR, born with the integration of two pioneering institutes — CFRI and CMRI — in 2007, remains a catalyst for environmentally sustainable research and development of India's mining and energy industries

competencies and the great visions of the two erstwhile premiere institutes: Central Fuel Research Institute (CFRI, 1946) and Central Mining Research Institute (CMRI, 1956). The core R&D strengths of the institute lie broadly in the areas of Mining Technology, Infrastructure and Civil Sector, Fuel Sector, Environmental Management, Testing, Analysis and Calibration Services. The present director of CSIR-CIMFR is Prof Arvind Kumar Mishra.

#### RESOURCE CENTRES: DHANBAD, DIGWADIH, RANCHI, BILASPUR, NAGPUR, ROORKEE, RANIGANJ Objectives

The mission of CSIR-CIMFR encompasses a comprehensive array of objectives aimed at optimising the utilization of natural resources and fostering sustainable industrial practices. These include efficient recovery of fossil fuels, minerals, and ores, development of clean coal technologies, nationwide coal quality monitoring for power generation, R&D support spanning the mining industry, scientific assistance to strategic sectors, innovative underground mining methods, environmental preservation, and the facilitation of industry-society synergy through skill development and knowledge dissemination.

#### CSIR-CIMFR'S KNOWLEDGE BASE Mining Technology

Opencast mining, a predominant practice in India, has witnessed remarkable advancements. The introduction of large-sized draglines, shovels, dumpers, and surface miners has revolutionized opencast mining operations. CSIR-CIMFR has played a pivotal role in this success story by offering critical assistance to large opencast mines. Through its expertise, the institute has optimized blast designs, slope designs, highwall structures, overburden removal, and backfilling, thereby enhancing safety, productivity, and efficiency.

For six decades, CSIR-CIMFR has researched engineering rock mechanics and ground control for designing stable mining operations in India's diverse geological conditions. The institute has developed indigenous norms and technologies, using extensive field investigations and simulations. CSIR-CIMFR has formulated key methodologies, including Rock Mass Rating for roof support, failure criteria for coal measures, safe vibration limits, pillar strength estimation, stress prediction models, and subsidence forecasts. The institute has also developed guidelines for mechanised depillaring, estimating strata behaviour, and roof support with Roof Bolt Based Breaker Line Support (RBBLS) design norms. The institute has also pioneered many technologies for energy efficient and fire safe ventilation, DOF technique for free silica determination in air borne repairable and coal mine fire dealing methodologies

#### **Fuel Sciences**

CSIR-CIMFR collaborates closely with coal exploration agencies, conducting comprehensive studies on coal resources nationwide. The lab and pilot-scale studies of the institute support steel plants, washeries, power stations, and the coal industry. The institute has gained international recognition for its research on coal structure, especially hydro-aromatic properties. It has standardized coal-related standards for the Bureau of Indian Standards, aiding in coal classification and pricing. The work of CSIR-CIMFR on coal washing led to establishment of



Air-Blown Pressurized Fluidized Bed Gasification (PFBG) Pilot Plant Facility of CSIR-CIMFR. The institute has expertise in gasification technology to handle Indian coal, providing critical support to the industry

public sector coking coal washeries. The institute has also developed coal beneficiation techniques for low volatile coking coals, formulated coal blends for steel production, designed innovative coke ovens, and utilized coke by-products.

#### **Technological Innovations**

CSIR-CIMFR, is dedicated to reducing India's reliance on imported coking coal for coke production. The institute has developed groundbreaking non-recovery and drag-type coke ovens with stamp charging and coke quenching methods. Additionally, CIMFR has devised innovative processes for coal and coke briquette production. In safety and security, the institute introduced a biometricbased exploder and dry fog dust suppression system, enhancing operational

CSIR-CIMFR has gained international recognition for its research on coal structure, especially hydro-aromatic properties. It has standardized coal standards for the Bureau of Indian Standards (BIS), aiding in coal classification and pricing safety. The innovations extend to mining, with systems like the Mine Transport Surveillance System and Vision Enhancement System for improved visibility in foggy conditions. The institute's expertise in geo-mining conditions has led to the development of robust ground reinforcement systems, enhancing safety and productivity in Indian underground mines. Formulation of failure criteria for Indian coal, pioneered equivalent material mine modelling techniques, and promoted various mining methods for optimal coal extraction have also been contributed by the institute.

CSIR-CIMFR addresses environmental concerns by repurposing fly ash for stowing in mines and as value-added products like bricks and fertilizers. The guidelines produced by the institute for safe blasting practices and standards are internationally recognized. The institute is advancing mining safety further by transforming physical mines into 3D virtual mines with cutting-edge technologies like IoT devices, AI, and wireless communication.

Beyond mining, CSIR-CIMFR evaluates coal quality, estimates resources,



CSIR-CIMFR provided vital technical support to the construction of India's longest road tunnel — the Chenani-Nashri tunnel road, also known as Patnitop tunnel, built on the Jammu-Srinagar highway

and contributes to coal-based industries' growth. The institute has tackled challenges posed by hard-to-wash Indian coals, including low-volatile coking coals, fine coal slurry, and high-ash non-coking coals, developing innovative stamp charging methods for improved coke quality. In the pursuit of cleaner energy solutions, the organization plays a pivotal role in the methanol economy mission, converting coal into methanol and dimethyl ether. The institute's 1.5 TPD pilot plant for oxygen-enriched pressurized fluidized bed gasification aids this mission.

CSIR-CIMFR actively addresses environmental concerns by mitigating fugitive methane emissions during coal mining. The institute is involved in estimating methane emissions and GHG emissions from fossil fuel combustion, aligning with emissions reduction goals. The cutting-edge oxy-fuel combustion pilot plant pioneers CO2 capture research, while microbial routes are explored for CO2 capture in thermal power plants. To promote cleaner energy, the institute is researching biogas from coal washery effluent and biomass, offering alternative energy solutions.

The institute's involvement in the Minamata Convention on Mercury demonstrates the commitment of CIMFR to environmental responsibility by compiling a national inventory of mercury emissions, particularly in extraction industries. CSIR-CIMFR's contributions extend to redefining mining methods. The institute's work on techniques such as the wide stall method, cross-development-based extraction, shortwall methods, and longwall mining technologies has been instrumental in optimizing the extraction of thick seams and lockedup coal reserves. Beyond mining, the institute has played a crucial role in expediting road construction projects, particularly in challenging terrains and border areas, through controlled blasting techniques.

#### **Pilot Plant Services**

CSIR-CIMFR aims to achieve excellence in providing basic R&D and industry support in the areas of clean coal and combustion technologies. There are varying concerns about their applicability and commercial viability under Indian context that need to be addressed expeditiously. The institute has developed several pilot plants towards implementation of clean coal technologies in India.

• 30-60 kg/h pilot scale oxy-fuel combustion test facility.

• Co-combustion study of coal and biomass blends using pilot scale combustion facility i.e., drop tube furnace (DTF).

• Pilot scale air blown pressurized fluidized bed gasifier (PFBG) of 1.5 TPD.

• Pilot plant for coal to liquid (CTL) synthesis (process development unit, PDU; catalyst capacity: 10 L) of maximum 5 L per day liquid hydrocarbon production.

#### **Unique Facilities**

• National facilities for FLP, Intrinsic Safety, Explosive & Mining safety equipment testing including human breathing simulator for performance evaluation of life saving equipment in mines.

• Testing facilities for coal properties; spectro-radiometric technique for differentiating coal litho-units in the field for selective mining; drop tube furnace; simultaneous thermogravimetric analysis; PFBG.

• High temperature and pressure single tube fixed bed reactor and pilot plants for coal processing.

• High performance computing for large scale geo-mining modelling and simulation.

• Petrographic and geochemical testing facilities: Rock-Eval 6, Field Emission Scanning Electron Microscope (FE-SEM).

• Unique test facility for geo-mechanical properties of rock: MTS 815 Rock Mechanics Test System.

#### Societal Work of CSIR-CIMFR

CSIR-CIMFR has played a vital role in empowering rural women within the climate change context through sustainable energy initiatives. These efforts involve customized domestic biogas systems, active involvement of rural women in green energy and climate initiatives, and the creation of model villages that promote sustainable development. Additionally, the institute has introduced mine water reclamation technology to provide



CSIR-CIMFR has been studying ground control and engineering rock mechanics for six decades to construct stable mining operations in India's varied geological circumstances

safe drinking water and offers training to villagers in various socio-economic activities like medicinal plant cultivation, reforestation, carbon sequestration, and value-added product development. These endeavours underscore the institute's unwavering commitment to positive change.

#### External Cash Flow

CSIR-CIMFR through its knowledge base and transfer of technology achieved positive cashflow of Rs 1000 crores in the financial year 2019-2020. The institute strives to continue this trend using its privileged position as a premiere organisation in the field of mining and fuel technology.

#### **R&D Roadmap of CSIR-CIMFR**

**Mining Technology:** The institute primarily concentrates on mining technology, with a key emphasis on accessing

Through its knowledge base and transfer of technology, CSIR-CIMFR achieved a positive cashflow of Rs 1000 crore in the financial year 2019-2020 coal resources located beneath surface structures and creating methods for extracting deep-seated coal deposits in an effective and environment-friendly manner. Additionally, the institute places a strong emphasis on advancing safety, productivity, and sustainability in both open-pit and underground mines. Furthermore, it is committed to pioneering new, state-of-the-art technologies for the mining industry, including automation and the utilisation of drones, to enhance overall efficiency and innovation in the field.

Intelligent Mining Systems: CSIR-CIM-FR has multifaceted approach to mining technology, which includes the creation of real-time analysis systems for coal and mineral grades and sizes during dispatch. The institute is committed to digitize every operational mine in India, allowing centralized monitoring from control rooms. Additionally, Augmented Reality and Virtual Reality systems with computer vision for mining applications are being developed.

**Coal to Methanol:** Cutting-edge research is focused on two critical fronts. The first involves the creation of zero-emission, energy-efficient gasification technologies, facilitating the targeted production of hydrogen and valuable chemicals. In parallel, researchers are advancing syngas-based poly-generation methods, shaping a sustainable energy landscape. **Coal to hydrogen:** Innovative approaches are being explored across various domains. Hydrogen production methods encompass pulverization, photothermal, and ultrasonic techniques. Meanwhile, Type V composite cylinder development, from design and fabrication to prototyping and rigorous testing, is underway. The institute scientists are investigating hydrogen storage within underground coal seams, focusing on high-pressure solutions.

**Carbon Capture Utilization and Storage** (CCUS): The institute is actively engaged in pioneering advancements in carbon capture and storage (CCS) and biofuel development. This includes innovative methods to convert CO<sub>2</sub> into valuable chemicals, fuels, and polymers. Additionally, efforts are focused on sub-surface CO<sub>2</sub> sequestration within geological reservoirs, enhancing hydrocarbon recovery and mitigating carbon emissions. Coal Carbonization: In the realm of coal and coke innovation, multiple initiatives are underway. These encompass labscale development of Hot Stamp Charging Technology, bench-scale processes for needle coke and graphite electrode production, H2-rich coal gas generation, and continued enhancements in By Product Coke ovens technology.

#### PATH AHEAD

The CSIR-CIMFR is a trailblazing institution at the forefront of India's mining, energy, and environmental sustainability sectors. Its relentless pursuit of excellence, alignment with national priorities, and commitment to innovation underscore its pivotal role in driving technological advancements and economic growth in India. As CSIR-CIMFR continues to adapt to evolving challenges, it remains a catalyst for transformative change, forging a sustainable and prosperous future for India's mining and energy industries.

\*The writer is Chief Scientist and Head, Mine Fire, Ventilation and Minor Safety Research Group, CSIR-CIMFR, Dhanbad.

#### NATIONAL SCIENCE ROUNDUP

#### Govt seeks inclusion of Ayurveda in WHO's ICD-11 list

The government of India is seeking the inclusion of Ayurveda and related systems in the 11th revision of the World Health Organisation's International Classification of Diseases (ICD), as the second module of a supplementary chapter on traditional medicine conditions. Once included, the Indian medicine system will come on the world



India is hoping that the WHO will include Ayurveda in its International Classification of Diseases soon

stage and get a common standardized language. According to a report published in *The Hindu*, Ministry of Ayush Secretary Vaidya Rajesh Kotecha said: "We are hopeful that the addition of Module-2 for Ayurveda could happen as early as by next January." After a decade of repeated consultations, ICD-11 had facilitated the inclusion of Module-1, which covers traditional medicine conditions originating in ancient China, which are now commonly used in China, Japan, Korea and elsewhere in the world.

### Chandrayaan-3's discovery of polar sulfur holds promise

Scientists were always aware of the presence of sulfur on moon but Chandrayaan 3's landing near the south pole of the lunar surface has brought to light the fact that higher levels of sulfur may be present at the



Chandrayaan 3 has found concentration of sulfur on the poles of the lunar surface

poles compared to that in the volcanic rock near the moon's equator. Theories abound on the higher concentration of polar sulfur. One suggests that it could have resulted from volcanic eruption in the region millions of years ago. Another suggests meteorites could have deposited sulfur at the poles during collision with the moon. But data gathered by Chandravaan 3 suggests higher concentration of sulfur at the pole of the moon, which could prove immensely helpful in future explorations, such as acting as local resource that need not be carried from the earth; or in producing solar cells, or creating waterless concrete, etc.

#### Self-care tips to manage arthritis pain

The world observes October 12 annually as the World Arthritis Day to create awareness about a condition that afflicts millions worldwide yet has no specific treatment. Arthritis is an inflammatory joint disorder, which affects the tissues around joints, and

other connective tissue, causing joint pain and stiffness and difficulty in movement. There are more than one hundred types of arthritis, but the most common are osteoar-



Arthritis has no specific treatment

thritis and rheumatoid arthritis. The theme of the World Arthritis Day 2023 is 'Living with an RMD at all stages of life' where RMD stands for Rheumatic and Musculoskeletal Diseases. Self-care tips to take care of arthritis include: balanced diet, nutrient intake such as Vitamin D and calcium, weight check, regular physical activity, and goodbye to smoking.

### Mission Indradhanush 5.0 to focus on measles and rubella

The Intensified Mission Indradhanush (IMI 5.0), a flagship routine immunization programme of the Union Ministry of Health and Family Welfare that concludes mid-October, is playing a pivotal role in ensuring routine immunization reaches children and pregnant women who might have previously missed or dropped out of



Indradhanush 5.0 has been conducted across all districts of India

the vaccination programmes, according a release by the ministry. IMI 5.0 marks the first time the campaign has been conducted across all districts of India, including children up the age of 5 years. The previous Indradhanush campaigns were limited to children up to 2 years of age. IMI 5.0 has placed special focus on improving vaccination coverage for measles and rubella, with the aim of eliminating these diseases by the end of the year.

#### Permission to test vaccines on stray dogs withdrawn

The Committee for the purpose of Control and Supervision of Experiments on Animals (CCSEA), under the Department of Animal Husbandry,

Ministry of Fisheries and Animal Husbandry, has withdrawn permission to use stray dogs to be used in vaccine trials. In September 2022, the committee had recommended that



stray dogs may be used for new vaccine trials and challenge studies of vaccines, with the condition that these animals must be quarantined and rehabilitated according to given guidelines. Last September, PETA (People for the Ethical Treatment of Animals) had opposed the recommendation and requested the order be withdrawn.



#### **INTERNATIONAL SCIENCE ROUNDUP**

#### Largest map ever of the human brain made

The largest atlas of human brain cells ever has been published by a collaboration between hundreds of scientists from different institutes the world over. The atlas was recently published in a package of 21 papers in the journals *Science, Science Advances and* 



A new atlas lists more than 3,000 cell types in human brain

Science Translational Medicine, the Nature magazine reported. According to the authors, this atlas is likely to aid the study of diseases, cognition and what makes us human. The atlas has revealed more than 3,000 cell types, many of which are new to science. The research is part of the US National Institutes of Health's Brain Research through Advancing Innovative Neurotechnologies Initiatives - Cell Census Network (BICCN), in which hundreds of scientists collaborated. The data from the cumulative 21 studies has been made available publicly on the Neuroscience Multiomic Archive online repository.

### Carvings of extinct camels discovered in Saudi Arabia

According to a report published recently in the journal *Archaeological Research in Asia*, researchers have uncovered the carvings of several dozen



Carvings of camels date back to the Neolithic period (10,000-4,000 BCE)

extinct camel species on a rocky outcropping, known as Sahout, along the southern fringes of the Nefud desert in northern Saudi Arabia. These carvings - or ancient rock art - date back to the Neolithic Period (10,000 - 4,000 BCE). These animal carvings have survived the harsh climate of the region for millennia because they have been nestled in crevices, protecting them from natural weathering. The carvings seem to have been made in distinct periods, as they have been discovered in different layers of the rock, by different groups of people as evident from the differences in techniques and style of creating the likenesses of animals. Some images are also drawn over carvings of domesticated sheep.

### Remains of a massive dinosaur discovered in Spain

Remains of a giant new species of dinosaur, called Garumbatitan morellensis, have been discovered from the Morella region of Spain, adding to our knowledge of understanding about dinosaurs. Being called the Giant of Garumba, the new species of dinosaur identified lived in the Iberian Peninsula approximately 122 million years ago during the Early



The Giant of Garumba lived in Iberian peninsula 122 million years ago

Cretaceous period. The new dinosaur was identified by a team of Spanish and Portuguese paleontologists, and published recently in the Zoological Journal of the Linnean Society. Garumbatitan morellensis belongs to the Sauropod group, characterized by their immense size, quadrupedal stature, herbivorous diet, and distinctive long necks and tails. Its metre-long vertebrae, twometre-long femur and long ribs indicate that this dinosaur stood at a height of a whopping 10 metres.

#### The biggest Ozone hole over Antarctica

Satellites have detected an ozone hole over Antarctica, which is the biggest on record, roughly three times the size of Brazil. The ozone-depleted area over Antarctica has been measured at 26 million square kilometres (10 million square miles). The hole was detected last month by the European Space Agency's Copernicus Sentinel-5P satellite as part of its environmental monitoring programme. The ozone layer is a trace gas in the stratosphere, one of the four layers of the earth's atmosphere. It functions as a protective shield that absorbs ultraviolet

radiation, protecting humans and ecosystems from dangerous amounts of UV. The size of the ozone hole over Antarctica fluctuates every year, opening annually in August and closing again in November-



The Ozone hole over Antarctica measures 26 million sq kms

December. Experts believe that this development is not a concern for climate change just yet.

### How did the Earth's mantle get precious metals?

Researchers have come up with the first geophysically viable explanation for the presence of an abundance of precious metals such as gold and platinum in the earth's mantle. The mantle is mostly solid bulk of the earth's interior, lying between the dense core and the thin, outer layer called crust. Around 4.5 billion years ago, earth was hit by a Mars-sized planet, and the Moon was born from the resultant material flung into the orbit. Following this era of bombardment, known as 'late accretion', planetesimals as large as the moon impacted the earth and metals with a strong affinity for iron were absorbed into the young earth.









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# **First 'Made In India' Battery Cell Line for EVs**

The battery pack of an electric car accounts for 40-50 percent of the entire cost, which should get reduced substantially by locally built battery cell

#### Science India Bureau

hina is the world's largest provider of the cells that constitute the battery packs for electric vehicles (EV), as is the case with many other hardware components and goods. More crucially, India imports these cells for lack of local production.

However, Bengaluru-based Log9 Materials has created aluminum-air batteries and aluminium fuel cells for both mobile and fixed energy applications. The company produces its own battery pack components, including the cells that go into them.

Initially, there was no skill pool for Log9 to draw from for inventing a lithium-ion cell, setting up the requisite R&D, and then building a factory to create them, even though India has millions working in the IT services sector.

Over the past three years, Log9's cell team, which has gradually grown organically to include more than 40 members, is working to change this under the leadership of Akshay Singhal, Kartik Hajela, and Pankaj Sharma.

In addition to producing cells domestically, beginning with a 50MW factory in Bengaluru, Log9 is tackling two significant technical issues that are present in all the current cells and batteries on the market. One is that attempting to charge them faster actually shortens their life and hastens their deterioration. The second is that every consumer purchase of an EV has a certain amount of 'range anxiety' if they can't be charged quickly enough.

Additionally, the government's EV subsidy will end soon. These are some of the difficulties that Log9 encounters when designing its cells.



The introduction of battery cells made in-country is a major boost for the market for electric vehicles. The indigenous battery cells should significantly reduce cost levels since batteries account for a major portion of an EV's asking price. The commercial manufacture of the battery cells created by Log9 is still some way off, and it will take a few more months for testing to be finished before they can be put to use. By collaborating with producers of electric vehicles, the company is creating its own ecosystem.

One significant advancement made by Log9 is a solution to the problematic issue of lithium plating, which in the worst scenario can result in what engineers refer to as "thermal runaway" and cause the battery to overheat, melt, or even burn. They've discovered a technique to limit the issue while enabling rapid charges using a combination of materials, cell chemistry, battery, and cell control.

The founders of Log9 contend that their cells — one rated at 3.2V 50Ah and the other at 2.3V 50Ah — are superior to those currently on the market. They function well in Indian circumstances and deliver greater energy per unit quan-



Deeptech startup Log9 was founded in 2015 by (from left) Kartik Hajela, Akshay Singhal and Pankaj Sharma

tity of the contents of the cell.

The business was the first startup to be incubated at IIT-Roorkee in 2015. In 2015, Akshay Singhal and Kartik Hajela created Log9, which has now amassed 16 patents related to graphene. In 2017, Gems Partners, a micro venture capital fund, led Log9's first round of funding for the establishment of its own R&D facility in Bengaluru. Log9 also partnered with the IISc.

Rather than using the typical lithium-ion batteries seen in EVs, the researchers initially concentrated on aluminium air fuel cells (Al-AFCs). In 2018, Log9 created India's first Al-AFC after a year of study. Long-distance cars use Al-AFC technology.

In the year 2019, Log9's first EV battery (test pack) was created. The RapidX battery for intra-city use was introduced the following year. Log9 was valued at \$250 million when it raised \$40 million in finance in January, with Amara Raja Batteries and Petronas Ventures acting as the lead investors.

The Department of Science and Technology, Government of India, presented Log9 with the title of 'Most Innovative Technology Company of 2018'.

### **Quiz: Cyber Security**

1. Researcher Bob Thomas created the first computer program in the 1970s that could move across a network and leave a trail, which could well be likened to a virus. What was the program called?

- A. Trailer
- B. Breadcrumb
- C. Creeper
- D. Reaper

2. Ray Tomlinson, the inventor of email, wrote a program to chase and delete the answer to question number 1, which was the first ever antivirus, created in 1972. Name it.

- A. Trailer
- B. Breadcrumb
- C. Creeper
- D. Reaper

3. The term 'computer virus' was first formally coined by American computer scientist Frederick B. Cohen while a student at University of Southern California. When was this? A. 1982 B. 1983 C. 1984 D. 1985

4. Which is the oldest phone hacking technique used by hackers to make free calls?

A. Spamming B. Phreaking C. Cracking D. Phishing

5. Which of the following platforms is used for the safety and protection of information in the cloud? A. AWS B. Cloud security protocols C. Cloud workload protection platforms

#### D. One Drive

# 6. Which technique is used to hide information inside a picture?

- A. Image rendering B. Steganography
- C. Rootkits
- D. Bitmapping

7. A common cyber security threat that involves the practice of sending fraudulent emails from reputable sources is called...

- A. Phishing
- B. Phreaking
- C. Social engineering
- D. None of the above

8. Which of the following is considered the fastest growing category of computer viruses / attacks? A. Malware B. Phreaking

#### C. Phishing D. Ransomware

9. In the short history of computers, there have been several big virus attacks. Which of the following was the biggest, that caused damage worth \$38 billion? A. Mydoom, 2004

A. Mydoom, 2004
B. Sobig, 2003
C. Klez, 2001
D. WannaCry, 2017

10. During World War II, French military officer René Carmille prevented information on French Jewish population reaching the Nazis, making him what we can call him as the world's first...

- A. Data scientistB. Data programmerC. Anti-virus agent
- D. Ethical hacker

### **Cyber Security in India: Digital India Act 2023**

Cyber security is a relatively new phenomenon the world over given the recent development of computers in the evolutionary progress of human civilization. It is even newer in India.
 With more and more aspects of life in general getting a digital component, cyber security today is of as much importance to any nation as defending its physical borders from enemy nations.

The government has recently announced the Digital India Act 2023 (DIA), which is aimed at establishing a future-ready legal framework for the country's burgeoning digital ecosystem.

The proposed DIA is poised to replace the Information Technology (IT) Act of 2000, to be able to freshly address the fast-changing digital scenario in the country with the rapid development of internet and emerging technologies.

■ It hopes to define various aspects of online safety and what constitutes cyber crime/ cyber fraud, providing a contemporary legal framework to tackle 21st century crimes hitherto handled by amended provisions of 19th century British-era laws.

The bill is being led by the Ministry of Electronics and Information Technology (MeitY).

The ministry has entrusted the task of fleshing out finer details of the bill to Gurgaon-based Management Development Institute and Cybersaathi Foundation of Supreme Court advocate NS Nappinai.

• Earlier this year, the government conducted two rounds of public consultations in the pre-drafting stage of the bill that led to certain provisions being put in the draft.

### Subrahmanyan Chandrasekhar (19 October 1910 – 21 August 1995)



mage Courtesy: Wikimedia Commons

"Science is a perception of the world around us. Science is a place where what you find in nature pleases you."

- Subrahmanyan Chandrasekhar, Indian American theoretical physicist, winner of the 1983 Nobel Prize for Physics, along with William A Fowler



# **Celebrating Science This Month**

#### **OCTOBER 1**

Jayakrishna Indraji, Indian botanist and ethnobotanist, was born in 1849. He wrote the first botanical treatise following Hooker's classification in an Indian regional language (Gujarati), titled *Vanaspati Shastra*, in 1910.

#### **OCTOBER 3**

Kadambini Bose Ganguly, the first Indian woman physician to practice western medicine in India, passed away in 1923.

#### **OCTOBER 4**

World Animal Welfare Day is observed every year.

#### **OCTOBER 5**

Radhanath Sikdar, an Indian mathematician, the first person to calculate the height of Mount Everest, was born in 1813.

#### **OCTOBER 6**

Meghnad Saha, a globally renowned Indian astrophysicist, was born in 1893. He developed the Saha ionization equation, used to describe chemical and physical conditions in stars.

#### **OCTOBER 11**

Dr Harish Chandra, Indian American mathematician and physicist, was born in 1923. He worked on representation theory, especially harmonic analysis on semisimple Lie groups.

#### **OCTOBER 12**

Megha-Tropiques, an

Indo-French Joint Satellite Mission, was launched in 2011, to study the water cycle and energy exchanges in the tropics.

Dr Atma Ram, an Indian scientist, was born in 1908. He was the Director of Central Glass and Ceramic Research Institute, Kolkata, and later, Director General of Council of Scientific and Industrial Research(CSIR). In his memory, the Atmaram Award is given by the Central Institute of Hindi, an autonomous institute of HRD Ministry.

#### **OCTOBER 13**

Girjesh Govil, molecular biophysicist known for his research on semi-empirical quantum chemical theories, passed away in 2021. He was awarded the Shanti Swarup Bhatnagar Prize in 1978.

#### **OCTOBER 14**

Raghunath Dhondo Karve, a pioneer in initiating family planning and birth control for the masses, passed away in 1953. He started the first birth control clinic in 1921.

#### **OCTOBER 15**

Dr APJ Abdul Kalam, Indian aerospace engineer and former President of India, was born in 1931. He spent his life as a scientist, mainly at the Defence Research and Development Organisation (DRDO) and Indian Space Research Organisation (ISRO). He came to be known as the Missile Man of India and also played a pivotal role in Pokhran-II nuclear tests in 1998. Dr Kalam received the Bharat Ratna in 1997.

#### **OCTOBER 16**

Dr Harish Chandra, Indian American mathematician and physicist, passed away in 1983.

#### **OCTOBER 19**

Subrahmanyan Chandrasekhar, Indian American astrophysicist, was born in 1910. The Chandrasekhar limit is named after him. He won the 1983 Nobel Prize for Physics with William A. Fowler.

#### **OCTOBER 20**

Biraja Sankar Guha, an Indian physical anthropologist, who classified Indian people into races around early 20th century, passed away in 1961. He was the first Director of the Anthropological Survey of India.

#### **OCTOBER 21**

CSIR-Central Food Technological Research Institute (CSIR-CFTRI) opened in 1950 in Mysore.

#### **OCTOBER 22**

Chandrayaan-1, India's first mission to the Moon, was launched successfully in 2008 by PSLV -C11.

The Technology Experi-

ment Satellite (TES) was launched in 2001 from Sriharikota by PSLV-C3.

#### **OCTOBER 23**

Mole Day is observed annually to commemorates Avogadro's Number.

Darashaw Nosherwan Wadia, a pioneering Indian geologist, was born in 1883. He is remembered for his work on the stratigraphy of the Himalayas. He helped establish the Institute of Himalayan Geology, Dehradun, which was renamed in 1976 after him as the Wadia Institute of Himalayan Geology.

ISRO's heaviest rocket Launch Vehicle Mark 3 launched 36 satellites of UK-based OneWeb from Sriharikota in 2022.

#### **OCTOBER 24**

Sisir Kumar Mitra, who established the first-ever course to study wireless technology in India at Calcutta University, was born in 1890.

#### **OCTOBER 30**

Homi J. Bhabha, founding director of Tata Institute of Fundamental Research (TIFR), was born in 1909. He is known as the 'Father of the Indian Nuclear Programme'. Atomic Energy Establishment, Trombay, was renamed Bhabha Atomic Research Centre in his honour.







2nd International **AYUSH Conference &** Exhibition, 2024

> 13-15 January, 2024 **Dubai World Trade Centre** Dubai



JSH ECONFERENCE &

### Focal Theme

### Non-communicable Chronic Diseases -Prevention & Management through Ayush

#### Sub Topics:

 Evidence Based Ayush Practice
 Ayush for Mental Health Integration of Ayush in the Management of Type 2 Diabetes Mellitus Preventive Cardiology in Ayush
 Ayush Solution for Degenerative & Inflammatory Arthritis • Ayush Based Nutrition Solutions • Ayush Cure for Allergies & Asthma • Role of Ayush in the Management of Auto-immune Diseases • Ano-rectal Diseases- Prevention & Management through Ayush Ayush Care for Liver Health
 Ayush Treatment for Neurological Disorders

 Ayush Practises in Women & Child Healthcare 
 Ayush Geriatric Care Ayush Integrated Oncology
 Ayush Veterinary Care

Dates to Remember

#### Mail Your Abstracts Avurveda

Naturopathy &

Sowa Rigpa

Homeopathy

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  - unani@ayushdubai.org
  - siddha@ayushdubai.org
- homeopathy@ayushdubai.org

Delegate Registration Fee: AED 300 (Exclusive of Visa, Food & Accommodation)

### **General Enquiry on Delegate Registration:**

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Conference dates: 13-15 January, 2024



#### ecretariat (India) WAC Secretariat,

Last date for submitting abstract: 10th October, 2023

Notification of selected abstracts: 20th October, 2023

Last date for delegate registration: 15th December, 2023

#### World Ayurveda Foundation

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For delegate registration please log onto www.ayushdubai.org

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### **CSIR-AMPRI TECHNOLOGY**

### CSIR-Technos Raman (CTR) Series Raman spectrometers

#### **APPLICATIONS** :

- Pharmaceutical and cosmetic
- Materials Science, Carbon Materials
   Geology and mineralogy
- Environmental Science and Life Sciences

#### **FEATURES**:

- Compact and Flexible System Configuration
- High Resolution <0.3 cm -1
- Measurement down to 10 cm -1
- Confocal Optics for Microscope and Remote Probe
- Fully Automated 2D, 3D Raman Imaging
- Attachable to other Advanced analytical tools (e.g., AFM, XRD, SEM etc)
- Modular Approach and Customized solutions (UV-VIS-NIR etc.)



### Lead Free X-ray Shielding Red Mud Tiles



#### **APPLICATIONS:**

- X-ray shielding walls, floors and ceiling for CTscanner, Cath lab, X-ray diagnosis, Bone Mineral Densitometer, etc.
- Movable X-ray shield for operators.
- Makeshift X-ray diagnostic centers.
- Conversion of existing rooms into X-ray diagnostic centres.

#### **SPECIFICATIONS OF THE PRODUCT :**

- 13.5 mm thick tile = 2mm lead at 100 kV.
- Flexural strength: > 30 N/mm<sup>2</sup>.
- Breaking strength: >3000 N.
- Interlockable to avoid radiation leak through the joints.
- Free from toxic lead.
- Cheaper than lead.
- Can be paved by layman.
- Easily repairable and suitable for light weight
- buildings.

### Bamboo Composites for Modern Housing & Structures



#### **APPLICATIONS:**

The newly developed bamboo composite material can serve as a competitive, sustainable, and environment-friendly material, and possesses all the necessary properties to qualify as a construction material alternative.

#### **SPECIFICATIONS OF THE PRODUCT :**

- Density: 0.9-1.1 g/cc
- Flexural Modulus: 18 22 Gpa
- Flexural Strength: 160 180 Mpa
- Compressive Strength: 90 170 Mpa
- Tensile Strength: 110 140 Mpa
- Water Absorption: 4 6 %
- Impact Strength: 70 120 kg-cm

#### **SALIENT FEATURES :**

High Strength, Durable & Dimensionally Stable, Weather Resistant, Termite & Fungal Resistant, Natural & Aesthetic, and Economical.

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