News for Apr-June 2018

SCIENCE AND TECH.

THE CRUX OF THE HINDU

Vol. 14

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Aspirant Forum is a Community for the UPSC Civil Services (IAS) Aspirants, to discuss and debate the various things related to the exam. We welcome an active participation from the fellow members to enrich the knowledge of all.

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Contents

aspirantforum.com
Science and Tech.
The Crux of The Hindu
Vol. 14
News of Apr-June18

About the 'CRUX'

After the success of our monthly magazine The Crux of The Hindu and PIB, we are introducing a new and convenient product, to help the aspirants for various public services examinations. Today, the knowledge of the Current Affairs (Science and Technology) constitutes an indispensable tool for all the recruitment examinations. However, as per the examinations are concerned, it is quite tedious task to memorise each and every news. Moreover, every news as given in magazines and newspapers may or may not be relevant from exam perspective which forces the candidates to spend a quality time in extracting useful matter and framing notes. This problem of aspirants strikes our minds and made us to think for a sure shot solution as a result of which our experts have come out with the unique magazine of Science and Technology, Crux of Science and Technology. This trimonthly convenient product is going to save our aspirants' time. The whole concept of the CRUX is to provide you with a summary of the important news and current affairs, from an exam point of view. By reading the CRUX, you will be able to save your precious time and effort, as you get all the relevant matter in a summarized and convenient form. The Crux is particularly helpful for the Civil Services, Banking, SSC and other exams that have a current affairs section. The material is being provided in such a manner that it is helpful for both- objective and descriptive sections. Our aim is to help the candidates in their effort to get through the examinations. Your efforts and dedication inspire us to keep going. It is our sincere effort to make your journey easier.

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Science and Tech.
The Crux of The Hindu
Vol. 14
News of Apr-June18

SPACE

NASA launches spacecraft to explore depths of Mars

NASA on Saturday launched its latest Mars lander, InSight, designed to perch on the surface of the red planet and listen for 'Marsquakes'.

The $993 million project aims to expand human knowledge of conditions on Mars, inform efforts to send human explorers there, and reveal how rocky planets like the earth formed billions of years ago. The lander should settle on Mars on November 26.

Its name, InSight, is short for Interior Exploration using Seismic Investigations, Geodesy and Heat Transport. "How quake-prone is Mars? That is fundamental information that we need to know as humans that explore Mars," Jim Green, NASA chief scientist, said.

The key instrument on board is a seismometer, called the Seismic Experiment for Interior Structure. After the lander settles on the Martian surface, a robotic arm is supposed to emerge and place the seismometer directly on the ground.

The second main instrument is a self-hammering probe that will monitor the flow of heat in the planet's subsurface.

Called the Heat Flow and Physical Properties Package, it was made by the German Space Agency with the participation of the Polish Space Agency.

The probe will bore down 10 to 16 feet below the surface, NASA said, 15 times deeper than any previous Mars mission.

Future plans

Understanding the temperature on Mars is crucial to NASA's efforts to send people there by the 2030s, and how much a human habitat might need to be heated under frigid conditions, said Mr. Green.

Daytime summer temperatures near the Martian equator may reach 20 degrees Celsius, but then plunge by night to -73 degrees Celsius.

"It is an important part of knowledge of how this planet is evolving," Mr. Green said.

The solar and battery-powered lander is designed to operate for 26 Earth months, or one year on Mars, a period in which it is expected to

pick up as many as 100 quakes.

The spacecraft was initially supposed to launch in 2016 but had to be delayed after temperature tests showed a problem with part of the seismometer, which engineers have since fixed.

NASA's IMAP to study cosmic rays in heliosphere

NASA is targeting 2024 for the launch of a new mission to learn more about the generation of cosmic rays in the heliosphere, a sort of magnetic bubble surrounding and protecting our solar system.

Cosmic rays created locally and from the galaxy and beyond affect human explorers in space and can harm technological systems, and likely play a role in the presence of life itself in the universe.

The Interstellar Mapping and Acceleration Probe (IMAP) mission will help researchers better understand the boundary of the heliosphere, NASA said in a statement on Friday.

IMAP was selected following an extensive and competitive peer review of proposals submitted in late 2017, it added.

Heliosphere is the region where the constant flow of particles from our Sun, called the solar wind, collides with material from the rest of the galaxy.

This collision limits the amount of harmful cosmic radiation entering the heliosphere. IMAP will collect and analyse particles that make it through.

Protective sheath

"This boundary is where our Sun does a great deal to protect us. IMAP is critical to broadening our understanding of how this 'cosmic filter' works," said Dennis Andrucyk, Deputy Associate Administrator for NASA's Science Mission Directorate in Washington.

"The implications of this research could reach well beyond the consideration of Earthly impacts as we look to send humans into deep space," Andrucyk added.

The spacecraft will be positioned about 1.5 million kilometres away from Earth towards the Sun at what is called the first Lagrange point or L1.

Milky Way disc much bigger than

thought: study

It would take us 200,000 years to cross the disc of our galaxy if we could travel at the speed of light, say scientists who found that the disc of the Milky Way is bigger than thought.

Spiral galaxies, such as the Milky Way, have discs which are really thin, in which the major fraction of their stars are found. These discs are limited in size, so that beyond certain radius there are very few stars left.

In our Galaxy, we were not aware that there are stars in the disc at distances from the centre more than twice that of the Sun. This means that our own star was apparently orbiting at about half the galactic radius.

However, now we know that there are stars quite a bit further out, at more than three times this distance, and it is probable that some stars are at more than four times the distance of the Sun from the Galactic centre.

Galaxy's diameter is 2 lakh light years

"The disc of our Galaxy is huge, around 200 thousand light years in diameter," said Martin Lopez-Corredoira, a researcher at the Instituto de Astrofisica de Canarias (IAC) in Spain.

In broad terms we can think of galaxies like the Milky Way as being composed of a rotating disc, which includes spiral arms, and a halo, spherical in shape, which surrounds it.

This piece of research has compared the abundances of metals (heavy elements) in the stars of the Galactic plane with those of the halo, to find that there is a mixture of disc and halo stars out to the large distances indicated.

The researchers came to these conclusions after make a statistical analysis of survey date from APOGEE and LAMOST, two projects which obtain spectra of stars to extract information about their velocities and their chemical compositions.

"Using the metallicities of the stars in the catalogues from the high quality spectral atlases of APOGEE and LAMOST, and with the distances at which the objects are situated, we have shown that there is an appreciable fraction of stars with higher metallicity, characteristic of disc stars, further out than the previously assumed limit on the radius of the Galaxy disc"

said Carlos Allende, a researcher at the IAC.

"We have not used models, which sometimes give us only the answers for which they were designed, but we have employed only the statistics of a large number of objects. The results are therefore free from a priori assumptions, apart from a few basic and well established ones," said Francisco Garzon, an IAC researcher.

Indian PRL scientists discover an 'EPIC' planet

In an epic Indian discovery, a team from the Physical Research Laboratory, Ahmedabad, has spotted for the first time a distant planet six times bigger than Earth and revolving around a Sun-like star about 600 light years away. Both the planet and the star have been named EPIC.

"With this discovery India has joined a handful of countries which have discovered planets around stars," Indian Space Research Organisation has announced. PRL is supported mainly by the Department of Space, whose arm ISRO is. Significantly, the discovery was made using a PRL-designed spectrograph, PARAS, to measure and confirm the mass of the new planet.

EPIC 211945201b (or K2-236b) is the name given to the planet by the discovery team led by PRL's Abhijit Chakraborty. The host star is named EPIC 211945201 or K2-236.

Spectrograph studies

"The spectrograph is the first of its kind in the country which can measure the mass of a planet going around a star. Very few such spectrographs exist around the world (mostly in the USA and in the Europe) that can do such precise measurements," the space agency said on its website late on June 8.

The scientists observed the target over a time 420 days or about 1.5 years. They measured the mass of the planet using the indigenously designed PRL Advance Radial-velocity Abu-sky Search or PARAS spectrograph integrated with the 1.2-metre telescope located at PRL's Gurushikhar Observatory in Mount Abu, Rajasthan.

PRL, described as the cradle of space sciences in India, conducts fundamental research in a host

of physical sciences including astronomy and space.

"Such a discovery is of importance for understanding the formation mechanism of such super-Neptune or sub-Saturn kind of planets that are too close to the host star." The detection also adds to a sparse catalogue of 22 other confirmed exoplanet systems that have a mass and radius in this range, ISRO said.

Ice and iron planet

EPIC was found circling very close to the Sun-like star, going around it once in about 19.5 days and unlikely to be inhabitable because of its high surface temperature of around 600°C. The team found the planet to be smaller in size than Saturn and bigger than Neptune. Its mass is about 27 times Earth's and six times that of Earth at radius. The scientists estimate that over 60% of its mass could be made up of heavy elements like ice, silicates and iron.

Asked for his view, Jayant Murthy, senior professor of the Indian Institute of Astrophysics, Bengaluru, said Dr. Chakraborty's group is the only one in the country doing this important work and has spent several years in developing the facility. "Over the next few years, I expect that they will be able to make further contributions to this exciting field of astronomy."

Dr. Murthy said, "The work done by Dr. Chakraborty and his collaborators is important in characterising the nature of the exoplanet and they were able to show that the candidate is a close to Saturn-size planet orbiting near its star. These planets are very unlike those in our own Solar System and understanding them will tell us more about how planetary systems are formed." However, he said, radial velocity observations as made in this case "are not, in general, discovery observations but [a] look at already known planetary systems for a better understanding of their nature."

The research work will appear in the June issue of the Astronomical Journal owned by the American Astronomical Society

Agni-5 successfully test-fired

Long-range ballistic missile Agni-5 was successfully test-fired off the Odisha coast on Sunday, proving its reliability. This is the sixth successful test of the missile and the second in

its pre-induction configuration.

Govt approves Rs 10,000-cr continuation programmes for PSLV, GSLV

The Centre on Wednesday approved the continuation of the Polar Satellite Launch Vehicle and Geosynchronous Satellite Launch Vehicle Mark-III programmes, together costing over Rs. 10,000 crore, in a move that will help ISRO launch light and heavy satellites.

ISRO plans next launch mission in Aug.

PSLV-C42 to carry an earth observation satellite apart from 20 to 30 smaller ones of foreign customers

The Indian Space Research Organisation (ISRO) has slated its next launch mission, an earth observation satellite, tentatively for August. The last one was in April.

The upcoming episode will include 25 to 30 small secondary foreign satellites as passengers on the light payload lifting rocket, PSLV-C42.

The partly commercial launch is somewhat similar to the January 12 event in which a PSLV rocket (flight C-40) put 28 customer satellites to space along with Cartosat-2E and two small Indian satellites.

"We are looking at including 25 to 30 small satellites of foreign customers in the next PSLV launch depending on the configuration. They may total 250 kg," said Rakesh Sasibhushan, Chairman and Managing Director of Antrix Corporation Ltd., which exports ISRO's products and services.

New customers

C-42 would have new customers as well as repeat users of the Indian launch vehicle, he told The Hindu. The main load in it from ISRO could weigh around 800-1,000 kg.

Mr. Sasibhushan said the international launch market was "looking very good" and Antrix had sought two fully commercial launches (i.e., without an ISRO satellite) each year from the space agency.

Dedicated commercial missions — those that put a large single customer satellite to space — earn more money per flight than from lifting many tiny satellites to space at once.

This year, there would be only 'piggyback' customer rides such as C-40 or C-42 with a primary ISRO satellite. However, "Antrix has contracted three dedicated customer satellites [which will be sent to space in] the next four years and is discussing some more probables," he said.

To date the PSLV has launched 237 foreign customer satellites, a few of them in singles.

C-42 will be the fourth mission of 2018 and the third PSLV mission.

Around this time, ISRO had planned to launch the large, 5,400-kg communication satellite GSAT-11 on a European launcher but brought it back from French Guiana to its Bengaluru facility for a confirmation test. The satellite awaits a new launch date, ISRO Chairman K. Sivan earlier said.

ISRO's clock to prop up India's own GPS

He added that once it passes qualification tests, "We will first demonstrate the indigenous clock in an upcoming navigation satellite, along with the imported ones. Work on them is going on in full steam."

The cost and timing of the new satellites are not finalised, Mr. Sivan said. The development and eventual use of an indigenous atomic clock, at a cost of a few hundred crore rupees, was part of the NavIC concept, he added.

The rubidium atomic clocks from Europe started failing on the first navigation satellite, IRNSS-1A, around 2016, soon after ISRO put the last and seventh satellite in orbit. Until a few months ago, three more satellites were said to have suffered "one or two dysfunctional clocks" each, while two satellites did not have any problematic clocks. Each satellite carries three atomic clocks, including a standby.

ISRO is concerned that if more clocks fail, it may render the Rs. 1,400-crore fleet a dud. NavIC, which will be controlled by India, unlike the U.S. GPS or Russian Glonass systems, will serve the armed forces.

aspirantforum.com
Science and Tech.
The Crux of The Hindu
Vol. 14
News of Apr-June18

ISRO making green propellant

Scientists at the Indian Space Research Organisation (ISRO) have reported progress in the development of an environment-friendly propellant to power satellites and spacecraft.

The effort is to replace the conventional hydrazine rocket fuel, a highly toxic and carcinogenic chemical, with a greener propellant for future missions. Initial tests by a research team at the Liquid Propulsion Systems Centre (LPSC) here have shown promising results in the formulation and associated tests of a propellant blend based on hydroxylammonium nitrate (HAN).

Due to its high performance characteristics, hydrazine has dominated the space industry as the choice of propellant for over six decades, despite its environment and health hazards and the challenges faced in its manufacturing, storage, ground handling and transportation.

The LPSC team comprising Arpita Dash, B. Radhika and R. Narayan formulated the HAN-based monopropellant and carried out a variety of tests to investigate its characteristics, like thermal and catalytic decomposition and compatibility with different materials. A monopropellant is a chemical propulsion fuel which does not require a separate oxidizer. It is used extensively in satellite thrusters for orbital correction and orientation control.

The in-house formulation consists of HAN, ammonium nitrate, methanol and water. While methanol was added to reduce combustion instability, the choice of AN was dictated by its capacity to control the burn rate and lower the freezing point of the propellant.

In a paper presented at the national conference on Future Directions in Propulsion, organised by the Aeronautical Society of India here, the researchers said the propellant formulation was tested for compatibility with four metal samples over a period of six months.

The LPSC is planning further tests in flight configuration.

NASA spacecraft provides new evidence of water plumes on Europa

Scientists re-examining data from an old NASA spacecraft have found evidence that the liquid water reservoir under the surface

of Jupiter's moon Europa are venting plumes above its icy shell. Data collected by NASA's Galileo spacecraft in 1997 was put through new and advanced computer model to untangle a mystery – a brief, localised bend in the magnetic field – that had gone unexplained until now.

Previous ultraviolet images from NASA's Hubble Space Telescope in 2012 suggested the presence of plumes. However, the new analysis published in the journal Nature Astronomy, used data collected much closer to the source and is considered strong, corroborating support for plumes. "There now seem to be too many lines of evidence to dismiss plumes at Europa," said Robert Pappalardo, Europa Clipper project scientist at NASA's Jet Propulsion Laboratory (JPL) in the US. "This result makes the plumes seem to be much more real and, for me, is a tipping point. These are no longer uncertain blips on a faraway image," said Pappalardo.

At the time of the 1997 flyby, about 200 kilometers above Europa's surface, the Galileo team did not suspect the spacecraft might be grazing a plume erupting from the icy moon. When they examined the information gathered during that flyby 21 years ago, sure enough, high-resolution magnetometer data showed something strange. Drawing on what scientists learned from exploring plumes on Saturn's moon Enceladus – that material in plumes becomes ionised and leaves a characteristic blip in the magnetic field – they knew what to look for. Scientists detected a brief, localised bend in the magnetic field that had never been explained.

They layered the magnetometry and plasma wave signatures into new 3D modelling developed at the University of Michigan in the US, which simulated the interactions of plasma with solar system bodies. The final ingredient was the data from Hubble that suggested dimensions of potential plumes, NASA said. The result that emerged, with a simulated plume, was a match to the magnetic field and plasma signatures the team pulled from the Galileo data. The findings are good news for the Europa Clipper mission, who may launch as early as June 2022, NASA said.

From its orbit of Jupiter, Europa Clipper will sail close by the moon in rapid, low-altitude flybys, it said. If plumes are indeed spewing vapour from Europa's ocean or subsurface lakes, Europa Clipper could sample the frozen liquid and dust particles.

Scientists develop new model to determine monsoon variations across India

Scientists have developed a new model for estimating variability and trends in rainfall over different climate regions of the country, which is set to help in improving the existing weather forecasting for both the southwest and northeast monsoons.

The new statistical model based on multiple linear regression (MLR) has been developed by scientists from the Centre for Oceans, Rivers, Atmosphere and Land Sciences (CORAL), IIT Kharagpur, the Indian Institute of Tropical Meteorology (IITM), Pune, and the Indian National Centre for Ocean Information Services (INCOIS), Hyderabad.

"Indian monsoon, both southwest and northeast is complex. It depends on various climatic forcings (conditions) like El Nino, Indian Ocean Dipole, which affect rainfall in different regions, in different ways. We studied these factors and assigned a value to each," said professorArunChakroborty from IIT Kharagpur.

Researchers highlight that current dynamic models used for monsoon forecast face two major problems. First, they respond a little too much to El Nino Southern Oscillation (ENSO). Second, the relationship between Equatorial Indian Ocean Oscillation (EQUINOO) and summer monsoon in models has been found to be opposite to actual observation.

"In observation, we find a positive co-relation between EQUINOO and monsoon, but it is opposite in the models. So, if we can improve our understanding of EQUINOO's impact on monsoon, then we can make corrections in the dynamic model and improve our teleconnections. This will help us get an accurate monsoon forecast," said Dr P.A. Francis, from INCOIS, highlighting that it is also one of the objectives of the National Monsoon Mission.

The study published recently in Scientific Reports also analysed changes in the monsoon from 1979 to 2017 and found a significant positive trend (0.43mm/day/decade) in northwest India for the southwest monsoon. “But it showed a decline in south and northeastern states,” said first author P.J. Nair, from IIT Kharagpur.

“It’s significant to note that the increase/ decrease of rainfall, for both summer and winter monsoon is not uniform in all regions and so is the effect of these climatic factors. For instance, for most of mainland, El Niño is bad, but for the northeastern parts of the country, it is not that bad,” said co-author Professor J. Kuttippurath from IIT Kharagpur.

The research is one of the first to have analysed the variability of the Indian monsoon because of these factors together. It confirmed with statistical analysis, that ENSO and EQUINOO are two major drivers for Indian monsoon and explain around 50% variability in monsoon.

With the accuracy of current monsoon forecast models limited because of the lack of data and adequate information on climatic processes, researchers said such studies would help scientists to better tune their models for accurate weather prediction.

The research assumes significance as the monsoon decides the livelihood of more than a billion people and influences the agrarian economy which is largely dependent on its accurate forecast. The situation warrants continuous surveillance of Indian rainfall.

After glitch, ISRO trying to restore link with GSAT-6A

A day after GSAT-6A, the country’s newest communication satellite, went incommunicado in space; officials of the Indian Space Research Organisation (ISRO) said that they were working to restore the link with it.

The silence is initially believed to have been caused by a power glitch or a short circuit on the satellite.

The spacecraft, launched on March 29, was meant to support military communications in hostile regions using handy ground terminals. Built to last 10-12 years, it was to be a standby for its three-year-old replica GSAT-6.

ISRO chief hopeful

ISRO Chairman K. Sivan, for whom this was the first mission after taking charge, said, “Going by preliminary data, we expect that we will be able to recover the satellite. Its systems are in good health. Our teams are working round the clock to re-establish contact with the satellite. We are trying through our ground stations across the world.” Functionally, there would be no shortage or disturbance as GSAT-6 would be at work for some more years, he said.

“There will be no impact of this problem on our next missions,” Dr. Sivan said.

The launch of the navigation satellite IRNSS-1I is scheduled for April 12. An expert committee is looking into the issue and will suggest recovery and other options.

Orbit correction

After the 36-minute second orbit correction of Friday, GSAT-6A had an orbital period of 18-20 hours, close to the final 24 hours. The command team at the ISRO’s Master Control Facility (MCF) at Hassan would get another shot at recovery when the satellite passes over India morning.

Dr. Sivan also referred to the latest case of Russian scientists getting back an Angolan satellite that had lost its link after launch in December.

Earlier, an ISRO statement said, “Communication from the satellite was lost after the second firing of the on-board engine” . “Efforts are under way to establish the link with the satellite,” it said. News about a glitch started floating in around forenoon. The ISRO brass, including Dr. Sivan and officials of the satellite and control teams, went into a huddle at the ISRO headquarters and then at the MCF. Multiple but unofficial sources connected with the ISRO believe the spacecraft may have died.

GSAT-6A still eludes ISRO

Contact is still to be re-established with the delinked communication satellite GSAT-6A, according to an ISRO official.

Engineers at the ISRO Master Control Facility at Hassan continued to try to hook up with it. “We must wait for Tuesday when it is expected to fly over India,” the official said.

Apparently, the best efforts to reach Indian satellites can be made from the two inland

MCFs — at Hassan and Bhopal — although ISRO has a handful of ground stations across the world to track its satellites.

Team set up

A team led by former director of ISRO Satellite Centre P.S. Goel is to look into the latest anomaly and how to address it in future missions.

GSAT-6A was sent to space on March 29 on ISRO's GSLV rocket. However it stopped sending signals soon after the second routine orbit raising exercise was performed on March 31.

It had then reached an orbit of around 36,000 km x 20,000 km and would be circling Earth every 18-20 hours.

ISRO Chairman K. Sivan said that his team was not yet giving up on the satellite, said to be important for strategic communications in remote areas and for the armed forces. "We hope to recover the satellite and will keep on trying to contact it," he had said.

If they cannot do so, the satellite will continue to go around Earth idly until it loses height and comes down one day.

IRNSS-1I to enrich navigation fleet

Navigation satellite IRNSS-1I was flown into space from Sriharikota space pad in the early hours of Thursday. The 1,425-kg satellite will shortly become the eighth satellite to join the NavIC constellation of Indian regional navigation satellites.

The launch completes the first phase of the constellation, K.Sivan, Chairman of the Indian Space Research Organisation, said after a 19-minute flight put the satellite in a precise initial orbit. It was put to orbit on the PSLV-C41 rocket from the Satish Dhawan Space Centre in Andhra Pradesh at 4.04 a.m.

NavIC (Navigation with Indian Constellation), dubbed India's own GPS, has been designed to provide precise information on position, navigation and time related to objects or people. The eight satellites have a civilian and restricted military/security application to aid security and disaster management and fleet monitoring on land, air and sea.

Space stint

Built for a 10-year stint in space, the IRNSS-1I is expected to be ready for work in about a

month's time, after routine orbit manoeuvres and tests, ISRO officials said after the launch at 4.04 a.m.

"The NavIC constellation is going to create history and make innovative applications for the entire community of position-based services, especially the under- served and un-served," Dr. Sivan said in a post-launch address. ISRO is developing many applications, and industry and institutions should take them to users.

ISRO teams returned to launch this mission in a record 14 days after the communication satellite GSAT-6A on March 29. However, IRNSS-1I was flown from the older, first launch pad.

ISRO launched the first seven navigation satellites — IRNSS-1A to 1G — between July 2013 and April 2016. Although 1I is the ninth to be built and launched for the NavIC fleet, the previous satellite, 1H, was lost in a faulty launch last August.

1I and 1H were planned as backups but became necessary after all three imported rubidium atomic clocks on 1A failed in orbit. All seven satellites are required for accurate, 24-hour information from the fleet.

Both 1I and 1H were fitted with corrected atomic clocks. ISRO involved a consortium of six Indian industries in their assembly, integration and testing at Bengaluru — an exercise that will be replicated in coming missions, Dr. Sivan said.

Once the IRNSS-1I was ejected from the rocket, its solar panels opened out automatically. At the same time, engineers at ISRO's facility at Hassan in Karnataka took control of the satellite.

ISRO recalls mega GSAT-11 from Kourou for re-tests

Just over a fortnight after flying GSAT-11 out to Kourou for launch, the Indian Space Research Organisation has recalled the heaviest communication satellite it has built. The reason is said to be for conducting additional technical checks in Bengaluru, where it was built.

The 5,700-kg high-throughput or Internet broadband satellite had reached French Guiana in South America on March 30 and was slated for launch on May 26 (IST), according to its launch agency Arianespace.

ISRO's spokesman and officials were not

reachable for comment.

The European space transporter said that it has postponed the Ariane 5 launch numbered VA 243 that was initially planned for May 26, 2018 in the wee IST hours "[d]ue to additional technical checks with ISRO's GSAT-11 satellite, to be conducted from the ISRO Satellite Centre (ISAC) at Bangalore." GSAT-11 is aimed at providing multiple spot beam coverage in Ka and Ku bands over the Indian region and nearby islands. Its 12 gbps service is expected to be far more superior to older Indian communication satellites.

Technical checks

The satellite and its foreign launch, estimated at Rs. 1,117 crore, was formally approved by the Union Cabinet in March 2016.

Mathieu Weiss, space counsellor in the French embassy in Bengaluru and MD of the India liaison office of French space agency CNES (which is associated with the Ariane rocket design,) said, "These things happen in the space sector. We fully understand that the customer has to make thorough technical checks. The spacecraft being an exceptional satellite, one has to be super cautious in launching it. We will do everything to accommodate ISRO in a forthcoming launch."

Arianespace had matched and paired GSAT-11 to be flown along with Azerspace-2/Intelsat-38. While GSAT-11 will have to be tested, cleared in the city and flown back to Kourou at least a month before it is launched, its new launch date is not known yet.

NASA junks robotic mission to explore Moon's polar region in 2022

In a move that shocked lunar scientists, Nasa has cancelled the only robotic vehicle under development to explore the surface of the Moon, despite President Donald Trump's vow to return people there.

Scientists working on the Resource Prospector (RP) mission, a robotic rover that had been in development for about a decade to explore a polar region of the Moon, expressed astonishment at the decision.

"We now understand RP was cancelled on 23 April 2018 and the project has been asked to

close down by the end of May," said the letter dated 26 April by the Lunar Exploration Analysis Group, addressed to Nasa chief Jim Bridenstine and posted on the website NASAWatch.com.

"This action is viewed with both incredulity and dismay by our community," particularly because Trump's space policy "directs Nasa to go to the lunar surface," the letter said.

The robotic rover was being built as the world's only vehicle aimed at exploring the polar region of the Moon, and was expected to undergo a design review next year ahead of launching in 2022.

It would have been the first US lunar lander since Apollo 17 in 1972, and the first ever US robotic rover on the surface of the Moon.

RP was intended to be the first mission to mine the surface of the Moon, in search of volatile compounds like hydrogen, oxygen and water.

Nasa responded with a statement posted online Friday which said some of the instruments aboard RP would be flown on future missions.

"Nasa is developing an exploration strategy to meet the agency's expanded lunar exploration goals," said the statement.

"Consistent with this strategy, Nasa is planning a series of progressive robotic missions to the lunar surface."

It did not specifically refer to any plans to cancel RP, but said the space agency is seeking "to evolve progressively larger landers leading to an eventual human lander capability," as part of a broader strategy to return people to the Moon for long-term exploration.

"As part of this expanded campaign, selected instruments from Resource Prospector will be landed and flown on the Moon," it said.

Bridenstine, who was confirmed this week as the new head of Nasa, insisted on Twitter that the US space agency is "committed to lunar exploration."

"Resource Prospector instruments will go forward in an expanded lunar surface campaign. More landers. More science. More exploration. More prospectors. More commercial partners," he wrote.

In December 2017, Trump formally directed Nasa to focus its efforts on returning people to

the Moon as a foundation for an eventual mission to Mars.

Atomic Energy

Draft mission to kick-start renewable energy storage

The draft National Energy Storage Mission expects to kick-start grid-connected energy storage in India, set up a regulatory framework, and encourage indigenous manufacture of batteries, according to a member of the expert committee set up by the Ministry of New and Renewable Energy (MNRE) last month.

The draft sets a "realistic target" of 15-20 gigawatt hours (GWh) of grid-connected storage within the next five years, according to Debi Prasad Dash, director, India Energy Storage Alliance (IESA), an industry body that is a part of the committee. Power grids do not currently use storage options that would help in smoothly integrating renewable energy sources.

The draft has been submitted to the Ministry, and will be released for public feedback in the next few months, said Mr. Dash. He added that the mission will focus on seven verticals: indigenous manufacturing; an assessment of technology and cost trends; a policy and regulatory framework; financing, business models and market creation; research and development; standards and testing; and grid are planning for energy storage.

Inherently intermittent

Renewable energy sources now make up almost one-fifth of India's total installed power capacity. However, as power grids increase their share of solar and wind energy, the problem remains that the peak supply of renewable sources does not always meet peak demand, explained P.C. Pant, a senior scientist with the MNRE. For instance, solar energy generation may be at its peak at noon, but unless stored, it will not be available when needed to light up homes at night. Moreover, renewable sources are inherently intermittent: there are days when the wind doesn't blow or the sky is cloudy.

Batteries could help store surplus energy during peak generation times, but are more immediately needed to stabilise the grid when shifting between renewables and the baseload thermal capacity. "Once the installed capacity of renewables reaches 100 GW [from the current

65 GW], it will become critical to incorporate storage options," said Mr. Pant.

The Solar Energy Corporation of India (SECI) expects to issue tenders for grid-connected storage by the end of the year, said its managing director JatindraNath Swain. For its own 160 MW plant in Andhra Pradesh, the SECI will issue tenders for a storage option by the end of July, he added. "Up to 10% of [solar] power can be injected into the grid without storage," he said. "After that, storage will become a necessity."

Cancelled tenders

However, industry players complain that the SECI as well as the NTPC and the NLC cancelled at least nine earlier tenders for grid storage in 2017. "This sends a negative signal both to global manufacturers and Indian companies who are looking to diversify into lithium ion battery manufacturing," said Mr. Dash. He added that the Central Electricity Authority is considering regulation to make storage mandatory for large scale solar projects ranging between 100 MW and 200 MW.

SECI's Mr. Swain indicated that price concerns were the reason for the cancellation of bids. Adding storage options could result in solar power spiking Rs. 3-4 per unit above its current low price of Rs. 2.44 per unit, making it unattractive to distributors.

It is important to look beyond mere capex costs, and also consider life cycle costs, and the distributor's costs due to grid instability and transmission and distribution losses, emphasised Rashi Gupta, director, Vision Mechatronics, one of several players assembling lithium ion cells into battery packs in India. Currently, the lithium ion cells needed for battery storage are not manufactured in India, although major players, including Indian Oil Corporation and Exide, are working to develop indigenous manufacturing capacity.

ENVIRONMENT AND ECOLOGY

NCBS researcher has a go at the paradox of the plankton

Microbe groups found in the soil, the gut, the tongue and many other places show many behavioral properties that are not clearly understood such as the reason for their diversity and stability. All microbial populations are not exactly alike; there are 'core' species which are always present in different samples and some 'peripheral' species which are seen only in some samples. A study published recently in the journal Physical Review Letters attempts to explain these features using a simple mathematical model.

There are many puzzles about the behaviour of microbes such as bacteria and archaea (which don't have a membrane-bound nucleus). For instance, a naturally occurring microbial ecosystem seen in soils, wastewater or even the human gut consists of hundreds or even thousands of species coexisting stably within a small, microscopic area. Given that the food sources are relatively few, and that the microbes tend to grow in number exponentially, how is it that they do not destroy each other in their competition for survival? How does the ecosystem maintain its diversity of microbiota? This is known as the paradox of the plankton. This and the related questions are addressed in this model. Here, apart from existing sources of nutrition, secretions given off by one species of bacteria form the nutrition for other species of bacteria.

Akshit Goyal, a PhD student at the National Centre for Biological Sciences, Bengaluru, is the first author of the paper. He refers to the fact that there are a small number of species that are 'core' and many that were 'peripheral'. While there are large numbers of bacteria of the peripheral and core species, there were few showing an intermediate degree of prevalence. "Hardly any species falls in between," he adds. When the prevalence of species is plotted as a graph, it therefore gives rise to a U-shaped distribution. "Many microbial ecosystems show the same [U-shaped] pattern," he says.

Food supply model

When microbes use resource molecules as food, they usually cannot convert them completely to energy — there's always some waste which form the by-products. "These by-products can sometimes be used as a food source by another species," says Goyal. Thus the waste given out by a core species becomes the food for a peripheral species. This can lead to increase in diversity. Goyal has done this work in collaboration with Sergei Maslow of University of Illinois, Urbana-Champaign, in the U.S.

The key finding of the study is regarding the existence of core and peripheral species and that such a simple model of the underlying process can explain this. Further the authors talk about the displacement of one species by another under conditions and when they share the propensity to consume the same resource, such a displacement is termed extinction.

Mukund Thattai, cell biologist from NCBS who was not involved in this research says, "A nice feature of this idea is that things which can be measured in a snapshot, for example, human tongue microbiome diversity, could potentially be explained by an ongoing evolutionary process." Referring to other work on this problem, he adds, "Of course, this is only one of several theories that have been put forward to address the diversity question... The key to discriminating between these ideas would be to not rely on a snapshot, but to actually watch the diversity of a microbiome change over time," says Prof. Thattai.

For example, the authors of this paper predict a certain rate at which large numbers of species would go extinct. "Such things are, given current technologies, measurable in principle and would go a long way to clarifying how diversity really arises in nature [in this context]," he adds.

Gujarat: Fossil reveals ancient tree which is new to science

The dry thorn forests of southeast Gujarat were rich rainforests nearly 55 million years ago. The recent discovery of a wood fossil, whose closest living relatives are rainforest trees, adds proof to this theory.

Plant fossils can help palaeobotanists reconstruct ancient vegetation. Scientists have discovered numerous such fossils from the 55 million-year-old Vastan lignite mine in Gujarat's Surat district. In an excavation here, palaeontologists at Lucknow's Birbal Sahni Institute of Palaeosciences, too, came across a small wood fossil.

"It was brown in colour, around 8 cm long and 5 cm wide," says R. C. Mehrotra, one of the co-authors of the study published in Palaeoworld.

When the team observed its fine wood slivers under a microscope, they noted several minuscule wood cells and rays (pale streaks on a tree trunk that run parallel to the circular tree rings). These closely resembled the wood of plants in the mahogany family (Meliaceae). The characteristic long rays of the fossil helped narrow the search further: they were similar to those of living evergreen trees belonging to the genus Chisocheton, which are found in parts of India, China, south Asia and Australia.

The scientists realised their find was very similar to a wood fossilChisochetonoxylon bengalensis (named for its similarity with Chisocheton tree wood) discovered in West Bengal in 1979.

However, the new fossil's vessels (a type of plant cell) were smaller and rays arranged in fewer layers. They christened their find Chisochetonoxylon vastanensis.

Vastan has also yielded other evergreen tree fossils in the past, the closest living relatives (based on morphology) of which include Aglaia and Calophyllum trees found in India's evergreen forests. Hence, the Vastan area – where tropical thorn forests now dominate – was a "luxurious" evergreen forest around 55 million years ago, write the authors. The reason lies in continental drift: as the Indian subcontinent broke away from the supercontinent Gondwanaland and drifted near the Equator, the resulting tropical weather created lush rainforests here, they add. As the landmass moved further north and away from the equator, drier vegetation replaced these forests.

Researcher Anusree A.S. Pillai of Norway's Oslo University, who has studied ancient vegetation

changes in India from tiny plant fossils, agrees. "These studies put together do point to the existence of evergreen forests in the region during this time," she wrote in an email to The Hindu.

Plants butterflies depend on

Before they become colourful nectar-feeding butterflies, caterpillars are voracious leaf-eaters. Scientists have compiled a list of 834 such plants that most butterfly caterpillars of the Western Ghats feed on, hoping this will aid ecological studies and butterfly conservation.

The Western Ghats is home to 336 butterfly species. Their 'larval host plants' — plants that butterfly larvae or caterpillars feed on — range from common plants like the Indian curry leaf tree to rarer ones like the curled Aerides orchid found only in the southwestern tracts of the Ghats. Though many of these host plants have been documented since the 1800s, the records are scattered and hard to find, says Ravikanthachari Nitin of the National Centre for Biological Sciences (NCBS), Bengaluru.

"The taxonomies of the plants [as well as the] butterflies are also archaic and outdated," he says.

Curating existing literature and recent unpublished records, Nitin and his colleagues (including naturalists from the Travancore Natural History Society) assembled a complete list of butterflies and their larval host plants for the biodiversity hotspot. Updating their scientific names based on latest taxonomy, the team's paper — published as a monograph in the Journal of Threatened Taxa — lists a total of 834 larval host plants used by 320 butterfly species in the mountain range. Their list reveals that the larval host plants of 16 butterflies are still unknown (including those of the Nilgiri tit and the Kodagu brush flitter which are found only in specific localities in the Ghats).

Specific families

The team's compilations also show that 81 butterfly species depend on plants belonging to the pea or legume family (Fabaceae). Another 71 of these winged insects such as the aces, scrub hoppers, demons and bobs lay their eggs on grasses and bamboos (belonging to

the plant family Poaceae). On the other hand, some plants are used by just a single butterfly species. Only the larvae of the moth-like Indian dusky partwing, for instance, live on wild arrowroot leaves (Marantaceae).

Dependence

The authors hope their list will highlight the diversity of plants on which butterfly species of the Western Ghats depend; 48 species of butterflies are found nowhere else in the world. The plants are also important because their decline can signal a decrease in butterfly diversity too, says Nitin. “Endemic butterflies like the Malabar banded peacock, Kodagu forest hopper and Shiva sunbeam which feed only on a single plant species would be more at risk,” he adds.

New plants from Western Ghats

In just four months, nine new plants have been discovered in the Western Ghats, according to papers published in journals. Apart from the discoveries of the world’s smallest land fern and two shrubs of the rattlepod family reported in The Hindu, six species including two balsams, two shrubs belonging to the mint family (Lamiaceae), a herb of the coffee family (Rubiaceae) and 10-cm-tall Sonerila, a flowering plant commonly found in the tropics, have been discovered.

Their stunning pink blooms make some Sonerilas well known as ornamental plants. Sonerila lateritica however, is a rock-loving wild herb that researcher S. Resmi at the University of Calicut and her colleagues discovered in the laterite hills of Ponkunnu in Kerala’s Kozhikkode district. Only two populations of the plant were found in the area, write the researchers in their study in the journalPhytotaxa.

Rare balsam

Kozhikkode is also home to a new balsam species, Impatiens saulierea, which the researchers discovered from wet, rocky surfaces in Kakkayam’s evergreen forests. Its occurrence in only a small area could make it an endangered species, write researcher Bince Mani of St. Thomas College, Kottayam, and colleagues, in their study published in Phytotaxa . Another balsam described in

the same study, Impatiens josephia, is found in Kerala's Idukki district where it grows on wet slopes of evergreen forests.

In Idukki district's Kulamavu evergreen forests, V.S. Hareesh and Mamiyil Sabu from the University of Calicut and their colleagues collected Ophiorrhiza jacobii,a herb that belongs to the coffee family. Clearing of roadsides – where the plant predominantly grows – could be a threat here, write the authors of the study published in The Nordic Journal of Botany.

It was again in Idukki district – on wet slopes near the popular tourist location of Munnar's Lockhart Gap – that the University of Calicut scientist P. Sunojkumar and his colleague found the 60-cm-tall herb Plectranthus sahyadricus (mint family) flowering. It is near this area that the Kochi–Danushkodi National Highway – which passes through the Lockhart Gap – is currently being widened. "Road expansions could definitely be a threat," says Sunojkumar. The results were published in the journal Phytotaxa.

In another study published in Phytotaxa, the scientist also describes a new shrubAnisochilus kanyakumariensis from Maruthwamala in Tamil Nadu's Kanyakumari district.

Scientists used morphological features to tell each plant apart from similar-looking species. All new plants are currently known only from the localities they have been collected from.

"More field surveys in the Western Ghats would surely lead to more such discoveries," said Sabu.

Bacteria isolated from domestic sewage remove organophosphorus pesticide

Using three bacterial species isolated from domestic sewage, researchers from India have successfully removed chloropyrifos pesticide from both water and soil. Chloropyrifos is an organophosphorous pesticide and is moderately toxic to humans. Poisoning from chlorpyrifos may affect the central nervous system, the cardiovascular system and the respiratory system.

The highlight of the work is the wholesome removal of the pesticide by the three species of bacteria, without leaving behind any toxic metabolites that persist in the soil for a long time. This was because, unlike other studies, none of the three bacteria used by the team led by Prof. Mukesh Singh from

Haldia Institute of Technology, Haldia, degraded the pesticide. The results were published in the journal Bioresource Technology.

"Bacteria found in domestic sewage are quite regularly exposed to low levels of this pesticide. So the bacteria adapt themselves to pesticide exposure for survival. This is the reason why we turned to domestic sewage to isolate the bacteria," says Prof. Singh.

To isolate the bacteria that can absorb the pesticide, the researchers exposed the bacteria found in sewage to different concentrations of pesticide along with nutrient media. The next day, seven bacteria that showed tolerance to 50 mg/ml of pesticide were isolated.

The next step was to check whether the isolated bacteria species could coexist with each other or displayed antagonism. Only three bacteria species were found to coexist without any antagonism.

Water and soil tests

The ability of the bacteria to remove the pesticide was then tested by using very high concentration of 500 mg/l of the pesticide. In the case of pesticide added to water, all the three bacteria both individually as well in a mixed culture were able to remove over 90% of the pesticide in three days.

In the case of soil containing 300 mg/kg of pesticide, the mixed culture of bacteria could remove up to 50% in 30 days. "The mixed culture comprising all three bacteria showed better uptake of pesticide compared with individual species," says Prof. Singh.

Studies were carried out to confirm the accumulation of the pesticide inside the bacteria and to know the location where it was found. "The pesticide bioaccumulates in the cell as well as being bound on the cell surface without any degradation," says Md. Shabbier from Haldia Institute of Technology and first author of the paper. The greater ability of the bacteria to absorb the pesticide arises from their ability to reduce the hydrophobic nature of the pesticide through the production of biosurfactants.

"Since the bacteria multiply in the soil or water, the pesticide released from the dead microbes will be absorbed by the newly formed ones. So it is quite possible that the soil or water will be free of the pesticide," says Shabbier.

The three bacteria and the mixed culture in soil containing did not inhibit the germination and growth of mung bean seedlings. While sample containing the pesticide destroyed red blood cells of goat

blood, the samples treated with the bacteria did not cause any damage to red blood cells.

"This once again confirmed that the bacteria had completely removed the pesticide from the sample," Prof. Singh says.

Western Ghats' forests vital for Tamil Nadu's monsoon rainfall

Researchers have found one more reason why urgent steps have to be taken to stop deforestation in the Western Ghats. The dense vegetation in the Western Ghats determines the amount of rainfall that Tamil Nadu gets during the summer monsoon.

A team led by Prof. Subimal Ghosh from the Department of Civil Engineering at the Indian Institute of Technology (IIT) Bombay has found that dense forests of the Western Ghats contribute as much as 40% of moisture to the southwest monsoon rainfall over Tamil Nadu during normal monsoon years. The average contribution is 25-30%. But during monsoon deficit years, the contribution increases to as high as 50%.

The study found the forests of Western Ghats contribute as much as 3 mm per day of rainfall during August and September over a "majority of locations" in Tamil Nadu and 1 mm per day during June and July.

The study published in the journal Geophysical Research Letters also found that deforestation of the Ghats led to 0.25 degree C increase in surface temperature across the State. The work was done in collaboration with Prof. Raghu Murtugudde of University of Maryland and Dr K. Rajendran from CSIR-Fourth Paradigm Institute (CSIR-4PI), Bengaluru.

To study the role of vegetation cover in the Western Ghats in supplying moisture to the southwest monsoon rainfall, the researchers used models to compare the contribution of Western Ghats with and without the forest cover.

Effect of forest cover

The researchers found a significant drop in rainfall in the range of 1-2.5 mm per day when the vegetation cover was removed from the Western Ghats. This translates to an average of 25% of the total monsoon rainfall over Tamil Nadu. But only small parts of Kerala get affected by deforestation in Western Ghats.

The team selected three years (1993, 1999 and

2002) when Tamil Nadu experienced extreme deficit in summer monsoon rainfall. They found that deforestation over Western Ghats reduced rainfall over the State by 40-50% during all the three years. "The effect of deforestation is more during the deficit years than monsoon surplus years," says Supantha Paul from IIT Bombay and first author of the paper. "During the three extremely monsoon deficit years studied, we found Tamil Nadu gained the most from vegetation in Western Ghats. If there is no vegetation in the Ghats then Tamil Nadu will be severely impacted especially during the monsoon-deficit years."

While the decline in rainfall during the break period is widespread across the State, during the wet spells the contribution of vegetation in the Ghats to rainfall is mostly over the southern part of the State and is 25-30%. "The Western Ghats acts as a capacitor. The forest land and vegetation gets recharged with water during the wet spell and during the break periods moisture is released and which contributes to rainfall to the State," says Prof. Ghosh.

The researchers also cross-checked the role of vegetation in supplying moisture to the southwest monsoon rainfall by tracking the source of the moisture. "The results of this were consistent with the model with and without vegetation. So the results were not coincidental," says Prof. Ghosh.

Unregulated harvest threatens a Himalayan herb

A common herb of the Himalayas, the Himalayan trillium, could soon go locally extinct in many parts of its range in India if its excessive harvests are not regulated, claims a recent study in the Journal of Ethnopharmacology.

The Himalayan trillium — found across India, Bhutan, Nepal and China — is a natural source of steroidal saponins which are important components of steroidal drugs. The plant is popular in traditional Chinese medicine. Increased demands over the last decade has made its illegal collection from the wild a rather lucrative business in India: a kilogram fetches about Rs.3,000-5,000.

A team including researchers at Uttarakhand's Kumaun University studied the techniques used to gather the plant in Uttarakhand and Himachal Pradesh. They accompanied plant collectors on gathering trips (usually between April-May) and

interviewed 579 plant gatherers and 19 traders. They found that current gathering practices are entirely destructive: a single team uproots all plants in an area lest other collecting teams get to them later. Gatherers also noted that they now have to travel further away from their villages to collect the plants. Traders, who buy the plants in sacks from villagers, reported that it moves through a well-established illegal network to Tibet.

The team also studied the occurrence and regeneration of the plant through field surveys of 17 populations growing in three different regions. They found trilliums growing mostly in moist hill slopes with dense tree cover. The plants germinated from underground tubers immediately after snow melt in April and became dormant in September as winter set in.

Mature plants (which can live to 30 years or more) usually produce only one flower per year and vegetative reproduction through tubers occurs only in very old plants, said Harsh Chauhan from Kumaun University and lead author of the study. Unregulated harvests combined with such low levels of reproduction and other pressures like grazing could cause local extinction of the plant in many regions.

"We did not find trilliums in many regions where it was recorded before," said Chauhan.

"The scale at which it is collected will surely result in a huge reduction in population and even local extinctions," said Navendu Page, a plant ecologist independent of the study. It would be important to include it as a schedule species under the Wildlife Protection Act to ensure more protection, he added.

Royal Bengal tiger genome sequenced

For the first time, the genome of the Royal Bengal tiger, an endangered big cat, has been sequenced as part of plans to generate a high-quality draft genome sequence of the animal. Although endangered and threatened by various extinction risks, this tiger subspecies is the most populous one with the highest genetic diversity and the strongest chance of survival in the wild.

The high coverage genome sequencing and identification of genome variants in Bengal tiger (Panthera tigris tigris) were carried out by scientists from the Centre for Cellular and Molecular Biology (CSIR-CCMB) and a Hyderabad-based private

company. The details of the study were published online in BioRxiv recently. This genome was compared with the genome of Amur or Siberian tiger. These two subspecies occur in diverse environments and the new data also reveals major variations between the two. While Amur tiger occurs exclusively in sub-temperate and snow-covered habitats, the Bengal tiger occupies diverse tropical habitats ranging from Himalayan foothills to Central India plateau and the Western Ghats.

Genome data provides an insight into the genetic differences at individual level — ranging from single nucleotide variations to large structural variants. It also provides a better understanding of how the gene variants play a role in adaptation to the environment and disease susceptibility. In other words, it will reveal the changes triggered in the genes due to the adaptability to different environments in the evolutionary time scale.

The study observed "For a very long time it was believed that single nucleotide variants (SNVs) contribute to a majority of the individual genomic variations. Now it is recognized, albeit poorly understood, that much larger changes in the genome like structural variants and copy number variants also contribute significantly to disease susceptibility, phenotypic variations and immunity".

The researchers claim that this is the first report on the discovery of copy number variants and large structural variants in the genome of a wild, endangered species. The comprehensive data of Bengal tiger and Amur tiger genome sequences "will initiate our understanding on genomic changes and the species ability to adapt to discreet habitats", the scientists write.

The identification of numerous Simple Sequence Repeats (SSRs) will help in gaining a better insight into population genetics and gene flow. Dr. P. Anuradha Reddy, the lead author of the paper said that the numerous SSRs and SNVs identified in the genome can be used to strengthen forensic evidence in tiger poaching cases.

Such studies will also help in improving conservation management as authorities attempting to relocate an endangered animal will have a better understanding of its adaptability to the new environment.

CCMB Director, Dr. Rakesh Mishra said that genome sequencing will help in precise understanding of the evolutionary linkage of the organism. Besides, epigenetic analysis becomes possible once the

genome is available.

Elephant drives lead to spikes in stress levels

Despite adapting to stressful human-dominated landscapes, elephant stress levels increase drastically after 'elephant drives' – where people actively chase away elephants – find scientists.

Like humans, elephants also experience stress. Humans are also one of the causes of this stress: as their habitats are encroached, elephants have no option but to use human-dominated landscapes, which brings them in contact with people regularly. People react by driving elephants away using crackers, loud noises and even vehicles. The resulting stress signatures, including specific hormones such as glucocorticoids, are evident in elephant poop.

To find out how stressed wild elephants in human landscapes are, a team of scientists from institutes including the National Institute of Advanced Studies (NIAS) followed 69 elephants in Tamil Nadu's Valparai – a place of intense man-elephant conflict – and picked up fresh elephant dung deposited right after elephant drives. Similarly, they also studied elephants in the evergreen forests of Vazhachal nearby, where there is no prolonged exposure to human presence. At the Laboratory for the Conservation of Endangered Species, CCMB, Hyderabad, they quantified faecal glucocorticoid metabolite (fGCM) levels, higher levels of which imply more stress.

Contrary to their expectations, elephants in human-dominated regions had similar baseline stress levels as those dwelling in the fairly undisturbed forests of Vazhachal.

"This tells us that despite facing more stressful incidents in human landscapes, the stress levels of elephants there are comparable to those in undisturbed regions," says Sreedhar Vijayakrishnan (NIAS), lead author of the study. "So elephants in human-dominated regions seem to have adapted to the stress."

But interestingly, they have not been able to adapt to the stress that elephant drives cause, adds Vijayakrishnan.

After drives, the stress levels of adults and sub-adults increased by 24% and 54% respectively. Calves showed the highest stress: more than 100% higher than normal. Males too showed almost 40%

higher stress.

"Such negative interactions that cause consistently high levels of stress can affect elephant survival and reproduction," says Vijayakrishnan.

Elephant immune systems starts shutting down and even the estrus cycle in females can cease due to stress. Hence, elephant drives should be discouraged and the free movement of elephants facilitated, to reduce stress, write Vijayakrishnan and his colleagues in their study published in General and Comparative Endocrinology.

"The study provides good insight into how driving operations could influence elephants' physiological health," commented Sanjeeta Sharma Pokharel, who was not part of the research and has studied faecal glucocorticoid metabolites in elephants in the Nilgiris.

Decline in low-intensity rainfall reduces groundwater recharge in north India

Based on data collected between 1996 and 2016 from over 5,800 groundwater wells spread across India, researchers from Indian Institute of Technology (IIT) Gandhinagar have been able to find that rainfall intensity is "strongly" linked to groundwater recharge.

While low-intensity rainfall during summer monsoon is responsible for groundwater recharge in the case of India, particularly north-west and north-central India, high-intensity rainfall is a major driver for recharging groundwater in south India. The size of aquifers and the yield are much larger in north India compared with south India. The results were published in the journal Geophysical Research Letters.

Rainfall is classified as low-intensity if the amount is between 1-35 mm per day. High-intensity rainfall is characterised by rainfall in excess of 35 mm per day.

Nature of aquifers

A team of researchers led by Prof. Vimal Mishra from IIT Gandhinagar found that groundwater recharge with respect to intensity of precipitation in the three regions studied is related to the nature of the aquifers. While aquifers across north India, particularly in the Indo-Gangetic Plain, are characterised by alluvial soil, southern India is characterised by hard-rock aquifers.

Though specific yield of alluvial soil is higher than

hard-rock aquifers, alluvial aquifers take longer time to get recharged in response to rainfall. “Low-intensity rainfall provides maximum time for water to percolate and recharge the aquifer and so is favourable for groundwater in north India,” says Prof. Mishra. “High-intensity rainfall mostly leads to surface run-off and doesn’t contribute much to groundwater recharge in north India.”

“In contrast, hard-rock and basaltic aquifers are seen in south India. Here, high-intensity rainfall contributes more to groundwater recharge than low-intensity rainfall in south India,” he says.

The researchers used groundwater level data available between 1996 and 2016 from over 5,800 wells and estimated the groundwater recharge for each well and for each year. Groundwater recharge estimation was done using water table fluctuation method by taking the groundwater table difference between pre-monsoon (May) and post-monsoon (November) months.

Total amount of rainfall received per year between 1951 and 2016 has declined in the Indo-Gangetic Plain, Maharashtra, parts of Tamil Nadu and Western Ghats. But specifically, the total rainfall contributed by low-intensity rainfall has significantly declined across India, with the maximum reduction seen in central India, Indo-Gangetic Plain and to a less extent in north-west India and south India.

In contrast, the total rainfall from high-intensity precipitation has increased in north-west India (Gujarat and Rajasthan), south India, West Bengal and Orissa. Kerala has witnessed a decline in both high- and low-intensity rainfall.

The study found the decline in groundwater recharge between 1996 and 2016 is strongly associated with decline in low-intensity rainfall in north-west and north-central India. At the same time there is an increase in groundwater recharge in south India due to an increase in high-intensity rainfall.

Managing groundwater

“Our findings have implications on managing groundwater resources in India. Nature of rainfall supportive of groundwater recharge has changed in north India even as groundwater withdrawal for irrigation has been increasing to meet the demands of intensive agriculture. This has created an imbalance and has led to an unsustainable scenario for groundwater use for irrigation,” he says.

"Our study suggests that north India must make additional efforts (in the form of artificial groundwater recharge) to check the decline in groundwater table while also reducing groundwater withdrawal for irrigation. Both these measures have to be adopted simultaneously," he adds.

Mapping southern Bay of Bengal for insights into the summer monsoon

An international team of ocean researchers has now generated a comprehensive in situ observational dataset of the physical, chemical and biological parameters of the southern Bay of Bengal, air–sea interface and the overlying atmosphere. The ocean–atmosphere interaction plays a major role in controlling the weather systems associated with the Indian summer monsoon (June–September).

The field programme was carried out as a part of the Bay of Bengal Boundary Layer Experiment (BoBBLE) to collect the dataset, onboard one of India's research ships Sindhu Sadhana, and the findings were recently published in theBulletin of the American Meteorological Society.

The two-month study — June to July 2016 — was carried out on multiple platforms (ship, ocean gliders and Argo floats) to measure salinity, conductivity, temperature, dissolved oxygen and chlorophyll content in the sea water.

Salinity contrast

"There is a huge salinity contrast between Arabian Sea and the Bay of Bengal. There are no major rivers in the western side of India. So Arabian Sea does not get much fresh water. But [since] rivers [such as] Ganga, Brahmaputra, Mahanadi and Godavari empty huge amounts of fresh water [into the Bay of Bengal] and with heavy rainfall, the salinity of Bay of Bengal is comparatively less. The exchange between these two basins takes place in the southern Bay," explains Prof. P.N. Vinayachandran from the Centre for Atmospheric and Oceanic Sciences at Indian Institute of Science, Bengaluru. The southern Bay region hosts a salt pump which draws high salinity water from the Arabian Sea and supplies to the Bay of Bengal.

The research was mainly focussed on the waters east of Sri Lanka which are marked by intense Summer Monsoon Current and at the Sri Lankan Dome, which is a patch of ocean with anti-clockwise circulation with upwelling in its centre. "The Experiment shows that a barrier layer of about 40

metres thickness can be found here. This boundary layer exists between the upper warm fresh layer and the bottom layer.

The layer insulates the upper layer of the ocean from cooling from below while maintaining high sea surface temperature thus helping rapid build-up of weather systems," he says in an e-mail to The Hindu.

Gliders equipped with photosynthetically active radiation sensors were used for studying the biological components of the water. "Phytoplankton was studied, as the southern Bay of Bengal is a biologically productive region [which is] rich in chlorophyll content," he says. "The physical processes such as upwelling at the Sri Lankan Dome and [the] nutrient carried by monsoon currents support the biological process."

Carbon dioxide

The study region exhibited high carbon dioxide and the report says that southern Bay of Bengal could be a possible source of carbon dioxide to the atmosphere during summer.

The data collected during BoBBLE programme found that the sea surface temperature in this region increases steadily during the break period of the monsoon.

The paper states that as the rainfall over the entire Asian landmass during the monsoon is linked to moisture and heat exchange over the Indian Ocean, it is essential to get a detailed understanding of this region.

The researchers are now analysing the data to understand how the monsoon system and ocean atmospheric systems in the southern Bay of Bengal are linked.

Being preyed may be a good thing for stick insects

Even before they are born, some stick insects can disperse to far-away regions. Scientists find that the eggs of some stick insect species are so hard that even if their mothers are eaten by birds, they can pass through the birds' guts unaffected and hatch successfully once they come out in their predator's poop. For an insect that cannot travel very far, this method could serve as an important means of dispersal to new regions.

Like plant stems

Stick insects resemble thin plant stems. But birds can still see through this camouflage and do prey

on them. Incidentally, the eggs of many stick insect species resemble seeds in colour, shape, size and texture. This piqued the interest of a team of Japanese scientists: If birds ate stick insect eggs, could they still hatch after they come out in bird poop?

Over 2015 and 2017, the team fed 210 stick insect eggs — of three species found in Japan — along with artificial feed to the brown-eared bulbul, a small bird that feeds on the insects in the wild. When the scientists examined bird poop after the meal, they found that up to 20% of the eggs remained intact. Stick insect eggs take time to hatch, and the team found that two of the intact eggs eaten by the birds in 2017 hatched this February. This provides direct evidence that stick insects can hatch out of eaten eggs and, in turn, could be dispersing to new places that the birds unwittingly take them to.

This is possible not just because stick insects eggs are hard, write the authors in their study published in Ecology. Females of many stick insect species are parthenogenetic: They do not have to mate with a male to fertilise the eggs that they carry in their bodies. So even if they are eaten, their eggs could still hatch once outside their predator's body.

Genetic structure

"Based on this we'd like to investigate whether similar genetic structure of stick insects can be found along birds' migration flight paths, and whether there are genetic similarities between stick insects and plants that rely on birds for seed distribution," said lead author Kenji Suetsugu of Japan's Kobe University Graduate School of Science in a press release.

It is indeed possible that stick insect species in India too could show this pattern of dispersal, wrote Suetsugu in an email to The Hindu.

Even small dams have severe impact on river ecology

It seems to stand to reason that small dams cause less environmental problems than large ones. But the first study on small hydropower projects in India proves that they cause as severe ecological impacts as big dams, including altering fish communities and

changing river flows.

Such hydroprojects, which usually generate less than 25 megawatts of power and consist of a wall that obstructs a river's flow, a large pipe that diverts the collected water to a turbine-driven powerhouse to generate electricity and a canal that releases the water back into the river, are touted to be better than large dams because they submerge fewer regions and barely impact river flow. Such projects receive financial subsidies — even carbon credits — for being 'greener'.

To see how green such small dams really are, scientists from organisations including Bengaluru's Foundation for Ecological Research, Advocacy and Learning (FERAL) compared almost 50 kilometres of three river tributaries — over one undammed and two dammed stretches — of the Netravathi river in the Western Ghats of Karnataka.

They studied three zones in detail: above the dam (upstream), in the area between the dam's wall and the powerhouse, sometimes completely devoid of water ('de-watered') and below the powerhouse (downstream). Here, they studied differences in water depth and width, which signify how much habitat is available to the river's denizens, and habitat quality through factors including dissolved oxygen content and water temperatures.

Their results show that changes in water flow in the dammed sections reduced the stream's depth and width; water in these stretches was also warmer and had lower dissolved oxygen levels. These changes were most evident in the 'de-watered' zones and worsened in the dry seasons.

Habitat quality

This decrease in habitat quantity and quality showed in fish diversity too. The team found that un-dammed stretches recorded a higher diversity of fish species, including endemics (species seen only in the Western Ghats).

"The upstream and downstream stretches get disconnected and this impedes the river," says Suman Jumani, lead author of the study and researcher at FERAL.

Such small hydro-projects cropping up on rivers in the Ghats is a serious worry, she adds, especially because they do not require environmental impact assessments.

"It is not a question of small versus big dams," says Jumani. "Small dams are not necessarily bad if there are proper regulations in place."

Regulations could include limiting the number of dams in a river basin or maintaining a minimum distance between dams on the same river stretch.

Now, polyethylene plastic with antibacterial properties

Silver nanoparticles embedded on clay have now been successfully dispersed inside plastic to create new antimicrobial films, filaments and can also be moulded into other plastic items. Silver nanoparticle-embedded plastics were found to have greater than 99% antibacterial activity against common bacterial pathogens like Escherchia coli and Staphylococcus aureus.

Silver nanoparticles of about 10 nanometre size were deposited on clay particles of about 200-300 nanometre length. "We used an inorganic clay found in volcanic sites called Montmorillonite. Silver nanoparticles have a tendency of agglomeration or clumping due to high surface area, so we provided clay as a platform for the silver to sit on," explains Anasuya Roy, PhD scholar at IIT, Delhi and first author of the paper published in Polymer Composites.

Clay-silver compund

The clay–silver compound, containg 10% silver, was then loaded into the high density polyethylene plastic using a melt compounding method. "The clay is inorganic and highly hydrophilic, whereas our plastic is organic, hydrophobic and nonpolar. They are highly incompatible. So we use a compatibilizer, which gives the required adhesion between the two phases. Also, inside the twin screw extruder machine, the necessary speed, temperature and time gives uniform mixing and the silver-clay is well embedded inside the plastic," explains Prof. Mangala Joshi, from Department of Textile Technology at IIT Delhi and corresponding author of the paper.

Films and filaments

They then converted the newly formed silver–clay–plastic nanocomposite into films, filaments and also moulded these into specimens and checked the antibacterial property. The films and filaments showed higher activity than the moulded ones. "In the moulded ones, we found that the antimicrobial silver was not available on the surface leading to the reduction in activity. But when the concentration of silver–clay complex was increased from 3% to 5%, the moulded ones also showed excellent

activity against the two pathogens," adds Joshi. The research team has got a U.S. patent.

The team also tried other metal ions like zinc and copper in the place of silver. "Silver has a high reduction potential, meaning it can quickly go from silver ions to silver nanoparticles without the need of any external reducing agent. These silver nanoparticles interact with the bacterial cell wall and also generate oxidative stress inside the cell, thus killing it," explains Roy. "The content of silver is very low in these nanocomposite plastic so no toxicity to human cells. Further, we checked the biocompatibility of the plastic with human skin and blood in vitro . In vivo tests are in progress and we hope that the new plastic can find a wide range of applications in the biomedical field and also in commodity items where this antimicrobial property can be an added advantage."

What caused Dec. 1, 2015 Chennai downpour?

On December 1, 2015 Chennai and its surrounding regions experienced an unprecedented, heavy rainfall. In a region where the average rainfall during the season is expected to be 8-10 mm per day, one of the rain gauges in the city recorded an abnormally high, 494 mm, rainfall over 24 hours that day. This led to death of nearly 250 people, and Chennai was declared a 'disaster zone'. There have been attempts to explain this phenomenon of how clouds remained stationary over this region, continuously giving rain over 24 hours. In a first, Jayesh Phadtare of Centre for Atmospheric and Ocean Sciences, Indian Institute of Science, Bengaluru, links the presence of the Eastern Ghats to this phenomenon, in a paper published in Monthly Weather Review.

Cold pool

When clouds give out water droplets, the droplets evaporate mid-air, as they fall down. This cools the surrounding air, forming a cold pool of air which sinks down and flows horizontally. "The gusty cold wind that heralds an approaching thunderstorm is nothing but a cold pool, which plays a pivotal role in cloud dynamics." says Jayesh.

Unlike the Western Ghats, which run close to the west coast of India, the Eastern Ghats are nearly 200 km away from the coast. Therefore, the link between the mountains' orography and the rainfall over the region is not obvious, and this is the first study to link the two. Jayesh, who is studying cloud

propagation over the Indian region, could see the connection by observing satellite images: “In Kalpana-I satellite images, I saw that the clouds that gave so much rain over Chennai on 1 December 2015 moved from Bay of Bengal to the coast and became stationary there,” he says. Realising that the Eastern Ghats must be having a role in this, he went on to study a model of the system. “The interaction between mountains, clouds and cold pools became clear after performing the model experiments,” he adds, in an email to The Hindu.

According to the model, the cold pool was obstructed by the Eastern Ghats from flowing downward. Hence it piled up and remained stationary over the Chennai region. “The reason for the clouds remaining stationary was that there was a balance between the piling of cold pool along the mountain and the winds from the bay. This does not happen in all heavy rainfall incidences over Chennai,” says Jayesh.

Sensitivity experiments were done to check this model. In the experimental model in which the orography was absent, the winds just swept downstream and the clouds moved inland. In the model where the evaporative cooling was removed, the cold pool did not form at all and the clouds moved over the Ghats.

Dust storms

Cold pools are known to play an important role in the dust storms (Aandhi) that form in northern India. They form by the evaporation of raindrops. This process is more efficient in the drier and warmer environment as there is lot of scope of evaporation. So, the cold pools that form in these conditions, are deeper and more vigorous. “As pre-monsoon conditions in north India are very dry and warm, cold pools that accompany the pre-monsoon thunderstorms there are far more destructive, causing widespread damages,” says Jayesh. For the first time, this study links cold pools and the mountain structure to explain rainfall over south India.

Though the primary aim of the study is to explain the anomalous rainfall over Chennai on December 1, 2015, “the understanding gained from this analysis can be useful for improving the general weather forecast over this region,” the author writes in the paper.

New route to clean wastewater

Self-propelling nanomotors, just 200 nanometre in size, could be used for wastewater management in chemical industries. Developed by researchers from Indian Institute of Science Education and Research, Kolkata, and The Institute of Mathematical Sciences, Chennai, the nanomotor can be used for transporting catalysts needed in harsh chemical environments and removing unwanted chemicals in water.

Nanorods (rod shaped nanomotors) aremadeusing ammonium heptamolybdate tetrahydrate and dispersed in the solution to be treated. When hydrazine sulphate is added to water, it reacts with the nanorods producing nitrogen gas. This leads to an osmotic stress in the fluid and causes the nanorods to move along the direction of the gas evolved.

The paper published in Frontiers in Chemistry says that this nanomotor is amongst the fastest reported active nanoparticles.

"Molybdenum based soft-oxometalates are non-toxic and easy to synthesize. The complementary charge interactions on the surface trigger their motion. The speed can be increased by increasing the concentration of the fuel hydrazine on the surface of the nanorods and they were found to remain in their motile state for about three days," says Prof Soumyajit Roy from the Department of Chemical Sciences, IISER Kolkata and one of the corresponding authors of the paper.

Structure matters

The anterior end of these structures is capped like a pencil while the posterior end consists of a series of rod like protrusions. "We believe that these exposed ends of the rods provide a more accessible reaction surface than the capped end.

Therefore, the fuel hydrazine preferentially reacts at the posterior open end and generates gaseous nitrogen which triggers motion and the propulsion speed reaches up to a maximum of 600 metres per hour." says Prof. R. Adhikari from Department of Physics at IMSc, Chennai who is one of the corresponding authors of the paper, in an email to The Hindu.

In a paper to be published in the journal Nanoscale, the researchers have shown that another type of nanomotor in the form of a sphere (using titanium dioxide, heptamolybdate and gold) can also be used for delivering a catalyst to a particular area of interest by using visible light. The nanospheres were

found to move away from visible light. “The catalyst triggers a reaction and the pollutants get adsorbed on the nanospheres leading to quickly removal of organic pollutants from water. The solution can then be filtered, dried and the nanosphere can be retrieved,” says Apabrita Mallick, an Integrated PhD student at IISER Kolkata and one of the first authors of the paper.

How insects evolve immune-memory against bacterial infections

Much like humans, insects too develop an immune-memory in response to infection, a team at the National Centre for Biological Sciences (NCBS), Bengaluru has found. In humans, for instance, natural infection or vaccination can lead to the formation of important immunological memory in the human immune system. In other words, once infected, the immune system becomes ready to deal with that particular antigen because of immune-memory. For long, it has been a point of debate whether insects have such a memory that can protect them against future infections. The present study shows that such a memory can evolve over generations in red flour beetles (Tribolium castaneum)infected with Bacillus thuringiensis (Bt). The results of the study were recently published in Proceedings of the Royal Society B.

The study was conducted in Deepa Agashe’s lab at NCBS and the experiment was designed by Imroze Khan, first author of the paper, and Dr. Agashe, the principal investigator. The team infected nearly 5,000 to 6,000 beetles in every generation. “Every insect had to be pierced at the right point and injected with a standard number of bacterial cells. It took a year to standardise this process,” says Dr. Khan, who is now a faculty at Ashoka University, Delhi. With a generation being approximately 45 days long, the study of 10 generations stretched over two years. “Every day Arun Prakash [one of the authors] and I had to infect 1,000 insects,” he adds when asked what the most challenging part of the study was. The beetle populations were exposed to a single large dose of live Bt antigens or exposed to dead bacteria followed by live infection.

Evolved immunity

After observing ten generations, the team found that the new generation of insects had evolved better defence against Bt antigen. The emerging

populations showed either improved innate resistance or immune-memory, as opposed to control populations which were injected with a buffer solution and did not evolve any special ability to deal with the pathogen.

"This is the first real-time observation of the evolution of immune-memory in an insect; we showed that this can happen very quickly, and quite often," says Dr Agashe, in an email to The Hindu. "If our results hold true for other insects (which remains to be tested), this suggests that immune-memory can be a very broad system of defence against pathogens," she adds. Since insects do not have the kind of immune cells that humans have, for a long time, scientists did not think it was even possible for insects to develop an immune-memory.

In the past few years, multiple studies showed that insects do show some form of immune-memory, but how such memory evolves remained a puzzle. "We now have some clues about how fast and how reliably memory could evolve, what might be the mechanisms involved and when might immune-memory versus resistance be favoured by natural selection," says Dr Agashe.

Together, Dr. Khan and Dr. Agashe's labs are now trying to figure out the molecules responsible for immune-memory and resistance.

Do river dolphins hunt prey using many methods?

Asia's river dolphins may be nearly blind, but they compensate by using many methods to catch prey. Though chiefly known as echolocators, researchers now suggest that these dolphins could also be listening for surface-swimming fish and sensing electrical signals emitted by bottom-dwelling prey on the river-bed.

Eyes are of no use for river dolphins (genus Platanista) in the naturally murky waters of the Indus and Ganga. Instead, they have evolved to use echolocation to navigate and catch fish: the small clicks they produce underwater echo back at them, helping them identify a prey or obstacle on their path. Despite increasing pressures on their habitat – from ships' underwater noise (which could affect dolphin echolocation) to dams that alter the river's flow – dolphins still survive in many heavily human-used river stretches.

Wondering if these aquatic mammals have other methods to catch prey and thereby survive, a team

of researchers from institutes including Bengaluru's Asoka Trust for Ecology and Evolution (ATREE) first dug through 105 studies and historical references for information about dolphin anatomy and physiology as well as that of their prey (shrimp and fish). They also complemented this by studying the prey they found in dead dolphins' stomachs and acoustic information on the echolocation clicks Gangetic river dolphins use in varying depths of a 100-km stretch of the Ganga in Bihar.

The results show that dolphins choose their prey based on size; bottom-dwelling fish dominate their diets. Dolphins grasp their prey and potentially suck them into their mouths using their unusually large tongues. The study, published in Mammal Review, is the first to calculate the distance that these dolphins can detect a fish from: their echolocation enables them to 'see' a fish the size of the finger from 20 metres away.

Depths matter

There is also a clear difference in the way dolphins catch fish at various river depths: at the surface they listen for fish movement; prefer echolocation at the middle depths (dolphins produced the most number of clicks here) and sensitive snout-whiskers, especially in calves and juveniles, could help sense weak electrical signals emitted by bottom-dwelling fish and shrimp. This could make Platanista dolphins one of the few mammal groups in the world that use this method, says ATREE's Nachiket Kelkar, lead author of the study.

"The use of these different feeding strategies together could perhaps also explain why we see Platanista dolphins even in some highly disturbed habitats," adds Kelkar.

Novel packaging extends shelf-life of chicken

Now, chicken kept in the chiller of the fridge may remain fresh and without any bacterial contamination for up to two weeks thanks to researchers from Bhabha Atomic Research Centre (BARC), Mumbai. The researchers have developed a new eco-friendly food-packaging material using mango peel extracts and three other biodegradable polymers to extend the shelf-life of chicken. The packaging film showed good antimicrobial properties against common food microbes and also exhibited high antioxidant characteristics.

Peels from four different mango varieties were used for the study — Alphonso, Kesar, Langra and Badami. The peel content was extracted using different techniques and the bioactive properties, antioxidant and antimicrobial activity of the extracts were studied.

Amongst the four mango peel varieties studied, the Langra variety extract exhibited the highest inhibition against Staphylococcus aureus and Pseudomonas fluorescens. It was also rich in bioactive compounds like phenolics and carotenoids and thus had high degree of antioxidant capacity.

The packaging films were then made using the Langra extract (5%), polyvinyl alcohol, gelatin and cyclodextrin. “All the ingredients are biodegradable, and the new film can be a viable option for developing new eco-friendly packaging material. Also, India is one of the highest producers of mango, and the peel, which is usually thrown away, has higher phenolic content than the pulp and can serve as a good antioxidant,” explains Dr. Sweetie R. Kanatt, Senior Scientific Officer from the Food Technology Division of the Centre and first author of the paper published in Journal of Food Safety.

The packaging film was 150 microns in thickness and exhibited good tensile and punctures strength. The package was then tested for storing minced chicken meat.

The meat was stored at 2–4˚C and tested every three days. The meat packed using the mango peel film was able to keep the meat fresh and without spoilage for up to 12 days whereas the ones packed in normal polythene bag got spoilt within three days. “Meat has high lipid content that is prone to oxidation on storage/processing. We wanted to check how the film preserved the meat from both microbial spoilage and oxidative rancidity,” adds Dr. Kanatt. “Increase in shelf life as well as safety of the meat will be a boon to the food processer as they can store this meat in chilled rather than frozen state. Film preparation methods are being fine-tuned for possible commercial applications.”

Arctic sea route not possible: Finnish official

A 2008 photo of Baffin Bay near the Arctic Circle. Owing to global warming, the region may be ice-free by 2060APJonathan Hayward

‘Despite melting ice, it’s tough to navigate the waters’

Contrary to popular belief that the melting ice in the Arctic would open up alternate shipping routes, a senior Finnish official said it would still not be an easily navigable route. He also called for a greater Indian role in the region as an observer in the Arctic Council.

"Even if the Arctic becomes ice-free, the Northern sea route will not be an easily navigable route anytime soon. It will not be practical for container traffic, it may be okay for bulk carriers carrying gas. But it is containers which constitute the major traffic," Rene Soderman, senior Arctic official in the Finland Ministry for Foreign Affairs told The Hindu .

Finland is holding the Chairmanship of the Arctic Council from 2017-19.

Temperatures a hurdle

He explained that despite melting ice, the waters would be tough to navigate due to sub-zero temperatures and would pose serious challenges to ships effecting their movement and schedules which carries a premium in container traffic.

The Arctic region which has permanently frozen ice is melting at an increasing rate due to global warming and is expected to be ice- free by 2060. Already several countries have sent their ships and ice breakers in the summer months to demonstrate the navigability. Countries such as China and Japan are investing in infrastructure development there. It is seen as an alternate shipping route to cut time and costs and also circumvent the global choke points.

Mr. Soderman, who held discussions with several officials in the government, welcomed greater Indian role especially in renewing commitment to climate change and environmental protection. There is increasing concern in India as China makes inroads into the strategically important Arctic region which has large reserves of untapped minerals and fossil fuels.

The Arctic Council is currently formulating a long-term strategy for action looking into the 2030s based on its founding charter. "This is the first time the council is trying to see what it can do in the long term. Hopefully the strategy will be adopted by the ministerial council in May next year," Mr. Soderman said.

The Arctic Council, which is an intergovernmental organisation, has eight member-states,

six independent permanent participating organisations and observers which are non-Arctic states like India and China.

Decline in low-intensity rainfall reduces groundwater recharge in north India

Low-intensity rainfall provides maximum time for water to percolate and recharge the aquifer and so is favourable for groundwater in north India, says Vimal Mishra (left) Special arrangement

The findings have implications on managing groundwater resources in north India

Based on data collected between 1996 and 2016 from over 5,800 groundwater wells spread across India, researchers from Indian Institute of Technology (IIT) Gandhinagar have been able to find that rainfall intensity is "strongly" linked to groundwater recharge.

While low-intensity rainfall during summer monsoon is responsible for groundwater recharge in the case of India, particularly north-west and north-central India, high-intensity rainfall is a major driver for recharging groundwater in south India. The size of aquifers and the yield are much larger in north India compared with south India. The results were published in the journal Geophysical Research Letters.

Rainfall is classified as low-intensity if the amount is between 1-35 mm per day. High-intensity rainfall is characterised by rainfall in excess of 35 mm per day.

Nature of aquifers

A team of researchers led by Prof.Vimal Mishra from IIT Gandhinagar found that groundwater recharge with respect to intensity of precipitation in the three regions studied is related to the nature of the aquifers. While aquifers across north India, particularly in the Indo-Gangetic Plain, are characterised by alluvial soil, southern India is characterised by hard-rock aquifers.

Though specific yield of alluvial soil is higher than hard-rock aquifers, alluvial aquifers take longer time to get recharged in response to rainfall. "Low-intensity rainfall provides maximum time for water to percolate and recharge the aquifer and so is favourable for groundwater in north India," says Prof. Mishra. "High-intensity rainfall mostly leads to surface run-off and doesn't contribute much to groundwater recharge in

north India."

"In contrast, hard-rock and basaltic aquifers are seen in south India. Here, high-intensity rainfall contributes more to groundwater recharge than low-intensity rainfall in south India," he says.

The researchers used groundwater level data available between 1996 and 2016 from over 5,800 wells and estimated the groundwater recharge for each well and for each year. Groundwater recharge estimation was done using water table fluctuation method by taking the groundwater table difference between pre-monsoon (May) and post-monsoon (November) months.

Total amount of rainfall received per year between 1951 and 2016 has declined in the Indo-Gangetic Plain, Maharashtra, parts of Tamil Nadu and Western Ghats. But specifically, the total rainfall contributed by low-intensity rainfall has significantly declined across India, with the maximum reduction seen in central India, Indo-Gangetic Plain and to a less extent in north-west India and south India.

In contrast, the total rainfall from high-intensity precipitation has increased in north-west India (Gujarat and Rajasthan), south India, West Bengal and Orissa. Kerala has witnessed a decline in both high- and low-intensity rainfall.

The study found the decline in groundwater recharge between 1996 and 2016 is strongly associated with decline in low-intensity rainfall in north-west and north-central India. At the same time there is an increase in groundwater recharge in south India due to an increase in high-intensity rainfall.

Managing groundwater

"Our findings have implications on managing groundwater resources in India. Nature of rainfall supportive of groundwater recharge has changed in north India even as groundwater withdrawal for irrigation has been increasing to meet the demands of intensive agriculture. This has created an imbalance and has led to an unsustainable scenario for groundwater use for irrigation," he says.

"Our study suggests that north India must make additional efforts (in the form of artificial groundwater recharge) to check the decline in groundwater table while also reducing groundwater withdrawal for irrigation. Both these

measures have to be adopted simultaneously," he adds.

Mapping southern Bay of Bengal for insights into the summer monsoon

The ocean–atmosphere interaction plays a major role in controlling weather systems

An international team of ocean researchers has now generated a comprehensive in situ observational dataset of the physical, chemical and biological parameters of the southern Bay of Bengal, air–sea interface and the overlying atmosphere. The ocean–atmosphere interaction plays a major role in controlling the weather systems associated with the Indian summer monsoon (June–September).

The field programme was carried out as a part of the Bay of Bengal Boundary Layer Experiment (BoBBLE) to collect the dataset, onboard one of India's research ships Sindhu Sadhana, and the findings were recently published in theBulletin of the American Meteorological Society.

The two-month study — June to July 2016 — was carried out on multiple platforms (ship, ocean gliders and Argo floats) to measure salinity, conductivity, temperature, dissolved oxygen and chlorophyll content in the sea water.

Salinity contrast

"There is a huge salinity contrast between Arabian Sea and the Bay of Bengal. There are no major rivers in the western side of India. So Arabian Sea does not get much fresh water. But [since] rivers [such as] Ganga, Brahmaputra, Mahanadi and Godavari empty huge amounts of fresh water [into the Bay of Bengal] and with heavy rainfall, the salinity of Bay of Bengal is comparatively less. The exchange between these two basins takes place in the southern Bay," explains Prof. P.N. Vinayachandran from the Centre for Atmospheric and Oceanic Sciences at Indian Institute of Science, Bengaluru. The southern Bay region hosts a salt pump which draws high salinity water from the Arabian Sea and supplies to the Bay of Bengal. The research was mainly focussed on the waters east of Sri Lanka which are marked by intense Summer Monsoon Current and at the

Sri Lankan Dome, which is a patch of ocean with anti-clockwise circulation with upwelling in its centre. “The Experiment shows that a barrier layer of about 40 metres thickness can be found here. This boundary layer exists between the upper warm fresh layer and the bottom layer.

The layer insulates the upper layer of the ocean from cooling from below while maintaining high sea surface temperature thus helping rapid build-up of weather systems,” he says in an e-mail to The Hindu.

Gliders equipped with photosynthetically active radiation sensors were used for studying the biological components of the water. “Phytoplankton was studied, as the southern Bay of Bengal is a biologically productive region [which is] rich in chlorophyll content,” he says. “The physical processes such as upwelling at the Sri Lankan Dome and [the] nutrient carried by monsoon currents support the biological process.”

Carbon dioxide

The study region exhibited high carbon dioxide and the report says that southern Bay of Bengal could be a possible source of carbon dioxide to the atmosphere during summer.

The data collected during BoBBLE programme found that the sea surface temperature in this region increases steadily during the break period of the monsoon.

The paper states that as the rainfall over the entire Asian landmass during the monsoon is linked to moisture and heat exchange over the Indian Ocean, it is essential to get a detailed understanding of this region.

The researchers are now analysing the data to understand how the monsoon system and ocean atmospheric systems in the southern Bay of Bengal are linked.

Environment Day bouquet: 539 species discovered in India in 2017

Name and fame:1, 1A & 1B: Drypeteskalami;

2: Rhabdopsaquaticus; 3: Xenophryssanu; 4: Himalayapotamon garhwalense;5: Monolophussuksathanii; 6: Impatiens zironiana; and 7: Gyroporusparamjitii.Special Arrangement

Publications from the Zoological and Botanical Surveys of the country record the species discovered in the past year, a big plus for the biodiversity of the country

As many as 539 new species of plants and animals were discovered by scientists and taxonomists in the country in 2017, say publications from two major survey organisations: the Zoological Survey of India (ZSI) and the Botanical Survey of India (BSI).

Released on Tuesday, World Environment Day, Animal Discoveries, 2017 from the ZSI lists 300 newly discovered species of fauna.

Plant Discoveries, 2017 lists as many as 239 newly found flora species.

Besides these discoveries, the biodiversity in the country recorded another 263 species with 174 new records of animals and 89 of plants found.

The number of discoveries of sub-species and varieties takes the number of floral discoveries to 352.

Among the animal discoveries are 241 invertebrates. The number of vertebrates discovered includes 27 species of fish, 18 of amphibians and 12 of reptiles.

New fossils

The highlight of the animal discoveries is a new fossil reptilian species —Shringasaurus indicus — recorded by scientists of the Kolkata-based Indian Statistical Institute.

The important discoveries include a frog species, Nasikabatrachusbhupathi , with snout-shaped nose like a pig and named after Indian herpetologist S. Bhupathy; and a snake, Rhabdopsaquaticus , discovered from the northern Western Ghats and deriving its name from the Latin word for water in reference to its presence in freshwater bodies.

With these discoveries, the number of animal species in India stands at 1,01,167, which is 6.45% of the faunal species found in the world.

The number of plant species has increased to

49,003, which is 11.4 % of the world flora.

Among the 352 species and sub-species and varieties of plants, there are 148 flowering plants, 108 macro and micro fungi, four pteridophytes, six bryophytes, 17 lichens, 39 algae and 30 microbes.

In 2017, scientists discovered some 20 species of balsams and three species each of wild musa (banana) and jamun.

The BSI publication lists 18 species of grasses discovered under the familyPoaceae and two gymnosperms particularly cycads. In terms of names for the discoveries, Tupistrakhasiana , named after the Khasi tribe of the Khasi hills, andDrypeteskalami , named after former President A.P.J. Abdul Kalam, stand out.

Riches among hills

The Western Ghats and the Himalayas are home to most of the plant and animal discoveries.

While the Western Ghats contributed 19% of the discoveries of species and sub-species of plants, the number was 37% in terms of animal discoveries.

The Himalayas contributed 35% of all plant discoveries (18% of the plant discoveries from the western Himalayas and 17% from the eastern Himalayas).

In terms of animal discoveries, over 18% of the new species were discovered from both the eastern and western Himalayas.

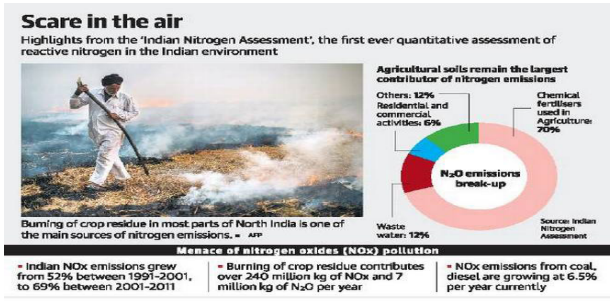
Kerala's record

Among the States, Kerala recorded the highest number of discoveries — 66 species, sub-species and varieties of plants and 52 species of animals.

Tamil Nadu recorded 31 new species of animals and 24 species, sub-species and varieties of plants.

West Bengal, which has the distinction of having both Himalayan and coastal ecosystems, recorded 27 discoveries in categories of plants and 45 discoveries of animal species.

Nitrogen emissions going up: study



Make up largest fraction of PM2.5; fertilizers, agriculture and untreated sewage causing the rise

Nitrogen particles make up the largest fraction of PM2.5, the class of pollutants closely linked to cardiovascular and respiratory illness, says the first-ever quantitative assessment of nitrogen pollution in India.

While the burning of crop residue is said to be a key contributor to winter smog in many parts of North India, it contributes over 240 million kg of nitrogen oxides (NOx: a generic term for the nitrogen oxides that are most relevant for air pollution, namely nitric oxide and nitrogen dioxide) and about 7 million kg of nitrous oxide (N2O) per year.

The Indian Nitrogen Assessment assesses the sources, impacts, trends and future scenarios of reactive nitrogen in the Indian environment, says N. Raghuram, Dean, School of Biotechnology, GGS Indraprastha University, who is one of the authors of the report.

Though agriculture remains the largest contributor to nitrogen emissions, the non-agricultural emissions of nitrogen oxides and nitrous oxide are growing rapidly, with sewage and fossil-fuel burning — for power, transport and industry — leading the trend.

Indian NOx emissions grew at 52% from 1991 to 2001 and 69% from 2001 to 2011.

Annual NOx emissions from coal, diesel and other fuel combustion sources are growing at 6.5% a year currently, the report says.

“As fertilizer, nitrogen is one of the main inputs for agriculture, but inefficiencies along the food chain mean about 80% of nitrogen is wasted, contributing to air and water pollution plus greenhouse gas emissions, thereby causing threats for human health, ecosystems and livelihoods,” Dr. Raghuram said at a conference to mark World Environment Day.

Agricultural soils contributed to over 70% of N2O emissions from India in 2010, followed by waste water (12%) and residential and commercial activities (6%). Since 2002, N2O has replaced methane as the second largest Greenhouse Gas (GHG) from Indian agriculture.

Chemical fertilizers (over 82% of it is urea)

account for over 77% of all agricultural N2O emissions in India, while manure, compost and so on make up the rest. Most of the fertilizers consumed (over 70%) go into the production of cereals, especially rice and wheat, which accounts for the bulk of N2O emissions from India.

Cattle emissions

Cattle account for 80% of the ammonia production, though their annual growth rate is 1%, due to a stable population.

India is globally the biggest source of ammonia emission, nearly double that of NOx emissions. But at the current rate of growth, NOx emissions will exceed ammonia emissions and touch 8.8 tonnes by 2055, the report says.

The poultry industry, on the other hand, with an annual growth rate of 6%, recorded an excretion of reactive nitrogen compounds of 0.415 tonnes in 2016.

That is anticipated to increase to 1.089 tonnes by 2030.

The authors suggest that nutrient recovery/ recycling from waste water for agriculture could cut down N2O emissions from sewage and waste water by up to 40%.

'Uranium contamination in Rajasthan groundwater'

Many parts of Rajasthan may have high uranium levels in their groundwater, according to a study by researchers at the Duke University in North Carolina, United States, and the Central Groundwater Board of India.

The main source of uranium contamination was "natural," but human factors such as groundwater table decline and nitrate pollution could be worsening the problem.

"Nearly a third of all water wells we tested in one State, Rajasthan, contained uranium levels that exceed the World Health Organization (WHO) and U.S. Environmental Protection Agency's (EPA) safe drinking water standards," said AvnerVengosh, a professor of geochemistry and water quality at Duke's Nicholas School of the Environment, in a press statement.

"By analysing previous water quality studies, we also identified aquifers contaminated with similarly high levels of uranium in 26 other

districts in north-western India and nine districts in southern or south-eastern India," he said.

While previous studies have referred to high uranium levels in some districts of India, this analysis gave a bird's eye view into the extent of such contamination. The WHO has set a provisional safe drinking water standard of 30 micrograms of uranium per litre, a level that is consistent with the U.S. EPA standards. Despite this, uranium is not yet included in the list of contaminants monitored under the Bureau of Indian Standards' Drinking Water Specifications.

Mr. Vengosh and his colleagues published their peer-reviewed study on May 11 in Environmental Science & Technology Letters.

Second-phase nesting leaves a stench at Rushikulya

Remnants of eggs from second-phase mass nesting of olive ridleys at Odisha's Rushikulya rookery has made the coast a stinking, polluted place.

Fishermen from the region said they are facing the stench problem this year because of the unique recurrence of mass nesting of olive ridleys.

Thousands of decomposing remnants of turtle eggs can be seen strewn on the coast between Podampeta and Gokharkuda, the region where mass nesting had recurred in April this year.

Environmental activist Rabindranath Sahu, who heads the Rushikulya Sea Turtle Protection Committee, said this problem has been caused by nature and nature only will alleviate it with time. Olive ridley eggs incubate on their own by the heat of the sand under which they are buried. The hatchlings come out in 45 to 50 days and after that the covering of the eggs decompose and mix with the sand.

Vagaries of nature

This year, the olive ridleys nested twice at Rushikulya coast — the first time in February when it's the regular mass nesting period, and the second time in April from 18th to 22nd. In the second phase, around 37,000 mother olive ridleys laid eggs at the beach. This untimely second-phase mass nesting faced vagaries of nature like eroding sea waves which could not be stopped by using sand bags. A large

number of olive ridley nests were exposed and damaged by the waves. These eggs have started to decompose now and the stench emanating from them is driving tourists away from the beach, said Mr. Sahu.

Khallikote ranger of Forest Department Dilip Kumar Martha said the summer sun and saline water of the sea will gradually decompose the remnants of the eggs and the beach will become free from the debris which will mix up with the sand.

Kharif crop sowing slows down as monsoon stalls

With the western sweep of the monsoon stalled over the Konkan coast, kharif crop sowing has also slowed. About 12 lakh fewer hectares have been planted than at the same time last year, according to a statement by the Ministry of Agriculture and Farmers' Welfare.

The biggest lags are seen in rain-fed crops such as pulses and oilseeds. At this time last year, 9.93 lakh hectares of oilseeds — mostly soyabean — had been planted. This year, only half that area has been planted, at just over 5 lakh hectares.

"The monsoon has not started yet in many of the key areas. This is a rainfed crop, so farmers are delaying planting till the onset of the monsoon," said a senior official at the National Mission on Oilseeds and Oilpalm, who did not wish to be named. The mission was launched in 2014 in an effort to reduce India's dependence on edible oil imports by increasing domestic production to meet rising domestic demands. However, oilseed prices crashed to a five-year low last year, even as production increased. The official said lower prices were unlikely to impact the final acreage of oilseed crops.

'Too early to say'

Siraj Hussain, former Agriculture Secretary and now a Senior Fellow at the Indian Council for Research on International Economic Relations, also felt it was too early to predict sowing

trends. “The monsoon has slowed down, so farmers are waiting,” he said. “Even if prices have fallen, they will have to sow. They are not going to leave their fields empty.”

The overall acreage ofsowing so far stands at 115.9 lakh hectares, in comparison to 128.35 lakh hectares at the same time last year. Apart from oilseeds and pulses, sowing for paddy, coarse cereals and cotton is also lagging behind slightly.

Bacteria isolated from domestic sewage remove organophosphorous pesticide

Using three bacterial species isolated from domestic sewage, researchers from India have successfully removed chloropyrifos pesticide from both water and soil. Chloropyrifos is an organophosphorous pesticide and is moderately toxic to humans. Poisoning from chlorpyrifos may affect the central nervous system, the cardiovascular system and the respiratory system.

The highlight of the work is the wholesome removal of the pesticide by the three species of bacteria, without leaving behind any toxic metabolites that persist in the soil for a long time. This was because, unlike other studies, none of the three bacteria used by the team led by Prof.Mukesh Singh from Haldia Institute of Technology, Haldia, degraded the pesticide. The results were published in the journal Bioresource Technology.

“Bacteria found in domestic sewage are quite regularly exposed to low levels of this pesticide. So the bacteria adapt themselves to pesticide exposure for survival. This is the reason why we turned to domestic sewage to isolate the bacteria,” says Prof. Singh.

To isolate the bacteria that can absorb the pesticide, the researchers exposed the bacteria found in sewage to different concentrations of pesticide along with nutrient media. The next day, seven bacteria that showed tolerance to 50 mg/ml of pesticide were isolated.

The next step was to check whether the isolated bacteria species could coexist with each other or displayed antagonism. Only three bacteria species were found to coexist without any antagonism.

Water and soil tests

The ability of the bacteria to remove the pesticide was then tested by using very high concentration of 500 mg/l of the pesticide. In the case of pesticide added to water, all the three bacteria both individually as well in a mixed culture were able to remove over 90% of the pesticide in three days.

In the case of soil containing 300 mg/kg of pesticide, the mixed culture of bacteria could remove up to 50% in 30 days. "The mixed culture comprising all three bacteria showed better uptake of pesticide compared with individual species," says Prof. Singh.

Studies were carried out to confirm the accumulation of the pesticide inside the bacteria and to know the location where it was found. "The pesticide bioaccumulates in the cell as well as being bound on the cell surface without any degradation," says Md. Shabbier from Haldia Institute of Technology and first author of the paper. The greater ability of the bacteria to absorb the pesticide arises from their ability to reduce the hydrophobic nature of the pesticide through the production of biosurfactants.

"Since the bacteria multiply in the soil or water, the pesticide released from the dead microbes will be absorbed by the newly formed ones. So it is quite possible that the soil or water will be free of the pesticide," says Shabbier.

The three bacteria and the mixed culture in soil containing did not inhibit the germination and growth of mung bean seedlings. While sample containing the pesticide destroyed red blood cells of goat blood, the samples treated with the bacteria did not cause any damage to red blood cells.

"This once again confirmed that the bacteria had completely removed the pesticide from the sample," Prof. Singh says.

Carbon stock loss in mangrove forests: India ranks 8th

Mangrove forest destruction caused as much as 122 million tonnes of carbon to be released to the atmosphere globally between 2000 and 2015. As a result of 3,957 hectares of mangroves being deforested between 2000 and 2015, India ranked eighth worldwide for the amount of carbon stock loss.

However, since India has been effective in its

efforts to curtail mangrove deforestation, it is also among the top 20 for the amount of soil carbon storage in mangrove forests globally.

Carbon stock refers to the amount of carbon stored in the forest ecosystem. It helps mitigate the impact of greenhouse gases, which lead to global warming and climate change. Soil carbon – the amount of carbon stored in soil – is the basis of fertility.

A study by USA-based think tank Woods Hole Research Center (WHRC), used satellite (30-meter resolution) remote sensing data to estimate soil carbon emissions.

"Our analysis revealed that soil carbon stored in mangrove forests across the world holds more than 6.4 billion tonnes of carbon globally, which is about 4.5 times the amount of carbon emitted by the US economy in one year," said Jon Sanderman, lead author of the study and associate scientist at WHRC.

According to the India State of Forest Report 2017 compiled by the Forest Survey of India (FSI), mangrove cover in India was calculated at 4,92,100 hectares, which 0.15% of the country's geographical area. FSI estimated soil carbon stock for mangrove forests in India to be 3,979 million tonnes. Overall, carbon stock from all forests in India is 7,082 million tonnes.

Loss of soil carbon depends on how the land is used. Sanderman said, "Deforestation due to wood harvesting or conversion to rice will results in much lower losses of the soil carbon than conversion to shrimp aquaculture or draining, filling for urban development."

In India, the study found that soil carbon storage in mangrove forests varied dramatically depending upon location.

"The Sundarbans in West Bengal have very low soil carbon stocks primarily due to the fact that there is high sediment input from the Ganges River system. A similar system is observed along the west coast of India. Whereas, mangroves down the coast in Tamil Nadu, such as the Pichavaram mangroves, contain almost four times as much carbon in a given hectare of forest due to low sediment deposition," said Sanderman.

IMD to add 30 doppler radars across country

The India Meteorological Department (IMD) will add 30 doppler radars in the next two-three years across the country, of which 14 will be in the northeast, a senior department official said. A doppler radar is a tool to provide precise information about thunderstorms, dust storms, hailstorms, rainfall and wind patterns. With a radius of 250 km, it helps in issuing nowcasts two-three hours prior to severe weather conditions.

More tests required for GM mustard: regulator

The Centre has demanded more tests for genetically modified mustard, a year after clearing the crop for "commercial cultivation."

The Genetic Engineering Appraisal Committee, the apex regulator of genetically modified crops, in a March meeting said that in light of several representations both "for and against" the release of GM mustard, there was a need for more tests.

"Applicant may be advised to undertake field demonstration on GM mustard in an area of 5 acres at 2-3 different locations with a view to generate additional data on honey bees and other pollinators and honey, and on soil microbial diversity," said the minutes of the meeting made public on May 13.

Activists said the demand fell short. "What about the fact that GM mustard has never been tested as a herbicide tolerant crop, for its environmental and health ramifications… a point that has remained unaddressed by the regulators," the Coaltion for a GM-Free India queried in a statement.

The clearance for GM mustard has been mired in confusion. On May 12, last year the then GEAC chairperson Amita Prasad said that the crop had been recommended for cultivation. In October, the government did a volte-face and said there was an "inadvertent error" in the announcement regarding mustard and said that "…subsequent to receipt of various representations from different stakeholders, matters related to environmental release of transgenic mustard are kept pending for further review."

Union Environment Minister, Harsh Vardhan — who had the final say on the matter said that

wider consultations on the release of the crop were needed.

Dhara Mustard Hybrid (DMH -11), the transgenic mustard in question, had been developed by a team of scientists at Delhi University, led by former Vice-Chancellor Deepak Pental under a government-funded project.

Cabinet approves new policy for biofuels

The Union Cabinet approved a national policy on biofuels that seeks to not only help farmers dispose of their surplus stock in an economic manner but also reduce India's oil-import dependence.

"The policy expands the scope of raw material for ethanol production by allowing use of sugarcane juice, sugar containing materials like sugar beet, sweet sorghum, starch containing materials like corn, cassava, damaged food grains like wheat, broken rice, rotten potatoes [that are] unfit for human consumption for ethanol production," the government said in a release.

"Farmers are at a risk of not getting appropriate price for their produce during the surplus production phase," the release added. "Taking this into account, the policy allows use of surplus food grains for production of ethanol for blending with petrol with the approval of National Biofuel Coordination Committee."

The policy also provides for a viability gap funding scheme of Rs. 5,000 crore in six years for second generation (more advanced) ethanol bio-refineries in addition to tax incentives and a higher purchase price as compared to first generation biofuels.

"One crore litres of E10 [petrol with 9-10% ethanol blended in it] saves Rs. 28 crore of forex at current rates," the government said. "The ethanol supply year 2017-18 is likely to see a supply of around 150 crore litres of ethanol which will result in savings of over Rs. 4,000 crore of forex."

The release added that one crore litres of E10 saves reduces carbon dioxide emissions by about 20,000 tonnes.

"For the ethanol supply year 2017-18, there will be lesser emissions of CO2 to the tune of 30 lakh tonnes," it said. "By reducing crop burning and conversion of agricultural residues/wastes

to biofuels there will be further reduction in greenhouse gas emissions."

Solar microgrids light up remote Jharkhand villages

When the lights went on in Birgaon for the first time on a chilly winter evening late last December, it allowed the government to announce in April this year that every village in India now had electricity. Every home in Birgaon actually has power, thanks to a solar microgrid set up in the village centre and wired into every home.

By government definition, a village is electrified if 10% of its homes have a power connection. This means that while all its villages are officially electrified, 42% of Jharkhand households — the highest in the country — do not have power, yet. Now, the State government is mulling a new policy, encouraging solar microgrids, even in villages that are already connected to the traditional grid.

Powering change

Birgaon is proof of change. This tiny tribal hamlet — home to about 100 people in 20 households — lies in the hilly Gumla District of Jharkhand. It is one of the 249 remote villages which got solar microgrids last year, thanks to a Rs. 110-crore project by the Jharkhand Renewable Energy Agency (JREDA), as part of the Centre's DeendayalUpadhyay Gram JyotiYojana. Private solar provider Azure Power won the bid to build and maintain microgrids in 11 villages in Gumla and Hazaribagh districts.

The 20 photovoltaic panels glint in the scorching sun, out of place amid the old mud houses of Birgaon. Power lines snake out of a shed which stores the batteries and inverter.

"We are on the elephant route to the Basariver and they rampage through the village, mostly before harvest," says Srisai Kawar, the villager who donated the land on which the microgrid stands. A few street lights dot the common areas of the village, while each home has three LED bulbs and two power sockets. "We haven't had any elephant attacks since the light came," he adds.

For most of the 25 children at the local primary school the arrival of electricity means they can occasionally watch films on the village's only

television. For Dahari Kawal, a Class 6 student, it allows her to study at night, leaving the day for other chores. She hopes to continue her education at a high school in a bigger village five km away. “I want to become a teacher,” she says.

With free power, villagers save Rs. 200 to Rs. 300 per month otherwise spent on kerosene. They are willing to pay the nominal tariff of Rs. 30 per month.

‘The only way’

When Azure Power’s deputy manager Bikash Kumar first reached Birgaon after a 200-km journey from Ranchi, he was appalled by the last stretch. “I wasn’t sure how we would get the components of the grid over that bumpy track,” he says. To exacerbate, to reach Hisir, another project village, Azure was forced to build a five-km road through dense jungles and across three rivers. “These kinds of villages will be almost impossible to reach with regular transmission lines. Microgrids are the only way,” he says.

JREDA director Niranjan Kumar has bigger plans. “We are coming out with a new solar microgrid policy in a month. People want quality, 24/7 power. If a microgrid can provide that, they are willing to pay,” Mr. Kumar adds. He cites a pilot project where 10 villages are paying up to Rs. 10 per unit for solar microgrids that power small enterprises: rice hullers, oil extractors, wheat mills and poultry farms.

“When the government says that all villages are electrified, it’s not really true,” says Gabriel Pujur, pradhan of Galu, another electrified village.

He points to Pakartoli, a village on the government’s “electrified” list, where only 21 out of the 114 households actually have power according to government data.

IMD stands by monsoon forecast

“Mekunu is likely to develop into a very severe cyclonic storm in the next 24 hours. It is very likely to move northwestward and cross south Oman and southeast Yemen. As the system is away from the Indian coast, no adverse weather is expected along and off the west coast of India and Lakshadweep,” she said.

The IMD has advised fishermen not to venture into southeast Arabian Sea from May 26 as

winds may strengthen in the region.

In its forecast for the monsoon, the IMD had said the country would receive normal rainfall: 97% of the Long Period Average (LPA) with a model error of ± 5%. "The country is likely to get 97% of the 89 cm it normally gets between June and September. Last year, it got 95%," the forecast had said, ruling out "deficient rainfall."

The forecast was part of the first stage report and the IMD said it would update the report in June, with separate forecasts for July and August, and for rainfall over the country as a whole and seasonal (June-September) rainfall over the four geographical regions. The IMD uses a statistical model for its forecast. Another model, called the dynamical model, forecasts 99% rainfall.

India falling short of meeting conservation goals on biodiversity

India is failing to meet its conservation goals amid declining global biodiversity, even as the world celebrates the International Day for Biological Diversity (IBD) .

IBD marks "25 Years of Action for Biodiversity" initiated by the United Nations Convention on Biological Biodiversity (CBD). A total of 196 countries, including India, are signatories of the CBD and will highlight their achievements as part of the programme.

India is a treasure trove of biodiversity, hosting 7-8% of all recorded species globally, including over 45,000 species of plants and 91,000 species of animals. It is also among the few countries that have developed a biogeographic classification for conservation planning, and has mapped biodiversity-rich areas, a government report says.

"India currently spends about $2 billion per year on biodiversity conservation efforts, but the country requires between $5-15 billion more every year to meet its biodiversity conservation targets," said Yuri Afanasiev, United Nations resident coordinator for India.

All 196 signatories are part of the Strategic Plan for Biodiversity for 2011-2020. However, with only two years left for completion, experts say there is little to celebrate when the actual figures and status are considered.

India is falling way short of fulfilling conservation goals. In the last three years, it has lost 36,500 hectares of forest land to development. Expansion of National Highways 6 and 7 in central India is destroying at least six crucial tiger corridors, including the Pench-Kanha corridor. The submergence of a part of the Panna tiger reserve by river interlinking projects, proposed denotification of tiger reserves for mining and hydropower projects are also huge setbacks for the conservation of biodiversity.

The government says there has been an increase by 1% or 8,021 sq. km in forest and tree cover in 2015-2017.

Yet there are glaring examples of how natural forest is getting fragmented by linear infrastructure. Rampant poaching of endangered species, excessive pollution, unplanned infrastructure and urban development are indicating a decline in biodiversity, experts say.

Globally, biodiversity continues to decline in every region of the world. "Nature's capacity to contribute to people is being degraded, reduced and lost due to a number of common pressures – habitat loss; overexploitation and unsustainable use of natural resources; air, land and water pollution; the impact of invasive alien species and climate change. This alarming trend endangers economies; livelihoods, food security and the quality of life of people everywhere," said over 550 global scientists and experts in a statement at the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) held in March.

Nasa Curiosity rover drilling Mars rocks again

Nasa's Curiosity Mars rover has successfully collected the first rock samples on the red planet in over a year, using a new way to drill rocks and extract powder from them. Curiosity tested percussive drilling this past weekend, penetrating about two inches into a target called "Duluth."

Nasa's Jet Propulsion Laboratory (JPL) in the US has been testing this drilling technique since a mechanical problem took Curiosity's drill offline in December 2016. This technique, called Feed Extended Drilling, keeps the drill's

bit extended out past two stabiliser posts that were originally used to steady the drill against Martian rocks. It lets Curiosity drill using the force of its robotic arm, a little more like the way a human would drill into a wall at home.

"The team used tremendous ingenuity to devise a new drilling technique and implement it on another planet," said Steve Lee, Curiosity deputy project manager at JPL. "Those are two vital inches of innovation from 60 million miles away. We're thrilled that the result was so successful," said Lee.

Drilling is a vitally important part of Curiosity's capabilities to study Mars. Inside the rover are two laboratories that are able to conduct chemical and mineralogical analyses of rock and soil samples. The samples are acquired from Gale Crater, which the rover has been exploring since 2012. Curiosity's science team has been eager to get the drill working before the rover leaves its current location near Vera Rubin Ridge.

Fortunately, it was near enough to drill targets like Duluth to drive back down the ridge. Sunday's drill sample represents a quick taste of the region before Curiosity moves on. Demonstrating that Curiosity's percussive drilling technique works is a milestone in itself. But that doesn't mean the work is over for engineers at JPL.

"We've been developing this new drilling technique for over a year, but our job isn't done once a sample has been collected on Mars," said Tom Green, a systems engineer who helped develop and test Curiosity's new drilling method. "With each new test, we closely examine the data to look for improvements we can make and then head back to our test bed to iterate on the process," said Green.

Officials hope to release water from Periyar dam in time

Public Works department officials are hoping to release water from Periyar dam for irrigation of the first crop in double-cropping area of Cumbumvalley in the first week of June, thanks to the early onset of Southwest monsoon and heavy inflow into the dam.

Catchment areas of Periyar dam and the dam site have been experiencing heavy downpour

for the past few days. Inflow into the dam shot up to 1,213 cusecs morning which was just 488 cusecs.

The officials, however, reduced the discharge from 100 cusecs to 50 cusecs to improve the storage level. The dam site recorded a rainfall of 73 mm and Thekkadi 38.2 mm.

The officials said combined Periyar credit was 2,426 mfct and for releasing water it had to go up to at least 4,000 mcft.

If this trend continued for a week, the storage level would go up to facilitate release of water for irrigation of the first crop.

Meanwhile, Agriculture department officials have started importing required quantum of fertilizers and other inputs to maintain sufficient stock in all sales outlets, including cooperative societies, for timely distribution to farmers.

Farmers were jubilant over the early onset of the monsoon in Kerala. Summer rain helped them plough lands. Intermittent showers in the last one week too encouraged them to start preliminary work, including preparing fields, for the first crop in the valley.

Farmers in rain-fed areas are also happy as early onset of monsoon will ensure at least single crop this season. They also hope that they will not face any water shortage. They have been advised to mechanise farm activities in order to tide over labour shortage.

Water level in major dams in Theni district has been increasing steadily. Sothuparai dam has been overflowing for the past 11 days. Storage level is comfortable in Manjalar and Shanmughanadhi dams.

Farmers are hopeful that water will be released from all dams for irrigation.

The PWD officials said they would release water from the dams once they received order from the government.

Delhi becomes first city to roll-out Euro VI fuel. What does this mean?

With an aim to combat the rising levels of air pollution in Delhi-NCR region, petrol pumps in the capital from Sunday started supplying ultra-clean Bharat Stage VI grade fuel (both petrol and diesel). This move makes New Delhi the first city in the country to switch from BS-IV

grade fuels to BS-VI (equivalent to fuel meeting Euro-VI emission norms). Other cities like Noida, Ghaziabad, Gurugram and Faridabad along with 13 major cities, including Mumbai, Chennai, Bengaluru, Hyderabad and Pune, will also switch over to cleaner BS-VI grade fuel from January 1 next year. However, BS- VI fuel will be rolled out in rest of the country by April 2020.

Difference between BS-IV and the new BS-VI

The major difference in standards between the existing BS-IV and the new BS-VI auto fuel norms is the presence of sulphur. The newly introduced fuel is estimated to reduce the amount of sulphur released by 80 per cent, from 50 parts per million to 10 ppm. As per the analysts, the emission of NOx (nitrogen oxides) from diesel cars is also expected to reduce by nearly 70 per cent and 25 per cent from cars with petrol engines.

However, the introduction of higher grade fuel will be beneficial only if it is done in tandem with the roll-out of BS-VI compliant vehicles. Using BS-VI fuel in the current BS-IV engines or, conversely, running BS-VI engines on the current-grade fuel, may be ineffective in curbing vehicular pollution, and may damage the engine in the long run.

Price of the new fuel will be 50 paisa/litre more than present rate

The director of Indian Oil Corp (IOC), B V Rama Gopal while speaking to media in New Delhi confirmed that state-owned oil firms will start supplying the BS-VI grade fuels (equivalent to fuel meeting Euro-VI emission norm) at all the 391 petrol pumps running in the national capital territory (NCT). He added, the price of the newly introduced fuel would cost around 50 paisa a litre more.

Pointing out the investment and work being done to meet Delhi's annual fuel consumption, which is 9.6 lakh tonnes of petrol and 12.65 lakh tonnes of diesel, the official said, Mathura refinery in Uttar Pradesh, Panipat refinery in Haryana, Bina in Madhya Pradesh and Bhatinda in Punjab have started producing Euro-VI grade fuel. The official also mentioned that around Rs 183 crore has already been spent on Panipat refinery alone for producing cleaner fuel.

Deadline for rest of the country

It was decided in 2015 that the country will switch from BS-IV grade fuel to BS-VI grade fuel by April 2020. While the deadline stands for the rest of the country, in Delhi the authorities were compelled to advance the introduction of a cleaner fuel looking at the deteriorating conditions of the air quality. The decision was taken by the Petroleum Ministry on November last year, where it stated that BS-VI grade auto fuels would be dispensed with effect from April 1, 2018 instead of the scheduled April 1, 2020. The ministry had then said the advancement was part of the government's "concerted efforts to reduce vehicular emissions and improve fuel efficiency with an aim to reduce the carbon footprints and keep a healthy environment."

Where will the supply come from?

A report in PTI states that IOC, the nation's biggest oil firm controlling roughly half of retail fuel market, will source the BS-VI fuel to meet Delhi's requirement from its Mathura and Panipat refineries, while Hindustan Petroleum Corp Ltd (HPCL) will do so from its joint venture refinery at Bhatinda. Bharat Petroleum Corp Ltd (BPCL) will supply the fuel from its Bina refinery.

It must be noted that BS-IV grade fuel was first introduced in the country in April last year, but India subsequently decided to jump to BS-VI grade by April 2020 to meet international best practices. The petroleum ministry, justifying the move, had said, "This measure is expected to help mitigate the problem of air pollution in National Capital Territory of Delhi and surrounding areas."

Society must take a view on GM mustard: scientist

"The commercial release of genetically modified mustard wasn't merely a scientific issue but a 'socio-political one' that required the understanding of a wide section of society," K. VijayRaghavan, 64, Principal Scientific Adviser (PSA) said in an interview.

He was formerly Secretary, Department of Biotechnology that had funded the development of the seed. While the transgenic plant has been cleared for commercial cultivation by the Genetic Engineering Appraisal Committee — a scientific body — it's yet to be cleared by Dr. Harsh Vardhan, the Union Environment and

Science Minister.

Scientific view

"There's the scientific view [that it's safe and useful] and another, in my view, a very small number but more vocal with a contrary view. Scientists argue that you are giving equal time to a rational view and an irrational view and so a hard decision must be taken. In the case of GM, it's important that society take a view. Science can bring evidence but the policy decision is a more complex process."

However India's science academies needed to "speak more" and play a greater role especially in its advice to government on matters of science.

"Indian science needs to get out from being intellectually not vibrant and exploring a vast space, into one which does. And India's science academies need to play a special role," said Mr. VijayRaghavan, a biologist and member of India's prominent academies.

While the Economic Survey in February said that India didn't spend enough on science relative to its GDP, Mr. VijayRaghavan said resources would increase but the fact that there weren't significant budgetary cuts to science showed that the "Prime Minister was seeing value in science" and directly intervening in matters of science.

"Our process of delivery of funds does need improvement," he emphasised.

Last month, 150 scientists signed a petition demanding that Indian science establishments take more stringent measures to punish scientists and senior researchers proved guilty of sexual harassment.

Gender parity

Government intervention on its own wasn't enough to address problems of sexual harassment and gender parity in India's research institutions. Rather, scientists should be talking about addressing them in their institutions and emulate organisations that have better policies and administrative practices in place, he added.

Mr. VijayRaghavan, who's the first PSA not connected to India's atomic energy or space programmes, said improved battery technology and applying them for increased mobility and

power would be "transformative" to the Indian economy and to this end solar and nuclear energy were critical to India's fuel mix, he argued.

Among his priorities, he said, would be to closely work with the National Institution for Transforming India (NITI) Aayog as well as the other scientific ministries.

"One must keep in mind the mandate and roles each Ministry has. There needs to be synergy between different groups. This is primarily about defining what each one's goals are and about how to achieve them."

Olive ridleys start hatching at Rushikulya

Sporadic hatching of olive ridley eggs has started at the mass nesting site at Rushikulya rookery coast in Ganjam district of Odisha.

According to forest officials, hatching of eggs occurred at around 100 olive ridley nests during Monday and Sunday night. On an average around 80 to 100 hatchlings came out of these nests. Hatching also begun at four artificial hatcheries in the region. Eggs from areas beyond the mass nesting site were collected and incubated at these hatcheries.

This year 4,45,091 mother olive ridleys laid their eggs during this seven-day-long mass nesting that ended on February 27 night. It was expected that mass hatching of eggs will start on the night of April 7 or 8. But it was delayed due to summer drizzles during the past few days which lengthened the incubation period from the usual 45 days. Buried under the sand, the eggs use ambient heat of the beach for incubation. Rainfall reduced the temperature of the eggs in the nests, explained BivashPandav, a scientist of Wildlife Institute of India.

CCTVs installed

As mass hatching is again expected to start in the next few days, the forest department has begun the process to document the phenomenon by opening a centre at Gokhakuda, said Berhampur Divisional Forest Officer AshisBehera. CCTVs have been installed to check human intervention during the hatching process.

This year, no tourist or outsider would be allowed to step into the six to seven kilometre long mass nesting coast. Three special barricaded zones have been constructed for visitors at Bateswar,

Podampeta and Gokhakuda.Visitors can watch the mass hatching process from a distance. Use of mobile phones by visitors has also been banned.

North Indian reservoirs run dry as summer sets in

North India saw good rains last week, but its reservoirs are precariously deficit. The total live storage now is 3.62 BCM (billion cubic metres), which is 20% of capacity. The storage during the corresponding period last year was 23% and the average storage of the last 10 years during the corresponding period was 27% of live storage capacity.

"Thus, the storage during the current year is less than the corresponding period of last year and is also less than the average storage of the last 10 years during the corresponding period," the Central Water Commission (CWC) said in its weekly note. The northern region includes Himachal Pradesh, Punjab and Rajasthan. There are six reservoirs under CWC monitoring, having a total live storage capacity of 18.01 BCM.

Poor pre-monsoon rain last month contributed to the water shortage. According to figures from the India Meteorological Department (IMD), north-west India, which normally gets 5.9 cm of rain from March 1 to April 12, got only 3.4 cm — a 42% decline.

A national problem

The water shortage in reservoirs is a national problem. According to data available from the CWC, storage in 91 major reservoirs for the week ending on April 12, 2018 was 40.857 BCM which is 25% of total storage capacity. This is lower than the 27% for the week ending April 5, 2018. The level of water storage in the week ending on April 12, 2018 was 84% of the storage of the corresponding period of last year and 90% of storage of the average of last ten years.

The total storage capacity of these 91 reservoirs is 161.993 BCM, which is about 63% of the total storage capacity of 257.812 BCM estimated to have been created in the country; 37 reservoirs out of these 91 have hydropower benefit with installed capacity of more than 60 MW.

The decline in storage comes on the back of warnings of a scorching summer. The summer months from March-May will be "warmer" than normal and several parts of north India, at least a degree hotter than their average summer temperatures, the IMD had said in its annual forecast. The 'normal' temperatures refer to the mean temperatures during those months between 1981 and 2010.

While rains are necessary to increase storage in the reservoirs, farmers in the north-west are anxious. Widespread rain during the past few days in parts of Punjab and Haryana could delay the harvesting of the standing wheat crop by at least a week, officials told The Hindu. This, even as a fresh western disturbance could bring more rain in the region on April 15 and 16. While the IMD hasn't yet announced its monsoon forecast, private agencies have said India is likely to get a normal monsoon.

Olive Ridleys return for rare mass nesting

In a rare occurrence, Olive Ridley turtles turned up for mass nesting for the second time at the Rushikulya rookery on the Odisha coast in the early hours of Wednesday, where mass hatching of eggs of these endangered marine turtles is still continuing.

This is for the first time that such a phenomenon has occurred at this major nesting site on the Indian coast, said Berhampur divisional forest officer (DFO) AshisBehera.

More than 5,000 mother turtles came out of the sea from 4.30 a.m. onwards to dig nests in the sand and lay eggs in them. They nested on the stretch between Gokharkuda and Podampeta villages.

'Needs study'

Though sporadic nesting of a few Olive Ridley turtles was observed at the coast, a recurrence of mass nesting was never expected.

As per past records, mass nesting had never occurred during the month of April on the Odisha coast. The reason behind this late recurrence of mass nesting should be studied by wildlife experts, said the DFO.

This year, 4,45,091 Olive Ridley turltles laid eggs at Rushikulya rookery coast during the week-long mass nesting that ended on February 27.

The mass hatching of eggs started from April 14 night.

In 2006, the Rushikulya rookery witnessed two phases of mass nesting of Olive Ridley turtles, but at short intervals. A similar event occurred in 2009 when mass nesting took place in February as well as in March. But in both cases, the second phase of mass nesting occurred when eggs laid by the first group of turtles were incubating under the sand. Mass nesting had never occurred during mass hatching on this coast.

A ridley riddle at Rushikulya coast

Olive ridley turtles are posing new riddles for observers at the Rushikulya rookery coast in Odisha this year.

First they returned weeks after the mass nesting period to lay eggs again at the coast, and now they are daring the summer sun to nest in large numbers in broad daylight, ignoring their normal practice of nesting during night or early morning.

Hundreds of olive ridleys were seen coming out of the sea to nest in the hot sand during the daytime.

"The real number of nesting during the day is still being assimilated from different zones of mass nesting coast. But it is for sure that more than 1,000 olive ridleys have nested during the daytime," said Forest Department Ranger Dilip Kumar Martha, who is posted at the Rushikulya rookery.

Since April 19 morning, this coast is witnessing an interesting phenomenon of recurrence of mass nesting of olive ridleys even as hatching of eggs laid during the mass nesting in February is still continuing.

According to Mr. Martha, till Thursday night over 12,400 mother turtles had nested during their second phase of mass nesting at the Rushikulya coast.

Nesting of olive ridleys did not stop even when sun went up in the sky. Throughout the day mother turtles continued to dig up nests and lay eggs between Podampeta and Gokharkuda villages on the coastline. Their nesting was continuing till evening.

Daytime nesting is not unprecedented at this mass nesting site. On February 15, 2013, mass

nesting had started at noon and continued till evening at the Rushikulya coast.

Ramsar tag likely for Sunderbans

The Sunderban Reserve Forest, spread of 4,260 sq. km. with over 2,000 sq. km. of mangrove forests and creeks, is likely to be declared a Ramsar Site soon. Earlier this week, the West Bengal government gave its approval to the State Forest Department to apply for recognition under the Ramsar Convention.

"We have got approval from the government. All the necessary documents are ready and through the Government of India, we will apply to the Ramsar Convention Secretariat. It will take anything between three and six months for the status," Ravi Kanta Sinha, Principal Chief Conservator of Forests, West Bengal, told The Hindu .

Mr. Sinha said, being conferred the status of a wetland of international importance will not only be a matter of pride for the Sunderbans but also bring a lot of international scientific attention and intervention to the area.

The Indian Sunderbans, with 2,114 sq. km. of mangrove forests, comprise almost 43% of the mangrove cover in the country according to a 2017 Forest Survey of India report. Other than the forests, home to about 100 Royal Bengal tigers, the creeks and river systems of the Sunderbans are also part of the reserve forest and once conferred a Ramsar site status, it will be the largest protected wetland in the country. There are currently 26 sites in India recognised as Ramsar wetland sites of international importance, including the East Kolkata Wetlands also in West Bengal.

Alarming reduction

Experts, however have been raising questions about increased encroachment at the East Kolkata Wetlands.

"Spread over 125-square-km (12,500 hectare) the wetland area of the water bodies has been decreasing over the past three decades. In 1986, the percentage of water bodies was 30.6% which dropped to 26.3% and in 2011 further dropped to 24.7%," Ajanta Dey, joint secretary of Nature Environment and Wildlife Society, said.

Environmental activist Subhas Datta said the Sunderbans is already a World Heritage Site, and another feather in its cap as a Ramsar site will not help in its conservation, even as the recognition has not helped the East Kolkata Wetlands. "What is required is the implementation of existing laws and regulations by the tribunals. I have submitted more than 500 photos citing environmental degradation of the Sunderbans before the National Green Tribunal," Mr. Datta said.

Other than threats such as climate change, sea level rise, widespread construction and clearing of mangrove forests for fisheries is posing a danger to the Sunderbans. Ms. Dey said another threat is the 1,320-megawatt coal-based thermal power plant at Rampal, just a few kilometres north of the reserve forest in Bangladesh.

"Sunderbans is a contiguous ecosystem spread across India and Bangladesh and any adverse move will affect the entire ecosystem. We had raised the issue at the IUCN [International Union for Conservation of Nature] meeting of 2017," she said.

Death, iceberg collision mark 'difficult' Antarctic expedition

In February 2018, 30 Indian scientists on an expedition to one of India's base stations in Antarctica had to be evacuated after their ship collided with an iceberg. The hired Russian ship,m.v. Ivan Papanin, was on its way to Maitri, India's inland research base, from Bharati, another India station. The impact punctured a three - foot hole into the hull and led to water seeping in.

While there were no reports of injury, and the scientists were flown back to the Bharati station, one of those scientists — Subhajit Sen — was involved a month later in another, unrelated accident at India's second research station, Maitri, and succumbed to his injuries. His body is in now in transit via ship, and is expected to reach Cape Town, South Africa, this week from where, after a post-mortem, it will be flown to his native Kolkata.

'First time'

While India's scientific expeditions to

Antarctica since 1981 have had their share of misadventures, this is the “first time”, according to an official, that m.v.IvanPapanin, a 28-year-old ice-breaker owned by Murmansk Shipping and frequently commissioned by India, suffered from a breach of this kind. “It struck an iceberg or some other underground structure and the scientists had to be evacuated by helicopter. Luckily, there wasn’t an oil spill or else, even though we are using a Russian ship, India would have been guilty of polluting Antarctica and violating the Antarctica treaty,” said M. Ravichandran, director, National Centre for Antarctic and Ocean Research, the Goa-based organisation charged with coordinating the annual exercise.

Another Russian ship had to be hurriedly arranged and the Indian scientists used it to continue on their expedition to base station Maitri, which is located about 100 km inland via a seven-day ship journey from Bharati.

Normally, Indian scientists from several research institutions are selected every year to go in batches to Antarctica from November to March, the only clement months when ships and chartered flights can reach the continent — the ice being too thick otherwise.

The late Mr. Sen, a student-scientist of the Indian Institute of Technology (IIT)-Bhubaneswar, was injured on March 26 when he was helping unload a trailer, as big as a train coach and used to store cargo. One of the persons handling the trailer lost control of its brakes, crushing him. Though he was taken to the hospital aboard the ship and given emergency care, he did not survive. “Few realise the hardship of working in Antarctica. This year’s events have made it a particularly difficult year,” said Dr.Ravichandran.

Harsh realities

Not all of the bodies of those deceased in Antarctica necessarily make it home. KuldeepWali, a 57- year-old meteorologist with the India Meteorological Department and part of India’s 2008-9 expedition, died of a heart failure in June 2009 at Maitri. That’s the period when impenetrable ices, and gales, prevent outgoing traffic. As a result, Wali had to be cremated at the station itself.

Inspite of regular expeditions to Antarctica, India doesn't yet have an ice-breaker ship of its own. India's plans to acquire a Rs. 1,000-crore polar research vehicle (PRV) — a ship that can cut through ice sheets and glaciers — has been on the anvil since 2005.

Indian 'elephant now ready to run,' says IMF

Global investors feel that the Indian "elephant is ready to run" after sustained economic reforms, a top IMF official has said, but underlined the need for implementing these reforms and having a sound banking sector balance sheet for a steady growth path.

Changyong Rhee, director, Asia and Pacific Department at the International Monetary Fund (IMF), also praised the Union government for doing well in the area of reforms.

'Impressive reforms'

Mr. Changyong — who oversees the IMF's work in the region, including its lending operations and bilateral and multilateral surveillance of economies ranging from China, Japan, and India to the Pacific Islands — said that investors are telling him that after four years of impressive economic reforms, 'the elephant is now ready to run.' "I think, I would rather emphasise [on] implementation. If India can lead global growth like China in the last decade; you have the potential, you have the population, you have the market size... everything. Implementation is actually the key, he said.

Referring to the 7.4% growth rate, he said, at this moment it was one of the highest growth rates among large emerging economies.

"Now, India's growth rate is higher than China's growth rate," he said.

Monsoon: India's problem of plenty

GangabhishanThaware, a 53-year-old farmer from the drought-prone Marathwada region of Maharashtra, took an unusual step in July last year.

Thaware and his fellow villagers had toiled on their fields and spent thousands of rupees on seeds and fertilizers, hopeful that rains will arrive as predicted by the India Meteorological Department (IMD), the government forecaster.

After waiting for more than a month for the rains

to arrive and watching his investments dry up slowly on the fields for want of water, a frustrated Thaware went to the local police station.

There, he filed a complaint against the director of India Meteorological Department's office at Pune, the person responsible for the monsoon forecast.

District police officials were at a loss.

"We spent so much based on the forecast, which turned out to be incorrect. We wanted Pune's weather office to be locked and shut," Thaware said in a phone interview from Anandgaon village in Beed district of Maharashtra.

Discontent among farmers is not confined to rural Maharashtra. A combination of weather-related shocks, depressed prices, indebtedness and inadequate attention to the plight of farmers have led to distress among farming communities across the nation, triggering protests at a time when Narendra Modi's Bharatiya Janata Party (BJP) faces elections in as many as five states and national polls over the next 12 months.

While the monsoon was overall near normal last year, more than one-third of India received either below normal or excess rains, leading to acute distress and loss of crops such as soybean and pulses, and pest attacks on cotton driven by dry weather. But India's aggregate food production touched a record high, setting in motion a deeper crisis: an unprecedented collapse in crop prices. Another year of record harvest could, in fact, further depress crop prices.

On 14 April this year, IMD forecast a normal monsoon for 2018 at 97% of the 50-year average. If the forecast holds true, India will witness the third successive year of normal rains, after consecutive years of drought in 2014 and 2015.

"Normal monsoons in past years delivered a good harvest, but not decent income to farmers… barring wheat, there is not a single crop where farmers have sold their produce above government-announced support prices," said Yogendra Yadav, a politician and member of Jai KisanAndolan, a farmers' body.

A normal monsoon this year, if distributed evenly across states and over the June-to-September period, is expected to provide a shot-in-the-arm for the rural economy by raising

crop production, improving rural wages and farm incomes. It is also likely to boost sales of farm inputs, consumer products, tractors, motorcycles and small cars.

"There is a strong correlation between, say, tractor sales and rainfall. However, maintaining the growth seen in the previous two years may be difficult, and growth may taper off," said Dharmakirti Joshi, chief economist at ratings agency Crisil Ltd. "If the government acts on its promise of providing better crop prices to farmers—and that is likely in an election year—there will be a positive spillover for the FMCG (fast-moving consumer goods) sector."

A normal monsoon is also likely to positively impact agriculture gross domestic product (GDP) growth rate, a proxy for growth in farm revenue. Past data shows a strong correlation between these growth rates and actual rainfall (see table). Also, via higher crop production, a normal monsoon will help keep food inflation in check.

"A normal monsoon is crucial to pushing economic growth, which slowed last year under the lingering impact of demonetisation and disruptions due to implementation of the goods and services tax (GST), both of which impacted private consumption demand as well as exports," ratings agency Crisil said in a note on IMD's forecast.

But Thaware is less upbeat. "Even if the rain gods are kind this year, who will guarantee a decent price for my soybean and pulses?" he asks.

That question is troubling policymakers and politicians alike as 2018 will see crucial state elections beginning with Karnataka in May, followed by Madhya Pradesh, Chhattisgarh and Rajasthan. In about a year's time, Indians will also vote in a general election, with Prime Minister Narendra Modi seeking a second term in office.

Farmers are aware of their bargaining power in an election year. Between 1 and 10 June, farmer bodies in several states have decided to stop supplying fresh produce to cities and stop purchasing any merchandise from nearby towns. Their demands are remunerative prices and waiver of bank loans.

Last year, a similar round of protests began

in June in Maharashtra, where farmers spilt milk on the road and stopped supplies of perishable produce to cities. In neighbouring Madhya Pradesh, five protesting farmers died in police firing. The anger on the streets forced Maharashtra to announce a Rs34,000-crore loan-waiver package while Madhya Pradesh rolled out its own price support scheme for pulses and oilseeds.

"There is a sense of urgency within farmer movements that governments are more likely to concede in a heavy election year," said Yadav.

By what extent did a normal monsoon and record harvest impact farm gate prices?

Data on wholesale food prices, including grains, pulses, perishables and milk, show that prices rose by a mere 3.6% annually between 2014-15 and 2017-18, the first four years of the Modi-led National Democratic Alliance government. In 2017-18, the rise was a mere 2%. This compares with the more than 10% per year rise in prices between 2010-11 and 2013-14, the last four years of the previous United Progressive Alliance (UPA) government at the centre (refer to table above)—those were also double-digit retail inflation years for which the UPA paid a political price. "Essentially, farmers have been made to pay the price for keeping food inflation low. The dismal rise in food prices also suggests less demand and consumption in rural areas," said Himanshu, a development economist and associate professor at Delhi's Jawaharlal Nehru University.

According to Himanshu, while the headline inflation hovered between 4% and 5% in the past two years, higher than the rise in food prices, terms of trade moved against agriculture. "Due to lower consumption demand for agriculture produce, traders are also reluctant to purchase from farmers and stock, further depressing farm-gate prices," Himanshu said.

Apart from low crop prices, successive years of normal rains and the uptick in farm activity did not lead to higher rural wages. Sticky wages in rural India suggest that non-farm activity like trade and construction did not pick up pace, indicating continuing rural distress (see table above).

A set of data which further corroborates the distress in rural areas is the fact that despite normal rains in 2017, demand for work under the federal government's employment guarantee scheme was high, although wages paid under the scheme were lower than statutory minimum wages for agricultural labourers in most states. This implies a paucity of jobs for rural workers. So much so that households were ready to work for less than minimum wages. In fact, expenditure under the rural safety net scheme was the highest in 2017-18—a staggering Rs63,887 crore—since it was launched 12 years ago (see table above).

Impending elections in states and the general election next year are now pushing the Modi government to act fast.

The Union budget presented in February promised to fix minimum support prices (MSP) at levels to ensure a return of 50% over cost of production.

Further, the budget promised to ensure that farmers actually benefit from MSP announcements as presently it is limited to growers of rice and wheat—crops, which are procured for the subsidized public distribution system.

Resource-poor marginal farmers who grew pulses and oilseeds, for instance, bore the brunt in the past two years by selling their harvest at prices below the floor price set by the government, on account of higher production and adverse trade policies promoting cheaper imports.

The government is now considering different models to ensure remunerative prices to farmers. Its think-tank, NITI Aayog, has proposed options such as direct procurement, reimbursing farmers the loss they incur when they sell at lower than support prices, and incentivizing traders to buy farm produce at MSP.

According to calculations by NITI Aayog, this can cost the government around Rs45,000 crore, depending on the model opted by states.

The federal government is expected to roll out this new support price policy by October, in time for the kharif harvest.

"If the government delivers on its promise of better crop prices, that will raise inflationary

pressures; but it will also be a redistributive income transfer from urban to rural India," said Crisil's Joshi.

A new price support policy, the government hopes, will help revive rural incomes and placate farmers ahead of important elections.

Thaware, meanwhile, is still hoping that the normal monsoon prediction will come true this time and bring some relief to farmers like him, who are living precariously at the mercy of the weather, markets and middlemen.

"I have nothing against the weather department, I'm also praying to god that they are correct this time," chuckles Thaware, realizing the absurdness of his move to file a complaint against the Met department director.

Tough terrain saves Sikkim's high-altitude forests

Being higher and out of reach is probably saving Sikkim's high-altitude tropical forests. Scientists find that land-use patterns changed more drastically in the more-accessible lower regions, causing a staggering 16% decline in primary broadleaved forest cover in the Sikkim Himalaya.

Primary forests, which host native vegetation and are still undisturbed by human activities, are declining worldwide. Globally, more than 40 million hectares of such forest have been converted for other uses since 2000. A majority of this has been in the tropics, where logging and clearing forests for industrial development are concerns. Human activities also transform primary forests into agricultural land and secondary forests (disturbed forests which replace logged primary forests).

Unfortunately, this is common in the broadleaf forest tracts of India's Sikkim Himalaya which thrive between 1,000-2,800 metres above mean sea level. When researcher Radhika Kanade of Bengaluru's Ashoka Trust for Research in Ecology and Environment (ATREE) went looking for primary forest patches in the lower reaches (around 1,000 m) here, she could barely find any. However, most of the slightly higher reaches (2,000-2,800 metres, which were difficult to access due to the terrain), still supported primary forests.

Wondering if topography, such as the presence of steep terrain, could be influencing this pattern, Kanade and Robert John (Indian Institute of Science Education and Research, Kolkata) studied satellite

images from 1990 to 2013 to examine the land-use changes near Sikkim's Teesta River.

They surveyed several areas between 2011 and 2013 to confirm current land use.

The team's results, published in the journal Applied Geography, show a 16% decline in primary forest cover in this Eastern Himalaya biodiversity hotspot. This is higher than regional level declines reported so far (such as the 8.4% decline in Southeast Asian forest cover estimated by the Global Forest Resources Assessment in 2015). A staggering 14,740 hectares of primary forest was transformed during the 23-year period — some into secondary forest, parts of which again transitioned to agricultural land.

The scientists' hunch was right: elevation, slope and aspect (the direction a slope faces) influenced land-use patterns. Agricultural areas steadily expanded, mainly in the lower regions. Undisturbed primary broadleaved forest is now restricted to higher reaches that are relatively difficult to access and unsuitable for activities like agriculture and agroforestry.

"These higher-altitude areas are also legally protected and this plays a role too," says Kanade.

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HEALTH AND MEDICINE

Initial step to treat breast, prostate cancer

By using a smartly designed, customized E. coli vector, researchers at Indian Institute of Technology (IIT) Gandhinagar have successfully produced a large quantity (15 mg/ml) of a biologically active protein (human tousled-like kinase-1b or TLK1b) in pure form.

The reported yield for this protein using bacteria is only about 1 mg/litre. The protein is mainly involved in DNA damage response pathway in breast and prostate cancer cells.

The team led by Dr. Sivapriya Kirubakaran and Dr. Vijay Thiruvenkatam from the institute's Discipline of Biological Engineering found a handful of the 120 small molecules they had designed and synthesised were able to inhibit the protein.

Though the protein is produced in excess in cancer cells, the inhibition, which was as high as 75%, prevents the protein from repairing the DNA damage leading to death of cancer cells.

DNA gets damaged when cells are exposed to radiotherapy, chemotherapy or other environmental factors.

The researchers were able to get high yield of the protein by inserting a recombinant DNA into E. coli. The recombinant DNA has a gene that expresses both TLK1b protein and the bacteriophage lambda phosphatase protein.

The simultaneous expression of both the proteins is responsible for the high yield," says Dr. Thiruvenkatam, one of the corresponding authors of a paper published in Scientific Reports.

In the absence of the bacteriophage lambda phosphatase gene, the TLK1b protein produced is not active as it remains insoluble. "The lambda phosphatase gene removes the phosphate so we were able to get the pure, active protein. Getting pure, active protein from bacteria has been a challenge so far," says Dr. Kirubakaran, the other corresponding author.

Since the yield has been much more than expected, the researchers are testing the bioactivity and the 3D crystallographic structure of the protein. "There is limited information on this protein's expression. So we intend studying the protein function and mechanism biochemically and structurally," she says.

The team has already biochemically confirmed that the protein produced by the bacteria is active. The next task is to know the precise structure the protein takes inside the cells. “Knowing the crystal structure of the protein will help in identifying the mechanism of DNA repair. It will help us in knowing the amino acid sequence that is responsible for DNA repair,” he says.

Though a handful of small molecules were found to be effective in inhibiting the protein, the researchers are yet to study the mechanism of inhibition. “By knowing the crystal structure of the protein we can tell the sites where the small molecules get attached leading to inhibition. It will also help us design better small molecule inhibitors,” Dr. Thiruvenkatam says.

“We are working on two other proteins in the DNA repair pathway which when inhibited using small molecules will increase the chances of cancer cell death. The inhibitors should be used along with chemotherapy or radiotherapy for best results,” says Althaf Shaik, a co-author of the paper.

“The work we are currently doing is preliminary in nature. Our long-term goal is to know which functional groups on the small molecules needs to be modified to make them more specific so that they target the TLK1b protein present only in the cancer cells,” says Siddhant Bhoir, first author of the paper.

Healing wounds with leather, meat waste

Protein extracted from discarded animal tissues can now be put to better use — wound healing and human tissue engineering. This waste-to-wealth feat was demonstrated by researchers from the Chennai-based CSIR-Central Leather Research Institute (CSIR-CLRI).

In the meat industry, tonnes of animal tissues that are rich in collagen (protein) go waste. The researchers have found that various collagenous tissues available as inedible by-products in abattoirs can be successfully used for the production of collagen-based products for biomedical applications. “Collagen has been reported to play a major role in healing of tissues, but their low mechanical strength and fast biodegration has restricted its use. We tried to overcome these limitations by incorporating the collagen with another biopolymer, chitosan, obtained from shells of crustaceans,” says Dr. Chellan Rose, the corresponding author of the paper published in RSC Advances, who has now retired from CLRI.

The collagen-chitosan scaffold was cross-linked

with an amino-acid L-arginine to impart stability. It also helps avoid side-effects caused by toxic chemical cross linkers.

The freshly prepared 3D scaffolds were first tested in vitro on mouse fibroblasts. The cell population increased significantly in 48 hours suggesting that they were able to anchor to the 3D scaffold and proliferate. For in vivo studies, a small cutaneous wound was created on a lab rat and treated with the new scaffold and covered using micropore tape. Complete wound closure was seen at the end of 14 days with no scar formation.

Computer simulation studies further examined the possible interactions of the collagen with arginine and chitosan. Molecular docking revealed that the compounds bind well and the arginine helped the stability of collagen-chitosan interaction.

Scanning electron microscopy studies showed that the scaffold had a uniform, interconnected porous structure with pore size of about 50-400 micrometre. The decreased pore size but high porosity of the material helped in water uptake by the scaffold and facilitated cell migration, adherence and proliferation.

"This hybrid scaffold is specifically developed for highly exudating wounds to absorb the fluid and to keep the wound dry for faster healing," explains Mr. S. Udhayakumar, first author of the paper.

"Even the collagen scraps generated during the different operations of leather making can be used as biomaterial in the field of regenerative medicine. The scaffolds will cost less than the existing collagen-based healing products. Human clinical trials are in progress and the results are encouraging," says Dr. C. Muralidharan at the Leather Processing Division, CLRI and one of the authors of the paper.

IGIB shows how fat cells protect TB bacteria from oxidative stress

Dormant and actively dividing TB bacteria form distinct groups with very different susceptibility to anti-TB drugs. Now, researchers from the Institute of Genomics and Integrative Biology (CSIR-IGIB), Delhi, have found that even among the actively dividing bacteria, the essentiality of TB genes varies depending on whether the bacteria reside in fat-rich environment or not. The team led by Dr. Sheetal Gandotra also found inherent synergy between fat and iron in host cells providing the bacteria resilience

to oxidative stress.

Tuberculosis bacteria are known to also reside in lipid-rich environments, both within and outside the cells, where they end up once they multiply within and bring about cell death. To better understand the physiology of the bacteria in such an environment, the researchers studied fat cells (adipocytes) and their precursors (preadipocytes) which have relatively less fat content.

Besides thriving and multiplying inside both cell types and killing them, the bacteria also thrives on dead cellular environment. “This is similar to the extracellular environment that supports bacterial growth in TB lesions,” says Dr. Gandotra who is the corresponding author of a paper published in the journal Infection and Immunity.

Since the fat content in both the cell types (adipocytes and preadipocytes) are very different, the researchers questioned whether pathways that bacteria employ to survive in these cell types are also different. They undertook gene-expression studies to answer this question. Their analysis showed that genes responsible for iron intake were less expressed in bacteria found in adipocytes than in preadipocytes, suggesting higher iron concentration in fat cells.

High fat and iron

A series of investigations showed that indeed the high fat content is associated with higher iron also. “But as high iron also induces oxidative stress, we hypothesised that bacteria in the adipocyte environment might be making the bacteria resilient to oxidative stress,” says Dr. Gandotra.

The researchers experimentally tested their hypothesis by using TB mutant bacteria which are sensitive to iron-mediated oxidative stress. “We found the mutants growing unhindered in adipocytes though they are rich in iron but unable to grow in preadipocytes which are not iron-rich. This proved that the adipocyte environment was providing protection to TB bacteria from iron-mediated oxidative stress,” says Ananya Nandy from IGIB and first author of the paper.

The researchers do not yet know the complete mechanism by which TB bacteria mitigates oxidative stress. “But fat from the adipocytes may be involved in providing resistance to oxidative stress,” says Dr. Gandotra.

When there is excess cell necrosis (death of cells) there is accumulation of lipids within the granuloma. The researchers carried out mouse infection studies to test the link between lipid accumulation and iron storage in the granuloma. "The mouse infection studies showed that when there is excess fat there is excess accumulation of iron-storage protein in the granuloma. This provided a clue to the link between lipid accumulation and iron storage," says Nandy.

Nutrients

"Our work sheds light on the link between macro (fat) and micro (iron) nutrients in a tissue. And different regions of a tissue will have different levels of availability of these nutrients. Tuberculosis bacteria have the ability to adapt to each condition," says Dr. Gandotra. "This probably is the reason why it is difficult to treat tuberculosis because the genes essential for survival of the bacteria in one environment will not be essential in another region of the granuloma."

Also, anti-tuberculosis drug isoniazid, which kills TB bacteria by inducing oxidative stress, is not effective against bacteria that grow in fat cells (adipocyte). So inhibiting the pathways essential for reducing oxidative stress in fat-rich environment can possibly make isoniazid drug more efficacious.

IASST researchers use smart bandage for faster wound healing

A smart bandage material that can heal wounds better and faster and has antimicrobial properties has been fabricated by a team of researchers from the Institute of Advanced Study in Science and Technology (IASST), Guwahati. The bandage is made of cotton patch coated with chitosan-based hydogel that is loaded with curcumin and graphene oxide. The researchers used curcumin as a model drug and the same can be replaced with other antimicrobials.

"Cotton tends to stick to wounds and being fibrous it is difficult to remove it. By coating the cotton with chitosan and compressing the bandage we get a material with similar properties (porosity and ability to absorb water) as cotton but one that does not stick to the wound," says Dr. Devasish Chowdhury from the Physical Sciences Division at IASST and corresponding author of a paper published in the journal ACS Sustainable Chemistry & Engineering.

Antimicrobials

More importantly, the absorption capacity of the cotton patch can be utilised for loading nanomaterials and antimicrobials to impart wound-healing properties. The researchers used graphene oxide nanomaterial, since its antimicrobial properties and biocompatibility are already well documented. The nanosize of graphene oxide allows large amount of drug to be loaded on to the patch. Graphene oxide also increases the strength of the patch especially when it gets wet.

“We used curcumin as a model drug. Different drugs can be loaded on the patch depending on the nature of the wound,” says Achyut Konwar from the Physical Sciences Division at IASST and first author of the paper.

Testing

The antimicrobial property of four cotton patches was tested in vitro usingStaphyllococcus aureus and E. coli bacteria. While no antimicrobial property was seen in the case of cotton coated with chitosan, patches that had either graphene oxide or curcumin exhibited antimicrobial activity.

“Patches that had both graphene oxide and curcumin had only minimal or no growth of bacterial colonies. The superior antibacterial activity comes from combined action of the antimicrobials,” Dr. Chowdhury says.

The wound-healing property was also tested on rat models for a period of 21 days. The wounds were infected with S. aureus one day after wounds were created and treated with one of the four cotton patches three days after infection. Cotton patch with graphene oxide or curcumin showed almost similar wound-healing capacity at the end of 21 days. But wounds treated with the patch containing both graphene oxide and curcumin showed faster and satisfactory healing along with hair growth in the wounded area by the end of three weeks.

“The cotton patch containing graphene oxide and curcumin served as a smart dressing material for wounds infected with bacteria,” says Konwar. “The high absorption capacity of the patch takes care of the pus and porous nature provides good oxygen supply for faster healing. The absorption capacity was tested using blood plasma and was found to be good.”

“Currently, there is no control over drug release. We are trying to address this by using different

nanomaterials. We should first functionalise the nanomaterial so that when the drug is loaded it attaches to the nanomaterial and gets released in a sustained manner," Dr. Chowdhury says. "We must make sure that like graphene oxide, the chosen nanomaterial is biocompatible and does not get released into the wound."

How gut bacteria affect immunity

The abundance and type of bacteria in the intestine gets altered when infected with tuberculosis, a study by Indian researchers shows.

The team studied the gut bacteria of six patients diagnosed with TB and compared them with one healthy relative from each household. Despite the food consumed by the patients and healthy individuals remaining the same, there were significant differences in the type and abundance of gut bacteria.

The faecal samples of the two groups were examined at three different time points — immediately after TB diagnosis, one week after treatment and one month after treatment.

They found that Prevotella and Bifidobacterium were abundant in the healthy individuals. "These bacteria are important for normal digestion and metabolism of the body. You can find them in abundance in the Indian gut due to the carbohydrate-rich diet," explains Dr. Richa Misra from Sri Venkateswara College, Delhi, one of the first authors of a paper published in Environmental Microbiology.

In TB patients, bacteria like Faecalibacterium, Roseburia, and Eubacterium andPhascolarctobacterium were significantly higher.

"These bacteria are known to produce short-chain fatty acids like butyrate and propionate, which are important for our gut, but their increased abundance can also lead to anti-inflammatory response, altering the immunity of our body," says Prof. Vineet K. Sharma at the Department of Biological Sciences, Indian Institute of Science Education and Research (IISER) Bhopal and one of the co-authors of the paper. "The high number of these bacteria can also alter the normal metabolism of our body and can even reduce the appetite."

Tuberculosis is usually associated with low BMI and

low cholesterol levels. As butyrate and propionate regulate appetite-regulatory gut hormones and cholesterol bio-synthesis, a balance of these microbes is critical. “This makes more studies on gut microbiome extremely crucial since upsurge in butyrate and propionate-producing bacteria may prove detrimental for host response in infectious disease such as TB,” adds Dr. Misra.

One month after treatment, the gut microbes did not return to their original abundance highlighting the requirement of the six-month-long TB regimen.

`Nonetheless, recovery in microbial pathways involved in amino acid and vitamin metabolism were observed by one month as indicated by the functional gene pool.

“We have planned to further carry out cause–effect study as we are still unsure if the TB infection is causing the change in gut bacteria or if it is the other way round,” adds Dr. Misra.

This novel study may help further in understanding how drugs alter the gut microbiome and if probiotics/ prebiotics and nutritional supplements should be given along with certain prescribed drugs.

IIT Delhi team increases the usability of donated corneas

As much as 20-30% of human corneas taken from cadavers and transplanted into patients get rejected. Unlike in the case of other tissues, the conventional tissue engineering technique that uses polymer scaffolds to seed cells and culture tissues in the lab do not succeed in the case of cornea as transparency, which is vital for cornea, gets compromised. Against this backdrop, a team of researchers led by Prof. Sourabh Ghosh from Indian Institute of Technology (IIT) Delhi have found corneas taken from goats and transplanted into rabbits are not rejected and transparency is not compromised. The work was done in collaboration with clinicians from All India Institute of Medical Sciences, Delhi.

Dr Radhika Tandon, Professor of Ophthalmology at AIIMS and one of the authors of a paper published in the journal ACS Biomaterials Science & Engineering is optimistic of study’s translation potential. “These findings open up maximal utilisation of donor corneas. Human donor corneas, which for various reasons are categorised as unsuitable for keratoplasty [where abnormal corneal tissue is replaced by a healthy cornea], can be processed in

this manner and be useful for successful transplants for patch grafts and anterior lamellar keratoplasties," she says.

Though there is no blood supply to corneas (avascular), lymphatic system is absent, and the blood-eye barrier greatly minimises the chances of rejection, cornea from one species to another gets rejected. Removing all traces of protein, cellular and nuclear material from the cornea without destroying the anatomical microstructure and extracellular matrix of the cornea is therefore essential to minimise the chances of rejection.

Corneal transparency

"Corneal transparency is determined by the orderly alignment of collagen fibres in a particular direction and regular spacing between the fibres so light does not get diffracted and instead passes through the cornea," explains Prof. Ghosh, corresponding author of the paper.

By directly passing a detergent at very precise flow rate and direction through the cornea, the researchers had already demonstrated the ability to remove all cellular and nuclear material without affecting the integrity of corneas. However, the secondary collagen alignment or confirmation still gets distorted leading to certain hidden antigenic sites getting exposed.

Thus there are chances of immune response getting evoked leading to rejection when the decellularised cornea is transplanted.

To overcome this problem, the team used a chemical (chondroitin sulphate) naturally found in a cornea to combine with the decellularised cornea. "The chemical combines with the decellularised cornea and restores collagen alignment thereby increasing the chances of integration of the cornea, and reducing the chances of evoking immune response and a possible rejection," says Juhi Chakraborty from IIT Delhi and first author of the paper.

Enhanced integration

The researchers hypothesised that combining the chemical with the decellularised cornea will result in enhanced graft integration, reduced immune response and less inflammation. To test this they used cornea without removing any cellular or nuclear material, corneas with cellular and nuclear material removed and finally decellularised corneas with the chemical combined to them. "During in vitro studies

we found some immune response in the case of decellularised corneas but decellularised corneas was conjugated [combined] with the chemical showed no immune response," says Prof. Ghosh.

The researchers implanted the three types of goat corneas in rabbits and tested the immune response. Three rabbits were used for each group. "Decellularised cornea showed the most inflammation and blood vessel formation [vascularisation]. Interestingly, the decellularised cornea combined with the chemical had less inflammation and vascularisation," says Chakraborty.

TB infection in the eye can lead to autoimmunity

Researchers from Bhubaneswar have for the first time found evidence of how TB infection of the eye leads to autoimmunity — wherein the immune cells attack the cells of the body instead of protecting them — causing widespread disease of the eye (uveitis). According to the NIH's National Eye Institute, U.S., uveitis is a group of inflammatory diseases that produces swelling and destroys eye tissues. Uveitis can cause mild to severe vision loss.

"TB-associated uveitis is the most common cause of infectious uveitis in India. It causes about 10% of all infectious uveitis," says Dr. Soumyava Basu from L V Prasad Eye Institute, Bhubaneswar.

Certain parts of the body such as the eye, brain, and reproductive organs (testes and uterus during the time of pregnancy) are immune-previleged,

in that they effectively prevent the entry and exit of cells, the immune cells included. In the case of the eye, the blood-retinal barrier does the job of blocking the entry of immune cells. The immune privilege of the eye is exploited for corneal transplantation from cadavers without the need for tissue matching, unlike in the case of other organs such as kidney.

"It's generally believed that infection and autoimmunity are two separate entities and follow different paths during the evolution of disease. But we found TB infection of the eye was responsible for the activation of autoimmunity," says Dr. Basu who is one of the corresponding authors of a paper published in the journal Investigative Ophthalmology & Visual Science. The work was done in collaboration with Dr. Satish Devadas from the Institute of Life Sciences, Bhubaneswar.

The TB infection of the eye per se does not cause

autoimmunity. Instead, it is likely that TB infection damages the blood-retinal barrier thereby allowing some of the autoimmune cells that are present in the blood to reach the retina. Once inside the eye, the autoimmune cells specifically target the retina where they proliferate in large numbers and produce inflammatory chemicals called cytokines, leading to widespread eye disease.

"T cells are generated in the thymus and get exposed to different cell types present in the body. While most T cells that act against body cells (autoimmunity) naturally die in the thymus, a few escape and enter the blood circulation," says Ravichandra Tagirasa who is first author of the paper.

The researchers isolated vitreous humor (gel) from the diseased eye of patients with ocular TB and stimulated the immune cells using either TB antigen or retinal antigen. "We thought only the TB antigen can activate the T cells. But to our surprise, both antigens were able to activate the T cells. This was completely unexpected," says Tagirasa.

Though both TB-specific and retinal-specific immune cells are present in the eye, the researchers found only the retinal-specific immune cells were responsible for the inflammation and eye disease.

In subsequent experiments, the researchers found retinal-specific immune cells (T cells) were also resistant to cell death. While the TB-specific T cells were dying at a normal rate, retinal-specific autoimmune T cells that were activated weren't dying easily in the eyes. The ability of the retinal-specific autoimmune cells to persist in the eye for longer duration results in persistent inflammation and prolongation of the disease process. This adversely affects the long-term prospects for restoring good vision in the affected eyes.

"As there are many retinal-specific T cells, prescribing only anti-TB drugs is not enough. The patients must be given adequate anti-inflammatory therapy as well," says Dr. Basu.

In a first, WHO recommends quadrivalent influenza vaccine?

Sanofi Pasteur's injectable influenza vaccine (FluQuadri) containing two A virus strains — H1N1 and H3N2 — and two B virus strains — Victoria and Yamagata — for active immunisation of adults of age 18 to 64 years was approved in May last year by the Drug Controller General of India (DCGI). The

application for the paediatric indication is under review by the DCGI and final approval is expected by the end of this month.

Sanofi's quadrivalent influenza vaccine was licensed for use by the U.S. Food and Drug Administration (FDA) in 2013; it is licensed in 26 countries.

Better protection

While a trivalent influenza vaccine contains both A subtype viruses, it has only one of the B subtype virus, the quadrivalent vaccine offers greater breath of protection as it includes both B subtype viruses. It is because of greater breadth of protection that a few other companies too have shifted from a trivalent to a quadrivalent vaccine.

Since the vast majority of influenza vaccines manufactured were trivalent till recently, the World Health Organisation (WHO) used to recommend two A subtypes and one B subtype, plus an optional fourth strain (the other B virus strain). But this February 2018, for the first time, the WHO issued an official recommendation for a quadrivalent vaccine. "It is recommended that quadrivalent vaccines for use in the 2018-2019 northern hemisphere influenza season," the WHO noted.

The quadrivalent vaccine will contain four influenza virus strains (two A subtypes and two B subtypes — H1N1 and H3N2, and Victoria and Yamagata respectively). The WHO recommendation then mentioned which B strain should be removed in the case of a trivalent flu vaccine.

The viruses used in the vaccine are killed and this eliminates the possibility of the virus in the vaccine itself causing infection. In India, the vaccine will be available as single dose pre-filled syringe. Eventually, it will be available in a vial for public health use. In the case of H1N1, there are two strains — California and Michigan — that cause influenza. In India, the Michigan strain was earlier circulating and has been replaced by the California strain. For 2018, the WHO has recommended the Michigan strain for the southern hemisphere, including India.

Each year, the vaccine changes to reflect the different strains in circulation. Year round, scientists across the globe track, analyse and classify the viral strains causing illness. This allows the WHO to select the strains in February for the upcoming season's vaccine.

Since 2011, there have been about 97,000 H1N1

cases and over 7,100 deaths in India according to the Integrated Disease Surveillance Project (IDSP) data. Till June 3 this year, there have been 1,740 seasonal influenza cases and 191 deaths caused by H1N1. The years 2015 and 2017 witnessed a sharp increase in the number of cases and deaths. There were 42,592 and 38,811 cases and 2,990 and 2,270 deaths in 2015 and 2017, respectively.

Indian context

Despite the high number of infections and mortality each year, India does not have in place a national policy for influenza immunisation. Pregnant mothers, children aged below five and young people with asthma, cardiovascular disease, diabetes and high blood pressure are at a greater risk of infection and death. The Ministry of Health issues only H1N1 vaccination guidelines for different vulnerable groups including healthcare workers.

"If you want to reduce the influenza burden in adults, then we must target children as they act as reservoirs," Dr. Su-Peing Ng, Sanofi Pasteur, Head of Global Medical Affairs.

"Influenza can be seasonal or pandemic. What we observed during the 2009 pandemic is that countries which traditionally had good seasonal vaccine coverage could reach 50% coverage during the pandemic. Other countries achieved only 20% vaccination coverage during the pandemic. So seasonal vaccination is part of pandemic preparedness," said Dr. Pier Luigi Lopalco, Professor of Hygiene and Preventive Medicine at the University of Pisa, Italy.

"When people can use the seat belt each time they drive why not get vaccinated against influenza just once a year?" asked Dr. Su-Peing.

New health scheme flawed: IMA

Warns that low rates for procedures will compromise patient safety

The Indian Medical Association (IMA) has demanded a review of the Centre's ambitious National Health Protection Scheme (NHPS), saying it has "conceptual deficits and operational flaws".

The doctors' body said the rates quoted by the government for various procedures were abysmal and impractical and most do not cover even 30% of the costs.

"No hospital can work on these rates without

seriously compromising patient safety. In the garb of cost-cutting, the government is exposing the people to danger in the hospitals. Caesarean sections underwritten for Rs. 9,000 cannot ensure safety of the mother and the child," IMA national president Ravi Wankhedkar said. The IMA has demanded that the costing be transparent and in the public domain.

Funding govt. hospitals

The association said the money allotted for the Ayushman Bharat-National Health Protection Scheme (AB-NHPS) would have better served the country if every district hospital was strengthened with an infrastructure of Rs. 2 crore each.

"The highly optic NHPS fails to create any new national asset. The same money invested in our public hospitals would have brought secondary and tertiary care closer to the poor in our government hospitals.

"In addition to non-creation of new public sector hospitals, the government will lose around Rs. 400 crore to private health insurance companies which will manage the scheme. The insurance-driven healthcare is a failed experiment," Dr.Wankhedkar said.

IMA members said apart from such conceptual deficits, the operational flaws of the scheme would ensure it is a non-starter.

The IMA said the current policy change in India would only end up strengthening the insurance business.

'Intermediaries gain'

"The IMA has suggested to the government that the NHPS be modelled as healthcare purchase directly from the provider hospitals, removing insurance companies and third party administrators. These intermediaries siphon off 40% of the budgeted money and are breeders of corruption and unethical practices," IMA secretary general Dr. R.N. Tandon said.

Twenty States have so far signed MoUs with the Union Health Ministry to implement the government's ambitious health protection mission, aiming to provide a cover of Rs. 5 lakh per family.

Nipah virus: How foreign media is covering the outbreak in Kerala

The rare Nipah virus has killed at least 10

people out of 12 confirmed cases in Kerala. Chief Minister PinarayiVijayan assured assistance to the victims' kin and added that the government was handling the issue with 'utmost seriousness.' "All efforts are also being made to ensure that more lives are not lost," he said. Health Minister KK Shailaja, meanwhile, told reporters that no new cases have been reported in the last 24 hours and that the World Health Organisation (WHO) has been informed about the outbreak. The Centre has also rushed a rapid response team to contain the outbreak.

The Nipah virus outbreak has triggered panic not only in Kerala but has also attracted global attention.

HenkBekedam, WHO's representative to India, said the agency is monitoring the outbreak. "Both the central and the state health authorities have been quick in responding to the situation and have promptly deployed teams and experts to the village to further assess the situation. WHO is in close contact with the teams of experts deployed to the affected areas. We await the assessment reports of the teams to clarify the situation and guide further action," he said.

Follow Nipah virus outbreak in Kerala LIVE UPDATES

Gulf News reported that Kerala "is in a state of panic after many cases of the killer Nipah virus were detected." The report also has a mention of nurseLiniPuthussery who succumbed to the virus and the letter to her husband Sajeesh that has been widely shared on social media.

In a report, the BBC also called it a 'deadly virus' which is on 'top of the list' of 10 priority diseases that the WHO has identified as potentials for the next major outbreak. Calling Lini "India's hero nurse", BBC added, "Her death is being hailed on social media as a sacrifice." Aljazeera and The Independent have also reported about the deaths in Kerala.

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BIOTECHNOLOGY

Genetic diversity can prevent rapid spread of infectious diseases

An infectious disease can spread at different rates in different countries. This phenomenon has been observed in many cases, for instance in the 2009 H1N1 influenza pandemic. An International group of researchers including those at Indian Institute of Science (IISc), Bengaluru, and The Institute of Mathematical Sciences (IMSc), Chennai, looks at genetics as a way to explain this phenomenon. They find that the greater the genetic diversity in immune response, the stronger is the barrier to the spread of the disease. The results have recently been published in PLOS Computational Biology.

Nagasuma Chandra's team at IISc chose to study H1N1 as modelling it had some advantages.

"There is a lot of work on H1N1 and a lot of data including clinical and epidemiological. These models are also best suited to study airborne diseases. As H1N1 spreads through air, choosing it made a lot of sense," says Dr. Chandra.

Pandemic H1N1 virus

The pandemic H1N1 2009 influenza A virus was different from other influenza viruses encountered until then. According to the WHO, this is because it originated from animal influenza viruses and is unrelated to the human seasonal H1N1 viruses that have been in circulation among people formany years In fact, this virus is thought to have arisen from a mixture of two viruses: a North American virus that jumped from birds to swine and humans and a Eurasian swine virus that had circulated in pigs for about a decade before entering humans. Clinically also the virus's effect was very different from that of other flu viruses in that younger people were more severely affected than older ones.

Narmada Sambataru and Sumanta Mukherjee who were at Dr Chandra's lab, and Martin Lopez-Garcia from the University of Leeds, UK, spent nearly a year building up the model. Their research led them to establish how an individual's genetic makeup can influence his

or her susceptibility to the infection.

The immune system has both innate and adaptive response types to infections, in general. In the case of H1N1 infection, the adaptive immune system can recognise the presence of a virus within the cell and respond to it only if a molecule called the human leukocyte antigen (HLA) binds to some fragment of the viral protein (epitope) and 'presents' it to the environment outside the cell. Dr Chandra's group has described the details of this aspect of H1N1 in an earlier paper published in the journal Clinical and Translational Immunology.

Immune response

"The main take-away from our work is that understanding how the immune response of different individuals leads to a spread of susceptibilities in a population is vital to figuring out how diseases spread," says Gautam Menon of The Institute of Mathematical Sciences, a co-author of the paper. "This problem, of how to go from what we know about how individuals can vary in their susceptibility to understanding how epidemics spread across entire populations, has been identified recently as one of the major challenges in the study of epidemics."

Having worked out how the genetic makeup of an individual can affect their susceptibility to the disease, the individuals can be grouped according to their susceptibility. Using a mathematical model called the SIR (Susceptible-Infected-Recovered) model; the researchers study how the presence of susceptibility sub-populations affects the spread of the disease. "In this model, individuals are initially susceptible but not infected.

"When an infection is introduced, individuals become infected at a rate determined by their estimated susceptibility to the pathogen, estimated using genetic information about the host as well as the pathogen. Infected individuals then proceed to recover," says Dr. Chandra.

Trends

The work captures the qualitative features of well-known trends of influenza spread in various parts of the world. "This work uses publicly available information about HLA class-I

genes and their prevalence in populations around the world. Unfortunately, there is a significant shortage of this information for Indian populations," she says.

The group is planning to propose a detailed study of this for Indian populations. "Once this information becomes available, we can do far more to predict disease spread in India. These predictions can be used to inform public policy and make better decisions. This is the real utility of such modeling methods, that we can explore different situations and ask what responses might be most effective in the context of specific diseases," says Dr Menon.

Microbes help in making hydrocarbons

Scientists at the International Centre for Genetic Engineering and Biotechnology (ICGEB), New Delhi, have succeeded in engineering the metabolic pathway of Escherichia coli in such way that it would synthesise hydrocarbons of carbon chain length 15 and 17, which are the fundamental components of diesel. The results were recently published in Journal of Metabolic Engineering.

They first added two genes from Cyanobacteria into E. coli. "Few cyanobacteria are known to produce a low quantity of alkane. So we put the genes responsible for this production into the laboratory bacteria. But then the production was very minimal. So we took the approach of in-silico metabolic pathway, and finally over-expressed a gene (zwf gene) and removed few genes from E. coliwhich resulted in significantly high hydrocarbon production," explains Zia Fatma, Postdoc researcher and first author of the paper.

Additions and deletions

The researchers also studied the phospholipid pathway of E. coli and made some gene deletions.

A total of three gene additions and eight gene deletions were carried out to increase the hydrocarbon production rate and concentration.

The added genes included those which code for cyanobacterial alkane producing enzymes and a host gene which can lead to availability of higher electrons needed for alkane production. The deletions helped in saving the substrate (glucose) from going to other competing products, and also helped in limiting the cell growth so that more carbon is available for alkane formation.

Cosmetic industries

This pathway engineering also led to higher production of fatty alcohol, which has a role in cosmetic industries.

Fed-batch cultivation of E.coli (culturing the bacteria in a bioreactor with continuous nutrition supply) was done - 3 litre of the substrate supplemented with glucose and other nutrient sources were used. The engineered bacteria were able to produce 2.54 g/L of alka(e)ne and 12.5 g/L of fatty acid in 72 hours.

The report says that this is the highest production levels achieved so far by any microbial source.

"Currently, most of our need for fuels is met by non-renewable crude petroleum. Few countries have commercialised biodiesel made via transesterification of vegetable oil, but they can only be blended in the proportion of 5-20% with diesel and are not compatible with the supply chain," says Dr Syed Shams Yazdani, from Microbial Engineering group and corresponding author of the paper. "The production is currently only at the lab level. We have to integrate the engineered plasmid into the genome and go for mass production. We are working to bring about a ten-fold increase in the production and at the same time bring down the cost of the new product."

Masquerade in nature

Try locating a leaf beetle on a leaf. It's difficult, and not just because these insects are tiny, barely half the size of our smallest fingernail. They have evolved a unique strategy to blend out of sight: they resemble the feeding marks – holes or scrapes – they make on leaves. This could be to avoid being seen by predators, say scientists.

A leaf beetle systematically eats out small bits of the leaf it rests on, creating numerous holes or scrapes on it. These marks are as big and of a similar colour as the beetle itself, often making a predator mistake a dark beetle for a hole in the leaf.

This deception even fooled entomologist Alexander Konstantinov (Smithsonian Institution, U.S.A.) on his beetle collection trips. Did leaf beetles across the world – there are more than 30,000 species – exhibit this masquerading strategy too?

From field data collected over 16 years, Konstantinov and a team including scientist K. D. Prathapan from the Kerala Agricultural University in Thiruvananthapuram studied the colours and sizes of 119 leaf beetle species found worldwide (including 24 species from India), as well as the colour of the beetles' feeding marks. They also

studied photographs which had inadvertently recorded some of these beetles on plant leaves in Europe in the 1920s.

A majority of the 119 beetles were found to be masqueraders.

Their results published in the Biological Journal of the Linnean Society, show that masquerading beetles are small (about 4 mm long) and mostly feed on leaves exposed directly to the sun. They are uniformly dark- or light-coloured and their shells lack warning colours or contrasting patterns. The team find that beetle body colour is linked to the colour of their feeding marks: beetles that make dark feeding marks are dark in colour and those that make light-coloured marks, pale.

Which came first?

That these beetles could have evolved to be dull and uniformly coloured because it makes them harder to spot is an interesting hypothesis, but the study has several gaps that need to be addressed, says scientist Deepa Agashe of National Centre for Biological Sciences, Bengaluru, who studies evolutionary and allied ecological processes and is not part of the study.

"An alternative hypothesis is that the behaviours necessary to make light or dark-coloured damage (i.e. chewing partly or fully through the leaf) evolved later," she wrote in an e-mail to The Hindu. "It needs to be tested more rigorously."

A new biological 'switch'

Scientists have discovered a new metabolic process in the body that can switch off inflammation.

They found that 'itaconate' - a molecule derived from glucose - acts as a powerful off-switch for macrophages, which are the cells in the immune system that lie at the heart of many inflammatory diseases.

"It is well known that macrophages cause inflammation, but we have just found that they can be coaxed to make a biochemical called itaconate," said Luke O'Neill from Trinity College, Dublin in Ireland. "This functions as an important brake, or off-switch, on the macrophage, cooling the heat of inflammation in a process never before described," O'Neill said.

The discovery, published in the journal Nature, is very much on the frontier of inflammation research and the researchers are now exploring its relevance

to the onset and development of inflammatory and infectious diseases.

They are also keen to explore whether the findings can be exploited in the effort to develop new anti-inflammatory medicines.

"The macrophage takes the nutrient glucose, whose day job it is to provide energy, and surprisingly turns it into itaconate," said Evanna Mills from Trinity College, Dublin. "This then blocks production of inflammatory factors, and also protects mice from the lethal inflammation that can occur during infection," Mills said.

Transforming yeast to become plant-like and produce medicines

Plants are rich sources of medicines and drugs. This has been known since we humans started living together in communities. (Indeed, it appears that even chimpanzees chose to pick and eat specific plants as medicines). Ayurveda, Unani, Siddha, tribal medicine, Oriental medicine and Homeopathy all use plant-based compounds as medicines and tonics. The discipline of organic chemistry has specific branches such as natural products chemistry and medicinal chemistry. Practitioners here collect chosen plants and try to isolate specific molecules from them, study their specific chemical structures, check their effectiveness against chosen diseases (an area called pharmaceutical chemistry).

A given plant contains thousands of molecules and has them in varying amounts. Often, the 'drug molecule' one is looking for occurs in tiny amounts. It is thus not just a 'needle in a haystack' problem; one needs many haystacks in order to collect the target compound in a reasonable amount (say several grams) to work with. Natural products chemistry has thus been a very challenging area, and the successful practitioners are considered heroes and decorated with awards and honours. A recent example is the Chinese woman scientist, Dr. Youyou Tu, who was given the 2015 Nobel Prize in Physiology or Medicine for her back-breaking decades-long work of isolating the anti-malarial drug molecule called artemisinin from the Chinese herb Qinghao.

Once the natural products chemist isolates and determines the actual chemical structure of the drug molecule, he/she attempts to make (synthesise) it in the laboratory. This is yet another challenging

and back-breaking task. Since the molecule is three-dimensional in shape, its architecture (or the spatial arrangement of atoms within) can be quite complex. To build such complex molecules in the lab is somewhat akin to the job of an architect putting together a building from bricks and mortar. (Here too, heroes are recognised. One such is the late Professor Robert Woodward of Harvard, whose decades-long successful achievement of the synthesis of several complex molecules fetched him the Nobel Prize in Chemistry in 1965). It was with this analogy in mind that the late Professor Subramania Ranganathan, an outstanding organic chemist, wrote a monograph titled: "The Art of Organic Synthesis".

How does Qinghao make artemisinin? It involves over a dozen steps, many of them catalysed by enzymes which are protein molecules. We have been able to decipher each of these steps, and the genes involved in synthesising these enzymes in the plant cells, in fact the whole gene cluster involved in the process. Now, given this knowledge, and given the advances in genetics and genetic engineering, can we make artemisinin in the lab, using genetic engineering methods, rather than organic chemical methods? And if we were to insert this gene cluster into a microbe, say baker's yeast, will the yeast produce artemisinin? If we can do this, we need not harvest tonnes ('haystack') of the herb, but brew the yeast in large cultures, and manufacture the drug in kilogram quantities!

This idea of recruiting a microbe to make artemisinin (or for that matter any molecule that a plant makes) is a true "Out of the Box" one. If we succeed, we would have made a 'plant' out of baker's yeast - which has been used in homes and bakeries for the last five millennia or more! But this demands that the yeast cells contain (besides their own genome) the genetic cluster that the plant has, in order to produce the desired drug.

Idea worth pursuing

Thanks to the advances in genetics and genetic engineering, this idea is no longer foolhardy but worth pursuing; so argued Professor Jay Keasling of the University of California, Berkeley, and Dr. Neil Renninger of the company called Amyris. Aided by a grant from the Gates Foundation, their team chemically synthesised the entire gene cluster used by the herb to produce the drug, modified it to suit the yeast cells, and inserted the cluster into yeast

cells. Culturing the genetically modified yeast in the laboratory, they found that they could produce artemisinin from yeast. (This landmark paper by V. Hale et al., inAm. J. Trop. Med. Hyg., 77, 198-202, 2007 is accessible free on the web). By 2013, the group had improved the method and has been able to produce as much as 25 grams of this anti-malarial medicine per litre of the culture medium.

During the last a few years, several other drugs, naturally found in plants and herbs, have been produced in yeast. The most recent is a paper by Li et al., from UC Riverside and Stanford, published in PNAS last month, where they made the anti-cancer drug noscapine (found in the opium-making poppy plant), again using yeast (www.pnas.org/cgi/doi/10.1073/pnas.1721469115). The trick is to identify the cluster of genes involved in making the molecule in the plant cells, make them in the lab, insert them in yeast, optimise the conditions and generate the molecule in yeast, the new plant 'avatar'. Baker's yeast (or Khmer as the Arabs call it), known for over five millennia, to leaven bread and to brew alcohol, now has another equally useful role.

CSMCRI uses seaweed to remove lead, chromium and dyes from wastewater

Removing toxic metals such as lead and chromium and certain dyes from industrial wastewater much more effectively has become possible thanks to the work of Indian researchers. Researchers at CSIR-Central Salt & Marine Chemicals Research Institute, Bhavanagar, Gujarat have synthesised a graphene–iron sulphide nanocomposite to remove these toxic materials from wastewater.

The nanocomposite was prepared by mixing dried green seaweed Ulva fasciatawith iron chloride and heated to 150 degree C for 30 minutes to remove all moisture and then heated at 800 degree C for three hours in inert condition. Hydrogen sulphide gas, which is produced when seaweed is heated, reacts with iron to form iron sulphide.

"The graphene nanocomposite functionalised with iron sulphide facilitates the adsorption of heavy metals and dyes," says Dr. Ramavatar Meena from CSMCRI, one of the corresponding authors of a paper published in the Journal of Hazardous Materials. The nanocomposite was found to have very high adsorption capacity for lead (645 mg/g)

at neutral pH. “The amount of lead adsorbed is the highest ever reported for any biomass derived carbon material. Lead adsorption was irreversible even at low pH as the interaction of lead with the composite is very strong,” he says.

The nanocomposite with adsorbed lead was found suitable for removing chromium (100 mg/g) too. However, the ability to adsorb chromium was dependent on the presence of adsorbed lead. “Lead has high affinity for chromate and dichromate leading to the formation of lead chromate or lead dichromate,” Dr. Meena says.

Complete recovery

Unlike lead which cannot be recovered from the nanocomposite; it was possible to completely recover the adsorbed chromium by dispersing the material in basic solution (pH around 12) for a few seconds. Thus, it was possible to reuse the nanocomposite twice to remove chromium without any drop in efficiency.

Effective against dyes

The nanocomposite showed very good ability to adsorb different dyes used in textile industry — methylene blue, methyl orange, crystal violet and congo red. Highest adsorption capacity of 970 mg/g was seen in the case of congo red followed by crystal violet (909 mg/g), methyl orange (664 mg/g), and methylene blue (402 mg/g). The adsorption capacity was tested for each dye individually and also in a mixed solution. “The material was highly efficient to fully remove all the dyes present in water,” he says. “The adsorption capacity remained more or less the same whether the solution contained single dye or a mixture. The adsorption capacity did not vary much even in the presence of high concentration of salts,” Dr. Meena says. Most importantly, the nanocomposite could be reused up to eight times to remove the dyes.

The researchers tested the ability of the material to remove the toxic reactive black-5 dye in a continuous flow condition by coating a filter paper with a thin layer of the composite. “All the dye was removed and the water became colourless within five minutes of treatment. The surface area of the material was high as it was coated on the filter paper and so it was able to remove the dye quickly. When the composite is used as such it will take about three hours to completely remove the dye,” he says.

The preliminary results using filter paper coated with the material highlights the potential of the composite to be used in combination with other membrane-based processes such as reverse osmosis and nanofiltration for complete and effective treatment of dye and textile industry wastewater.

IACS team designs logic devices for DNA-based computation

Scientists at the Indian Association for the Cultivation of Science (IACS), Kolkata, have been successful in designing DNA-based logic devices that would find application in DNA-based computation. They have designed reusable YES and INHIBIT logic systems by using a small molecule that serves as a fluorescent probe and binds to both a four-stranded DNA structure (G-quadruplex) present in human telomeres and nucleic acid cleaving enzymes (nucleases).

Fluorescence

The fluorescent probe — carbazole ligand — selectively binds to the G-quadruplex over other DNA structures present in the human genome. Once it binds to the DNA (G-quadruplex), the small molecule inhibits certain enzymes (nuclease S1 and exonucleases) from degrading the DNA. However, certain other enzymes (DNase I and T7 endonuclease I) can degrade the DNA even when bound by the small molecule.

While the small molecule by itself shows weak emission at 373 nm and 530 nm, the fluorescence intensity gets enhanced 14-fold at 530 nm once it binds to the DNA. Similarly, the small molecule bound to the DNA exhibits different fluorescence behaviour in the presence of different enzymes and this has been taken advantage of by the team led by Prof. Jyotirmayee Dash from the Department of Organic Chemistry to design conceptually novel logic devices. The results were published in the journal ACS Synthetic Biology.

Computation

For instance, DNase I enzyme degrades the DNA-bound small molecule and so when both the DNA the DNase I enzyme are used as inputs the fluorescence at 530 nm weakens. The output is therefore taken as zero. On the other hand, nuclease S1 enzyme does not degrade the DNA bound by the small molecule and so when both DNA and nuclease S1 enzyme are used as inputs the fluorescence at 530 nm does

not get affected. The output is taken as one.

"So the INHIBIT logic gate is constructed using DNA and DNase I as inputs while the inputs of DNA and nuclease S1 form a YES logic gate," she says.

Once the DNA is degraded by the DNase I enzyme, the logic system can be reused by supplying heat to deactivate the enzyme. "The logic system can be recycled for three cycles by adding a heat deactivation step. After three consecutive cycles, the efficiency of the system decreases by only 33%," says Prof. Dash.

The team went a step further to design combinatorial logic systems (individual logic gates integrated into one another such as INHIBIT−INHIBIT and NOR−OR) by using different combinations of four nucleases (enzymes) as inputs.

16 combinations

The researchers were able to get 16 different combinations by adding one, two, three or four enzymes (nuclease S1, Exo I, T7 Endo I and DNase I) to the DNA-bound small molecule. The different combinations of the four enzymes are taken as inputs and the fluorescence response at 530 nm is taken as the output.

Of the 16 combinations, only four combinations are fluorescent (output taken as 1) and 12 are non-fluorescent (output taken as zero). The square numbers (1, 4, 9, 16) are assigned as fluorescent combinations, whereas the rest are assigned as non-fluorescent combinations. "So by suitable programming we can modulate the system to carry out complex calculations (for example, identification of square numbers up to 16) by varying the inputs," she says.

"We hope that these DNA logic gates will provide the ability to not only create more complicated, sequential DNA computations but also create interfaces between silicon and DNA-based computers. The DNA-based nanodevice could be useful for diagnostic sensors and other biomolecular machines," Prof. Dash says.

IIT Roorkee develops a potent molecule to treat chikungunya

A team of researchers at the Indian Institute of Technology (IIT) Roorkee has achieved a measure of success by finding a small molecule that has good antiviral activity against chikungunya virus. The antiviral activity was so high that the small molecule was able to achieve almost 99% reduction in the

virus when 5 microMolar was used.

Currently, there are no drugs to treat chikungunya or any vaccine to prevent it.

Virus structure

Using structure-based studies of chikungunya virus-specific nsP2 protease, the team led by Prof. Shailly Tomar from the Department of Biotechnology had earlier identified two small molecules — Pep-I and Pep-II — for their inhibitory activity. Protease inhibitors have already been used successfully against HIV and hepatitis C virus.

In the latest study, published in the journal Biochimie, the researchers report that one of the two molecules — Pep-I — has superior antiviral activity against chikungunya virus. The small molecule was found to effectively bind to the protein of the virus (nsP2 protease) and prevent the virus from replicating.The researchers hypothesised that any molecule that inhibits nsP2 protease should have antiviral activity. To test the hypothesis they carried out antiviral studies using cell lines. "The studies confirmed that both molecules had significant ability to kill the virus. The Pep-I molecule was very efficient in killing the virus — 99% reduction in virus at 5 microMolar," says Prof. Tomar. The Pep-II molecule showed reduced antiviral activity of only 50% even at a higher concentration of about 200 microMolar.

"When 10 microMolar of Pep-I was used no viable virus could be detected in the culture. The antiviral activity was tested by adding the molecules directly into the virus culture. The two molecules also reduced the viral RNA thus confirming the antiviral activity," says Rajat Mudgal from the Department of Biotechnology at IIT Roorkee and one of the first authors of the paper.

"We found even when the concentration of the two molecules was less than 50 microMolar, they were able to effectively inhibit the protease. Generally, when less than 50 microMolar concentration produces good enzyme inhibition it is considered good in terms of potency and effectiveness," says Harvijay Singh who is the other first author of the paper.

Specific action

The team then tested whether the molecules were specifically inhibiting only the chikungunya virus. They used Sindbis virus, the model virus of the genus alphavirus to which chikungunya belongs, to test the specificity. "These two molecules did not show

antiviral activity against Sindbis virus indicating that they are very specific to chikungunya virus," says Prof. Tomar. The specificity of molecules to inhibit only the chikungunya virus is not surprising as these molecules are structure-based.

"We will try and improve the potency of the inhibitors by making derivatives of the molecules through in silico work," says Prof. Tomar.

Navigating nanomotors within living cells

Nanomotors and their applications in biomedicine have gained huge interest in recent times and now researchers from Indian Institute of Science (IISc), Bengaluru, have successfully shown how to move them around inside living cells.

In a paper published recently in Advanced Materials, the team demonstrated the maneuverability of magnetic-material-coated silica nanomotors inside different cell lines. Less than 3 microns in length, they can be used for targeted drug delivery, nanosensing and in therapeutics.

The group fabricated two helical nanomotors with different dimensions for their experiments. They found that nanomotors could move inside the cells when a rotating magnetic field of less than eighty Gauss (much below the safe level for human beings) is given.

The smaller ones (250 nm thick and 2.4 micron long) could move at a speed of around 500 nanometer per second, throughout the cell much easier than the big ones (400 nm thick and 2.8 microns long) due to the natural porosity of intracellular environment.

Three types of cell lines — human cervical cancer cells, human embryonic kidney and endothelial cells from cattle — were used for the study.

Incubated nanomotors

Around 100,000 cells were spread on a petri dish and a million nanomotors were incubated along with the cells for 24 hours. During incubation, the nanomotors come close to the cells and get internalised by the cell through an engulfing process (phagocytosis).

Using optical microscopy studies, the researchers found that the motors can be manoeuvred with high precision, direction and speed when rotating magnetic field was applied.

"We found that some of the motors were unable to move or moved very slowly inside the cells," says Prof. Ambarish Ghosh at the Centre for Nano

Science and Engineering and corresponding author of the paper. “We ruptured the cells with a solution to find out if the reduced speed was due to loss of magnetic property or some other reason. After the cells were broken, the motors were able to move, showing that they were getting entangled in the components of the cell, just like getting stuck in a traffic jam.”

The group developed a strategy to get the nanomotors out of the jam and move in the desired path. When the nanomotors faced an obstacle, a change in rotation was effected to take it back slightly and change its direction (10-15 degrees) to allow them to move towards its destination.

“The nanomotors can be used as a new imaging tool to study the organelles of the cell up-close. The way the motor moves inside the cell and the hindered motion patterns can help us get a better understanding of the make-up of cells in the body,” explains Malay Pal, PhD student at the Centre and first author of the paper. “Since normal and cancerous cells have variations in the intracellular environment (pH, temperature, energy), we have planned to study the differences in the fluidity of the intracellular matrix using nanomotors.”

Researchers mechanically divide liposomes in the lab

Growth and division are the fundamental characteristics of living cells. Yet the basic components essential for the functioning of these life processes remain shrouded in mystery. To answer this question, Siddharth Deshpande, a postdoctoral researcher at Cees Dekker’s lab at Delft University of Technology in the Netherlands dreams of constructing an autonomous, artificial cell using a bottom–up approach. Dr. Deshpande and team have now achieved a part of their goal by mechanically dividing liposomes, which are compositional equivalents of cell envelopes.

All living cells are enclosed in a lipid envelope. Thus, a liposome, which is a lipid bubble filled with water, is the simplest mimic of a living cell. Generating pure liposomes in a controlled fashion in the lab is not simple. To achieve this goal, Dr. Deshpande designed tiny fluid chambers with dimensions in the order of one-millionth of a metre to form stable liposomes. He reported this bubble-blowing method called octanol-assisted liposome assembly (OLA)

in Nature in 2016 and in Nature Protocols in 2018.

The team's next mission was to split these liposomes into 'daughter' liposomes. In the past, researchers have used different methods to divide liposomes. However, all these methods suffered from leaky daughter liposomes and asymmetric splitting.

Simple approach

In their latest study, published in ACS Nano journal, he kept the approach simple. "I thought why not collide them [liposomes] against a sharp wall inside the chamber to break them in two," he said. He designed a wedge in the microfluidic chamber that physically blocked the newly formed liposomes as they progressed down the channel. By adding a fluorescent dye to the water inside the liposomes, the researchers visualised their fate using a microscope.

Although the technique sounds simple, the journey was not devoid of challenges. Splitting any sphere into multiple stable ones poses an inherent issue: the smaller spheres have a larger surface area to volume ratio than the parent sphere.

This means that either the surface area of the liposomes had to be increased or their volume had to be decreased to compensate for the change in surface area to volume ratio after division. The team overcame this issue by exploiting the fact that the liposome membrane permits passage of water. They flushed in a high-salt solution in the chamber to create an osmotic pressure difference. Consequently, the liposome exuded water with a resultant reduction in its volume.

"Combining growth and division would be truly fantastic," said Deshpande regarding their plans of creating a truly autonomous artificial cell. Achieving the same would be interesting from a synthetic biology perspective and could further the understanding of cellular function.

Gandhinagar team takes initial steps to develop a vaccine for leptospirosis

A key peptide that can be used to develop a new preventive vaccine against leptospirosis has been successfully identified by researchers from the Gujarat Biotechnology Research Centre, Gandhinagar. Leptospirosis is an emerging tropical infectious disease, and currently there is no preventive vaccine for humans that is available in the market. The researchers used computer-

based analysis to study the whole protein set of the bacteria Leptospira interrogans and narrowed the search down to one effective immunogenic protein. This protein was found to be present in almost all the serovars (different types within a species) of the bacteria and can be an effective vaccine candidate against most serovars.

Major killer

According to a paper published in 2015, leptospirosis causes almost 60,000 deaths every year, globally. The bacteria can be transmitted via exposure to contaminated water or soil or direct contact with reservoirs hosts like wild or domestic animals.

The proteome (entire protein set) of a serovar Copenhageni strain was studied using bioinformatics (computational biology analysis) approach. "We looked at all the 3,654 proteins in the bacteria with the help of several advanced computational methods and predicted the antigenicity — ability to bind to the antibody present on B cells for inducing immune response," explains Swapnil Kumar, a Junior Research Fellow at the centre and an author of the paper published recently in Scientific Reports. "Extensive analysis helped us narrow down to 21 proteins which had high antigenicity score."

Membrane proteins

Among these proteins, the researchers further searched to identify the outer membrane proteins as these are known to play important roles in the interaction between the bacteria and their host. Further computational modelling and simulation helped the researchers narrow it to one specific protein. The protein was chosen as the candidate immunogen once the physicochemical and structural studies were carried out.

The researchers then looked for sites on human T cells and B cells where the antigen could bind. Identification of target sites is a key step in vaccine design. "We looked at the surface of the cells, their flexibility, affinity to water and identified regions or peptide sequences that could bind to our peptide vaccine and give a long lasting immune response," explains Dr. Jayashankar Das, the corresponding author of the paper.

"We have to carry out proteomic and genomic study for different strains of the bacteria followed by in vitro validation of the identified key proteins," he adds. The group is also working on high throughput genomic analysis for the development of an on-site diagnostic kit.

IISER Bhopal scientists decode peacock genome

To understand what gives peacock its ornamental plumage, long-train of tail feathers and disease-free long life, researchers from Indian Institute of Science Education and Research (IISER), Bhopal, sequenced the whole genome of the bird. This the first time the complete genome of peacock has been sequenced. They found several adaptive changes in its genes compared with five other related birds which contribute to these traits. A preprint version of the study is now available on bioRxiv.

Studying the complete set of genes gives crucial information regarding the development, physiology and evolut**ion of the species.**

To carry out the sequencing, blood sample was drawn from a peacock from Van Vihar National park in Bhopal. The whole genome sequencing yielded 153.7 Gb (Gigabit) of sequence data and contains about 15,970 genes with a data size of 1.1 GB (Gigabyte). As a handy reference the size of human genome is 3.2 GB, and contains more than 20,000 genes.

After sequencing, the researchers compared peacock genes with those of five other related birds — chicken, turkey, duck, flycatcher and zebra finch. Evolutionary analysis showed that peacock was a close relative of chicken. It also revealed that the bird had suffered two bottlenecks (sudden decline in population) around 4,000 million and 450,000 years ago.

They also found a total of 99 genes that showed beneficial changes in peacock in comparison to other five birds.

Functional analysis revealed that genes that played important roles in early development, cell proliferation and differentiation showed changes in their sequences. “This kind of adaptive evolution suggest that perhaps during the time of environmental changes, it was able to adapt its genes in order to evolve and survive,” explains Prof. Vineet Sharma from the Department of Biological Sciences, IISER Bhopal, and corresponding author of the paper.

“The changes in the genes of the immune system explain the possible way the bird has become resistant to many diseases compared with other birds. Peacock is resistant to many pathogens

including some viruses. Its relative, the chicken, lives only for seven–eight years, while the peacock can live for 10-25 years," explains Shubham K. Jaiswal, Ph.D scholar at the institute and one of the first authors of the paper.

Several genes that were involved in early development pathways that regulate the feather, bone and muscle development also showed adaptive changes. This adaptive evolution may have helped the bird diverge from the other birds and favour its survival.

"We have further planned to analyse the sequence to understand in detail about the specific genes that give the unique traits to the bird. It will also help in devising better strategies for the conservation of the species. We also wish to create a database for all India specific indigenous species," says Ankit Gupta, Ph.D scholar at the institute and one of the first authors of the paper.

"Recently, genome sequencing has been used for the possible revival of New Zealand's indigenous Moa bird. Similarly, the genomic data of peacock generated in this study will also help save our species in case it declines," says Jaiswal. The genomic understanding of peacock will also help to develop better breeding and conservation programmes and may help tackle any pathogen attacks.

Gene variations can influence risk of obesity

A team of researchers from New Delhi have found an explanation for why one sibling may develop obesity faster than the other though brought up under similar home environment with almost similar diet and habits.

The team analysed the genetic variations in genes of over 3,500 urban school going children (11-17 years) and found certain alterations in two genes — ARID1A and KAT2B — that can delay or hasten the process of obesity development with respect to the daily habits.

"We analysed the variations in 35 chromatin modifier genes. This is one of the groups of genes that signals the healthy and unhealthy habits to the body. In response to your habits (overeating, sedentary lifestyle, exercise) these genes modify the architecture of DNA and its associated protein-complex called chromatin leading to change in expression of several biomolecules responsible for obesity development," explains Anil K Giri, first

author of a paper published in Scientific Reports, from Institute of Genomics and Integrative Biology. These two genes need to be further analysed to fully understand the mechanism of obesity development in adolescents.

The study was carried out in two stages. In the first stage, 1,283 adolescent boys and girls divided into two groups based on their BMI — normal weight and obese/overweight were studied.

Blood sample was collected and DNA was isolated. Using bioinformatics tools, the team studied the genes and looked for any variations. A total of 179 variations in the 35 chromatin modifier genes were tested for their role in obesity. Twenty-eight variations in 13 genes were found to confer risk with overweight. To further validate the findings additional 2,247 adolescents were studied in the second phase.

Finally, a comparative analysis showed significant associations of two variants in the ARID1A gene and one variation in the KAT2B gene. The ARID1A gene regulates transcription of many genes that influence metabolism while the latter has been reported to code for a protein that controls bodyweight & hyperglycemia in mice.

"The variation in the gene increases the obesity risk by enhancing the effect of environmental factors. Several environmental factors like sedentary lifestyle, junk food can further increase the risk independently. We have found just few gene variations. Many more to be explored," says Anil

"The study was primarily carried out on Indian adolescents of Indo-European origin. Diet of the western population is different from ours and we are predominantly starch eating people. Diet has been known to play a direct role in influencing genes related to obesity" explains Prof. Dwaipayan Bharadwaj from CSIR-IGIB and corresponding author of the paper who is currently working at JNU. "Most of the obesity measures in our study were significantly associated with these three variants. Every human behaviour is dependent on the gene-environment interaction in some form or other. We are now working on understanding the various facets of the environment."

IIT Guwahati: Disposable biosensor selectively detects alcohol

There is a lot of interest now in developing biosensors that have short response time, selectivity and

sensitivity. Researchers from IIT Guwahati have developed a paper-based biosensor that can detect ethanol. The short response time of about 10 seconds to detect ethanol and the range of concentrations to which the response was proportional make the biosensor particularly attractive.

With available hand-held devices such as breath analysers being non-specific, non-selective, requiring extra power sources, being expensive to fabricate and so on, cheap and effective biosensors become necessary. The research has been published in the journal ACS Applied Materials & Interfaces.

The team fabricated the device using chromatography paper and patterned anodic and cathodic zones on it. A silk-based nano-biocomposite layer was fixed in the anodic zone, and when it was half-dry, the team coated it with cyanobacteria — a group of photosynthetic bacteria. The bacteria could stay alive and conduct their metabolic activities because of the silk-based composite. "The miniaturised device allowed a decrease in response time to about 10 seconds," says Dr Pranab Goswami of the Department of Biosciences and Bioengineering, IIT Guwahati, who led the study.

The cell membrane of cyanobacteria contains electron transfer proteins that can capture electrons from donors and transfer them to electron acceptors. When sprayed on the cyanobacterial layer, ethanol interacts with the cell membrane causing it to degrade and release the electron transfer proteins, which come in contact with the anode. They transfer electrons to the anode, causing a potential difference between the anode and the cathode. The researchers confirm that this potential surge increases with increase in the concentration of ethanol. Further, the response of the device to ethanol and methanol was markedly different. This selectivity was also established by the group.

The magnitude of the surge in potential when the device is sprayed with ethanol could be correlated with ethanol concentrations (0.001 to 20%). The device has a detection limit of 0.13%.

"The paper-based device is prepared in a disposable format and can be used only once," says Sharbani Kaushik, who is at the Centre for Energy, IIT Guwahati and is the first author of the paper. The team plans to make the biosensor commercially available.

IISc team synthesises artificial enzyme

Nanomaterials that can behave like human enzymes have now been successfully synthesized by a team of researchers from Indian Institute of Science (IISc), Bengaluru. They produced the new nanozyme — nanomaterial with enzyme-like activity — by using vanadium pentoxide nanocrystals of just 150-200 nm size.

The nanozyme was able to act like the natural antioxidant enzyme glutathione peroxidase in our body and help maintain the hydrogen peroxide levels within the threshold. They synthesised the nanozyme with four different morphologies — nanowires, nanosheets, nanoflowers and nanospheres.

"All four morphologies are basically made of the vanadium and oxygen in the same ratio. The methods of production is slightly different giving each type a different shape, size and crystal facet or plane," explains Sourav Ghosh, Ph.D. student at the institute and first author of the paper published in Angewandte Chemie.

The team then studied the ability of the nanozyme to catalytically reduce hydrogen peroxide, as high levels have been reported to generate reactive oxygen species and subsequently induce oxidative stress, which can damage the DNA, proteins and lipids.

The enzyme glutathione peroxidase maintains the levels of hydrogen peroxide in our body and prevents cell damage. But under oxidative stress condition, the amount of enzyme is not sufficient to maintain the hydrogen peroxide level. "Under these circumstances, the nanozyme that precisely functions as the natural enzyme can be used," explains Prof. G. Mugesh from the Department of Inorganic and Physical Chemistry at the institute and corresponding author of the paper.

Kinetics and spectroscopy studies showed that the nanozyme was able to bring down the level of hydrogen peroxide. The nanozyme uses the same pathway as the natural enzyme but without generating any free radicals.

The team then studied if the change in morphology affected the catalytic ability and found that the nanospheres showed the highest activity among the four types, indicating that the surface-exposed crystal facets play crucial roles in the catalysis.

The study was primarily aimed at understanding the effect of different crystal facets of nanozymes

on their enzyme mimetic activity. The team plans to carry out studies on mice models to understand more about the four nanozyme forms and their potential as therapeutic agents.

Nanozymes with tunable catalytic properties are emerging as the next generation of artificial enzymes that find applications in neuroprotection, cardioprotection and cancer therapy.

French team tests virtual reality path to pain relief

The very thought of visiting a hospital emergency department is stressful enough for many people, even without the discomfort or pain of an examination or treatment.

Enter an immersive virtual-reality programme created by three graduates being used in France to relax patients and even increase their tolerance of pain — without resorting to drugs.

"What we offer is a contemplative world where the patient goes on a guided tour, in interactive mode, to play music, do a bit of painting or work out a riddle," said Reda Khouadra, one of the 24-year-olds behind the project.

As patients are transported by chunky VR goggles into a three-dimensional world of Japanese zen gardens or snowy hillsides, they become more tolerant of minor but painful procedures such as having a cut stitched, a burn treated, a urinary catheter inserted or a dislocated shoulder pushed back into place.

Curbing anxiety

"The virtual reality project ... enables us to offer patients a technique to distract their attention and curb their pain and anxiety when being treated in the emergency room," said Olivier Ganansia, head of the emergency department at the Saint-Joseph Hospital in Paris. "I think in 10 years, virtual reality won't even be a question any more, and will be used in hospitals routinely."

The Healthy Mind startup is not a world first but has landed a $20,000 prize from a university in Adelaide, Australia, which will now pay for the three founders to present their project at Microsoft's headquarters in the U.S. city of Seattle.

Novel gold nanocomplex for cancer drug delivery

Using gold nanoparticles coated with a simple organic molecule (porphyrin), researchers from

CSIR-Indian Institute of Chemical Biology, Kolkata, have designed an efficient drug nanocarrier. The nanocarrier was found to effectively deliver doxorubicin (anti-tumour drug) to the nucleus of the diseased cell and bring about programmed cell death.

Porphyrin was armoured on the gold nanosurface via continuous stirring method. "Porphyrin is a simple organic compound and it gives the necessary protection and stability to the nanosurface. Porphyrins are essential co-factors in many human proteins such as hemoglobin and so it can escape from the macrophages in our body," explains Dr. Nakul C. Maiti, Senior Scientist at the Structural Biology and Bioinformatics Division of CSIR-IICB and one of the corresponding authors of the paper published in ACS Omega.

The porphyrin molecule was found to be uniformly distributed on gold nanoparticles and the porphyrin–gold complex was stable.

The anti-tumour drug doxorubicin was then successfully loaded on the porphyrin–gold nanosurface. "Doxorubicin is selectively released when it reaches the low-pH environment seen in cancerous cells," explains Kaushik Bera, research scholar at the institute and one of the first authors of the paper.

Activity of the complex

Its activity was then tested on brain and lung cancer cells and normal healthy cells. The porphyrin–gold complex without the drug showed no toxicity to healthy and cancerous cells. The nanoparticles coated with the drug showed very low toxicity to normal cells and caused programmed cell death both in brain and lung cancer cells.

Multidrug resistance is one of the major barriers in cancer cells, where the drug is quickly ejected out, reducing the effective drug concentrations within the cells and thus decreases its sensitivity.

"We found that the drug-coated nanoparticles were retained well inside the cells thus showing higher activity," says Samarpan Maiti, another research scholar at the institute and one of the first authors of this paper in an email toThe Hindu.

"There are several pathways by which the drug can damage the DNA. Currently we are studying the pathways, and trying to design a system that can release the drug more efficiently. We are also studying how the system works in real scenario of tumour model," says Prof. Chitra Mandal from the

Cancer Biology & Inflammatory Disorder division of this institute and one of the corresponding authors of the paper.

Treating latent TB of the uterus improves pregnancy outcomes in infertile women

For the first time, researchers have been able to find a direct association between latent TB of the endometrium (inner lining of the uterus) and fewer eggs in the ovary, technically called low ovarian reserve, in infertile women.

Compared with infertile women who did not have latent TB, there was significant improvement in pregnancy outcome in women with latent TB who had successfully completed the standard TB therapy lasting six months. Results of the study were published in the journal Human Reproduction.

Low ovarian reserve

"We came across infertile women with low ovarian reserve having latent TB. So we wanted to find out if there was indeed any association between latent TB and low ovarian reserve in these women. Loss of fertility due to latent TB has not been studied before," says Dr. Padma Rekha Jirge.

Dr. Jirge is a gynaecologist at the Department of Reproductive Medicine, Shreyas Hospital in Kolhapur and corresponding author of the paper.

The team led by her undertook an observational study involving 431 infertile women with latent TB and 453 infertile women without latent TB. The women included in the study were in the 21–38 years age group and had infertility for more than two years and had received at least six cycles of ovulation induction with or without undergoing intrauterine insemination or IVF.

Though latent TB is generally believed not to have any clinical significance, earlier studies have shown that latent TB does cause silent inflammation. The present study did not look at whether latent TB was causing inflammation leading to loss of eggs. "The objective of the present study was not to find out how latent TB caused a reduction in ovarian reserve," Dr. Jirge says.

Other causes

"Inflammation of the endometrium could affect the ovaries too or the TB bacteria could be present in the ovaries as well," says Dr. Deepak Modi from the National Institute for Research in Reproductive Health, Mumbai and one of the authors of the paper.

After completion of treatment for latent TB, infertile women had nearly 52% successful pregnancy

compared with 40.5% in the case of infertile women who did not have latent TB.

Latent TB treatment did improve the chances of pregnancy. But the study did not look at whether the treatment halts the decline in eggs. “The women must be followed up for one year and the hormone that serves as a marker for ovarian reserve has to be tested to know if treatment halts ovarian decline,” says Dr. Modi.

“We know when the ovarian environment is affected the quality of eggs also gets affected. So what we saw was after the treatment, women had better quality eggs and the implantation rate was also proportionately higher when IVF was done,” says Dr. Jirge.

“If doctors come across infertile women with lower than normal anti-Mullerian hormone (AMH) [which serves as a marker for ovarian reserve] then they may test for latent TB of the endometrium and start treatment to improve the pregnancy outcome,” says Dr. Modi. Dr. Jirge next wants to study inflammation markers to find out if TB is affecting the ovarian environment.

IISc researchers find asthma drug effective in treating TB

A drug (Pranlukast) currently used for treating asthma has been found to be effective against tuberculosis, researchers from the Indian Institute of Science (IISc), Bengaluru, have found. Studies carried out in mice models found the drug to be effective in treating TB both when used alone and in combination with an anti-TB drug rifampicin. The results of the study have been published in EMBO Molecular Medicine.

Besides speeding up the process of drug discovery by repurposing an existing drug, the highlight of the study is the new approach adopted by researchers led by Prof. Avadhesha Surolia from the Molecular Biophysics Unit at IISc to zero in on the asthma drug. The drug uses a unique strategy to target the TB bacteria and is therefore quite unlikely to cause any adverse side-effects either to the human cells or the beneficial bacteria found in humans.

Most of the current anti-TB drugs target either the RNA synthesis (transcription) or cell-wall synthesis of the bacteria. “But we decided to look for drugs that target the arginine (an amino acid) biosynthesis pathway that is essential for the survival of the TB

bacteria as well the pathogenesis [process by which the bacteria cause the disease]," says Prof. Surolia. Many steps make up the arginine biosynthesis pathway and one of them involves an enzyme ArgJ (Ornithine acetyltransferase) which is essential for the survival and virulence of TB bacteria. The ArgJ enzyme is unique to TB bacteria and its counterpart neither exists in humans nor in the beneficial bacteria of human microbiome. This makes the ArgJ an exciting target for drug development and is very unlikely to cause any harmful side-effects in the human host.

To further reduce the chances of the chosen drug causing any side-effects, the researchers decided to target a unique site on the ArgJ enzyme that is not found in other proteins described so far. "If you target the active site in the enzyme, there is a possibility that the drug will target the same site in other biochemical reactions in the body," explains Prof. Surolia.

Based on these conditions, the researchers carried out in silico computational modelling of all FDA-approved drugs that bind to the site. After screening 1,400 drugs, 34 were found to be binding to the site. "Of the 34, we tested 15 drugs for their ability to bind to the enzyme site, and two drugs — Pranlukast (anti-asthma drug) and Sorafenib (anti-cancer drug) — were found to have inhibitory action," he says.

Effective drug

Both these drugs were tested in vitro and were found to be effective in curtailing the growth of TB bacteria. "The asthma drug was found to be more effective in curtailing the growth when used alone and in combination with other anti-TB drugs — rifampicin and isoniazid," says Archita Mishra from IISc and first author of the paper. "The combination of asthma drug and the two anti-TB drugs was significantly better in killing the bacteria than the currently used first-line combination drugs — rifampicin, isoniazid and ethambutol."

"Like the asthma drug, ethambutol is also a metabolic inhibitor. So replacing ethambutol with the asthma drug for the combination therapy would be a viable strategy," Mishra adds.

Both the drugs were also able to kill the bacteria found inside the macrophages (white blood cells) without causing any harmful side-effects to the macrophages.

The potency of the asthma drug was much higher than expected. This would mean that lesser amount of the drug will be sufficient to kill the bacteria within the macrophages. The higher potency comes from the drug's ability to counter the survival strategy of the TB bacteria. When bacteria infect the macrophages, they usually cause inflammation within the cells, which helps the bacteria multiply. The asthma drug was able to prevent the bacteria from causing inflammation thereby proving to be more potent in killing them.

"Since the drug targets the pathogen as well as the host pathway, it could potentially help in treating multidrug-resistant TB bacteria," says Mishra. The researchers are already working in that direction.

Animal trials

Even in mice models, the drug was more effective in killing the TB bacteria both when used alone and in combination with rifampicin. There were fewer granulomas in the drug-treated mice. "Our studies show that ethambutol can be replaced with the asthma drug," he says.

The researchers plan to test the drug on guinea pigs in a few months' time. The efficacy will be tested by using it alone and in combination with rifampicin. "If we get encouraging results from guinea pig studies, we can straight away conduct Phase II trials in humans, as the safety of the drug is already proven," says Prof. Surolia.

Lupin launches oral antibiotic Solosec in US

Lupin unveils oral antibiotic Solosec in U.S.

Drug major Lupin said it had unveiled Solosec, an oral antibiotic used in treating bacterial vaginosis (BV) in women, in the U.S. market, after receiving approval from the USFDA earlier.

With more than four million women treated for BV in the U.S. annually, and only 50% completing 5 to 7 day treatments, there is a clear need for an effective, single-dose oral treatment, Lupin CEO Vinita Gupta said in a statement.

Palm leaf manuscripts at ORI set to be digitised

The project is expected to cost the institute around Rs. 20 lakh

The Oriental Research Institute (ORI) in the city, which is a treasure trove of ancient palm leaf and paper manuscripts, is set to digitise its collection and preserve them for posterity.

To be taken up in a phase-wise manner, the digitization entails scanning and copying some of the oldest extant texts in Sanskrit, including Kautilya's 'Arthashastra' which was discovered in the ORI collection in 1905 by R. Shamashastry and first published in 1909.

There are about 30,000 palm leaf and paper manuscripts in the ORI collection apart from about 40,000 rare books of which 215 seminal works have been published so far to throw light on various facets of Indian history, literature and culture.

Director of ORI S. Shivarajappa told The Hindu that the project is expected to cost around Rs. 20 lakh and it may take up to two years for the digitisation work to be completed from the date of commencement. He said the institute was in the process of appointing additional staff for the purpose and shoring up the infrastructure for the purpose.

"Our objective is to not only ensure that the rare manuscripts in our collection are preserved for posterity but are easily made available to scholars across the world through download for a fee," he added.

"Scholars and indologists working on different facets of Indian history and culture may not have access to certain works that may be with us. At present the only way to access them is through a personal visit which is time consuming," said Prof.Shivarajappa.

But once the manuscripts are digitised, it would be easier for scholars to access the classical texts.

This would also help in dissemination of valuable

information and bringing it to public domain, he added.

ORI was established during the reign of the then Maharaja Chamaraja Wadiyar in 1891 and was housed in the present building which was constructed in 1897 to mark the golden jubilee of Queen Victoria's ascension to the British throne.

In addition to digitisation, the ORI has embarked upon publication of very rare works through private funding. It has identified nearly 20 classic works originally published by it and is in the process of printing about 500 copies of each work for the benefit of public.

Of the nearly 70,000 works in Sanskrit there are repetitions or multiple copies of the same work and hence the ORI is taking up works of scholastic importance which have not been published anywhere else earlier or not currently available, said T.V. Satyanarayana and K.V. Ramapriya, scholars working on the project.

The edifice housing the ORI was restored with funding by the US Consulate, Chennai, a few years ago.

The authorities are seeking additional funds for its digitisation and publication projects and plan to approach National Mission for Manuscripts, University Grants Commission, Infosys, TTD Board, Tirupati, Dharmasthala Manjunatheshwara Trust among others for the purpose.

Conquering the emperor of maladies

Cancer occurs when an otherwise healthy cell is damaged, leading to uncontrolled growth, affecting health

The title that the cancer specialist, Dr Siddhartha Mukherjee chose for his Pulitzer-prize winner book on cancer was "The Emperor of All Maladies." It signifies both the awe and a sportsman-like admiration of the challenge posed by the opponent, cancer. Earlier in 1971, President Richard Nixon of the US, on a similar vein, declared a "war on cancer," with a federal funding of $1.4 billion. And over these 47 years, the US National Cancer Institute alone has spent $90 billion on the war on cancer. We are yet to win.

Each year, 1.73 million new cancer cases are reported in the US, with apparently one cancer

death every 20 minutes. In India, it is 2.5 million people, with one death every 8 minutes. It is thus urgent and vital that solutions be found for this deadly disease, which has been with us since the dawn of civilisation.

Cancer occurs when an otherwise healthy cell is damaged, leading to uncontrolled growth, affecting the health of the body. Damage can occur either because of inborn or inherited errors in one or more genes affecting the cell, or due to lifestyle and environmental factors. While normal cells are programmed to multiply and grow to a certain size and stay so, cancer cells, whose DNA is mutated by such damage, go on rampant growth leading to tumours. The cancer specialist removes these errant cancer cells and tumour by medication or surgery. But the big challenge is not the first treatment alone, but that it should not recur and/or metastasise (move to and affect other parts of the body). The fight against cancer is thus to uproot the cause of the damage once and for all.

Immunity

It is here that we turn to the in-built defense mechanisms in the body. These are through the immune system, which is a complex network of cells, tissues and the molecules they make to help in fighting infections and other diseases, including cancer. White blood cells play the main role here. In particular, there is the group of cells called B-lymphocytes which recognise the shape of the molecules in the invader, and make proteins called antibodies which lock on to the invader and removes it. (Importantly, this shape is 'remembered' so that when a fresh attack by this same invader occurs, B cells are prepared!) Another set called T cells release chemicals that push the invading cells to commit suicide. In this process, these T-killer cells are aided by a group called T-helper cells. In addition, there is another group called dendritic cells which help activate both the B- cells and T-killer cells, enabling them to respond to specific threats.

Each cell has on its surface a little marker, a small molecular ID- card or a biometric, called an antigen. These are small molecular fragments found on the cell surface. Antigens in the normal cells of the body are recognized as "self" by the immune system of the body and left alone. But when "foreign" cells such as

those of an invading microbe or virus enter the system, their 'non-self' antigens are detected, attacked and thrown out of the body by the B and T lymphocytes.

This is also the basis of vaccines. In a vaccine, we introduce the disease- causing germs (either in the dead from or highly- disabled "live" form) into the body. This causes the immune system to recognise the "non-self" foreign antigen, grab it (using the antibody proteins) and throw it out of the body. Plus, the immune system 'remembers' this non-self-antigen and when the invader comes again, has the B cells make antibodies against it and remove it from the system, thus offering protection for a long time. This is the basis behind vaccination against many diseases, including cancer-causing viruses such as human papilloma virus (HPV) and the hepatitis B and C viruses.

Once bitten, twice prepared

How is this relevant to other forms of cancer? Cancer cells too have antigens on their surface. These form the cancer-associated antigens, including some that have not been seen previously by the body's immune system. These are called neo-antigens. They are foreign to the body, and come from the invader.

In the current excitement on the cure of the cancer, this idea of using our immune system and make an anti-cancer vaccine is on the high table. This is not a preventive vaccine (as the HPV or hepatitis vaccines are) but a therapeutic (or treatment) vaccine. Here, the doctor first treats the cancer by existing methods. In order that it does not recur, nor metastasise, he/she then takes a piece of the cancer tissue from the patient, and has the neo-antigens identified. Next, he/she works with a group of scientists who use computer methods to check which fragment will trigger the patient's immune system best to fight the cancer cells. The so-chosen neo-antigen is used to make the vaccine, and once the vaccine is made, use it on the patients to protect them from further recurrence of the illness and thus get rid of the cancer, hopefully forever.

Some cancer vaccines are already in the market; for example, HER2 against breast cancer, Provenge against prostate cancer, and T-VEC against melanoma. Increasingly though,

some researchers want to read the patient's genome, sequence the DNA or RNA of the tumor there, identify the mutations therein and make a specially constructed 'personalised' vaccine for the individual. The emperor may hit and maul. But now that we are adopting the Boys Scouts slogan, "Be Prepared", will his days be numbered?

New brain cells in the old? Study stokes debate

People as old as 79 may still generate new brain cells, US researchers said Thursday, stoking fresh debate among scientists over whether or when our mental capacity ever stops growing.

The report by scientists at Columbia University in New York, published in the journal Cell Stem Cell, runs directly counter to a different study published in Nature last month which found no evidence of new neurons are being created past the age of 13.

While neither study is seen as providing the definitive last word, the research is being closely watched as the world's population ages and scientists seek to better understand how the brain ages for clues to ward off dementia.

The focal point of the research is the hippocampus, the brain's center for learning and memory.

Specifically, researchers are looking for the foundations of new brain cells, including progenitor cells, or stem cells that would eventually become neurons.

Using autopsied brain samples from 28 people who died suddenly between the ages of 14-79, researchers looked at "newly formed neurons and the state of blood vessels within the entire human hippocampus soon after death," said the Cell Stem Cell study.

"We found that older people have similar ability to make thousands of hippocampal new neurons from progenitor cells as younger people do," said lead author Maura Boldrini, associate professor of neurobiology at Columbia University.

"We also found equivalent volumes of the hippocampus across ages."

The findings suggest that many seniors may retain more of their cognitive and emotional abilities longer than previously believed.

However, Boldrini cautioned that these new neurons might be less adept at making new connections in older people, due to aging blood vessels.

Animals like mice and monkeys tend to lose the ability to generate new brain cells in the hippocampus with age.

Just how the human brain reacts to aging has been controversial, though the widely held view is that the human brain does indeed continue to generate neurons into adulthood, and that this "neurogenesis" could one day help scientists tackle age-related brain degeneration.

A study last month led by Arturo Alvarez-Buylla of the University of California in San Francisco found the opposite, however.

Looking at brain samples from 59 adults and children, "we found no evidence of young neurons or the dividing progenitors of new neurons" in the hippocampi of people older than 18, he told AFP when the study was published.

They did find some in children between birth and one year, "and a few at seven and 13 years of age," he said.

That study was described by experts as "sobering," because it indicated the human hippocampus is largely generated during fetal brain development.

Alvarez-Buylla's lab responded to the latest research in a statement, saying that they were unconvinced Columbia University had found conclusive evidence of adult neurogenesis.

"Based on the representative images they present, the cells they call new neurons in the adult hippocampus are very different in shape and appearance from what would be considered a young neuron in other species," their response, published by the Los Angeles Times, said.

Boldrini, for her part, said her team used flash-frozen brain samples, while the California researchers used samples that were chemically preserved in a process that may have obscured the detection of new neurons.

COMPUTER & IT

Questionable studies on adverse effects of mobile phone radiation

At the end of August 2017, there were over 1,186 million wireless telephone subscriptions in India. Alongside growth, public concern on potential adverse health effects of cell phone radiation also grew. Government of India and its agencies such as the Indian Council of Medical Research (ICMR) started addressing these issues more seriously; ICMR extended modest funding to a few institutions to carry out projects on the adverse effects. These studies indicated some adverse effects. Regrettably, there was no critical appraisal of these questionable studies, though ICMR repeatedly asserted that there is no conclusive evidence for any harm.

As studies often appeared in obscure/predatory journals, expert bodies such as International Agency for Research on Cancer (IARC) mostly ignored them.

A paper in Current Science (December 27, 2017) claimed that mobile phone radiation induced sedation in cockroaches and caused changes in enzyme systems, protein content, total free amino acids.

The researchers used two separate plastic containers of equal size and put 15 healthy male cockroaches in each box. They exposed the test box containing cockroaches to radiation from a mobile phone for 1, 3 and 6 h by a full call (nearly 1 minute) every 5 minutes to the mobile phone that was kept inside the box.

In the April 10, 2018 issue of Current Science, Dr Vijayalaxmi, University of Texas Health Science Center, U.S. listed seven basic weaknesses of the study, which included poor design, lack of positive controls, failure to correlate the changes observed in several tests to their significance in human health and far-fetched exaggeration of observations to warn humans.

She served the working group of the International Agency for Research on Cancer (IARC), which classified radiofrequency electromagnetic fields as “possibly carcinogenic” (Group 2 B) as an expert.

She pointed out that in the cockroach-study “there was absolutely no dosimetry giving the actual exposure to electromagnetic radiation in the

cockroaches. It is impossible to replicate/confirm these observations by independent researchers using the information presented in the article."

"Overall, the study on cockroaches provides no useful information for the safety evaluation of EMR exposure because of the several weaknesses mentioned above. It is not possible to draw any meaningful conclusions related to human health and cell phone use to justify the warning," she added.

Other studies

On March 2, 2015, in response to questions in the Rajya Sabha, ICMR gave a list of 15 papers from ICMR-funded projects. These projects claimed that they found evidence for adverse biological effects.

Apparently, the ICMR ignored IARC's criticism of some of these papers. For instance, the two papers by Gandhi and Singh (2005), Gandhi, and Anita (2005) claimed that they found cytogenetic and genetic damage respectively in mobile phone users. The IARC monograph 102, an authentic review on the subject, had pointed out "several inconsistencies and weaknesses in laboratory methods, data collection, exposure assessment, etc. in both publications".

Another ICMR-funded project reported headache, dizziness, numbness in the thigh, and heaviness in the chest among mobile phone users. These are very unusual results! Specialists must examine whether the investigations satisfy the criteria recommended for research studies by the WHO framework for developing health-based EMF standards (2006).

Since a few countries chose guidelines stricter than those recommended by the International Commission for Non-Ionizing Radiation Protection (ICNIRP), a few groups in India demanded country-specific safety guidelines. On 12 February 2014, the 53rd report of the Standing Committee on Information Technology recommended that Government should entrust the scientific study on impact of telecom towers and handsets on humans to a reputed Government organization in a time-bound programme.

An ICMR-led, All India Institute of Medical Sciences-partnered multidisciplinary project is poised "to study the effect of RFR emitted from cell phone on cancer, heart, reproductive organs, ear and brain related problems, if any". It must be borne in mind that the $25 million, US National Toxicology Project which carried out studies of cell phone radiation on rats and mouse, with precise control over all variables,

is yet to produce a conclusive report.

The infinitely complicated, ICMR study is unlikely to offer any actionable inputs to arrive at India-centric guidelines. Since the present guidelines have a safety factor of 500, we need not lose sleep over the potential adverse effects of cell tower/phone radiation.

IIT Hyderabad: Dataset to understand online user-engagement

Understanding user engagement in online interactions is important in many contexts, with online shopping, advertising, e-learning and healthcare being just a few sectors. Now, IIT Hyderabad has built DAiSEE (Dataset for Affective States in E-Environments), the first multilabel video-classification dataset for recognising boredom, confusion, frustration and engagement. The dataset comprises 9,068 video snippets captured from 112 individuals. For each of these affective states, there are further four levels of labels – very low, low, high and very high. These labels are provided by observing the viewer's reactions.

Multiple labels

There can be multiple labels assigned to a snippet: "For example, when understanding some complex terminology from videos, a person could display high engagement and still be confused or frustrated at the same time," explains Vineeth N. Balasubramanian of Department of Computer Science and Engineering at IIT Hyderabad who has led the research. "The combination of data and annotations related to user engagement sets the platform for DAiSEE as a specialized dataset," he adds in an email to The Hindu. The dataset is available to the public at the website http://www.iith.ac.in/~daisee-dataset/ Recognising, interpreting, processing and simulating human affective states, or emotions, is an important area of research known as affective computing.

The usual emotions studied include anger, disgust, fear etc. "For a large part, researchers have focused on these basic expressions, we chose to go beyond," says Dr Balasubramanian.

For instance, in a classroom, the student could be engaged with the lesson, or bored, frustrated or even confused. "Subsequent affective states can be viewed as a result of these four," says Dr Balasubramanian. For instance, if a person is bored or confused, they could be distracted easily. "The

affective states we have considered in DAiSEE are a bit more subtle than the six basic expressions," he adds.

In the study, people were invited to voluntarily participate in an experiment whether they would watch certain videos and then respond to a questionnaire. The consent of the participants to share the videos was taken. They were shown one educational video and one recreational, so that both focused and relaxed settings may be captured. This gave the researchers 9,068 videos of 10-second length, from which they extracted 27,000,000 images/video frames. "This is larger than most contemporary video datasets," says Dr Balasubramanian.

Crowd voting

The researchers used a crowd-voting method to annotate the dataset, and the best possible answers were picked using a statistical aggregation method (the Dawid-Skene aggregation). This uses an algorithm to consider the quality of the responses, which are then weighted accordingly to compute the resultant response.

The annotated data can be used by deep-learning frameworks employed in AI to learn the model accurately. In many applications, it is important to learn user engagement so that the algorithm can respond and interact with the user. "We hope for DAiSEE to be a large stride in the direction of promoting a health and improved experience of personalized interaction with such digital systems," he says.

What the well-gadgeted man is wearing

Fans of P. G. Wodehouse will remember how the hero Bertie Wooster was persuaded by his aunt Dahlia to write a piece on 'what the well-dressed man is wearing' for her weekly magazine "Milady's Boudoir". That was in the 1920s and the days of gentlemen of leisure. A century later, these are the days of gentlemen (and ladies) on the go. And the biweekly magazine "Science News" has published an article called: "Fashion forward: Advanced textiles may add serious gadgetry to clothes", authored by Maria Temming and Mariah Quantanilla, in its May 25, 2018 issue.

The two authors, Maria and Mariah, write about how future 'smart' clothes could pack 'serious' gadgetry, and give a few examples presented by

several developers and innovators at some recent technological meetings in the US. Here are some excerpts from this article.

Clothes that change colour

About sixty or seventy years ago, one could buy a shirt made of a cloth teasingly called 'Bleeding Madras'. It would change colour upon each wash (and fade!). The one discussed here changes colour not upon washing, but reversibly upon exposure to light (such as sunlight or on stage), when the wearer taps his/her smartphone screen. How does this happen? The fabric is made of thin yarn containing some thinner strands of copper wire sheathed in polyester (or nylon). This polyester fibre is coated with pigments just as normal clothes are. A garment is made of this pigmented cloth, and the garment also carries a tiny battery. The wearer sends a wi-fi signal from his/her smartphone, which activates the battery to heat the copper wire in the yarn. With that signal, the colour changes and the wearer now shows off the new colour (or stripe or pattern – whatever has been built in) on his/her garment! Developed by Dr. Joshua Kaufman and Dr. Ayman Abouraddy of the University of Central Florida at Orlando, FL, USA, this fabric and the clothes, bags or upholstery will hit the market soon.

Traditional women in Gujarat and Rajasthan wear long skirts called lehangas or ghararas using fabrics which are studded with small discs made of glass mirror pieces. They shine when light falls on them. Well, now we have hi-tech versions that will be available soon; except, they will not have the traditional 'inorganic' mirror pieces but light emitting diodes or LEDs. And these LEDs too will be 'organic' in nature, or what the authors have called as OLEDs. These OLEDs are created on cloth- polyester- and are thus far more flexible than the conventional 'inorganic' LEDs. Developed by Dr. S. Kwon and associates at the Korea Advanced Institute of Science and Technology in Daejon, South Korea, these OLEDs, when activated using electric signals generated using smartphone signals, can light up the fabric. They can thus be organised in the fabric to display patterns and messages, or just light up the street to help pedestrians at night.

After a brisk run, you feel hot — the active motion generating thermal energy. Likewise, as you stand for a while in bright sunlight, you feel warm. Rather

than lose energy through heat this way, can we convert heat or body motion into electricity? This was the question that Dr. Jun Chen and Dr. Zhong Lin Wang of Stanford and Georgia Tech Universities attempted to work on. To this end, they threaded a fabric with photovoltaic wires which, when sunlight falls on them, generate tiny amounts of electricity just the way traditional solar cells do. And this energy can be stored safely in a small battery attached to the garment. Dr. Chen is reported to have said that a 4 cm x 5 cm piece of such a solar cell fabric stitched on to your T-shirt as you run in the sun can charge up your cellphone. Imagine wearing a whole shirt or a jacket made of such a fabric.

Dr. Chen has also devised a fabric made of a special type of polymer (called PTFE) which captures energy coming out of motion (movement of the body) and converts it into electrical energy. Maria and Mariah write: "this energy-harvesting material could also be built into tents that, when bathed in sun or rustled by wind, could charge campers' devices". The article by these two ladies, titled: "Future smart clothes could pack serious gadgetry", is available free on the net, and is recommended. It covers a few more such studies which focus on capturing energy from the environment through the use of devices of this kind, and converting it into storable and usable electric energy.

Light cell phone

Some people have done away with carrying bulky cell phones; instead, they go for wrist-wearable ones and earplugs. Many others no longer carry a laptop; smart phones do the job for them. (The Nobelist Prof. Martin Chalfie gave three different lectures recently in Hyderabad, with all lecture materials- slides and movies- saved in his smartphone, no laptop). Wearing gadgets (even computers) will become increasingly popular and convenient. Since these can now be charged using stuff in your clothes, look out for what Generation Z is wearing next year.

Artificial Intelligence system may help diagnose Zika

A platform developed by scientists at University of Campinas in Brazil can identify tens of thousands of molecules present in blood serum, with an AI algorithm

The Artificial Intelligence platform can identify positive cases of Zika even in blood serum analysed 30 days after the start of infection,

when the acute phase of the disease is over.

Photo: Reuters

Washington: Scientists have developed an artificial intelligence system that can accurately diagnose Zika virus and several other viral, bacterial and even genetic diseases from the patient's blood.

The platform developed by scientists at the University of Campinas (UNICAMP) in Brazil, can identify tens of thousands of molecules present in blood serum, with an artificial intelligence algorithm.

"We used infection by Zika virus as a model to develop the platform and showed that in this case, diagnostic accuracy exceeded 95%. One of the main advantages is that the method doesn't lose sensitivity even if the virus mutates," said Rodrigo Ramos Catharino, principal investigator at UNICAMP.

Strength of the platform, he added, is the capacity to identify positive cases of Zika even in blood serum analysed 30 days after the start of infection, when the acute phase of the disease is over.

"None of the currently available diagnostic kits has the sensitivity to detect infection by Zika after the end of the acute phase. The method we developed could be useful to analyse transfusion blood bags, for example," Catharino said.

Development and validation of the platform involved analysis of blood samples from 203 patients treated at UNICAMP's general and teaching hospital.

Of these, 82 were diagnosed with Zika by the method currently considered the gold standard in this field: real-time polymerase chain reaction (RT-PCR), which detects viral RNA in body fluids during the acute phase of the infection.

The other 121 patients were the control group. About half had the same symptoms as the group that tested positive for Zika, such as fever, joint pain, conjunctivitis and rash, but had negative RT-PCR results for Zika.

The rest had no symptoms and also tested negative or were diagnosed with dengue. All collected samples were analysed in a mass spectrometer, a device that acts as a kind of molecular weighing scale, sorting molecules according to their mass.

"We identified some 10,000 different molecules in the patients' serum, including lipids, peptides, and fragments of DNA and RNA. Among these metabolites, there were particles produced both by Zika and by the patient's immune system in response to the infection," Catharino said.

All the data obtained in the spectrometry analysis of both the group that tested positive for Zika and the control group were then fed into a computer programme running a random-forest machine learning algorithm.

This type of artificial intelligence tool is capable of analysing a large amount of data by specific statistical methods in search of patterns that can be used as a basis for classification, prediction, decision making, modelling and so on.

"The algorithm separates samples randomly, determines which one will be the training group and the blind group, and then carries out testing and validation," Catharino said.

"At the end, it tells us whether with that number of samples it was possible to obtain a set of metabolic markers capable of identifying patients infected by Zika," he said.

Each new set of patient data fed into the programme enhances its learning capacity and makes it more sensitive, he went on. In the case of Zika, the study established a panel of 42 biomarkers as a specific key to identifying the virus.

Twelve of these were found by the algorithm to be highly prevalent in the blood of patients who tested positive for the disease.

Who needs your data? And should you be worried?

In November 2008, a 22-year-old Mark Zuckerberg took the stage at the Web 2.0 Summit in San Francisco. As the audience listened in rapt attention, the young CEO, in what would go on to be his trademark round-neck T-shirt, went on a hardsell of the relatively new Facebook. "I would expect that next year, people will share twice as much information as they share this year, and next year, they will be sharing twice as much as they did the year before." This formula for social sharing came to be called the 'Zuckerberg Law'.

A decade on, as Facebook finds itself caught in a debate over Cambridge Analytica, a data

analytics firm accused of using the social networking site's user data to influence elections in the US, Zuckerberg might be hoping that his platform didn't grow at the pace he predicted. A speed at which the company itself could not keep up with the amount of data it was generating, the number of third parties that were using this data and the kind of problems this mix was creating.

What Did Cambridge Analytica& Facebook Really Do

An increasing number of Facebook's 2.2 billion users are now becoming more cautious of what they share, but the majority still live in denial. While most people, like Donald Duck in the meme that's been doing the rounds since the Cambridge Analytica controversy, might think that "your data is as worthless as you", the fact remains that it is an asset with immense value, especially when it forms part of a larger data set.

While users believe that the data they willingly surrender to Facebook, Google and other Internet companies is in return for personalised services, the troves of user information can often be very tempting for some players in this value chain.

Cambridge Analytica, for instance, used the data collected by a personality quiz app, called 'thisisyourdigitallife', to swing voting behaviour. Approximately 2.7 lakh people downloaded the app and in doing so, gave access to their friend lists, their reading habits and political inclinations.

Most apps collect permission for accessing much more data than they actually need — like a torch app getting access to a user's contact list. Some might end up misusing this data or selling this information to others. That's where the problem begins.

In an interview to The New York Times after the Cambridge Analytica row, Zuckerberg suggested that there could be other apps that "could have gotten access to more information and potentially sold it without us knowing or done something that violated people's trust" and that Facebook needed to "make sure we get that under control".

A Facebook India spokesperson told The Sunday Express they were investigating all

apps that had access to "large amounts of information before we changed our platform to dramatically reduce data access in 2014".

Facebook said it would tell people affected by apps that have misused their data and that from here on, if apps are removed for misusing data, "we will tell everyone who used it". A lot of other measures, which includes turning off access for unused apps, have been put in place.

In response to queries, Google India pointed to its Google Play Developer Policy Center, which elaborates on how apps should ideally handle user data. The policy says developers need to be transparent in how they handle data, including by "disclosing the collection, use, and sharing of the data", and must limit use of data to the description in the disclosure. Apps that handle personal data must post a privacy policy that mentions "the types of parties with whom it's shared".

MayankBhangadia, CEO and co-founder of Indian social media app Roposo, asks why would someone require user data for any other reason apart from making the in-app experience better? "Why share this data with a third party, if there are any chances of the data being misused? Capturing calls logs and capturing activity on other apps a user uses is, in my opinion, quite unethical."

What is data?

Internet businesses have thrived around the ad-funded model, where users give up their browsing data to access free services that are funded by ads that feed on this data. For instance, every time you search for a holiday destination, or even receive a mail from a friend to plan a trip, your data goes to advertisers who might have holiday packages or airline tickets to offer. This explains the ads that pop up on screen based on your online behaviour.

These data-driven ads are much more effective than traditional forms as they are based on user preferences. But then these user preferences are gleaned from what people do online, often without their consent and without their knowledge.

While most regular Internet users now think twice before filling any online form with their personal data, not many are aware that everything they do adds to a data pile somewhere. For instance,

while smartphone photographs and tweets share location data, social media posts give a clear idea about purchase preferences, habits and, of course, political leaning. Technology these days enables companies to read even the mood of the people from posts, even without the user selecting the 'feeling happy/sad/thrilled…' field.

Also, all this data is not voluntarily surrendered. For instance, from the day a user starts using an Android phone or a Google app, the search giant starts mapping all the physical places the user went to, unless the location tracking was switched off. According to some reports, Facebook logs call data of its users on the phone and anyway has all location data.

Others are catching up too. Ola, for instance, is working on serving targeted ads on its Ola Play screen given that it knows where you are headed, and maybe for what. So the ads will be different if you are headed for work, going to the airport or for a party.

And there are other forms of data these companies have access to. For example, commands to Google Assistant on an Android phone are stored and available for users to review on Google's MyActivity page. Similarly, every time a fingerprint scanner or an iris scanner for a device's security is used, this data is stored, but usually on the device itself.

Jon Stephenson von Tetzchner, co-founder and former CEO of Opera, clarifies that most companies do not collect data without consent. "It is only a few and no, they should not be able to do this, with or without asking for consent. There is nothing right about being able to collect user data at the scale we see today," says the Icelandic businessman who was one of the pioneers of the Internet as we know it.

As Tetzchner says, not all companies are interested in this data. At the Recode event this week, Apple CEO Tim Cook rebuked Facebook saying, "We could make a tonne of money if we monetised our customers, if our customers were our product." But, he added, Apple has elected not to do that. "We're not going to traffic in your personal life. Privacy to us is a human right, a civil liberty."

How valuable is your data?

Companies such as Facebook and Google that have made the most of this model enjoy a lion's share of the digital advertising revenue. According to investor data of both these companies, Google's ad revenue for Q4 2017 stood at $27.2 billion, while Facebook's jumped 48 per cent in Q4 2017 to $12.2 billion.

Google and Facebook corner about 62 per cent of all global ad revenues, but that's not surprising considering they together have about 2.5 billion monthly active users — a third of the world's population.

All Internet companies that have ad positions enabled charge a premium for targeting — the nicher the audience, the more the ad firm pays the Internet Company. So the more data the user gives to the platform, the more money the Internet Company makes.

Tetzchner puts things in perspective: "What we are talking about here is really stolen goods. The user data belongs only to the user and nobody should be able to steal this data and sell it." He says there is "something creepy" about the notion that surveillance data can be collected and sold with no consequences. "We used to call this spyware and trojans. The Internet is not built on spyware. The Internet would run just as well without companies having the ability to collect and sell user data the way it's being done now by some of the larger companies."

Just a week ago, Tetzchenr's new Vivaldi browser enabled DuckDuckGo as the default search engine in its Private Windows — even in private mode the default search engine knows what the user is doing. DuckDuckGo avoids personalised search based on user data.

However, Roposo'sBhangadia says it will be tough to offer customised services if users start withholding data. "If they stop or skip sharing data, it would clearly hinder the in-app experience a platform can offer," says Bhangadia, whose app now claims 8 million users. He says Roposo is "extremely careful" that no third party can directly or indirectly use any user data.

Bhangadia says users will be more secure if they stop ignoring terms and conditions. Tetzchner, who has studied Internet user behaviour for over two decades, too agrees that most people have

no clue what is happening. “They just have this strange feeling of being followed, which they are.”

What Indians Do Online

– Indians spend 45 per cent of their time on mobile phones. Weekly time spent on a mobile phone is seven times that spent on a television set

– Of the time spent on their phones, 45 per cent is on entertainment, followed by “search, social and messaging” at 34 per cent. News and media occupies just over 2 per cent of people’s online phone time. India is the Number 1 market for time spent on Android

– India’s top downloaded Android app is WhatsApp, followed by Facebook Messenger

– More apps downloaded on Google Play Store in India than in the US (Source: Mary Meeker 2017 report on the state of Internet)

How to be in control

On Facebook

Go to Facebook Settings page, click on Privacy. Here you can limit who sees what content. For instance, you can ensure that only friends can look you up on Facebook via your email address or even restrict this information as hidden to all by choosing ‘Only Me’.

On Google

Go to MyAccount.Google.com and sign in. This page lets you monitor how data for all Google services has been collected. This includes data for search, YouTube, video and audio devices, etc. On Google Maps, you can go to timeline and see your entire location history if you have that turned on. You can turn off this timeline feature if you wish to do so.

On Third-party apps

– On Android 6.0 and above, a user can review an app’s permissions. So if a photo-sharing app wants all your call access data, you can turn it off in the settings. On iOS too, you can monitor, which apps get access to what services. For instance, if you do not want to an app like Ola or Uber to access your location data all the time, you can make sure of it in the settings on iOS.

– Further, when downloading an app, make sure it is from the authorised Google Play Store or App Store on iOS. Do not download apps

from third-party stores as they might not be secure. Do not download apps from links sent over messages, Facebook, etc as these might contain malware.

Nyaaya: A digital guide to complex justice system

Legal processes are often tiresome, frustrating, lengthy and bureaucratic. Awareness and knowledge of law is still not an integral part of people's consciousness. The barriers of language, education and technological reach add to the absence of legal understanding in our society.

By creating a free online resource, Nyaaya is trying to simplify the heavily jargonized legal language, facts and practice for common people, and build a knowledge reserve about law that is more accessible to non-experts through simple interpretation. Nyaaya is a searchable repository of every central and state law in the country that provides information on laws in simple English and Hindi, and is managed in a way that users find answers with little effort.

Nyaaya was the winner of the SM4E awards, organized by the Digital Empowerment Foundation in 2017, in the category of communication, advocacy and development activism for creating an online and easy-to-comprehend repository of Indian laws.

"Nyaaya is based on a very simple idea. Laws were not written to be an exclusive, niche product meant for experts. They concern everyone in India and are applicable to almost everything. Hence, it's very important for laws to be accessible, simple and coherent," says Sumeysh Srivastava, outreach lead at Nyaaya. The law portal has been active since 26 January 2017 and has had more than 400,000 users. The portal was revamped on 16 February 2018, with design and product updates intended to make it easier to use and to access relevant information.

Nyaaya was originally conceived by philanthropist and chairperson of charitable foundation Arghyam, RohiniNilekani, who approached the Vidhi Centre for Legal Policy, a non-profit legal think tank, with the idea of creating a legal portal like the water portal that Arghyam has set up. "Rohini was keen on

financing an open access platform that would help citizens better equip themselves with knowledge of the justice system, and enable society and the law to be more in sync. This idea fell right into Vidhi's line of thinking and the Nyaaya website is an outcome of this discussion," says Srivastava.

Nyaaya is supported by RohiniNilekani Philanthropies and the Lal Family Foundation, and is run by a six-member team.

The design of the portal is such that various categories of laws—from domestic violence and sexual harassment to laws on drugs and against corruption—are tidily arranged for easy navigation. There are straightforward, short and lucid explainers for each of them, and for those who seek further reading, there's a copy of the law with provisions explained separately on the side.

The team agreed on a portal structure that it believed worked for users, outreach and technology. It worked on a fresh content that fit this structure while wire-framing the design, testing it on users and prototyping the technology.

Nyaaya uses different social media networks to make its content more widely available with accounts on Facebook, Twitter and LinkedIn, and also uses other niche platforms like Reddit, Quora and WhatsApp to reach different audiences.

Realizing that these technological mediums work differently, the team uses each platform with a specific goal and takes a different approach. For instance, Nyaaya believes that Twitter isn't great for getting traffic to the website, but is a great tool for visibility and brand image. So on Twitter, it acts more as a curator, where the team shares content that users and followers may be interested in, even if it's not Nyaaya's content.

"We have also tried to make laws less boring by trying to explain them through references to movies, TV serials and everyday situations. Being online also allows us to collaborate and learn from other organizations who are also looking at questions of accessibility with reference to public information," says

Srivastava.

Nyaaya's vision, he adds, is to ensure that each and every member of society fully understands their rights and obligations, as per the letter of the law. The team now plans to grow its content significantly with new topics every few weeks and to have content in other regional languages to increase accessibility of the law. "We will also continue to solicit feedback and improve our tech for speed, reliability and convenience. Very soon, we hope to have a new and improved search as well as multi-language support," adds Srivastava.

Users own and control their data, says Zuckerberg

Users own and control the data they share on Facebook, its founder and CEO Mark Zuckerberg repeatedly told American lawmakers, who remained skeptical of this argument through two Congressional hearings on the company's privacy policy and Wednesday.

Assurance on India

Facebook is committed to ensuring the integrity of elections in countries like India, Pakistan and the U.S., Mr. Zuckerberg told the hearings, attended by at least 42 Senators.

Personalised advertisement driven by data analytics will remain the mainstay of Facebook's business model, though the company might offer a subscription model that will shield users from advertisements and offer more protection for their data, Mr. Zuckerberg said.

"We think offering an ad-supported service is the most aligned with our mission of trying to help connect everyone in the world, because we want to offer a free service that everyone can afford."

Facebook is committed to ensuring the integrity of elections in countries like India, Pakistan and the U.S., Mr. Zuckerberg told the hearing.

He was questioned for nearly five hours by senators over the Cambridge Analytica scandal that has shaken the social media giant.

The hearing, attended by at least 42 Senators, had many light moments but the 33-year-old CEO largely appeared strained, trying to explain the company's technology and business model, without admitting to charges of inadequate data protection.

Mr. Zuckerberg sidestepped several questions that are at the heart of the privacy debate.

Senator Kamala Harris from California, where the company is headquartered, catalogued them, four hours into the hearing.

"And those questions have included whether Facebook can track user's browsing activity even after the user has logged off of Facebook, whether Facebook can track your activity across devices even when you are not logged into Facebook. Who is Facebook's biggest competition? Whether Facebook may store up to 96 categories of user's information.Whether you knew whether Kogan's terms of service and whether you knew if that Kogan could sell or transfer data," she said. Mr. Zuckerberg gave evasive answers to these questions and promised that his team would follow up with the senators with details.

Govt. ties up with IIT-Delhi for safety switches on vehicles

Under pressure on the issue of safety of women in the country, the NDA government has turned to technology for a solution. The Ministry of Electronics and IT in partnership with IIT-Delhi is working on a switch-based device in cars and buses to aid safety of women.

"We are using technology to ensure help in case of distress while travelling in public transport. The proposed panic switch system when invoked will generate a loud alarm in the vehicle which will attract public attention, and send the coordinates of the person to a server [police control room] to provide necessary help," a senior ministry official said.

Ensures system health

The system will include features such as authenticating the driver of the vehicles and a camera interface. "The system is designed [to] monitor the health of the switch… whether it is in proper working condition or not, and it will also enable tamper proof operation," the official said.

The field trials for the beta version of the system are already underway, and the Ministry expects to start rolling out the final version by next month. "The first version has been field tested and the final version is expected in May, 2018 for cars and by August, 2018 for buses," the

official said.

From Nirbhaya fund

The project, being developed by IIT-Delhi, is being funded by the Nirbhaya Fund, set up in 2013 for implementation of initiatives aimed at enhancing the safety and security of women in the country. However, the government has been facing criticism for under-utilisation of the fund.

The total number of crimes registered against women in the country during the year 2014, 2015 and 2016 were 3,39,457, 3,29,243 and 3,38,954, respectively, showing a mixed trend with a decline of 3.0% in 2015 over 2014 and an increase of 2.9% in 2016 over 2015, as per the government data.

In 2016, the government had announced plans to make it mandatory for mobile phone makers to provide a panic button on the device, starting January 2017. However, the plans were delayed by almost a year. The trial for the system finally started in U.P. earlier this year.

The bone printer

On 6 February 2017, a specialized team of doctors at Medanta hospital's Bone and Joint Institute in Gurugram inserted an unusual implant inside the body of a 32-year-old woman: the country's first customized 3D-printed vertebra.

Two weeks before the operation, SG, a Hindi teacher, had walked into the office of V. AnandNaik, a senior surgeon at the hospital, complaining of tremendous pain in the neck and numbness in the extremities. "She walked in holding her head like so," explains Dr Naik in his office, cupping his hands and placing them beneath his chin. "The moment she removed her hands, her head would begin to slip forward."

Multiple MRIs revealed the 32-year-old was suffering from tuberculosis of the spine—a potentially fatal disease which eats into the backbone. "We found that the normal curvature of the neck was gone, and her spine was sliding forward along with the skull," says Dr Naik.

Physical trauma, cancerous tumours or accidents are the typical causes of spinal destruction on this scale. SG's medical records reflected no such history, but for the past few months, she had been receiving high-dosage corticosteroid injections, prescribed by a

different doctor, to treat infertility. The steroids caused her immune system to collapse, making her body susceptible to tuberculosis. When the disease hit, it spread far and wide, affecting various parts of her spine. “By the time she came in, there was no connection between her skull and the lower spine,” says Dr Naik. “Everything was destroyed.”

We are seated in his office at Medanta, a typical clinical room: X-ray box on the wall, a cluster of miniature spine models on the shelf, an examination bed. The doctor retrieves images of SG’s upper-neck MRI scans on his phone. The photographs show how, instead of a formidable column of cube-like vertebral bodies that form a healthy spine, almost each cervical bone (particularly the second and third) had been reduced to thin flakes. “The pus around the bones was causing a pincer effect on the spinal cord, so her limbs were beginning to become numb.” More importantly, though, she was having difficulty breathing. SG was on the brink of going into respiratory paralysis. Quick action was essential.

Over the past seven months, as the pain escalated, the 32-year-old had visited several hospitals, consulted roughly 10 doctors, and always hit a roadblock. “I could not turn my neck or sleep,” says SG, on the phone. “The pain became insufferable when I lay on my back. As soon as I lay down, the pain would be too much. I would cry and scream through the night.” (SG declined to meet Lounge in person or get photographed, citing privacy concerns). Most doctors indicated that she would go on to live a life confined to bed, encased in an uncomfortable metal brace that would allow zero movement, while drugged with painkillers. Dr Naik, however, offered a different solution—one that would make her the first Indian to have a 3D-printed implant in her body.

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A prototype of the vertebra that was implanted in SGV.

Three centimetres in length, a prototype of the 3D-printed vertebra, designed specifically for SG, can disappear easily within my fist. I run my fingers over the coarse surface of this tubular structure. Dotted with holes of equal diameter, “the rough texture and micro-porous body allow the bone cells to go inside the implant, and eventually grow through and over it,” explains Sanjay Kumar Pathak, who runs a 3D-printing firm called Global Healthcare in Delhi. “The process is similar to the organic way the roots of a tree grow.” Pathak is a pioneer in providing 3D-printed surgical solutions in India. He co-designed the titanium vertebra, with inputs from Dr Naik.

Pathak’s office is in a corner of north Delhi’s sprawling industrial area, tucked away amid several small factories. A part of the office (which he runs under a separate company name with a business partner) focuses on designing and 3D-printing dental aligners—transparent plastic mouth guards that are more effective than traditional metal braces. The other part of the office (run under a separate company, of which he is the sole owner) focuses on designing medical solutions. He outsources the printing of the titanium implants to 3D printing companies in Sweden and France, since owning a medically certified titanium printer in India costs close to Rs1 crore. Then, there’s also the cost of running and maintaining the machine, and employing skilled operators.

It was in 2015 that Pathak heard about a conference, “Inside 3D Printing”, in Mumbai. Pathak knew doctors were always looking for new high-end technology that could assist in surgery. “When I attended the conference, I started thinking about 3D printing as a medical solution that could be provided in India. I knew it was going to be difficult, but achievable.”

In 2016, he approached the All India Institute of Medical Sciences (Aiims), in Delhi, offering 3D-printed surgical models (not implants)—identical organ replicas—which would help surgeons perform critical, invasive surgeries better (see box for a detailed overview). As word got around, Pathak’s name came to be associated with healthcare 3D printing. In 2017,

Medanta approached him to take things a step further and design a 3D-printed implant.

Pathak says he gave the titanium vertebra practically for free: SG was his first customer. Today, however, 3D-manufactured implants can cost anywhere from Rs1.5-7 lakh (inclusive of the cost of labour and material) in the Indian market. Abroad, these implants can cost anywhere from Rs25-50 lakh.

Since the surgery, Pathak has been working closely with other Indian hospitals. Eight months ago, for instance, Max Super Speciality Hospital in Saket, New Delhi, approached Pathak to reconstruct the skull of a gun-shot victim. The medical team scanned the patient's facial structure and learnt that his right eye socket and part of the forehead directly above it had been shattered beyond repair. Pathak successfully got a titanium replica of the fractured parts of the skull printed, but the patient did not return for the surgery.

"The piece is lying safely with me," Pathak says, taking out the implant and placing it on the table. "The patient had financial problems, but he will return when he has to." He then retrieves a peculiar, bright-yellow plastic skull from his drawer. "This is a 3D-printed copy of his face," Pathak says, pointing to the deformed piece. "This is what his face looked like when the patient was admitted." Looking at the shattered skull can be disorienting: A large chunk above the right eye socket is missing, the gouged-out bit defined by sharp, jagged edges. As a solution, Pathak designed an asymmetrical titanium structure which would be placed over the broken part completely, making the skull whole again. The implant carries holes similar to SG's printed vertebra.

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Recently, a handful of companies have begun providing such implants to hospitals in India. In January, when the team at Medanta began work on a particularly tricky case, they turned to one of Pathak's competitors, XL Orthomed.

It was for 11-year-old LakitaMwangi, an active gymnast and swimmer at her school in Kenya, who for over a year had been complaining of a subtle pain in her right knee, almost always

after sports class. When the pain escalated, and began recurring daily, her mother Joyce Mwangi suspected cancer. “Seven years ago, Lakita’s father had died of colon cancer,” says Joyce Mwangi. “I realized my daughter might have cancer too.”

Mwangi is a single parent who runs a small business in Kenya. Shy and soft-spoken, she is almost inaudible when she speaks. “When I took Lakita for a medical scan in Kenya, the doctor confirmed that she had a tumour. In my country, though, the only solution is to amputate the leg. But I said, ‘That won’t do.’” On the advice of friends who live in India, Mwangi bought her daughter to Delhi in September.

Mwangi first approached another hospital, where the doctors did a biopsy test. “They took too much time to do the tests.” So, she turned to Medanta in December. “Lakita’s mother was adamant that she did not want to amputate the leg,” says Sanjiv K.S. Marya, who heads the Bone and Joint Institute. “I remember her asking, ‘What else?’”

Most adults suffering from bone sarcoma (cancer of the bone) have the tumour sliced away, and then have the remaining leg bone fused to the joint through arthrodesis. The problem with this process is that while patients can walk after surgery, they have difficulty bending the knee. But Lakita had her whole life ahead of her. Dr Marya and his team began looking into the solutions that 3D-printing could provide.

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The rough texture and micro-porous body (of the implant) allow the bone cells to go inside the implant, and eventually grow through and over it.- Sanjay Pathak, Director, Global Healthcare

The first 3D printer was designed in the 1980s. Its inventor, Charles Hull, built a machine that used acrylic ink and functioned by printing layers. Layers would be added in turn, and the ink, when exposed to UV laser light, would harden to form the required object. In 1983, Hull successfully printed a black eyewash cup. The solid imaging process (known as stereo-lithography) is commonly known today as three-dimensional printing. Hull went on to patent the machine three years later, and subsequently

co-founded 3D Systems in California, to commercialize the invention.

Thirty-five years later, 3D printing can potentially influence almost every realm of life. The machines now print in various metals, including gold and silver, as well as ceramics and wax. In fact, we can now even print edible food. For instance, "Foodini", designed by Natural Machines, can produce anything from ravioli to pizzas; while US space agency Nasa has invested in a 3D-printer prototype that can print food in space. The possibilities are boundless, portending, for the optimistic, the utopian future of Star Trek, where 3D food printers have ended the need for war and competition amongst humans. Another famous piece of science fiction, Michael Crichton's Westworld, imagines a future where human-like figures are 3D-printed in a sterile, glass-walled underground laboratory.

While "printing" androids is still far in the future, scientists are currently attempting to print biocompatible tissues, muscles and organs. Attempts at growing human tissue are a common avenue of scientific exploration, but they have been repeatedly unsuccessful, since artificially created tissues have not been able to thrive for long as living organisms. But now, researchers at North Carolina's Wake Forest University have constructed a bio-printer that can engineer fully-functional organs and tissues (with blood vessels) that can, hypothetically, be inserted into the human body.

The bio-printer at the Wake Forest Institute for Regenerative Medicine uses hydrogel (a water-based "ink" carrying a patient's cells), which is used to promote cell growth. To print an ear cartilage, for instance, the bio-printer, equipped with small nozzles, deposits hydrogel as well as "bio-degradable, plastic-like material in order to form the tissue 'shape'", says Anthony Atala, director at the Wake Forest Institute for Regenerative Medicine, on email. In addition, the shape is layered with a printed network of micro-channels throughout, which allow "nutrients and oxygen from the body to diffuse into the structures and thus keep them alive while the tissues develop their own system of

blood vessels".

The scientists at the institute have managed to successfully implant this cartilage in laboratory mice, where the cells have exhibited no signs of failure. Though the bioengineers have not implanted these artificially manufactured parts into humans yet, this technology is a breakthrough. In India, according to a 2017 report published on the NDTV website, about 500,000 people die every year due to the unavailability of organs. While 200,000 need liver transplants, 150,000 suffer from kidney diseases and the rest from cardiovascular diseases. If printed organs are available for liver or heart transplants, patients in line for organ donation would no longer have to wait years for a "right match". In addition, the question of organ rejection, a common occurrence during transplants, would not arise. A brand-new organ could be printed from the patient's own cells within days.

In similar vein, researchers at the Feinberg School of Medicine at Northwestern University were recently able to print bio-prosthetic ovaries for mice, enabling them to successfully give birth. The real breakthrough, however, will be when bioengineers are able to implant these in cancer patients who have been sterilized due to treatment, to help restore fertility.

Our ability to print large organs such as a kidney or a heart, however, will "probably not exist for many decades to come", says Jason Chuen, director of the Austin Health 3D Medical Printing Laboratory, on Skype. Chuen says certified regulatory bodies would have to work on a blueprint on the ethics behind implanting such organs, if and when the technology allows us to create them. "At the moment, we don't have a way to define what the responsibility of each person who will be a part of this process would be," says Chuen. "So, if I was to print an organ, how would I know whether it is produced to a certain standard? How do we create some sort of manufacturing quality control? These are questions which have not been answered yet. There is a lot of discussion at WHO (World Health Organization) and the FDA (food and drug administration) about how such a system would work."

Dr Marya has a packed schedule. Every now

and then, he pulls back the sleeve of his coat to check the time. He is scheduled for a surgery right after our conversation. When I ask about the complicated procedure that Lakita, the young girl from Kenya, needed, he relaxes his shoulders and leans forward.

"With young patients who still have a few years left to grow, arthrodesis is not the best solution," explains Dr Marya. As the child grows, the length of the legs becomes incongruous—one continues to grow while the operated leg remains the same size. A team of doctors headed by NishantSoni, a hand and limb reconstructive surgery specialist, and Chandeep Singh, the associate director at the Bone and Joint Institute, concurred that Lakita needed an expandable implant that could be routinely manipulated in length to match her normal growth. "This means that it has a provision where, every six months, we can make a small stab—an incision into the implant—and increase it by 5mm," explains Dr Singh.

Mwangi was sceptical. "At first, I was scared about having a 3D-printed implant," she recalls. "I was wondering whether it would work." The implants are expensive, and an overarching concern is whether this new technology can be as effective as traditional autograft procedures, where a piece of bone is severed from the patient's body (normally the rib cage or the hip) and transplanted to another part of the body. In SG's case, for example, autografting as an alternative was impossible due to the serious, deteriorating condition of her spine. The implant was her only hope. For patients like Lakita, who have bone tumours, printed implants are a viable option.

"So I did some research on the internet," continues Mwangi. "And learnt that in the US they've performed such surgeries on children. That's when I told the doctors to go ahead."

Lakita's personalized 3D-printed titanium implant is designed to function as a knee joint; what makes it even more remarkable is that it was also uncemented. "We don't use cement to glue the implant to the bone," explains Dr Marya. "If you fix it with cement, the chances are that the implant will loosen or de-bond as the child grows." In order for the implant to integrate completely with the bone, it needs to be coated

with a special substance called hydroxyapatite. Hydroxyapatite is not available in India yet, so the piece had to be sent to France for the coating.

After the surgery, Lakita, who now has a semi-open cast around her leg, makes 1-hour visits to the hospital, six days a week, for physiotherapy exercises. “The first thing Lakita asked when we met was, ‘Will I be able to swim?’” says Dr Soni. “While she might not be able to perform gymnastics, she will be able to swim in the future thanks to the implant.”

With the advent of 3D-printed bone implants, one would imagine there would be more and more patients opting for 3D bone implants. But in India the cost is proving prohibitive. Dr Marya, however, believes this will soon change. “Once we begin using it more frequently in healthcare, the cost will come down,” he says. “When I returned to India, from London 25 years ago and began practising here, there was hardly anybody doing knee-replacement surgeries. I found it difficult to convince people about what it was. Then came a strange phenomenon, where a lot of people suddenly began performing knee-replacement surgeries—but with inadequate training. Some patients insisted that they wanted knee-replacement when they didn’t need it, and because of that, their results were suboptimal. Then they would wonder what went wrong.

“I think for any surgery—especially ones with expensive implants—the first thing a surgeon must be mindful of is patient selection. If you don’t select properly, the procedure will not go correctly.” Perhaps this is why, after SG’s procedure, it took Medanta almost a year to schedule its second 3D-printed implant surgery. Today, SG has recovered completely. She can walk and engage socially with friends—a life remarkably different from the one several doctors envisaged. Three months after her surgery, Lakita too can stand on her feet with the assistance of a walker.

3D-printing is beginning to revolutionize the medical industry, and though it still may be at an embryonic stage in India, it is clear that the country will play a crucial role in embracing this new technology in the future—changing millions of lives forever

A 3D-printed skull of a gun-shot patient, with a

3D-printed titanium implant.

3D printing: the big impact

Why 3D-printed implants win over ready-made ones

Three-dimensional printed implants are tailor-made, designed accurately to meet a patient's anatomical requirements. They have a strong advantage over ready-made implants. "Sometimes, in order to fit a ready-made implant, the surgeons are forced to shave off surrounding bone in order for the implant to fit," says Sanjay Pathak, who runs Global Healthcare, which offers medical solutions to hospitals. "With 3D, this is no longer required."

In addition, the implant has a coarse texture, which allows the bones to grow over and integrate easily with it. "The rough surface is achieved through this kind of printing," explains Pathak. "Implants which are traditionally made have to be scratched manually in order to get the required unevenness. This takes more time for the piece to be ready for a patient; and manual scraping would produce some kind of a harsh surface, but not as good as 3D printing."

The implant inserted in SG was designed using advanced software. V. AnandNaik's team of doctors took a CT scan of her damaged vertebra, and, with Pathak's help, used it to virtually recreate and construct an intricate, three-dimensional image. On this digital model of her spine, they removed the diseased parts that floated between the first and fourth vertebral bones, and measured the gaping void. Pathak then designed a titanium implant that would sit snugly between the first and fourth bones. Titanium is a metal commonly used in orthopaedic surgeries; it's preferred for its durable quality and biocompatible characteristics.

While printed implants are still a rarity in India, hospitals have been using 3D printers to make uncannily realistic (and identical) anatomical models for examination and practice before going into a surgery. This has been happening for a few years now. Rather than relying on two-dimensional CT scans for surgery, surgeons can now inspect, dissect and probe the printed replicas to assess what they may encounter with the real organ in the operating room. Not only does this ensure that surgeons are better

prepared before a crucial surgery, it means that nothing is left to chance. It saves a lot of time and helps them tackle otherwise unforeseen complications.

This is particularly valuable for small-sized organ or bone-related surgeries. In 2014, for instance, a team of doctors at the Jawaharlal Institute of Postgraduate Medical Education and Research (Jipmer) in Puducherry needed to fix the deformities in a three-year-old's skull. For this, they used a 3D-printed replica of the child's skull. "With the replica...we know where the holes in the skull are, and it will help us cut the bones with precision to get optimal results," Dinesh Kumar S., associate professor at Jipmer, who headed the surgical team, had said in an interview to Mint in August 2014.

Today, multiple hospitals, including Aiims, Max Super Speciality Hospital, Apollo and Fortis Healthcare, take the help of 3D-printed organ replicas.

Indian scientists using artificial intelligence to predict early onset of Alzheimer's

Indian scientists are using artificial intelligence (AI) to develop a smart diagnostics system to predict the onset of Alzheimer's disease early.

Professor Pravat Mandal and his group at the National Brain Research Centre (NBRC), and Neuroimaging and Neurospectroscopy Laboratory (NINS) are together working to develop a model to map metabolic patterns in different brain regions in healthy and pathological conditions. Alzheimer's disease is a chronic degenerative brain disorder.

Alzheimer's disease is an irreversible progressive brain degenerative disorder. It manifests as cognitive deterioration and associated behavioral disturbances, leading to impairment of activities of daily living. Early detection of Alzheimer's disease helps individuals achieve better quality care by identifying cognitive impairment early.

"Laboratory research and longitudinal clinical studies have helped to reveal much information about the disease but the exact causal process is not known yet. Such AI framework by putting imaging and neuro-chemical information altogether will help immensely in early diagnosis

of Alzheimer's disease," Dr Mandal said.

The scientists are devising a complete spectrum that includes anatomical atrophy (degeneration of cells), magnetic resonance spectroscopy (MRS) and neuropsychological measures to get sensitive specific characteristics of the disease.

"We will use the data information from a large data set from various diagnosis procedures to create an artificial intelligent system, which would help with the diagnosis of a new unknown case of Alzheimer's disease using machine learning approaches," said Dr Mandal.

"Such an integrated multi-modal predictive diagnostic system for Alzheimer's disease diagnosis would aid the clinician in early differential diagnostics to deliver the most appropriate treatment," he said.

Dr Mandal along with Deepika Shukla, also from NBRC , is developing an integrated framework called "GAURI" with statistical and predictive diagnostic capability that could indicate brain chemical changes such as significant depletion of glutathione in the hippocampus (a small organ located within the brain). The system provides a complete view of brain atrophy, metabolic change, and behavioral change, socio-demographic for the combined feature analysis. The research was also published in the latest issue of

Journal of Alzheimer's disease

"People from different research fields like physical science, engineering and mathematics as well as molecular biology need to come together to synergize the work. There is an urgent need for inter-disciplinary research involvement bringing technological advancements to understand the disease through knowledge merging in medical imaging field," said Dr Mandal. Prof. ManjariTripathi from Department of Neurology at All India Institute of Medical Sciences (AIIMS), New Delhi also supported the research.

Alzheimer's is the most common form of dementia, a general term for memory loss and other cognitive abilities serious enough to interfere with daily life. Alzheimer's disease accounts for 60-80% of dementia cases. According to the 'Dementia India' report published by the Alzheimer's and Related

Disorders Society of India, the country has an estimated 4.1 million people suffering from dementia. This is expected to double by 2035.

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DEFENCE

DAC approves procurement of radars, air cushion vehicles

The radars have capability to detect high speed targets

The Defence Acquisition Council (DAC) on Thursday approved procurement of high powered radars for the Indian Air Force and air cushion vehicles for the Army and the Coast Guard together worth over Rs. 5,500 crore.

The 12 high power radars will be procured indigenously under the 'Buy (Indian) IDDM' category.

"The radars will provide long range medium and high altitude radar cover with the capability to detect and track high speed targets following parabolic trajectories. Technologically superior, the radars will have the capability to scan 360 degrees without mechanical rotation of Antenna and will operate on 24x7 basis with minimal maintenance requirement," the Defence Ministry said in a statement.

In the other deal, air cushion vehicles (ACVs) to be procured from an Indian shipyard will enable travel at very high speeds over shallow water, sand banks, mud flats and swamps which are non-navigable by boats and small crafts due to draught restrictions or uncharted depths.

The DAC meeting, chaired by Defence Minister Nirmala Sitharaman, was scheduled to discuss the broad contours of the Navy's ambitious project to build six advanced submarines under the multi-billion P-75 (I) programme. But, it was not known whether there was any decision on it during the meeting.

India successfully test-fires BrahMos missile along Odisha coast

India successfully test-fired the Indo-Russian joint venture BrahMos supersonic cruise missile from a test range along the Odisha coast to validate some new features. The missile was test-fired from a mobile launcher stationed at

Launch pad 3 of the Integrated Test Range (ITR) at Chandipur near here at 10.40am, Defence Research and Development Organisation (DRDO) officials said.

The trial was conducted to validate its "life extension" technologies developed for the first time in India by DRDO and team BraHmos, said an official of the ITR. Defence minister Nirmala Sitharaman congratulated DRDO scientists and team BrahMos for the successful launch of BraHmos missile with new technology today.

"Smt @nsitharaman congratulates Team Brahmos& @DRDO_India for successful flight test carried out at 1040 hrs on 21 May 2018 from ITR, Balasore to validate BRAHMOS missile life extension technologies developed for the first time in India," her office said in a twitter post.

The successful test will result in huge savings of replacement cost of missiles held in the inventory of the Indian Armed Forces, it said.

The two-stage missile—first being solid and the second one, a ramjet liquid propellant—has already been introduced in the Army and Navy, while the Air Force version had witnessed successful trial, the DRDO scientists said. BrahMos variants can be launched from land, air, sea and under water.

India successfully launched the world's fastest supersonic cruise missile from a Sukhoi-30 MKI combat jet for the first time against a target in the Bay of Bengal in November, 2017, they said.

The missiles land and naval variants are already in service. At least two Su-30 squadrons with 20 planes each are planned to be equipped with the air-launch variant BrahMos missile, 500kg lighter than land/naval variants.

India has already extended the range of the three-tonne missile from its earlier 290km to 400km and successfully test-fired the variant in March 2017. Increasing the missile's range from 400km to further 800km is now possible after India's induction into the Missile Technology Control Regime (MTCR) in June 2016, they said.

Prior to that, India was bound by restrictions that limited the range of the missile, which is an Indo-Russian joint venture product, to less than 300km. Currently the Army is equipped

with three regiments of Block 111 version of Brahmos missile. Induction of the first version of BrahMos missile system in Indian Navy began with INS Rajput in 2005. It is now fully operational with two regiments of the Army, said the scientists.

After two successful test trials of BrahMos missile from INS Kolkata in June 2014 and February 2015, the test firing from INS Kochi on 30 September, 2015, had validated the newly commissioned ship's systems. The air launch version and the submarine launch version of the missile system are in progress.

So far, the Army has placed orders for the BrahMos missile which are to be deployed by three regiments. Two of them are already operational. The last land-based trial was conducted from the same base on 11 March, 2017 successfully.

Battle ready: Dhanush artillery gun clears final trials

The indigenously upgraded artillery gun Dhanush has successfully completed final user trials and is ready for induction into the Army. Dhanush is an upgraded version of the Swedish Bofors gun procured by India in the mid- 1980s. "This was the third and final phase of user exploitation firings in which six Dhanush guns were fired in battery formation from May 31 to June 7, 2018 at the Pokhran field firing range. A total of 301 rounds were fired from the six guns, including burst fire," said Dr.Uddipan Mukherjee, public relations officer of the Ordnance Factory Board (OFB), in response to a questionnaire from this newspaper.

The first phase of trials were conducted between July and September 2016 at the Pokhran and Babina ranges and the second phase was conducted between October and December 2016 at the Siachen base camp with three guns. A total of 1,520 rounds have been fired in all the three phases.

Tested in all terrains

During the trials, the guns travelled extensively

in towed/ self-propelled mode in desert and high-altitude terrains with each gun clocking over 1,000 km, demonstrating their mobility.

Dr. Mukherjee said the next step was the completion of general staff evaluation, after which Bulk Production Clearance (BPC) will be accorded. The OFB already has an indent from the Army for 114 guns and will start supplying the guns on receipt of the BPC. "The OFB has already supplied six guns for battery firing during the user trials. Another 12 guns will be issued within a year on receipt of the BPC," he stated.

The entire order of 114 guns is to be delivered within four years. To meet the requirement, the Board has undertaken capacity augmentation to manufacture over 400 barrels and 250 ordnances for large-calibre weapon systems, Dr. Mukherjee said, adding that the OFB was confident of producing eight to 10 guns per month within two to three years. As of now, the gun has over 80% indigenous content. The imported systems include the power pack, parts of the electronic suite, and some seals and bearings.

Women's health crucial to combat stunting: study

A first of-its-kind study across all 640 districts of the country highlights the impact of women's health on stunting of children.

According to the International Food Policy Research Institute (IFPRI) study, analysing data from the National Family Health Survey (NHFS)-IV, parameters related to women, including education and age at marriage, account for 50% of the difference between districts with high and low levels of stunting among children below the age of five.

Across the country, in 239 districts more than 40% of the children are stunted, while 441 districts record between 30% and 40 % of stunting. Only 29 districts have levels between 10% and 20%, most of them in South India, the study reports.

South does better

India accounts for approximately a third of the world's stunted children at 63 million.

While levels have improved in the country from 48% in 2006 to 38.4% in 2016, there are wide variations among different districts ranging

between 12.4% and 65.1%.

The populous northern States account for more than 80% of stunted children at 52.6 million. In comparison, all of the southern States together have 8.1 million stunted children and the north-eastern and island States account for nearly 2.4 million. Within the States, however, the levels vary with regions in Andhra Pradesh and Karnataka recording high prevalence.

The research highlights the need for targeted policy intervention to combat stunting, with a focus on addressing critical determinants in individual districts.

“Women related parameters are great drivers and these have to be focussed upon. This will involve interventions through the course of a girl’s life such as her education, nutrition, marriage as well as when she is a mother,” says Purnima Menon, senior research fellow at IFPRI.

Four parameters

The four crucial parameters in women that together contribute to a 44% reduction in stunting among children are levels of body mass index accounting for 19% of the difference between districts; education accounting for 12% of the difference; age at marriage contributing a 7% reduction and ante-natal care adding 6%.

Among other important factors highlighted by the study, authored by Purnima Menon, Rashmi Avula, Derek Headey, Phuong Ngyuen, are adequate diet for children (9%), household assets (7%) and open defecation (7%).

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MISCELLANEOUS

Bronze Age Egyptians' strategy holds a message for our civilisation

More than 3,000 years ago the queen of the Hittites, who lived in what is now Turkey, sent a clay tablet to Ramses II, the Egyptian pharaoh, with an SOS: "I have no grain in my lands."

Previously, the two kingdoms had been at war. Now a severe drought was carving a path of destruction through the ancient Levant, killing crops, cattle and people.

Egyptians and Hittites

But the Egyptians, unlike the Hittites, had anticipated a crisis and planned ahead for a food shortage, researchers at Tel Aviv University say. And in an attempt to stabilise their borders, the pharaohs appear to have mounted a relief effort, sending grain to their former enemies.

In a study published in this year's edition of the journal Egypt and the Levant,the researchers pieced together ancient evidence — including flint and bone records from the fallen city of Megiddo, fossilised pollen data from the Sea of Galilee and ancient cattle DNA — to shed light on how Bronze Age Egyptians foresaw and planned for a drought that would last from around 1250 B.C. to 1100 B.C.,while their ancient counterparts appeared to be less well prepared.

Even with preparation, however, the Egyptian empire ultimately collapsed. But the study shows how recognising and preparing for climate disaster can make societies more resilient.

"All this put together, you see a picture of a crisis and the reaction of an empire in order to try to stabilize the situation," said Israel Finkelstein, a professor of archaeology at Tel Aviv University and the lead author of the paper. "For a while they managed, and then it was too late."

Prescient pharoahs

For about a decade, archaeologists have known that widespread drought in the Mediterranean was a culprit in the fall of civilisations there in the Late Bronze Age. But it is only in this latest study that evidence of the pharaohs' prescience has emerged: In anticipation of a crisis in their empire's southeastern arid zones, ancient leaders ordered increased grain production in its greener parts, and

crossbred local cattle with zebu, or humped cattle, to create a more heat-resistant plow animal, the researchers found.

At the ancient ruins of Megiddo in northern Israel, Finkelstein and his colleagues also discovered sickle blades used for harvesting grain, and an unusually high frequency of cattle bones. The age of those bones indicates that the animals were used for plowing crops, rather than eaten, explained one of the paper's authors, Lidar Sapir-Hen, an archaeo-zoologist from the Steinhardt Museum of Natural History at Tel Aviv University.

These agricultural feats managed to extend the life of the Egyptian empire about half a century longer than it might otherwise have lasted, according to the archaeologists. The lesson for our own civilisation — which is likely to face increasingly severe droughts as humans change the climate far faster than nature has ever done — is to plan ahead, Finkelstein said. "This collapse of the Late Bronze Age is not just a matter of ancient history that has no relevance to us," said Eric H. Cline, a professor of classics and anthropology at George Washington University, who worked at the Megiddo site for two decades but was not involved in this latest study.

Just as drought was among the "stressors" leading to famine and war during the Bronze Age, Cline said, today's droughts could amplify existing problems.

"It's a perfect storm: You've got not just drought and famine but there's also earthquakes, there's also invaders, and that's what causes collapse," he said, referring to a confluence of events which some think led to the end of the Bronze Age, which included powerful earthquakes in the region, and the invasion of the Levant by a group known as the Sea Peoples. The ancient world, like our own, was interdependent and suffered a "domino" fall, Cline added.

Coping mechanisms

Gavin A. Schmidt, the director of the Goddard Institute for Space Studies at NASA, said that in some ways, modern civilisation had not advanced much in its coping mechanisms for climate crises. "If the sea is rising, you either get out of the way, or you get flooded; if there's a drought, you either plant more drought-resistant crops, or you die," he said. But, he added, modern humans possess much better predictive power and are therefore "the first generation who is able to take mitigation seriously."

Yet many countries are still behind on goals set as part of the 2015 Paris climate agreement. “This is the tragedy,” said John F. Haldon, a historian at Princeton University who studies how ancient civilisations coped with climatic upheaval. “Everyone’s aware of the problem but there’s a massive stasis in the system.”

If a civilisation’s leadership “has feet of clay and isn’t willing to take the challenge on in an innovative way,” Haldon said, “then often the challenge will overcome them.”

Present-day humanity may have the resources and tools to deal with climate change, Haldon said, but action is often stifled by those who have a vested interest in denying the reality of human-caused climate change. “We seem to have the idea that people in ancient times or people in the past generally weren’t quite as clever as we are, but Homo sapiens is Homo sapiens, ” he said.

“If it’s something that we are creating — and we see what happened the last time — I think we’d be foolish not to take steps to stop it,» Cline said. “The problem is when we have deniers,” he added. “Then we’re no better off than the Hittites.”

The chicken and egg story: The vital role of the shell

The chicken egg and its shell have been the subject of research by various groups of scientists. Typically, a hen lays about 300 eggs per year, so close to one a day, during which it takes about 25-26 hrs for the egg and its shell to form fully. After laying the egg, it takes about 21 days for the laid egg to hatch. Dr. Marvin A. Tung’s Ph.D. thesis at the University of British Columbia, Vancouver, Canada, in 1967 was devoted to the physical, chemical and rheological studies of the hen’s egg (<http://open.library.ubc.ca >media >pdf>), where he points out that the egg can withstand a vertical load of up to 4 kg, when pressed along its minor axis and that the shell stiffness is most important in offering it protection against crushing. Each hen’s egg is about 60 grams in weight and has about 6 grams of mineral in the shell which provides hardness.

About 200 years ago, the German mineralogist Frederich Mohs devised a scale to estimate the

hardness of materials. Taking diamond to be the hardest (by giving it a scale value of 10), the precious stone topaz was assigned a value of 8, quartz 7, and the mineral stone apatite (calcium phosphate) the value of 5.The tooth enamel in our mouth thus has a value of 5, since it is largely made of hydroxyl-apatite; it is thus the hardest mineralized tissue in our body; fingernails are only 2.5 while calcite (calcium carbonate) is harder, having a value of 3. The eggshell of chicken, which has calcite in it, is thus sufficiently hard to be protected from breaking. But then how does the fertilized newborn baby chick with its tiny beak manage to break the egg and come out into the world?

The answer to this puzzle has recently been published by a group led by Dentistry and Anatomy and Cell Biology Professor Marc McKee of McGill University inMontreal, Quebec, Canada, in the journal Science Advances (Sci Adv.2018;4:eaar3219). The group collaborated with Professor Richard Chromik of Mining and Materials at the same university, along with other scientists in Canada, Spain, Germany and the US, to determine the fine structure of the chicken eggshell. The shell is about 0.36 mm overall thickness, but has sub-layers, with different structure and protein composition.

The structure, composition and mineral content of the eggshell has been studied in some detail, previously, by an international group led by Professor Maxwell Hincke of the University of Ottawa, Canada, in collaboration with colleagues from France, Germany, Spain and Canada (see Hincke et al., Frontiers in Bioscience, 17,1266-1280,2012; free access on the web). Their work, as well as that of others, has determined that as many as 500 proteins are identified in the eggshell, and they have specifically focused on the major proteins ovocleidin (ovo-egg, kleidon-lockup) and ovocalyxin (ovo-egg, kalyx-bridge) and a third one called osteopontin (osteo-bone, and pont-a Latin word meaning bridge).

The shell is thus a composite material having a combination of minerals (calcite at 96% by weight) and the rest containing trace elements and so-called matrix proteins. The shell has been optimised by evolution for hundreds of millennia since the time of the dinosaurs and even before that during the transition of animals from marine to terrestrial

environments. The positive surface charges of calcium in calcite crystals bind the negatively charged matrix proteins like osteopontin, making a functionally cohesive biomineral composite.

The researchers have sliced the eggshell to view five sub-layers and examined each of those with advanced microscopy techniques and hardness testing. They discovered that, in the very thin slices, there was a nano-scale structure to the biomineral. The dimensions of the nanostructure varied from being the smallest in the outermost layer (30 nm) through 33, 59 and 74 nm, way down to the innermost layer which is 68 nm thick, all of which intimately covers the egg where development and growth of the chick is occurring. The innermost layer, called the mammillary layer, was softer, and slowly dissolved away its nanostructure to provide the growing chick with the calcium necessary to make its skeleton. The shell thus not only protects the growing chick, but also provides essential calcium mineral ions. This dissolution and thinning of the shell also allows for the hatching chick to break open and emerge to the outside world.

Over 50 years ago, a team of Japanese scientists had filmed the complete development of a chick from the egg, showing what happens day by day in the 21 days that it takes for the chick to form from the egg and come out to the world. Alas, that remarkable film is not readily available now, but a shorter (2 minute-long) video, called “Chick Embryo Development”, produced by the Poultry Hub in Australia, is available on YouTube, and is well worth watching. Looking at it, one marvels at how evolution has made sure how to protect the birth, growth and emergence of a new generation by encasing the embryo safely inside a hard-to-break-shell. With the understanding of each of the layers of the shell, we now have a better understanding of this remarkable protective structure, within which a new life is born.

Bacteria help remove sulphur from fossil fuels

Using novel bacterial strains, scientists have successfully removed sulphur from fossil fuels such as petroleum and coal. Sulphur is one of the major pollutants emitted during the combustion of fossil fuels.

Scientists from CSIR-Institute of Minerals and Materials Technology (CSIR-IMMT) in Bhubaneswar

used four bacterial strains that use dibenzothiophene (an organic sulphur compound which is a major contaminant of fossil fuel) as an energy source thereby getting rid of the sulphur.

Bacterial strains

To find novel bacterial strains that can selectively eliminate this organic sulphur, the researchers searched the microbial type culture collection (MTCC) of CSIR-IMTECH (Institute of Microbial Technology) and selected 10 bacterial strains with dsz genes.

"The dsz genes are central to sustainable bio-desulfurization. The presence of dsz genes and the metabolites which take part in desulfurization were first screened. We have also used bio-informatic tools for phylogenetic studies. More studies can reveal new bacterial species for desulfurization of coal," says Madhabi M. Bhanjadeo, PhD scholar at the institute in an e-mail to The Hindu.Ms. Bhanjadeo is the first author of a paper published in the journal PLOS ONE.

The selected bacteria were grown in a medium supplemented with dibenzothiophene and other nutrients required for growth. They found that four bacteria were able to use almost 99% of the sulphur compound in just 10 days.

The four strains are Rhodococcus rhodochrous, Arthrobacter sulfureou, Gordonia rubropertinita and Rhodococcus erythropolis.

"Since the sulphur-specific cleavage is vital for organic sulphur removal, we explored potential bacterial strains that desulphurise through a specific pathway (4-S pathway). Usual end products of this pathway are 2-hydroxy biphenyl and sulphate ions but in our study two of the bacterial strains are devoid of these end products, suggesting a variation in the pathway. The novel bacteria hold hidden pathways that we are yet to be explored," says Dr. Umakanta Subudhi, from CSIR-IMMT and corresponding author of the paper.

Ecofriendly

The new process is also eco-friendly and economical, and these new bacterial strains can be potentially explored for the removal of sulphur from fossil fuels on a commercial scale.

How Oman's rocks could help save the planet

In the arid vastness of this corner of the Arabian Peninsula, out where goats and the occasional

camel roam, rocks form the backdrop practically every way you look.

But the stark outcrops and craggy ridges are more than just scenery. Some of these rocks are hard at work, naturally reacting with carbon dioxide from the atmosphere and turning it into stone.

Veins of white carbonate minerals run through slabs of dark rock like fat marbling a steak. Carbonate surrounds pebbles and cobbles, turning ordinary gravel into natural mosaics.

Even pooled spring water that has bubbled up through the rocks reacts with CO2 to produce an ice-like crust of carbonate that, if broken, re-forms within days.

Scientists say that if this natural process, called carbon mineralisation, could be harnessed, accelerated and applied inexpensively on a huge scale — admittedly some very big "ifs" — it could help fight climate change. Rocks could remove some of the billions of tons of heat-trapping carbon dioxide that humans have pumped into the air since the beginning of the Industrial Age.

And by turning that carbon dioxide into stone, the rocks in Oman would ensure that the gas stayed out of the atmosphere forever.

"Solid carbonate minerals aren't going anyplace," said Peter B. Kelemen, a geologist at Columbia University's Lamont-Doherty Earth Observatory who has been studying the rocks here for more than two decades.

Capturing and storing carbon dioxide is drawing increased interest. The Intergovernmental Panel on Climate Change says that deploying such technology is essential to efforts to rein in global warming. But the idea has barely caught on: There are fewer than 20 large-scale projects in operation around the world, and they remove carbon dioxide from the burning of fossil fuels at power plants or from other industrial processes and store it as gas underground.

What Kelemen and others have in mind is removing carbon dioxide that is already in the air, to halt or reverse the gradual increase in atmospheric carbon dioxide concentration.

Although many researchers dismiss direct-air capture as logistically or economically impractical, especially given the billions of tons of gas that would have to be removed to have an impact, some say it may have to be considered if other efforts to counter global warming are ineffective.

If billions of tons of CO2 are to be turned to stone, there are few places in the world more suitable than Oman, a sultanate with a population of 4 million and an economy based on oil and, increasingly, tourism. The carbon-capturing formations here, consisting largely of a rock called peridotite, are in a slice of oceanic crust and the mantle layer below it that was thrust up on land by tectonic forces nearly 100 million years ago. Erosion has resulted in a patchy zone about 200 miles long, up to 25 miles wide and several miles thick in the northern part of the country, including here in the outskirts of Ibra, a dusty inland city of 50,000. Even the bustling capital, Muscat, on the Gulf of Oman, has a pocket of peridotite practically overlooking Sultan Qaboos bin Said's palace.

Peridotite normally is miles below the earth's surface. When the rocks are exposed to air or water as they are here, Kelemen said, they are like a giant battery with a lot of chemical potential. "They're really, really far from equilibrium with the atmosphere and surface water," he said.

The rocks are so extensive, Kelemen said, that if it was somehow possible to fully use them they could store hundreds of years of CO2 emissions. More realistically, he said, Oman could store at least a billion tons of CO2 annually. (Current yearly worldwide emissions are close to 40 billion tons.)

While the formations here are special, they are not unique. Similar though smaller ones are found in Northern California, Papua New Guinea and Albania, among other places.

The rocks here may be capable of capturing a lot of carbon dioxide, but the challenge is doing it much faster than nature, in huge amounts and at low enough cost to make it more than a pipe dream.

One possibility, Kelemen said, would be to drill pairs of wells and pump water with dissolved CO2 into one of them. As the water traveled through the rock formation carbonate would form; when it reached the other well the water, now depleted of CO2, would be pumped out. The process could be repeated over and over.

Experiments and eventually pilot projects are needed to better understand and optimise this process and others, Kelemen said, but so far Omani officials have been reluctant to grant the necessary permits.

The researchers may need to go elsewhere, like California, where the rocks are less accessible but

the state government has set ambitious targets for reducing emissions and is open to new ways to meet them.

Novel technique to detect paraffin oil contamination in coconut oil

Using a novel approach, researchers at Indian Institute of Technology (IIT) Madras have for the first time been able to use mass spectrometry to analyse various saturated and unsaturated hydrocarbons directly from solutions. Ionising the constituent molecules of a hydrocarbon sample for detection using mass spectrometry has not been easy till date as hydrocarbons do not tend to lose or gain electrons to form ions.

Using the novel technique — laser-assisted paper spray ionisation mass spectrometry — the research team led by Prof. T. Pradeep from the institute's Department of Chemistry could detect various hydrocarbons, importantly, paraffin oil contamination in coconut oil samples. Though it is common knowledge that vegetable oils are adulterated, the extent of contamination with paraffin oil was as much as 10%. "It was shocking to see such high levels of mineral oil contamination in coconut oil meant for cooking," says Prof. Pradeep. "We could detect down to 1% paraffin oil present in coconut oil."

The results were published in the journal Analytical Chemistry.

Detecting ions using paper spray ionisation mass spectrometry is known already. In this method, a regular filter paper containing the sample is subjected to high electrical potential and the charged droplets and the ions derived from them are analysed using a mass spectrometry. But this method cannot be used for detecting hydrocarbons.

Humble but handy

So the researchers turned to the humble laser pointer used commonly during presentations to turn the stubborn hydrocarbons to emit ions for the measurement. Tiny amounts of the sample to be analysed were added to the filter paper kept at about 10 mm from the mass spectrometer and subjected to an electrical potential of 1 kV. Ionisation of hydrocarbon molecules began the moment the tip of the paper containing the sample was exposed to the laser.

The hydrocarbons molecules present in the sample get trapped between the cellulose fibres that make

up the paper. “And when an electrical potential is applied, the molecules experience an intense electric field. This is because the molecules are trapped between the fibres which are about 10 microns apart,” says Prof. Pradeep.

“When 1 kV potential is applied, the electric field experienced by the molecule is comparable to the field experienced by electrons moving around the nucleus, but not sufficient enough for them to jump out. When we shine the laser, the small energy supplied is enough to cause ionisation,” explains Prof. Pradeep.

Different potentials had to be applied to cause different hydrocarbons to get ionised for the same laser. “If we modify the filter paper by coating it with carbon nanotubes, then the fibres will be in the nanometer range and the applied potential can be reduced to even 1 volt,” says Pallab Basuri from the Department of Chemistry, IIT Madras and first author of the paper. “This throws open new possibilities for detecting food adulteration, water quality and environmental contamination.” The detection limit of the analytes is in the range of nanogram quantities. According to Basuri, the paper strips containing the samples can be shipped to the place of analysis from remote locations. By varying the composition of the paper and structure of the fibres, it may be possible to store the paper strip containing the sample for future analysis.

First record of invasive aphid in Kashmir Valley

It’s bad news for Kashmir Valley, the fruit bowl of India. The brown peach aphid – an insect that attacks temperate fruit trees – has been recorded here for the first time. The spread of the aphid could affect the local economy which is dependant on fruit trees to a large extent, say scientists who documented the presence of the aphid in their recent paper published in Journal of Threatened Taxa.

Aphids feed on the saps of plants, attacking plant tissues that transport food to all different plant parts. The brown peach aphid Pterochloroides persicae is a notorious pest of peach and almond trees in the Mediterranean regions. In India, the aphid was recorded for the first time in the 1970s from Himachal Pradesh and Punjab.

Now, almost 40 years later, it has resurfaced in the Kashmir Valley, find scientists at Srinagar’s Central

Institute of Temperate Horticulture (CITH). Dr. G. Mahendiran and his team noticed the aphid in early 2013 in small patches near their institute. They collected live specimens and monitored them in the institute's peach and almond plantations between 2014 and 2016.

The tiny (nearly 3 mm long) aphids thrived best during the months of April, May, September and October. Though they were most 'prolific' between 20 and 22 degrees Celsius, write the scientists, the brown-and-white patched insects were active in temperatures as low as 3 degrees C. Peach trees were the preferred plants. Nymphs (baby aphids that hatch out of eggs) attain sexual maturity in a month and begin to produce more aphids. A single growing season in a year supported as many as six to eight such generations of aphids. However, there is some good news too. Several combinations and concentrations of natural chemicals including neem plant extracts and lavender oil can help control aphid numbers. The scientists also note that while the blood-red ant extracted honey dew from the aphid for food, wasps and several other parasites also preyed on the aphids.

Need for control

"But if the infestation is not controlled, the invasive aphid can spread fast," said CITH researcher Shahid Ali Akbar, one of the co-authors of the study. "It could definitely affect the economy of the Kashmir Valley." According to Akbar, the pest could have come with plants imported from other countries; the scientists are taking steps to ensure that the aphids do not spread along with the saplings they supply to several Indian states.

Agricultural landscape a crucial habitat for Bengal florican

The critically endangered Bengal florican – a grassland bird more threatened than the tiger – use not just protected grasslands but agricultural fields, too, find scientists. This suggests that conserving these cultivated areas could be as important as protecting the grasslands where these birds breed.

Fewer than 1,000 adult Bengal floricans remain in the world in two, very fragmented populations. One of them is in the grasslands of the terai, the fertile foothills of the Himalayas, which spans across Nepal and Indian states such as Uttar Pradesh. But how do these grassland dwellers deal with the monsoon, when the grasslands they dwell in gets flooded?

Researcher Rohit Jha of Dehradun's Wildlife Institute of India and a team from other organisations in India and Nepal came together to study the distribution, movements and survival of this poorly-understood population in the Indian subcontinent. They conducted 934 field surveys to spot floricans between 2013 and 2016 and studied the movement of eleven birds fitted with small satellite tags.

Their results show that during the monsoon (the non-breeding season), the birds had far larger home ranges. They moved out of protected grasslands and into low-intensity agricultural fields along large rivers – which were interspersed with grasslands, had no roads and very few people – to escape the floods common during this time. Floricans need alternating patches of short and tall grass to thrive, and till several decades ago, the large herbivores of the terai – such as rhinoceroses and swamp deer – would do this job of creating these perfect habitats, says Jha.

"But now there are fewer mega-herbivores left, so only dense, tall grasslands remain in protected areas," he says. "So this could be triggering this movement of floricans into fields."

Some of the tagged birds spent more than half a year in such fields, adds Jha. Hence, conserving these fields – by ensuring safe agricultural practices – could be as important as protecting the birds' grassland habitats.

Taking into account the floricans' preferences for grassland habitats, and with location data from their primary surveys, the team also tried to predict potential undiscovered populations of the birds in the area. Their analyses show that though the birds' habitats get severely fragmented towards the western parts of the Indian subcontinent, there could be some unrecorded populations of floricans in the states of Assam and Arunachal Pradesh which have not yet been surveyed. Jha hopes to go in search of these floricans in the immediate future.

PRL group deciphers climate variations recorded in stalagmite

Analysing bits of a stalagmite from Kotumsar cave in Central India, a collaboration involving researchers from Physical Research Laboratory (PRL), Ahmedabad, has revealed variations of the Indian summer monsoon over some 3,000 years, starting from 8,500 years ago to 5,600 years ago. The data shows fine resolution, allowing observers

to interpret sub-annual to sub-decadal variations in the monsoon, which can be used to understand climate, as well as to understand societal changes that took place in South Asia. The article is published in the journal Quaternary International.

Ancient rock

The Kotumsar cave is 35 metres below ground level and located in the Kanger Valley National Park of Chhattisgarh. It formed by slow dissolution of the Kanger limestone by water from the Indian summer monsoon (June to September) over hundreds of thousands of years. The team recovered the stalagmite rock sample with great difficulty. "When our team entered the Kotumsar cave, we had to crawl in a very suffocating and highly humid environment to look for a suitable sample," says Madhusudan G. Yadava, scientist with the Geoscience Division, PRL.

Of particular interest in understanding climate is the mid-Holocene, a period nearly 7,000 years back, during which rapid and significant changes took place that are supposed to have affected the cultural practices of early humans, such as agriculture.

Instrument-based records of climate do not go beyond a few hundred years, whereas to study paleoclimate, we need data that span thousands of years. The piecing together of paleoclimate is done using indirect records such as tree rings. One such record is held by the so-called speleothems – rocks that were formed in caves over several years by the deposition of water from monsoon. Just like tree rings, these also hold records of seasonal variations.

Mega droughts

The team used Uranium–Thorium dating to study the sample, for which the sample had to be sent to National Taiwan University in Taipei. "It took more than a year to get results from Taiwan," says Dr. Yadava. The U–Th dating requires careful handling under clean lab environment and also takes a lot of time. "Initially, we tried the radiocarbon dating method in PRL itself. It showed inconsistent results, indicating that the radiocarbon method is not suitable for this sample," adds Dr. Yadava.

The main answers the team sought were whether there were abrupt changes in the monsoon in the past, and, if so, what were the possible causative factors. The team found that at the beginning of the mid-Holocene, from 8,500 years ago to 6,500 years ago, the monsoon had started declining. The team also noticed 70–100-year-long mega drought

events. They also noticed that, gradually, the summer monsoon increased between 6,500 years ago to 5,600 years ago.

They also find a correlation between the variations in the Indian summer monsoon during the mid-Holocene and the El-Nino Southern Oscillation.

Shraddha T Band, first author of the paper, who is now a post-doctoral fellow in Academia Sinica in Taiwan, asserts how reconstruction of the paleomonsoon helped them understand various climate parameters modulating the monsoon dynamics at different timescales.

"Such studies at higher resolution may assist climate modellers in predictions of temperature and rainfall… Further speleothem analysis from the core monsoon zone of India may help link the Indian summer monsoon with the climate variability in the North Atlantic," she adds.

A step closer to Star Trek-style cloaking device

Scientists have developed a material that makes an underwater object invisible to sonar detectors, an advance that brings us a step closer to Star Trek-style invisibility cloaks.

A cloaking device is a fictional stealth technology that can cause objects, such as spaceships or individuals, to be partially or wholly invisible.

Now, researchers at Pennsylvania State University in the US are taking the introductory steps to make acoustic ground cloaks.

Metamaterials commonly exhibit extraordinary properties not found in nature, like negative density. These materials redirect approaching waves around an object without scattering the wave energy, concealing the object from the sound waves.

Metamaterials

To date, most acoustic metamaterials have been designed to deflect sound waves in air.

Amanda D Hanford from Pennsylvania State University decided to take this work one step further and accept the scientific challenge of trying the same feat underwater.

Acoustic cloaking underwater is more complicated because water is denser and less compressible than air.

These factors limit engineering options, researchers said. After multiple attempts, the team designed a three-foot-tall pyramid out of perforated steel plates. They then placed the structure on the floor of a large

underwater research tank.

Inside the tank, a source hydrophone produced acoustic waves between 7,000 Hz and 12,000 Hz, and several receiver hydrophones around the tank monitored reflected acoustic waves. The wave reflected from the metamaterial matched the phase of the reflected wave from the surface. Additionally, the amplitude of the reflected wave from the cloaked object decreased slightly, researchers said.

These results demonstrate that this material could make an object appear invisible to underwater instruments like sonar, they said.

The results show potential to contribute to real-world applications, such as acoustic materials to dampen sound and appear invisible underwater.

What if India hadn't made friends with science?

Seventy-two years ago, colonial empires collapsed, and close to 80 countries across Africa, Asia and Latin America became free nations. And each new nation had to plan for its future. Yet, among these 80, India was the lone nation that "made friends with science" as a policy for development. No other nation did so; it was unique and far-reaching!

Our first Prime Minister, Pandit Jawaharlal Nehru declared: "The future belongs to science and those who make friends with science." For our growth and welfare as an independent, democratic nation, we chose science and technology as major instruments. A gallery of distinguished and patriotic scientists, technologists and thinkers were approached for advice, and their advice heeded. Within a decade of independence, our food production tripled; small pox was eradicated; harmonious sharing of the five Indus rivers with Pakistan was agreed upon; dams and waterways was built and five IITs, two agricultural universities and one AIIMS were set up. (Readers will surely add more). We reap the benefits of their advice to this day and have added more. What if we hadn't?

Was India prepared for this daring initiative? As it turns out, modern (Baconian) science had already taken root in Colonial India since the mid-1700s. (In a forthcoming issue of the journal Indian Journal of History of Science, stories of about 35 successful Indian practitioners of 'Western Science' in colonial India will be highlighted). And many of its distinguished practitioners and their students

were Indians in India. It was the meeting of minds of these scholars and the political leaders that made India modern.

It is now 70 years since Independence. How well has the practice of science transformed India? It is on this theme that the Indian National Science Academy (INSA) has come out with the book: "Indian Science: Transforming India — A look back on its 70-year journey; impact of science in independent India". It has 11 stories, written in a lucid and non-jargonian fashion by Drs. Adita Joshi (biologist and educator), Dinesh Sharma (journalist and science writer), Kavita Tiwari (biotechnologist and writer) and Nissy Nevil (physicist and science policy consultant). These articles showcase how: (i) modern science is the key; (ii) large scale applications are possible which can transform the economy of a nation; (iii) community participation is vital for understanding, acceptance and practice, (iv) a sense of daring or challenging existing mores is important and (v) how a ready adaptation of 'modern biology', and its use for general welfare is appreciated even by rural populations.

Adita Joshi writes on how the indelible ink, used to identify voters, was first developed by Dr Salimuzzaman Siddiqui, way back in the 1940s for the CSIR in Calcutta. (On an aside, it is worth noting here that after he moved to Pakistan in 1951, he became the father of modern science and technology of that nation, establishing the Pakistan Academy of Sciences, Pakistan CSIR, Pakistan Atomic Energy Commission and others. He was thus Colonial India's gift to Pakistan).

Dinesh Sharma gives an eminently readable chapter on how the information technology (IT) revolution came about. It comes as a revelation to read that Dr P. C. Mahalanobis (who started the Indian Statistical Institute, ISI) helped fabricate computing machines locally in 1943, and how one of the earliest (analog) computers was the joint baby of ISI and Jadavpur University. Sharma recalls the untiring efforts of Dr R. Narasimhan at TIFR Bombay in developing the TIFRAC digital computer, and salutes the legendary Dr V. Rajaraman, without whose timely books India would not have advanced so fast in IT. His books became the "Grey's Anatomy" for IT students!

Kavita Tiwari describes how organic chemistry gave birth in India to generic drugs, and how Dr Yusuf

Hamied of Cipla dared major multinational pharma companies and began making and selling anti-HIV drugs to needy patients in Africa for a dollar a day per patient — a Gandhian dare! A similar, though less dramatic, dare is the story of Shantha Biotechnics, who make and sell hepatitis vaccines for less than Rs 50 a shot.

Kavita also writes about India's White Revolution, and how community partnership and ownership was brought about by Mr Verghese Kurien, making India the largest milk producer in the world. Community participation again becomes the major source of success in the Lab-to-Land story by Adita on the Samba Mahsuri rice (developed by Dr Ramesh Sonti), and the story of Kavita on the shrimp aquaculture by the Coastal Indian fishermen.

An unusual and not well known success story, narrated by Nissy Nevil, is that of two engineers Arvind Patel and Dhirajlal Kotadia, who along with the computer expert Rahul Gayvala, invented the technique of laser-assisted cutting of diamonds and quickly made Surat the capital of diamond processing technology of the world. It is also interesting to note that Patel and Kotadia engaged in the famous Indian practice of "reverse engineering"— open up a machine, study its parts, understand them well and then start making the machine yourself.

There are surely more such examples that transformed India, and we hope INSA will bring out these too. The pdf of the present book is available free at http://www.insaindia.res.in/scroll_news_pdf/ISTI.pdf and the hard copy from Dr. Seema Mandal at < sci-soc@insa.nic.in> for a price. Books of this kind are important since they give a perspective of what all a country dedicated to science can achieve. We need more science and even more science to make our country shine. Technology helps a country grow, but science is vital for technology to be born and to grow. It is for this reason that Prof. C. N. R. Rao persuaded the government to establish several Indian Institutes of Science Education and Research (IISER), similar to the IITs but with a focus on science. Many of them are already among the best centres of science.

There is one gripe that many of us have, and that is, while the Central government is the major, indeed lone, supporter of research in these areas, why do the states not pitch in? And why do private industrial houses and foundations not spend even a rupee to fund competitive research? The late Dr K. Anji

Reddy was a refreshing exception. He said: "you do good science, and I will give you the money". When will today's industrialists ever learn?

Paper-based electrodes show superior water-splitting efficiency

Using paper coated with nickel nanoparticles and model catalysts as electrodes, researchers at Indian Institute of Science Education and Research (IISER) Kolkata have been able to split water and generate oxygen and hydrogen gas with very low overpotentials (voltage applied over and above the theoretical voltage to split water). The flexible electrodes recorded 98% water-splitting efficiency and maintained robustness and durability even after more than 10 continuous days of operation.

The current produced by the nickel-coated paper electrodes remained constant even when the material was subjected to extreme deformation — bending up to 180 degree. Similarly, the electrodes remained stable even when the electrolyte (potassium hydroxide) was made highly corrosive — more than 10 days of continuous operation at 1M (pH 14) and at least 12 hours at 10 M concentration.

The researchers led by Prof. Sayan Bhattacharyya from the Institute's Department of Chemical Sciences showed that their method could be extended to other common substrates such as a cotton cloth which has similar structural characteristics like paper.

"Besides using it as paper-based electrodes, this is a platform technology for multiple applications. We are currently testing the nickel-coated paper as a glucose biosensor for detection of diabetes. It can be used in resource-poor settings," says Prof. Bhattacharyya. The team has used their electrodes to fabricate wearable paper-based batteries.

Porous surface

"The paper-electrode has highly porous catalytic surface and this increases the kinetics of the reaction — ability of water molecules to reach the active sites in the electrode. The high porosity is responsible for the high efficiency of the paper-electrode," says Atharva Sahasradudhe from the Department of Chemical Sciences, IISER Kolkata and first author of a paper published in Nature Communications.

The porous nature of the paper and abundance of functional groups on cellulose microfibres help in strongly binding different metal ions and finally nickel nanoparticles in a three-step immersion process.

Coating the paper with nickel makes it electrically conductive. The nickel-coated paper is then coated with two different catalysts (nickel-iron oxyhydroxide and nickel-molybdenum alloy) to serve as an anode and a cathode.

Splitting water to generate oxygen and hydrogen gas requires cost-effective and stable catalysts that have high activity — generate higher current at lower applied voltage. The more current produced the more will be amount of water split and hydrogen gas produced.

The researchers were able to split water and generate oxygen when the voltage applied (on top of the theoretical voltage to split water) was as low as 240 millivolt to get a current density of 50 milliamperes per sq.cm. In the case of hydrogen, the applied voltage was just 32 millivolt to generate 10 milliamperes per sq.cm current density. “The porosity increases the ability of the water molecules to reach the catalytic sites where the molecules get split into hydrogen and oxygen gas,” says Sahasradudhe.

The researchers also used nickel-coated paper electrodes that had no catalysts. According to Prof. Bhattacharyya, the paper electrodes coated with only nickel, which can be used both as anode and cathode for splitting water, had far better performance than other such catalysts reported till date.

The team achieved “excellent” water splitting ability when nickel-paper electrodes coated with catalysts were used in electrolysis cells.

The total cell voltage required was merely 1.51 V at 10 milliamperes per sq.cm current density. “The lower cell voltage required to split water reflects the performance of the electrodes. This is one of the lowest reported values for water splitting in basic medium,” says Prof. Bhattacharyya.

Novel initiative to encourage science communication

In an effort to encourage and equip PhD scholars and post-doctoral fellows with skills to communicate science with lay people, the Department of Science and Technology (DST) plans to reward students who write popular articles about their research. The articles can either be submitted to DST directly or published in newspapers.

The Augmenting Writing Skills for Articulating Research (AWSAR) initiative will each year reward

100 best articles by PhD students with cash prize of Rs.1,00,000 each and a certificate of appreciation.

The reward for post-doctoral fellows will be Rs.10,000 each and a certificate of appreciation for 20 best articles.

According to Dr. Rashmi Sharma, scientist at DST and in-charge of the AWSAR programme, DST is planning to reward the first batch on February 28, 2019, the National Science Day.

DST is expecting at least 5,000 articles from PhD students and about 1,000 articles from post-doctoral fellows. DST will soon make a call for article (1,000-1,500 words) submission.

"There is a yawning gap between research being done in labs across the country and what the public knows. The intent of the programme is to inculcate popular science writing skills and bring science closer to the society," says Dr. Sharma.

Students will be encouraged to write at least one popular science article during the tenancy of their scholarship.

"Science communication is an important activity for scientists and is a part of doing science. Yet, the importance of communicating with lay audience is not emphasised early on and those who do it are not rewarded," says Prof. Ashutosh Sharma, Secretary, DST. "We want to change this by producing a group of people who can translate their research work into popular science articles."

"We have very few science journalists in India and newspapers in general do not publish stories of science done here in India though they carry stores of research carried out in other countries. I personally know many researchers here doing research similar to the ones reported from abroad," he says.

Prof. Sharma is of the view that writing popular articles related to their research will allow PhD students and post-doctoral fellows, who are narrowly focussed in their research areas, to gain a wider view and gain insights into how their research will address the challenges and needs of the society.

The programme allows students to write only about their research. "Students understand their research better and so will have to build on the core competence to communicate their work to lay people through popular articles," Prof. Sharma says. "This initiative will only complement and not duplicate the traditional model of science reporting by journalists. We need both models of science communication."

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Conquering the emperor of maladies

The title that the cancer specialist, Dr Siddhartha Mukherjee chose for his Pulitzer-prize winner book on cancer was "The Emperor of All Maladies." It signifies both the awe and a sportsman-like admiration of the challenge posed by the opponent, cancer. Earlier in 1971, President Richard Nixon of the US, on a similar vein, declared a "war on cancer," with a federal funding of $1.4 billion. And over these 47 years, the US National Cancer Institute alone has spent $90 billion on the war on cancer. We are yet to win.

Each year, 1.73 million new cancer cases are reported in the US, with apparently one cancer death every 20 minutes. In India, it is 2.5 million people, with one death every 8 minutes. It is thus urgent and vital that solutions be found for this deadly disease, which has been with us since the dawn of civilisation.

Cancer occurs when an otherwise healthy cell is damaged, leading to uncontrolled growth, affecting the health of the body. Damage can occur either because of inborn or inherited errors in one or more genes affecting the cell, or due to lifestyle and environmental factors. While normal cells are programmed to multiply and grow to a certain size and stay so, cancer cells, whose DNA is mutated by such damage, go on rampant growth leading to tumours. The cancer specialist removes these errant cancer cells and tumour by medication or surgery. But the big challenge is not the first treatment alone, but that it should not recur and/or metastasise (move to and affect other parts of the body). The fight against cancer is thus to uproot the cause of the damage once and for all.

Immunity

It is here that we turn to the in-built defense mechanisms in the body. These are through the immune system, which is a complex network of cells, tissues and the molecules they make to help in fighting infections and other diseases, including cancer. White blood cells play the main role here. In particular, there is the group of cells called B-lymphocytes which recognise the shape of the molecules in the invader, and make proteins called antibodies which lock on to the invader and removes it. (Importantly, this shape is 'remembered' so that when a fresh attack by this same invader occurs, B cells are prepared!) Another set called T cells release chemicals that push the invading cells

to commit suicide. In this process, these T-killer cells are aided by a group called T-helper cells. In addition, there is another group called dendritic cells which help activate both the B- cells and T-killer cells, enabling them to respond to specific threats.

Each cell has on its surface a little marker, a small molecular ID- card or a biometric, called an antigen. These are small molecular fragments found on the cell surface. Antigens in the normal cells of the body are recognized as "self" by the immune system of the body and left alone. But when "foreign" cells such as those of an invading microbe or virus enter the system, their 'non-self' antigens are detected, attacked and thrown out of the body by the B and T lymphocytes.

This is also the basis of vaccines. In a vaccine, we introduce the disease- causing germs (either in the dead from or highly- disabled "live" form) into the body. This causes the immune system to recognise the "non-self" foreign antigen, grab it (using the antibody proteins) and throw it out of the body. Plus, the immune system 'remembers' this non-self-antigen and when the invader comes again, has the B cells make antibodies against it and remove it from the system, thus offering protection for a long time. This is the basis behind vaccination against many diseases, including cancer-causing viruses such as human papilloma virus (HPV) and the hepatitis B and C viruses.

Once bitten, twice prepared

How is this relevant to other forms of cancer? Cancer cells too have antigens on their surface. These form the cancer-associated antigens, including some that have not been seen previously by the body's immune system. These are called neo-antigens. They are foreign to the body, and come from the invader.

In the current excitement on the cure of the cancer, this idea of using our immune system and make an anti-cancer vaccine is on the high table. This is not a preventive vaccine (as the HPV or hepatitis vaccines are) but a therapeutic (or treatment) vaccine. Here, the doctor first treats the cancer by existing methods. In order that it does not recur, nor metastasise, he/she then takes a piece of the cancer tissue from the patient, and has the neo-antigens identified. Next, he/she works with a group of scientists who use computer methods to check which fragment will trigger the patient's immune system best to fight the cancer cells. The so-chosen

neo-antigen is used to make the vaccine, and once the vaccine is made, use it on the patients to protect them from further recurrence of the illness and thus get rid of the cancer, hopefully forever.

Some cancer vaccines are already in the market; for example, HER2 against breast cancer, Provenge against prostate cancer, and T-VEC against melanoma. Increasingly though, some researchers want to read the patient's genome, sequence the DNA or RNA of the tumor there, identify the mutations therein and make a specially constructed 'personalised' vaccine for the individual. The emperor may hit and maul. But now that we are adopting the Boys Scouts slogan, "Be Prepared", will his days be numbered?

Why do rock lizards display varied behaviour?

Lizards may perform comical push-ups, head bobs or suddenly transform from a stunning crimson body colour to a paler shade in just a few seconds, but this is no game. A recent study on male rock agamas published in Frontiers in Ecology and Evolution shows that such 'signals' advertise their quality to prospective mates and competitors.

An animal's quality or 'fitness' — measured by how successfully it obtains mates and reproduces — is an important concept in evolution, showing how well an animal's 'strategy' does in nature. So what do these males do to win females over?

Multiple signals

To find out, Shreekant Deodhar and Kavita Isvaran of Bengaluru's Indian Institute of Science studied all behavioural and physical (changes in body colour) signals displayed by 41 wild male rock agamas throughout the lizards' lifespan (for around 2.5 years) in Andhra Pradesh's Rishi Valley. They found that males used multiple signals, including head bobs, push-ups and neck flap extensions. Males often used these traits all at once; the frequency of most of these traits increased with the number of females in the vicinity, suggesting that these signals — directed towards females — are maintained by female choice.

"These behaviours may help females judge a male's quality quickly and more accurately," says lead author Deodhar. "It is often [energetically] costly to display all these signals together, and if a male does this, it can indicate his quality."

But there are costs to such flamboyance: it attracts predators and fellow competitors. The scientists found that most of these displays reduced in the presence of predators, proving that predation risk too played a role in the use of signals. Some colour-changing traits could be aimed at multiple receivers including competitors, but detailed experimental studies would be necessary to understand this better, says Isvaran.

Rare evidence

The team also quantified male 'fitness', which is usually extremely difficult to measure in the wild. Observing males throughout their lifetimes, Deodhar noted how many females each male had access to per day and 'breeding tenures', the time for which males occupied territories during the breeding season (the longer this time, the more the access to females). Males that signalled more had longer breeding tenures; thus these signals are relevant biologically because they also affected lifetime reproductive success.

"The biological relevance of this finding is also exciting because it is often difficult to follow individuals across their lifetimes," says Isvaran.

Agamas are well suited to answer this question because they have short lifespans, perform very unusual displays and live in open habitats which makes it easy to study their behaviour, she adds.

Sharp drop in tobacco smoking in India, says WHO report

Problem of chewing tobacco in country not addressed, say experts

From 19.4% in 2000, the prevalence of smoking tobacco in India dropped down to 11.5% in 2005, according to a World Health Organization report released on Thursday.

The report projected the prevalence to drop down further to 9.8% by 2020 and 8.5% by 2025.

"The prevalence of tobacco use has decreased more slowly in low and middle-income countries than in high-income countries, because the introduction of strong tobacco control policies by low and middle-income countries is impeded by relentless lobbying from the tobacco industry", it stated.

While the report only covered tobacco usage in the form of smoking, India has a large

population of chewing tobacco users, thus posing additional burden.

Experts said the decrease therefore is nothing to rejoice over. “The drop in smoking prevalence is in sync with the Global Adult Tobacco Survey (GATS) outcome. However, India has a unique problem of chewing tobacco. More than 3/4th tobacco users have it in the chewing form. Therefore, we need policies that address this form of tobacco rigorously”, said Dr. Pankaj Chaturvedi, head and neck surgeon from Tata Memorial Hospital in Mumbai.Dr.Chaturvedi who is also India’s most vocal anti-tobacco activist said that it is upsetting that our government has turned a blind eye towards regulating pan masala.

According to TedrosAdhanom Ghebreyesus, WHO Director-General, “Most people know that using tobacco causes cancer and lung disease, but many people are not aware that it also causes heart disease and stroke — the world’s leading killers.”

“This ‘World No Tobacco Day’, WHO is drawing attention to the fact that tobacco does not only cause cancer, it quite literally breaks your heart.”

While many people are aware that tobacco use increases the risk of cancer, there are alarming gaps in knowledge of the cardiovascular risks of tobacco use, said the health organisation.

It also noted that while tobacco use has declined markedly since 2000, the reduction is insufficient to meet globally agreed targets aimed at protecting people from death and suffering from cardiovascular and other diseases (NCDs).

Risk of ignorance

Tobacco use and second-hand smoke exposure were major causes of cardiovascular diseases, including heart attacks and stroke, contributing to approximately three million deaths a year. But evidence revealed a serious lack of knowledge of the multiple health risks associated with tobacco.

In China, over 60% people were unaware that smoking could cause heart attacks, said the Global Adult Tobacco Survey.

Govt. revamps website of ‘Incredible India’

The Centre has unveiled a revamped version of

its 'Incredible India' website with an aim to pitch the country as a 'must-visit' destination.

The website, which has been developed by Tech Mahindra, is mobile-ready and will provide more interactive and personalised experience for the travellers.

Engaging with visitors

"With the help of Adobe solution suite, the Ministry of Tourism will now be able to engage effectively with visitors across web and social channels and measure engagement to deliver real time personalised experiences for each visitor," an official statement said.

Tourism Secretary Rashmi Verma said that new website had already started getting visitors from U.S., Russia and China.

In a first, WHO recommends quadrivalent influenza vaccine?

The quadrivalent vaccine will have two A virus strains — H1N1 and H3N2 — and two B virus strains — Victoria and Yamagata

Sanofi Pasteur's injectable influenza vaccine (FluQuadri) containing two A virus strains — H1N1 and H3N2 — and two B virus strains — Victoria and Yamagata — for active immunisation of adults of age 18 to 64 years was approved in May last year by the Drug Controller General of India (DCGI). The application for the paediatric indication is under review by the DCGI and final approval is expected by the end of this month.

Sanofi's quadrivalent influenza vaccine was licensed for use by the U.S. Food and Drug Administration (FDA) in 2013; it is licensed in 26 countries.

Better protection

While a trivalent influenza vaccine contains both A subtype viruses, it has only one of the B subtype virus, the quadrivalent vaccine offers greater breath of protection as it includes both B subtype viruses. It is because of greater breadth of protection that a few other companies too have shifted from a trivalent to a quadrivalent vaccine.

Since the vast majority of influenza vaccines

manufactured were trivalent till recently, the World Health Organisation (WHO) used to recommend two A subtypes and one B subtype, plus an optional fourth strain (the other B virus strain). But this February 2018, for the first time, the WHO issued an official recommendation for a quadrivalent vaccine. "It is recommended that quadrivalent vaccines for use in the 2018-2019 northern hemisphere influenza season," the WHO noted.

The quadrivalent vaccine will contain four influenza virus strains (two A subtypes and two B subtypes — H1N1 and H3N2, and Victoria and Yamagata respectively). The WHO recommendation then mentioned which B strain should be removed in the case of a trivalent flu vaccine.

The viruses used in the vaccine are killed and this eliminates the possibility of the virus in the vaccine itself causing infection. In India, the vaccine will be available as single dose pre-filled syringe. Eventually, it will be available in a vial for public health use. In the case of H1N1, there are two strains — California and Michigan — that cause influenza. In India, the Michigan strain was earlier circulating and has been replaced by the California strain. For 2018, the WHO has recommended the Michigan strain for the southern hemisphere, including India.

Each year, the vaccine changes to reflect the different strains in circulation. Year round, scientists across the globe track, analyse and classify the viral strains causing illness. This allows the WHO to select the strains in February for the upcoming season's vaccine.

Since 2011, there have been about 97,000 H1N1 cases and over 7,100 deaths in India according to the Integrated Disease Surveillance Project (IDSP) data. Till June 3 this year, there have been 1,740 seasonal influenza cases and 191 deaths caused by H1N1. The years 2015 and 2017 witnessed a sharp increase in the number of cases and deaths. There were 42,592 and 38,811 cases and 2,990 and 2,270 deaths in 2015 and 2017, respectively.

Indian context

Despite the high number of infections and mortality each year, India does not have in place

a national policy for influenza immunisation. Pregnant mothers, children aged below five and young people with asthma, cardiovascular disease, diabetes and high blood pressure are at a greater risk of infection and death. The Ministry of Health issues only H1N1 vaccination guidelines for different vulnerable groups including healthcare workers.

"If you want to reduce the influenza burden in adults, then we must target children as they act as reservoirs," Dr. Su-Peing Ng, Sanofi Pasteur, Head of Global Medical Affairs.

"Influenza can be seasonal or pandemic. What we observed during the 2009 pandemic is that countries which traditionally had good seasonal vaccine coverage could reach 50% coverage during the pandemic. Other countries achieved only 20% vaccination coverage during the pandemic. So seasonal vaccination is part of pandemic preparedness," said Dr. Pier Luigi Lopalco, Professor of Hygiene and Preventive Medicine at the University of Pisa, Italy.

"When people can use the seat belt each time they drive why not get vaccinated against influenza just once a year?" asked Dr. Su-Peing.

IISc to boost science start-up incubation

The Indian Institute of Science, founded in 1909 by Jamsetji Tata and former Maharajah of Mysore Krishnaraja Wadiyar IV, plans to open a research park at its Bengaluru facility within the next three years to incubate sci-tech companies.

"Currently the Society for Innovation and Development is incubating about 15 companies," said Prof. G.K. Ananthasuresh, chairman of the Centre of Biosystems Science and Engineering. "We want to scale it up ten times and the tender for setting up the facility has already been issued."

Corporate collaboration

The institute has collaborations with companies such as Tata Consultancy Services, Volvo, Google Inc., General Motors, Microsoft Research, IBM Research, Boeing, Robert Bosch Foundation and Pratt & Whitney. It also works with the Indian Space Research Organisation, Aeronautical Development Agency and Centre for Development of Advanced Computing.

The institute, spread over 400 acres, is home to more than 40 departments.

Of about 12 companies incubated by the Society for Innovation and Development arm, an inter-disciplinary body, include simulators used for endoscopy, microsatellites to access the Internet at lower costs, a medical diagnostic kit and a superwave technology to extract oil from sandalwood.

"Many of these companies employ core technology. There are deep science and deep technology involved and the impact they can create is big," Prof.Ananthasuresh said in an interview.

"We have years of research behind us and comprehensive research is done before commercialisation."

Pathshodh, the name for the equipment that uses superwave technology, can also be used instead of needles to inject medicine into patients, Mr. Ananthasuresh said. "It is close to being commercialised."

"Another example is one project we did with Bellatrix where we used our knowledge to position and propel microsatellites. In Open Water, another project, we produced clean water from a contaminated [sample]," Mr. Ananthasuresh said.

An air-conditioned blanket invented by scientists in the institute enables one to cool "in cycles," he said. "It is a layered blanket and one does not have to cool the whole room. It is a personalised air-conditioner," he said.

The Robert Bosch Centre for Cyber-Physical Systems was established in 2011 at the institute as an interdisciplinary research and academic centre to promote research in cyber-physical systems.

Mimyk Medical Simulations, incubated at the centre, had developed the endoscopy simulator for gastroenterologists.

EPFO flags data breach after IB sounds alert

THE government's Common Service Centres (CSCs) scheme, which employs rural entrepreneurs to offer a slew of digital services to those in the hinterlands, has come under the scanner for the second time in four months with

the Aadhaar-seeding portal built for Employees' Provident Fund Organisation (EPFO) being suspended after suspected security-related "vulnerabilities".

A subsequent disabling of the portal, aadhaar.epfoservices.com, due to security concerns has impacted the process of Aadhaar authentication for the "Jeevan Pramaan" or life certification scheme for pensioners in rural areas where post offices are the only other option for availing this service. This comes close on the heels of a controversy earlier this year where CSC village-level entrepreneurs (VLEs) allegedly gained illegal access to UIDAI data to provide Aadhaar services to people for a charge.

The Aadhaar-seeding portal for EPFO was built by CSC e-Governance Services India Ltd, a special purpose vehicle set up by the Ministry of Electronics and Information Technology to oversee implementation of the CSC scheme, under which there are over 1.70 lakh service centres that are sometimes the only sources of digital services such as seeding of Aadhaar with various instruments in many villages.

Even as the portal has been suspended, the three agencies involved with the process, EPFO, CSC and UIDAI, have denied any theft of data. According to the EPFO, CSC services are limited to seeding of Aadhaar with Jeevan Pramaan — the biometric enabled digital service for pensioners of the EPFO. On March 22, the Intelligence Bureau, in a note, flagged the issue to Ministry of Labour and Employment, following which EPFO's Central Provident Fund Commissioner V P Joy wrote to CSC CEO Dinesh Tyagi on March 23 pointing out the vulnerabilities in the seeding website, aadhaar.epfoservices.com.

When contacted, Joy told The Indian Express that the suspected data leak "did not happen on the server or software run by EPFO" but "on the CSC software", following which the CSC services were curtailed on March 22.

But Dinesh Tyagi, CEO of CSC, denied any role in the reported breach and said that the concerned application is on the EPFO server and that the CSCs did not have anything to do with the incident. Joy, in the March 23 letter,

had said, "…it has been intimated that the data has been stolen by hackers by exploiting vulnerabilities prevailing in the website (aadhaar.epfoservices.com) of EPFO which are (i) strut vulnerability and (ii) backdoor shells".

He requested Tyagi to immediately deploy an "expert technical team" to plug the breach. "Strut vulnerability" indicates loopholes associated with Apache Struts, a software toolkit for creating Java-based web applications (the nature of the vulnerability was not detailed in the letter). A "backdoor shell" is a piece of code that can be uploaded to a site or a web page to gain access to files stored on that site. , the EPFO said that the news is related to "the services through common service centres and not about EPFO Software or data centre".

"…No confirmed data leakage has been established or observed so far. As part of the data security and protection, EPFO has taken advance action by closing the server and host service through Common Service Centres pending vulnerability checks," the EPFO said.

On the letter sent to him by EPFO's Joy, Tyagi said, "The letter was sent to us but this was basically saying that somebody has pointed out vulnerabilities in the system, so, therefore we are disabling this service and kindly look into it. This application was audited by an auditor, by a security audit. They have not pointed out anything specific, we are looking to find out if some vulnerability is there or not. We are getting another auditor to audit it."

The UIDAI, which is the nodal agency for the Aadhaar project, said: "The said website does not belong to UIDAI in any manner whatsoever. This matter does not pertain at all to any Aadhaar data breach from UIDAI servers. There is absolutely no breach into Aadhaar database of UIDAI. Aadhaar data remains safe and secure."

Partial success for Gram Swaraj Abhiyan

At the end of a three-week drive to bring seven flagship schemes to 16,850 villages with a high number of poor, SC (Scheduled Caste) and ST (Scheduled Tribe) households, less than 30% of the target households received an electricity connection, while less than 40% got a gas connection, according to government data.

Targeted outreach

However, financial schemes for rural beneficiaries to get Jan Dhan bank accounts and sign up for life and accident insurance achieved a high level of saturation. A scheme to fully immunise all pregnant women, and all children less than two years, also reached almost all targeted beneficiaries.

The Gram Swaraj Abhiyan was launched by Prime Minister Narendra Modi on April 14, the birth anniversary of Dr. B.R. Ambedkar, to reach out to villages, most of which have a majority of Dalit and tribal homes.

The official objective of the outreach programme, which was launched a fortnight after nationwide protests against the dilution of the Scheduled Caste and Scheduled Tribes (Prevention of Atrocities) Act, was to "promote social harmony, spread awareness about pro-poor initiatives of government, reach out to poor households to enrol them in various welfare programmes." Villages in Karnataka and West Bengal, where the election code of conduct is in effect, were left out of it.

The Saubhagya scheme to give every household an electricity connection reached 4 lakh homes, as against a target of 14.5 lakh homes, thus reaching 27% of the intended beneficiaries. Under the Ujjwala scheme to give gas connections to all homes, 39% or 5.6 lakh households were reached out of a total target of 14.4 lakh.

Till full saturation

A senior official at the Rural Development Ministry said that KYC (Know Your Customer) processing was still ongoing for many applicants, especially for the Ujjwala scheme, where a total of 11 lakh applications were received. The official added that while the Gram Swaraj Abhiyan officially ended, the government planned to continue until full saturation was achieved.

Financial schemes also saw high saturation, with a higher number of Jan Dhan bank accounts being opened. The Pradhan Mantri Jeevan JyotiBimaYojana, a life insurance scheme, enrolled 73% of targeted beneficiaries, while the Pradhan Mantri Suraksha BimaYojana, a risk insurance scheme for accidental death or disability, enrolled almost 88% of target beneficiaries.

'24-hour timeline'

Further, if there is any action or proposal that could affect the redemption, conversion, cancellation, retirement in whole or in part of the debt securities then it will also have to be disclosed "as soon as reasonably possible but not later than twenty-four hours from occurrence of event or information", as per SEBI's discussion paper.

"There was a view that SEBI's circular last year on debt default disclosure went beyond the securities market and so got stalled," said Sandeep Parekh, founder, Finsec Law Advisors. "This time though, the regulator has acted within its powers and has proposed changes to tighten the regulations for disclosure by amending the LODR regulations, which every listed entity has to comply with," he added.

"With the proposed changes, the regulator aims to move from principal-based to regulation-based disclosure requirements.

While there are obvious incentives for companies to suppress such disclosures, the proposed changes would explicitly state the compliance requirements for the listed entities." said Mr. Parekh, who has earlier worked with SEBI as an executive director in-charge of legal affairs.

Among other things, the regulator wants listed companies to disclose five days prior to every quarter details related to interest or dividend payable on all NCDs or NCRPS during the quarter. Thereafter, within two working days from the end of the quarter a certificate needs to be provided confirming all such payments.

Companies will also be required to report any material deviation in the use of proceeds on a quarterly basis instead of the current requirement of providing such information every six months.

"Material deviations in the use of proceeds is a serious issue and needs to be intimated more frequently than the instant provision," SEBI said in the paper.

'Discrepancy addressed'

TejeshChitlangi, senior partner, IC Universal Legal, is of the view that the proposals, if accepted in the form proposed, would address certain discrepancies in the manner disclosures are currently done.

"SEBI has sought to address two key issues in relation to the listed companies who have their debt securities listed. First, to tighten up the disclosure and governance norms whilst leaving no room for delay in dissemination of material information... [and] second, to also rationalise the disclosure norms to mitigate the unwarranted hardships faced by the issuers," he said.

Amarinder talks tough on molasses leak in the Beas

Punjab Chief Minister Amarinder Singh warned against any laxity in the probe into the leakage of molasses into the Beas river and directed the agencies concerned to pursue legal and penal action against the offenders.

The Chief Minister sought a detailed report by May 24 from the environment department on the inquiry initiated into the incident. Several tonnes of molasses, a by-product of sugarcane processing, from a mill in Beas town leaked into the river, damaging aquatic life, polluting the river water and disturbing the canal-based water supply in the southern districts of Faridkot, Muktsar and Fazilka in Punjab. A large number of fish were found dead in the Beas on May 17.

Formal hearing

An official release stated that the Punjab Pollution Control Board is scheduled to hold a formal hearing in the matter on May 24. Prosecution has already been initiated by the department of wildlife for the loss of aquatic life. The department of water resources has also initiated legal proceedings against the factory — Chadha Sugar Mill — under the Canal and Drainage Act.

Notice issued

The PPCB issued a notice to the mill seeking its reply on why action should not be initiated against it for the alleged violations detected by a probe committee.

The committee, which submitted its report to the State government , found violations in the storage of molasses at the factory.

"Notice has been issued to the Chadha Sugar Mill, Kiri Afghana in Gurdaspur to seek reply of its representatives on the findings of the probe committee," a senior official said here.

The mill belongs to Jasdeep Kaur Chadha, daughter of former Delhi Gurdwara Sikh Parbandhak Committee chief Harvinder Singh Sarna.

The sugar mill representatives have been asked to appear before the PPCB authorities , the official further said.

Quality of water

Reports of water samples collected by the PPCB from different places in the State suggest the quality of raw canal water had almost normalised. The departments of water supply, sanitation and local government, which are responsible for water supply to villages and towns in the affected districts, are, meanwhile, continuing with regular testing of water quality, said the statement.

Contaminated water with dead fish and snakes from Punjab had also entered Rajasthan through Indira Gandhi Canal, affecting water supply to Hanumangarh, Sriganganagar, Bikaner, Jodhpur, Jaisalmer and other districts.

The water sourced from the Indira Gandhi Canal is still unfit for drinking despite a drop in contamination levels, officials said .

"The drinking water supply has been reduced from 50 MLD per day to 15 MLD in Sriganganagar city as we are not using the canal water for supply due to contamination," said Vinod Jain, superintendent engineer (additional charge), Public Health and Engineering Department. He said the water is being supplied on alternate days.

The situation was similar in Hanumangarh. Superintendent Engineer PHED (Hanumangarh) Amar Chand Gehlot said 5 MLD water was being supplied against the regular quota of 13 MLD.

Remains of 2,000-year-old building discovered in China

The remains of a large building, said to be around 2,000-year-old, have been discovered in northeast China's Liaoning Province, local authorities said .

The excavation site, located in Fuxin Township, was a fort city along the Great Wall constructed during the reigns of Han Dynasty (202 BC-220 AD). The excavation work was launched

in October 2014 and around 850-square-metre area has been excavated, unearthing the findings, including the building ruins and a well, said Chu Jingang of the Provincial Cultural Relics Institute.

More than 500 pieces of pottery, bronze and iron ware, dating back from the Warring States period (475-221 B.C.) to the Tang Dynasty (618-907) have also been discovered in the area. The city's defence system has been damaged, and the findings have revealed the layout of the city and also provided new evidence which will be very helpful for research into ethnic minorities in ancient times, Chu was quoted as saying in the state-run Xinhua news agency.

BARC develops cheaper, lightweight bulletproof jackets

The Bhabha Atomic Reseach Centre (BARC) has developed a next-generation bulletproof jacket for the Indian armed forces, which is not only cheaper but also much lighter.

BhabhaKavach, named after nuclear physicist Dr.Homi J. Bhabha, the jacket was developed at BARC's Trombay centre in response to a request from the Central Reserve Police Force (CRPF) and the Ministry of Home Affairs.

Dr.KinshukDasgupta, scientific officer at BARC's materials group, told The Hindu that the jacket weighs just 6.6 kg in comparison to the 17-kg jackets in use, and has passed over 30 tests carried out by certified agencies. BhabhaKavach is available in three variants as per the requirement of the armed forces.

A five-member BARC team worked for a year in 2015-16 to develop the jacket, which is being tested by a joint team of the CRPF, Indo-Tibetan Border Police, and the Central Industrial Security Force. The northern command of the Indian Army is also testing a variant of the jacket in Jammu and Kashmir.

The jacket is made using extremely hard boron carbide ceramics that is hot-pressed with carbon nano-tubes and composite polymer. BARC has been using boron carbide in the control rods of its nuclear reactors.

While the cost of a BhabhaKavach is Rs. 70,000, jackets of similar strength are available in the range of Rs. 1.5 lakh and have to be imported.

"The superior performance of the light weight jacket derives from advanced ceramics and advanced nano-composite tubes indigenously developed at BARC," Dr.Dasgupta said.

Dr.Madangopal Krishnan, associate director, materials group, BARC, said presently, the forces use bulletproof jackets weighing over 10 kg and are made of jackal armour steel, alumina and silica. Jackets made using boron carbide are first in India, he said.

"Unfortunately, in certain incidents in Jammu and Kashmir, bulletproof jackets have failed to protect our jawans, as terrorists have resorted to Chinese-made hard steel core bullets capable of piercing the jackets," he said. These specialised steel bullets were used in an attack in Pulwama on December 31, 2017, where five CRPF jawans were martyred during a gun battle with terrorists.

"BhabhaKavach has been designed to protect our soldiers against AK-47 (hard steel bullets), SLR and INSUS weaponry," Dr.Dasgupta said.

BARC has transferred the technology of BhabhaKavach to Mishra Dhatu Nigam, Hyderabad, for its large-scale production. "It is estimated that about one lakh jackets will be required, per annum, for the next 10 years. The light jacket will surely save the government exchequer foreign exchange," he said.

BARC is now trying to improvise BhabhaKavach based on feedback from the forces. "On our part, we at BARC are looking at bringing down the cost to under Rs. 35,000 and make it even lighter," Dr. Krishnan said.

PM Okays diversion of forest land for bullet train

The overall progress of the acquisition work was reported at 51% in Maharashtra and 58% in Gujarat. Mr. Modi was apprised of the pending FRA certificates yet to be submitted to the Ministry of Environment, Forest and Climate Change by both the States.

"We have asked the collectors to submit the FRA certificates and maps of the alternate alignments for the private land. The final approval will not be given until the loopholes are fully plugged," senior officials said.

Earlier this month, a joint meeting of farmers

from the two States was held in Surat to oppose the land acquisition proceedings in the project.

Activists said the potential loss of green cover could further aggravate the issue, especially in Maharashtra's Palghar district where geotechnical investigations, hydrological survey and utility mapping are all being halted on a 90 km alignment due to the protests.

About 312 villages in Gujarat and Maharashtra will have to give up land while a total of 7,974 plots belonging to the Forest Department and Railways will have to be acquired for the project.

For posing a 'threat' to life and property, British-era rosewood trees face the axe

While everywhere afforestation is the buzzword, the Kerala Forest Department has been asked to do the opposite in Wayanad district. The department is on a massive tree felling spree, axing centuries-old Indian rosewood, 'Veeti' or 'Eeti' in local parlance, in Wayanad Colonisation land assigned to ex-servicemen seven decades ago.

More than 200 rosewood trees, of a total 1,094 identified for the purpose, were felled in a few weeks and the remaining will face the axe soon. Spread over 41,000 hectares in Muppainad, Ambalavayal, Nenmeni, SulthanBathery and Noolpuzhagrama panchayats in the district, the land under the Wayanad Colonisation Scheme was assigned to soldiers who fought in the Second World War by the British government in 1947.

While the land belongs to the veterans, the valuable rosewood (Dalbergialatifolia) trees and teak, however, are the property of the government as they were reserved and vested with the State government when the title deeds were formally granted to the landholders in 1969.

Dried trees

The State government in 1995 decided to sell the trees. Reason? Owners of the land requested the authorities to fell the dried trees as they were posing a threat to their life and property. The government also decided to provide Rs. 4,500 a cubic metre to the farmers as compensation. Many teak and a few rosewood trees on the colonisation land were felled between 1995 and

2000. The compensation too was hiked to Rs. 10,000 a cubic metre in 2005.

The Forest department has engaged two contractors to fell rosewood trees of more than 120 cm girth on the land, for which it conducted a survey in 2012 and identified nearly 1,094 gigantic trees. A majority of them are in the Ambalavayal and Thomattuchal villages, under the South Wayanad forest division.

The felled trees will be transported to the timber depot of the department at Chaliyam in Kozhikode and at Kuppadi in Wayanad, from where they will be auctioned. The department is expecting huge revenues through the auction as a cubic metre of rosewood could fetch between Rs. 2 lakh and Rs. 5 lakh in the open market.

Forest department sources, however, said they were extracting only matured trees with a girth of more than 120 cm. As the custodian of the teak and rosewood trees on the colonisation land, it was the responsibility of the department to fell mature trees and those posing a threat to the life and property of farmers, the sources said.

Vulnerable species

According to the study of the Kerala Forest Research Institute (KFRI), Peechi, the high demand for valuable timber and the irrational felling and extraction from the natural area has turned the tree into a most threatened species. The IUCN (International Union for Conservation of Nature) List of Threatened Species or Red List, or Red Data List, declared this species as vulnerable in 1998.

Overexploitation, low germination percentage of seeds in natural conditions and slow growth rate of the species lead to dwindling populations in forest areas, KFRI scientist Dr. P. Sujanapal said. “The growth rate of the seedling is very slow in Indian conditions. It takes long years for them to attain a commendable height. It is estimated that a 10-year-old tree reaches only six-metre height and 4-5 cm diameter,” Dr.Sujanapal said.

In plantations, crop rotation is estimated at 100-150 years for the production of high-grade timber. It takes 240 years for a tree to attain a diameter of 220-250 cm and a height of 30-35 metre. Due to slow growth, growing trees for timber is not an attractive option, he said.

"Hence, the Kerala Restriction on Cutting and Destruction of Valuable Trees Rules, 1974, does not allow cutting of dalbergialatifolia that has not attained a girth at breast height (GBH) of 2.5 metre," said N. Badusha, president, Wayanad Prakruthi Samrakshana Samiti, an environment protection group.

"Most of the rosewood trees in forest areas of the district were cut a few decades ago and the remaining patches are found only on the colonisation land," Mr. Badusha said.

Ironically, while the government is preparing to declare Wayanad as the first carbon-neutral district in the country and is spending huge amounts on planting thousands of saplings every year, the Forest department's move is contradictory, Mr. Badusha said. If the government gave incentives to farmers, they could conserve the trees that would survive many more decades.

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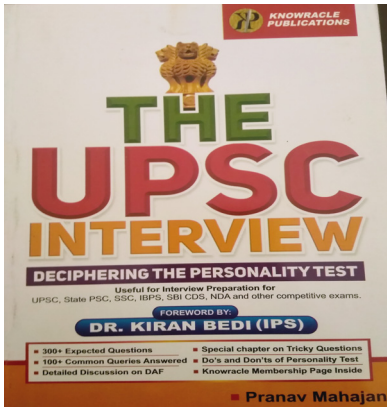

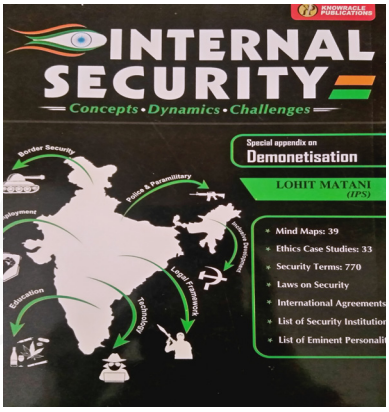

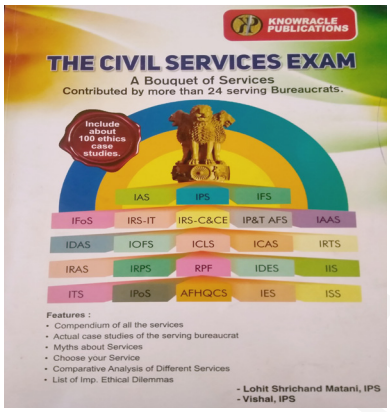

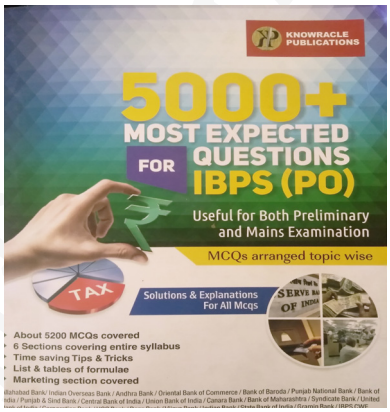

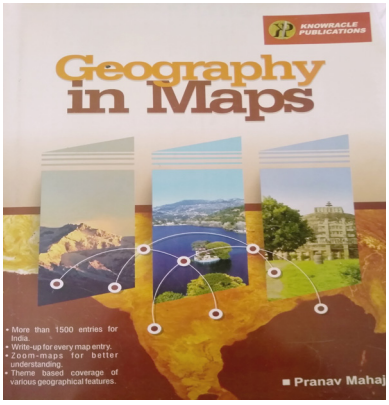

Vol. 14 Apr-June