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# Science Service

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### GLOBAL HEALTH EXPERTS ASK GOVTS TO FUND RESEARCH FOR COMBATING TB

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Three global public health experts have asked governments to make major commitments to fund the research in combating tuberculosis, noting that efforts to curb the “world’s deadliest infectious disease” remain underfunded.

Mel Spigelman, President and CEO, TB Alliance, Catharina Boehme, CEO of FIND, an international non-profit organisation and Jacqueline Shea, CEO, AERAS, also a nonprofit biotechnology organisation developing new tuberculosis (TB) vaccines, have made a strong pitch for promoting research in fighting the disease.

Their remarks come following the World Health Organisation’s ministerial meeting, which was recently held in Moscow, where health ministers, diplomats and other representatives met to discuss tuberculosis.

According to the WHO, in 2016, 10.4 million people fell ill with TB, and 1.7 million died from the disease (including 0.4 million among people with HIV).

Over 95 per cent of TB deaths occur in low- and middle-income countries and seven countries account for 64 per cent of the total, with India leading the count, followed by Indonesia, China, Philippines, Pakistan, Nigeria, and South Africa.

“While the meeting in Moscow will inform future discourse on TB, it must also serve as a springboard toward decisive action against the disease,” the three experts said in a statement.

“TB is the world’s deadliest infectious disease and efforts to curb it remain underfunded. We are calling on governments to make major commitments to fund the R&D that will end TB once and for all,” their statement said.

They said there were 10.4 million new cases of active TB in 2016 — of which only 6 million were diagnosed and notified while drug-resistant infections are on the rise.

There remains a dire need for better, faster-acting drugs, a new vaccine, and technologies that quickly diagnose TB and determine the degree of drug-resistance, the experts said.

“Science is not holding us back, funding and political will to implement is,” they said.

The WHO estimates that R&D budgets need more than USD 1 billion annually to turn around the odds of patients potentially losing years of their lives to a toxic treatment course, missing the opportunity for treatment due to poor diagnostics, or contracting TB in the first place because of an ineffective vaccine.

The WHO also reports that despite accounting for about 2 per cent of deaths globally, TB receives only 0.25 per cent of the estimated USD 265 billion spent worldwide on medical research each year.

“Simply put, TB science is woefully underfunded. Governments must work together to dramatically reshape the investment landscape,” the statement of the experts said.

They maintained that there is no vaccine that can effectively play a major role in eliminating this disease.

“Today, the Bacillus Calmette–Guérin vaccine is the only TB vaccine available. It is nearly a century old, only moderately effective in preventing severe TB in infants and young children, and it does not adequately protect teens and adults, who are most at risk for developing and spreading TB,” the experts said.

Noting that progress has been made but greater commitment is needed, they said there are 12 different TB vaccine candidates in clinical trials today, a significant increase from 2000, when there were zero.

Data from multiple mid- and late-stage efficacy trials will become available over the next 3 years, providing data that will help optimise and accelerate TB vaccine development.

But it will take a significant increase in resources to achieve critical breakthroughs and to reach success quickly, they said.

“At first glance, the TB diagnostics pipeline looks healthy. However, emerging game-changers are at risk due to underfunding at the clinical trial stage.

“In addition, very few diagnostic candidates would address the most critical need — a point of care test for primary care facilities. Diversification of the point of care pipeline, and identification of new biomarkers are urgently needed,” they added.

Union minister J P Nadda, who had also taken part in the conference in Moscow, had said there that over 30 million tuberculosis patients residing in remote areas in India have been screened as part of special campaigns. He had asserted India’s commitment to eliminate the disease by 2025.

The health minister had said the country has already eradicated polio, and will use similar intensified efforts to end tuberculosis (TB).

India is a major manufacturer of anti-TB drugs for the world, having almost an 80 per cent global market share, he had said.

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### ‘ROGUE ATTITUDE’ OF US HAMPERED PROGRESS AT BONN SUMMIT: CSE

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The “rogue and obstructionist attitude” of the US ensured progress at the UN climate summit in Germany’s Bonn city was extremely slow and the “old divide” between the developed and the developing nations remained, a green body said here today.

The 23rd meeting of the Conference of Parties (CoP-23) of the UN Framework Convention on Climate Change, which ended in Bonn on Friday, had no real headway in resolving

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outstanding issues on the agenda, according to an analysis by the Delhi-based Centre for Science and Environment (CSE).

A CSE team was stationed in Bonn through the conference.

“The US’s rogue and obstructionist attitude in the CoP process ensured that progress was extremely slow and hampered on several occasions and the old divide between developed and developing nations remained,” the analysis said.

The Bonn summit was the first UN meeting on climate change since the US President Donald Trump announced intention to pull out of the historic Paris Agreement on Climate Change in June.

The CSE, however, said that the US continued to dictate the terms of negotiations, blocked progress on equity and finance at the Bonn summit.

“Instead of working together and standing united against the US intransigence, the old bickering between developed and developing nations continued. This meant that the US continued with its business-as-usual obstructionist agenda in the negotiations and hampered meaningful progress on equity and finance issues across a range of agenda items, including stock take, accounting, enhanced transparency framework, adaptation, technology transfer,” said Chandra Bhushan, deputy director general of the CSE.

Vijeta Rattani, another climate analyst at the CSE, maintained that the US announcement was only a political decision with no legal bearing on the Paris Agreement, which has almost no legal options to contain the United States.

“Ideally, the US, having made its anti-climate agenda clear, should not have been allowed under any circumstances to determine the course of negotiations. Unfortunately, that did not happen,” Rattani said.

The main outcomes, CSE maintained, were the “Talanoa Dialogue, earlier referred to as the Facilitative Dialogue.

It is about stock take of the collective efforts, the outcome of which would determine the next round of the Nationally Determined Contributions in 2020.

The Dialogue would contain a technical phase - where Parties would provide the inputs - and a political phase, in which the outcome would inform improving of NDCs in 2020.

The final decision of the CoP, however, does not provide the details of the content and scope of the NDCs, the CSE said.

Another outcome, the CSE said, was that the developing countries succeeded in bringing immediate actions and pre-2020 commitments into the limelight.

“India was leading the demand on pre-2020 action. Parties agreed that there will be two stock takes to discuss pre-2020 commitments - in 2018 and 2019 - before the Paris Agreement becomes operative in 2020,” the CSE said.

“India’s stress on pre-2020 actions is encouraging, but it is more in the nature of procedure than action. It will require

more than the ratification of the Doha amendment to make developed countries raise ambition and support commitments. The big question now is how to ensure that the rulebook for Paris Agreement is fair, equitable and ambitious, keeping in mind the fact that the US remains active and obstructionist in negotiations,” Bhushan added.

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### AIR QUALITY IN DELHI BEST IN OVER A MONTH: CPCB

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Air quality in Delhi today was the best in over a month as drizzle coupled with bright sun and wind helped disperse particulates, an official said.

The Air Quality Index, at 298, was classified as ‘poor’ by the Central Pollution Control Board (CPCB). It was an improvement over ‘very poor’ recorded over the last few days.

The System of Air Quality and Weather Forecasting and Research (SAFAR) monitors recorded 24-hour average of Particulate Matter (PM) 2.5 and PM 10 at 128 and 199 micrograms per cubic metre respectively.

The corresponding prescribed standards are 60 and 100. ‘Poor’ quality air might trigger breathing discomfort to most people on prolonged exposure, the CPCB says.

However, it is a major improvement over what Delhi underwent over the last two weeks when pollution had hit emergency levels and a thick blanket of smog had descended over the region.

“More rains would have helped. But we certainly expect rapid clean up of the air over the next few days as wind movement will further pick up. Air channels have opened due to the weakening of a depression over Bay of Bengal,” CPCB’s air lab chief Dipankar Saha said.

The last time the AQI was recorded below 300 was on October 16.

Authorities in Delhi have lifted certain stringent steps such as ban on entry of trucks and construction activities in light of the improvement.

Saha said that light rains experienced at many parts of the city aided in the clean up process, which began a few days ago as pollutants from external sources such as stubble burning stopped entering due to a change in wind direction.

However, the SAFAR, which comes under the Ministry of Earth Sciences, had forecast that there may be a renewed spike in pollution levels due to rise in moisture which traps pollutants.

A ‘very poor’ AQI comes with the warning that people may develop respiratory illness on prolonged exposure while exposure to ‘severe’ air affects healthy people and seriously impacts those with existing respiratory or cardiovascular diseases.

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**MOST COAL-BASED PLANTS 'WILL NOT COMPLY'  
WITH NEW NORMS: CSE**

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The new emission norms for coal-based power plants are to come into effect from December, but most plants will “not comply” with them, a green body has claimed.

The Centre for Science and Environment (CSE), in a statement yesterday, said, “Ambitious timelines backed by strict penalties from the environment ministry are needed to prevent further delay in compliance.”

The new norms were enacted by the Union Ministry of Environment, Forests and Climate Change in December 2015 in view of the sector’s “massive contribution” to air pollution and its “huge water withdrawal”, the CSE said.

“The new emission norms for coal-based power plants are to come into effect from December 2017, but most plants will not comply with them,” the CSE claimed.

The green body further claimed that the Central Electricity Authority (CEA) is now “recommending” that plants be given “another five years” (which means the deadline should be extended from 2017 to 2022) to comply with the new norms.

Chandra Bhushan, the deputy director general, CSE said, “Another five years to meet these standards is unacceptable. Power plants have already wasted two years doing virtually nothing. It is important to push for ambitious timelines for compliance with the new norms.”

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**AIIMS CONDUCTS PILOT STUDY TO JUSTIFY  
PROPOSAL ON USER CHARGES**

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The AIIMS, which plans to do away with user charges on diagnostic procedures, like blood tests and X-rays, which cost less than Rs 500, has conducted a pilot study to justify its proposal.

The study comes in the wake of the Union Health Ministry prodding the premier medical institute to furnish information about reviewing user charges which have not been changed in the last 20 years.

The pilot study revealed that the patients had to spend a substantial amount in the form of cost for travel from the point of residence, cost of food and lodging for self and attendants and loss of income for the patients as well as for the attendants.

The study also stated that the patients encountered long queues for dates for prescribed investigations, for the payment of user charges and then for the investigations on the scheduled days.

The patients had to make multiple travels or visits for clinching each laboratory investigation which added to avoidable harassment and economical loss to the patients, the study stated.

According to the study, a patient from Delhi has to shell out Rs 1,900 on every visit to the All India Institutes of Medical Sciences while those from outside the national capital on an average spend Rs 4,300 per visit.

The study was conducted among 456 patients who visited the out-patient department of the hospital, out of which 234 were residents of Delhi while 222 were outsiders.

More than 95 per cent of the patients were accompanied by attendants and more than 25 per cent of the patients were accompanied by two or more attendants.

Among the interviewed patients, 63.8 per cent of them had received a single consultation while 31.9 per cent received multiple consultations.

The study mentions that the patients had to make a visit to the doctor who refers him or her to the laboratory test.

The patients had to make a payment often in different building, register for the test in another building and get the sampling or test done. Sometimes they have to collect the reports as well.

The time delay adds to indirect costs like wage loss to the patients and their caregivers, room rentals and transport costs, making the provision of health care costlier for the patients as well as the state.

“It is recommended that charges on low cost investigations like blood tests, X-rays, CT etc (below Rs 500 per test) should be eliminated to cut down on book-keeping costs, cost to patients and patient harassment,” it said.

The study also pointed out that the process of accessing services at the AIIMS is very cumbersome with multiple points of waiting.

Each patient had to first report for the registration at the Patient Reception Centre despite having prior appointments.

After the consultation, the patients had to encounter long queues for slots or dates for prescribed investigations, then the queues for the payment of the user charges and then for the investigations on the scheduled days.

Often many of these processes had to be repeated as a result of which the patients had to make multiple travels or visits for clinching each laboratory investigation which added to avoidable harassment and economical loss to them.

“On the other hand, in order to circumvent these delays and encumbrances, about 78 per cent of the interviewed patients stated that they were forced to obtain some or all their investigations from vendors outside the AIIMS which added to their economic costs,” it said.

A committee headed by Dr Anoop Saraya, head of department of the Gastroenterology at the AIIMS, constituted to review the user fee charges at the hospital have submitted its report.

The committee recommended that the private ward charges should be increased to Rs 3,000 and Rs 5,000 per day to

make up for the loss as their rates are cheaper than the semi-private ward charges in corporate hospitals that can be accessed by the Central Government Health Scheme (CGHS) employees.

“It is recommended that the charges on low cost investigations or interventions (below Rs 500 per test) should be eliminated,” Saraya said in his report.

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### GREEN BODIES LAUD CENTRE’S MOVE TO PRE-PONE INTRODUCTION OF BS-VI GRADE FUEL

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Lauding the Centre’s move to pre-pone the introduction of Euro-VI grade petrol and diesel to April 2018, green bodies said that given the scale of the air pollution crisis, such a drastic measure was required.

The Centre for Science and Environment (CSE) said the BS-VI (Euro-VI) fuel would bring down sulphur by five times from the current BS-IV levels.

Greenpeace India said the move showed the government’s commitment towards cutting down emissions and asserted that it should be expanded to other mega cities as well as across north India.

“This is the kind of proactive and responsive leadership we need to see in our government. This is also the kind of drastic measure which is required, given the scale of the crisis.

“We cannot work anymore with small and incremental steps to bring us the kind of air quality benefits that we need,” said Sunita Narain, Director General, CSE.

The government today pre-poned the introduction of ultra-clean Euro-VI grade petrol and diesel in the national capital by two years to April 2018, to help fight the air pollution which has reached alarming levels in Delhi-NCR.

India had, in 2015, decided to leapfrog straight to Euro-VI emission norm compliant petrol and diesel from April, 2020 from the current Euro-IV grade.

“Even though the full air quality gains will come when the vehicles also move to the BS-VI emission standards, the current move should not be underestimated in a choking city like Delhi.

“With substantially cleaner fuel emissions, the control system in the on-road fleet will improve and give some emission benefits,” said Anumita Roychowdhury, Executive Director, CSE.

The CSE, however, said this leadership had come from the petroleum ministry and not from the environment ministry, the nodal ministry for environmental regulations.

The environment ministry has given repeated affidavits to the Supreme Court, contesting the provision of the Comprehensive Action Plan on clean air, submitted by the Environment Pollution (Prevention and Control) Authority (EPCA), which had asked the industry to manufacture and sell BS-VI vehicles from April 1, 2020.

The CSE said the environment ministry had mentioned in its affidavits that “the technical challenges of leapfrogging directly from BS-IV to BS-VI are far more complex and challenging”.

“If the date shifts to become the date of registration, then it would actually reduce the time available to the industry for manufacturing to a mere two years or so, although BS-VI fuel will not be available across the country till April 1, 2020,” the CSE said.

Greenpeace India also lauded the move and said the early advancement to Bharat Stage-VI fuel in Delhi showed the government’s commitment towards cutting down emissions to reduce air pollution.

“It should be expanded to the other mega cities as well as across entire northern India to see an effective reduction in emissions from the transport sector.

“Similarly, we also need to focus on controlling the industries’ and thermal power plants’ emissions by implementing the stricter emission standard norms,” said Sunil Dahiya, Campaigner, Greenpeace India.

He said leaving away these big polluters out of the list to act against would keep us away from achieving breathable air quality levels across the country.

“Air pollution is a regional, national as well as global issue. Taking strong measures across sectors and geographies will lead us to achieve the Clean Air Nation status,” he added.

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### PREZ FOR BIGGER ROLE OF SCIENTISTS IN ‘NEW INDIA BY 2022’

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President Ram Nath Kovind hailed the commitment of scientists in nation building and said that they would have to now play a major role towards the realisation of ‘New India by 2022’.

“I appreciate the commitment of scientists to the nation. You make India proud. I can say without doubt that you are true nation builders and have a major responsibility for the realisation of New India – an India that will achieve certain developmental milestones by 2022,” Kovind said while addressing the ‘Vigyan Chintan - Scientific Ecosystem In Kolkata’.

On the 75th anniversary of the Quit India movement this August, Prime Minister Narendra Modi had asked the people to take a pledge to free the country of problems like communalism, casteism and corruption and create a ‘New India by 2022’.

Describing Kolkata as a city that has been “the capital of modern Indian science”, the President said that New India would not be achieved without New Bengal, which could not be possible without the contribution of the scientific community.

“New India cannot be achieved without New Bengal. And neither New India nor New Bengal can be achieved without

the scientific community here contributing in strong measure,” he said.

The President stressed on the need to harness the scientific talent pool in West Bengal for the good of the state itself and convert the city into a tech hub of India.

“It is important to harness that scientific talent pool in Bengal for the good of Bengal itself. And to once more convert Kolkata into the tech hub of India that it was a century ago, or even 50 years ago,” he said.

Referring to the contribution of scientists like JC Bose, SN Bose and Meghnad Saha and Acharya PC Ray from the state, he lauded the role of present day young scientists from West Bengal “to the furthering of science and of knowledge”.

“To this day, young students from Bengal, young science graduates and scientists, young engineers and technologists, contribute so much to the furthering of science and knowledge. They do so all over the country and all over the world,” the President said.

“There is truly something special about Bengal. On this soil, even a Swami devoted to spiritualism can have a sensitive appreciation for – and a fascination for – modern science,” he said.

Stating that science has been India’s intellectual trigger as well as force multiplier, Kovind said that in modern times, Kolkata and Bengal have played a central role in the process.

“Today, the challenge is to widen that culture to other geographies, both within the state and outside. As well as to deepen that culture by incubating a society that understands, encourages and embraces innovation – down from our leading scientific institutions to our schools and our educational system,” he said.

Chief Minister Mamata Banerjee, Governor Keshari Nath Tripathi, Chief Secretary Moloy De, Home Secretary Atri Bhattacharya, state Finance Minister Amit Mitra, Leader of opposition Abdul Mannan and BJP state president Dilip Ghosh were among the dignitaries present on the occasion.

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### RESEARCH FOR FUTURISTIC TECHNOLOGY DEVELOPMENT

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A research by IIT Kharagpur faculty in collaboration with the University of Rochester and ICTS, Bengaluru have paved way for futuristic technology development. Calling it a path breaking research, an IIT Kharagpur statement said it has opened up possibilities for the development of quantum devices.

Prof Sajal Dhara who joined the Department of Physics at IITKGP in 2016, has discovered along with his collaborators negative mass particles of polaritons which are composed of half-light and half-matter.

Mass of such polaritons thus created is lighter than the mass of an electron by a factor of 0.00001, the statement said.

Prof Dhara and his collaborators at University of Rochester and ICTS (International Centre for Theoretical Sciences) have discovered new insights on the mass of such particles which will lead to a giant leap towards futuristic technology development, the statement said.

The research has been featured in the esteemed ‘Nature Physics’ journal in their October 2017 issue.

The collaborators involved in this work are Dr C Chakraborty, Dr K M Goodfellow, Dr L Qiu, Dr T A O’Loughlin, Prof G W Wicks, Prof A N Vamivakas, all from University of Rochester and Prof Subhro Bhattacharjee from ICTS which is a centre of Tata Institute of Fundamental Research (TIFR).

Elaborating on the research, the statement said, scientists can artificially create a combined particle state that is made of half-light and half-matter, known as polaritons.

Light is an electromagnetic wave but it also shows particle properties with zero mass. On the other hand, matters are made of atoms with certain mass, the statement said.

“The area of research is itself a promising field for the development of a future generation of technologies at room temperature,” he said.

The aim is to look for a particle other than electron to build advanced devices. This will witness a giant leap from smart electronic to smart polaritonic devices promising to increase manifold the speed and storage capacity at which tomorrow’s devices like laptops and smart phones work.

Polaritonics is an intermediate regime between photonics and sub-microwave electronics. Dhara has received substantial funding from MHRD, ISIRD (International Society of Invertebrate Reproduction and Development and the SERB (Science & Engineering Research Board) Ramanujan Fellowship research grant for developing his lab facilities at IIT Kharagpur.

One of the long term goals of his ‘Nanoscale Optoelectronics’ lab (set up for understanding the optical, electronic, and quantum properties of novel solid state nano-structures by nanoscale device design) would be to investigate the light-matter interaction for the development of futuristic technologies and basic science.

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### NEED MORE PEOPLE IN SCIENTIFIC RESEARCH: PROF RAMASWAMY

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Eminent scientist Professor Ramakrishna Ramaswamy today said the country needs to have more people coming to scientific research and stay in the profession.

Ramaswamy, the president of Indian Academy of Science, Bengaluru, was talking to reporters after delivering the D M Bose Memorial Lecture at Bose Institute.

“We need to have more people coming in this profession and staying in this profession, people can be interested but you have to come all the way in doing serious research. That

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number is going down,” he said.

“This is going to be a problem for us in times to come. It is going to be a problem as we are creating lots of universities, lots of research institutes which need teachers, people who can communicate ideas,” Ramaswamy, a senior professor of Jawaharlal Nehru University, said.

Asked about the quality of research in the country, he said “Indian research right now is in fairly good position. There is lot of freedom to do what you want, there is certain amount of money. But we may not have the critical mass on most subjects.

“To make good advances you need to have large number of people working in the same areas, Then you can create better ideas,” he said.

To a question, Ramaswamy said the situation was better in West Bengal.

“In Bengal there is not dearth in the number of people pursuing pure science research as compared to other regions,” he said.

“However having said all that, still I believe even if a large part will not come, there can still be enough number of people in India who are interested in science. We need to popularise science research among them,” he said.

Ramaswamy delivered lecture on the subject ‘The spontaneous symmetry-breaking in dynamical systems’ before an audience of senior scientists, students.

Stating that he was happy with the turnout and the post-lecture question and answer session, he said, “This is to be expected in a campus like Bose Institute. This can not happen in smaller places where people do not have much exposure to different ideas.”

Debendra Mohan Bose, a.k.a D M Bose, was an Indian physicist who made contributions in the field of cosmic rays, artificial radioactivity and neutron physics and the longest serving Director of Bose Institute which holds a memorial research on his birthday every year. He was born on November 26 1885 and died on June 2, 1975.

Bose Institute, set up in 1917 by Acharya Jagadish Chandra Bose, is Asia’s first modern research centre devoted to interdisciplinary research.

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### TRANSFORM AGRICULTURE INTO ‘EFFICIENT, PROFITABLE’ BIZ: GATES

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Transforming agriculture into an “efficient and profitable business” could be the “key recipe” for transforming the Indian economy, Microsoft founder Bill Gates said today.

This transformation could happen by addressing the challenges confronting the smallholder farmers with the help of advances in science and technology, he said.

Gates was delivering the valedictory address at the AP AgTech Summit-2017, jointly organised by the Andhra Pradesh

government and the Bill and Melinda Gates Foundation (BMGF) at the APIIC ground.

“Everyone shares the goal of a prosperous India. And so, we must also share an interest in the process of agricultural transformation.

“When I say transformation, I’m referring to a shift from agriculture based merely on subsistence to agriculture that is run like a business to be efficient and profitable and that meets the needs of producers and consumers,” he said.

“More than half of India’s population works in agriculture. In rural India, three-quarters of working women make a living in agriculture. Just under half of India’s population suffers from malnutrition.

“And, over 300 million Indians live below the poverty line,” Gates, who is a trustee of the BMGF, said.

He suggested making smallholder farmers more productive so that they earn a good living.

“These might seem like distinct data points, but in fact they are closely related. It is the hundreds of millions of smallholder farmers who are most likely to be malnourished and impoverished.

“And it is smallholder women farmers who are so often trapped in subsistence farming. It is this nexus that explains why agricultural transformation is such a highly leveraged investment in the future.

“If we can help smallholder farmers be more productive and earn a good living, then—to adapt a phrase—we can kill three birds with one stone,” he added.

Through this transformation, agriculture, which is the largest economic sector in India, could be transformed into a dynamic source of growth instead of a drag on the economy, the IT czar said.

“We can make sure that this growth is inclusive, that it not only leads to a higher gross domestic product but also lifts people out of poverty, especially the millions of women farmers.

“We can also produce enough nutritious food to support a healthy and well-educated labour force for the future, when the Indian economy will depend even more on highly-skilled workers,” the billionaire innovator and philanthropist said.

“Over the last half-century, India has made extraordinary progress in agricultural production. But it faces big challenges—a growing population, serious malnutrition, and the very real threat of climate change,” he said.

“It is estimated that for each one degree centigrade rise in temperature, India’s rice yields could drop as much as 10 per cent. Wheat could fare even worse. This would be devastating for millions of smallholder farmers as well as for India’s economy.”

The government’s vision of doubling farmer income by 2022 will need help from advances in science and technology to become a reality,” said the founder of the world’s top software firm.

“It won’t come as a surprise that I’m a big believer in technology. But technology is only as powerful as the people who use it,” he said.

By integrating a variety of (digital) data, a more accurate picture of the overall agriculture sector could be provided and also help policymakers identify areas for improvement, he said.

“By making smart investments in the right things and by leveraging Indian talent and ingenuity, I believe it is possible to increase farmers’ productivity and incomes at a speed and scale that rivals or exceeds Asia’s agricultural transformation,” Gates said.

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### LUNG CAPACITY OF INDIANS 30 PER CENT LOWER THAN N AMERICANS: SCIENTIST

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The lung capacity of Indians is 30 per cent lower than North Americans or Europeans, making them highly vulnerable to diabetes, heart attacks or strokes, says a top scientist.

Dr Anurag Agrawal, director of the CSIR-Institute of Genomics & Integrative Biology (IGIB), believes air pollution, along with ethnicity, physical activity, nutrition, upbringing are the major factors behind this. The Shanti Swarup Bhatnagar awardee has now undertaken a major study to pinpoint the relative contribution of these factors in his capacity as a senior fellow of the Wellcome Trust - DBT India Alliance.

Agrawal said, according to data sourced from the American Thoracic Society, the Forced Vital Capacity (FVC) of Indians was 30 per cent lower than North Americans or Europeans and marginally lower than the Chinese.

FVC is the total amount of air exhaled as hard and as fast as possible after maximum inhalation, which, he said, was a major indicator of a person’s susceptibility to cardiovascular diseases, even more than cholesterol.

“It means an average Indian being measured by American standards would fall into restrictive low lung function capacity. People in this category have been shown to die much faster of diabetes, heart attacks and stroke,” Agrawal said.

The Wellcome Trust/DBT India Alliance is an initiative funded equally by the Wellcome Trust, UK and Department of Biotechnology, India.

A recent study, by the department of pulmonary medicine at the Vallabhbhai Patel Chest Institute, found that the lung capacity of children in Delhi was 10 per cent lower than those in the US or those of Caucasian origin.

However, in this case, the researchers had developed India-specific norms in arriving at the conclusion, to minimise possible errors arising out of direct comparison with American standards.

But Agrawal disagrees. He said doing so, just to make 90 per cent of Indians feel that they have normal lung capacity,

would be a “disservice”.

“Only if people are told they are at higher risk will they focus on nutrition, lifestyle. Of course, air pollution is one part of the story. The study I have undertaken will bring out whether we have genuinely healthy small lungs or diseased lungs,” he said.

A report released by the Centre for Science and Environment (CSE) yesterday says every third child in Delhi has impaired lungs. CSIR-IGIB is an institute of Council of Scientific and Industrial Research (CSIR), engaged in research of national importance in the areas of genomics, molecular medicine, bioinformatics, proteomics and environmental biotechnology.

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### ISC WINS GOLD AT INT GENETICALLY ENGINEERED MACHINE CONTEST

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A team from the Indian Institute of Science (IISc) here won the gold medal at the International Genetically Engineered Machine (iGEM) contest held at Boston, USA.

Over 300 teams from all over the world had participated in the competition, held from November 9 to 13, an official release said.

“Team IISc-iGEM participated in the contest with an extra-ordinary idea to develop a new method to purify recombinant proteins in the laboratory. They made use of naturally occurring gas vesicles isolated from Halobacterial species. The presence of these vesicles help the bacteria float to the surface of the liquid medium,” the release said.

Another part of the project was development of a device called Growth Curve and Optical Density Device (GCODE).

It is a portable, automated device to measure absorbance of any given liquid.

This design is the first of its kind where, microbial growth analysis can be performed in an automated and error-free manner.

The device has the features of real time optical density measurement.

It is easy to assemble and it can even send the readings to a smartphone. Most importantly, its performance is on par with high end commercially available spectrophotometer at a two orders lesser price, it said.

A team of 6 students travelled to Boston to participate in the competition and they were evaluated based on their elaborate poster as well as oral presentations by the experts in the field of biotechnology and bioengineering, it said.

iGEM has been encouraging students for the past 10 years to work together to solve real-world challenges by building genetically engineered biological systems with standard, interchangeable parts, the release said.

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### HIGH-SPEED QUANTUM ENCRYPTION COULD STOP HACKERS: STUDY

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Scientists have developed a high-speed encryption system that can protect against the common security attacks, even if the equipment has flaws that could make it vulnerable to leaks.

The system is capable of distributing encryption codes at megabit-per-second rates, five to 10 times faster than existing methods and on par with current internet speeds when running several systems in parallel.

In a study, published in the journal *Science Advances*, the researchers demonstrate that the technique is secure from common attacks, even in the face of equipment flaws that could open up leaks.

“We are now likely to have a functioning quantum computer that might be able to start breaking the existing cryptographic codes in the near future,” said Daniel Gauthier, from The Ohio State University in the US.

“We really need to be thinking hard now of different techniques that we could use for trying to secure the internet,” he said.

To a hacker, our online purchases, bank transactions and medical records all look like gibberish due to ciphers called encryption keys.

Personal information sent over the web is first scrambled using one of these keys, and then unscrambled by the receiver using the same key.

For this system to work, both parties must have access to the same key, and it must be kept secret.

Quantum key distribution (QKD) takes advantage of one of the fundamental properties of quantum mechanics - measuring tiny bits of matter like electrons or photons automatically changes their properties - to exchange keys in a way that immediately alerts both parties to the existence of a security breach.

Though QKD was first theorised in 1984 and implemented shortly thereafter, the technologies to support its wide-scale use are only now coming online.

The problem with many of these systems, said Nurul Taimur Islam, from the Duke University in the US, is that they can only transmit keys at relatively low rates - between tens to hundreds of kilobits per second - which are too slow for most practical uses on the internet.

Like many QKD systems, Islam’s key transmitter uses a weakened laser to encode information on individual photons of light. However they found a way to pack more information onto each photon, making their technique faster.

By adjusting the time at which the photon is released, and a property of the photon called the phase, their system can encode two bits of information per photon instead of one.

This trick, paired with high-speed detectors developed by Clinton Cahall, from Duke University, powers their system to transmit keys five to 10 times faster than other methods.

“It was changing these additional properties of the photon that allowed us to almost double the secure key rate that we were able to obtain if we hadn’t done that,” said Gauthier.

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### BABIES CAN TELL HOW BADLY DO YOU WANT SOMETHING

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Ten-month-old infants can assess how much someone values a particular goal by observing how hard they are willing to work to achieve it, a study has found.

This ability requires integrating information about both the costs of obtaining a goal and the benefit gained by the person seeking it, suggesting that babies acquire very early an intuition about how people make decisions, according to the study published in the journal *Science*.

“Infants are far from experiencing the world as a ‘blooming, buzzing confusion,’” said lead author Shari Liu, from the Harvard University in the US.

“They interpret people’s actions in terms of hidden variables, including the effort people expend in producing those actions, and also the value of the goals those actions achieve,” Liu said.

The researchers showed infants animated videos in which an “agent,” a cartoon character shaped like a bouncing ball, tries to reach another cartoon character.

In one of the videos, the agent has to leap over walls of varying height to reach the goal.

First, the babies saw the agent jump over a low wall and then refuse to jump over a medium-height wall. Next, the agent jumped over the medium-height wall to reach a different goal, but refused to jump over a high wall to reach that goal.

The babies were then shown a scene in which the agent could choose between the two goals, with no obstacles in the way.

An adult or older child would assume the agent would choose the second goal, because the agent had worked harder to reach that goal in the video seen earlier.

The researchers said when the agent was shown choosing the first goal, infants looked at the scene longer, indicating that they were surprised by that outcome.

“Across our experiments, we found that babies looked longer when the agent chose the thing it had exerted less effort for, showing that they infer the amount of value that agents place on goals from the amount of effort that they take toward these goals,” Liu said.

The findings suggest that infants are able to calculate how much another person values something based on how much effort they put into getting it.

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### **ARTIFICIAL PHOTOSYNTHESIS SYSTEM MAY LEAD TO GREENER PLASTICS**

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Scientists have developed a device that mimics photosynthesis and uses sunlight, water and carbon dioxide to produce ethylene gas - a key chemical used in large quantities for manufacturing plastics, rubber and fibres.

The method, developed by researchers National University of Singapore (NUS), could be scaled up to provide a more eco- friendly and sustainable alternative to the current method of ethylene production.

Ethylene, which is the building block of polyethylene, is an important chemical feedstock produced in large quantities for manufacturing plastics, rubber and fibres.

More than 170 million tonnes of ethylene was produced worldwide in 2015 alone, and the global demand is expected to exceed 220 million tonnes by 2020.

Current industrial production of ethylene employs steam cracking of fossil fuels at between 750 to 950 degrees Celsius, which consumes a large amount of energy and poses a strain on natural fuel resources.

The current method also leaves a significant carbon footprint, emitting about two tonnes of carbon dioxide for every tonne of ethylene produced.

Recognising the need for a more eco-friendly method, researchers tapped into renewable energy to produce ethylene.

The team first designed a copper catalyst that could generate ethylene from readily available water and carbon dioxide when powered by electricity.

This copper catalyst was subsequently introduced into an artificial photosynthesis system to convert carbon dioxide and water into ethylene using only solar energy.

“Carbon capture is a key step in fighting human-driven climate change. There has been a steady increase in the atmospheric concentration of carbon dioxide, because the rate of carbon dioxide emissions exceeds that of carbon capture,” said Jason Yeo Boon Siang from NUS.

“This has been attributed as a major cause of global warming which leads to undesirable environmental changes,” Siang said.

“Our device not only employs a completely renewable energy source, but also converts carbon dioxide, a greenhouse gas into something useful. This could potentially close the carbon cycle,” he said.

The team also incorporated a battery in the prototype device to attain stable and continuous production of ethylene, a key challenge in artificial photosynthesis systems.

The battery stores excess solar energy collected in the day to power the device at night or under low light, ensuring that

operations are not interrupted by varying amount of sunlight throughout the day.

The invention marks a significant milestone in the realisation of a scalable artificial photosynthesis system for clean and sustainable production of important organic molecules like ethylene, researchers said.

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### **‘BIKE CRASHES CAUSE 5 TIMES AS MANY DEATHS AS CAR ACCIDENTS’**

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Motorcycle crashes cause three times the injuries, six times the medical costs and five times the deaths as compared to car accidents, a study in Canada has found.

Researchers from the Institute for Clinical Evaluative Sciences looked at data on adults who presented to hospital for injuries from either a motorcycle or car crash between 2007 and 2013.

During the study period, 26,831 people were injured in motorcycle crashes and 281,826 injured in car crashes.

Victims in motorcycle injuries were younger, with a mean age of 36 years, and more likely to be men (81 per cent) than those injured in car accidents, according to the study published in Canadian Medical Association Journal.

Compared with car accidents, motorcycle accidents caused three times the injuries, 10 times the severity, six times the medical costs and five times the deaths, the researchers said.

People with injuries from motorcycle crashes were much more likely to be hospitalised and to be admitted to the intensive care unit (ICU) compared with car crash victims.

“The main results of our study were that each motorcycle causes 10 times the severe injuries, five times the deaths, and six times the medical costs of each automobile,” said Daniel Pincus, from the Institute for Clinical Evaluative Sciences.

“We know that the additional risk associated with driving a motorcycle has not translated into improvements in motorcycle safety. So we hope that estimating the medical costs of care for motorcycle crashes may provide an additional incentive to improve safety,” he added.

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### **NEW BIRD SPECIES EVOLVED IN JUST TWO GENERATIONS: STUDY**

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A new bird species belonging to the Big Bird lineage, which today consists of roughly 30 individuals, emerged on the Galapagos Islands in just two generations, according to a study.

Researchers previously assumed that the formation of a new species took a very long time, but in the Big Bird lineage it happened very soon.

The new species of Darwin’s finch was observed during field work carried out over the last four decades by B Rosemary

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and Peter Grant, two scientists from the Princeton University in the US, on the small island of Daphne Major.

All 18 species of Darwin's finches derived from a single ancestral species that colonised the Galapagos about one to two million years ago.

In 1981, researchers noticed the newcomer, a male that sang an unusual song and was much larger in body and beak size than the three resident species of birds on the island.

"We didn't see him fly in from over the sea, but we noticed him shortly after he arrived. He was so different from the other birds that we knew he did not hatch from an egg on Daphne Major," said Peter Grant.

They took a blood sample and released the bird, which later bred with a resident medium ground finch of the species *Geospiz fortis*, initiating a new lineage.

This gave rise to a new species that today consists of roughly 30 individuals, according to the study published in the journal *Science*.

The team followed the new "Big Bird lineage" for six generations, taking blood samples for use in genetic analysis.

Scientists from Uppsala University analysed DNA collected from the parent birds and their offspring over the years.

"The novelty of this study is that we can follow the emergence of new species in the wild," said B Rosemary Grant.

"Through our work on Daphne Major, we were able to observe the pairing up of two birds from different species and then follow what happened to see how speciation occurred," she said.

The breeding of two distinct parent species gave rise to a new lineage (termed "Big Bird" by the researchers). This lineage has been determined to be a new species.

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### **HIGH-SPEED QUANTUM ENCRYPTION COULD STOP HACKERS: STUDY**

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To fight back against the common security attacks, scientists have created a high-speed encryption system to stop hackers.

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### **'ENERGY FROM ELECTRIC CARS COULD POWER OUR LIVES'**

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Power stored in electric cars could be sent back to the grid - thereby supporting the grid and acting as a potential storage for clean energy - but it will only be economically viable if we upgrade the system first.

In a study, published in the journal *Energy Policy*, two scientists showed how their seemingly contradictory findings actually point to the same outcome and recommendations: that pumping energy back into the grid using today's technology can damage car batteries.

But with improvements in the system it has the potential to provide valuable clean energy.

Electric cars store excess energy when they are idle. Vehicle-to-grid (V2G) technology makes it possible to transfer that energy back to the grid when the car is not being used.

This energy could help regulate the frequency of the electricity supply, reduce the amount of electricity purchased at peak times and increase the power output of the system.

Two recent studies, one by Kotub Uddin at the University of Warwick in the UK and the other by Matthieu Dubarry at the Hawaii Natural Energy Institute in the US, seem contradictory, with one suggesting that V2G degrades car batteries and the other that it improves battery life.

But the two scientists worked together to look at how their studies overlap, showing that they actually come to the same conclusion.

“Although both our papers seem contradictory, they are actually complementary,” said Dubarry.

“V2G is not going to be easy, but, if done properly, it has a chance to make a difference for both utilities and electric vehicle owners. We need more research to understand the process better and benefit from the technology,” said Dubarry.

The two authors agreed that in order to be economically viable, V2G has to be optimised between the requirements of the car owner, the utilities and the capability of the grid.

In other words, the needs of the different people and systems involved have to be balanced.

The question then became ‘can this technology be profitable?’

The previous studies had different approaches to answering this question.

Dubarry showed that using today’s V2G technology can be detrimental to the car battery, while Uddin found a smarter grid would make the process economically viable, and even improve the battery.

With improvements to the system, V2G could actually improve electric car battery life and be profitable for everyone involved.

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### CANADIAN FILM INDUSTRY PLANS NEW CODE OF CONDUCT FOR MEMBERS

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The Canadian Film and TV industry are taking steps to end workplace sexual harassment and make environment safer for women in the wake of sexual harassment scandal in Hollywood.

In a statement posted on ACTRA (Alliance of Canadian Cinema, Television and Radio Artists) official website, Canadian industry representative said that they will “collaborate on an industry-wide response to sexual harassment, discrimination, bullying, and violence”.

ACTRA is a union of more than 23,000 professional performers working in English-language recorded media in Canada including TV, film, radio and digital media.

“We agree to zero tolerance for such behaviour. We recognize that increasing gender equality and diversity across our industry is an important part of the solution,” the statement stated.

The Canadian industry proposed “enacting an industry-wide code of conduct, clearly defining expectations of appropriate and inappropriate behaviour, enforcement and consequences”.

The Canadian industry follows the footsteps of the Academy of Motion Picture Arts and Sciences, which is also planning a new “code of conduct” for its members in the wake of allegations of misconduct against film mogul Harvey Weinstein and several other prominent figures in Hollywood.

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### NEW BATTERIES WITH IMPROVED PERFORMANCE, SAFETY DEVELOPED

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Scientists have devised a new sodium-based battery that has the potential to store more energy while maintaining high safety and reliability levels.

Researchers from Empa, the Swiss Federal Laboratories for Materials Science and Technology and the University of Geneva (UNIGE) in Switzerland focused on the advantages of a “solid” battery: faster charging together with increased storage capacity and improved safety.

The battery prototype known as all-solid-state uses a solid instead of a liquid electrolyte that enables the use of a metal anode by blocking the formation of dendrites, making it possible to store more energy while guaranteeing safety.

“But we still had to find a suitable solid ionic conductor that, as well as being non-toxic, was chemically and thermally stable, and that would allow the sodium to move easily between the anode and the cathode,” said Hans Hagemann, from the UNIGE.

In the study published in the journal *Energy and Environmental Science*, the researchers discovered that a boron-based substance, a closo-borane, enabled the sodium ions to circulate freely.

Since the closo-borane is an inorganic conductor, it removes the risk of the battery catching fire while recharging. It is a material, in other words, with numerous promising properties.

“The difficulty was establishing close contact between the battery’s three layers: the anode, consisting of solid metallic sodium, the cathode, a mixed sodium chromium oxide and the electrolyte, the closo-borane,” said Leo Duchene, from the UNIGE.

The researchers dissolved part of the battery electrolyte in a solvent before adding the sodium chromium oxide powder.

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Once the solvent had evaporated, they stacked the cathode powder composite with the electrolyte and anode, compressing the various layers to form the battery.

“The electro-chemical stability of the electrolyte we are using here can withstand three volts, whereas many solid electrolytes previously studied are damaged at the same voltage,” said Arndt Remhof, leader of the project.

The scientists also tested the battery over 250 charge and discharge cycles, after which 85 per cent of the energy capacity was still functional.

“It needs 1,200 cycles before the battery can be put on the market. In addition, we still have to test the battery at room temperature so we can confirm whether or not dendrites form, while increasing the voltage even more,” the researchers added.

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### **DYE TO HELP IDENTIFY ‘LOST’ OCEAN MICROPLASTICS**

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The smallest microplastics in our oceans - which go largely undetected and are potentially harmful - could be more effectively identified using an innovative and inexpensive method developed by researchers.

Scientists at the University of Warwick in the UK have developed a pioneering way to detect the smaller fraction of microplastics - many as small as 20 micrometres (comparable to the width of a human hair or wool fibre) - using a fluorescent dye.

The dye specifically binds to plastic particles, and renders them easily visible under a fluorescence microscope.

This allows scientists to distinguish microplastics amongst other natural materials and makes it easy to accurately quantify them.

The researchers took samples from surface sea water and beach sand from the English coast around Plymouth - and, after extracting the microplastics from these environmental samples, they applied their method and were able to quantify the smaller fraction of microplastics effectively.

In the study published in the journal *Environmental Science & Technology*, they detected a much larger amount of small microplastics (smaller than one mm) than was previously estimated - and significantly more than would have been identified previously with traditional methods.

These results challenge the current belief of the apparent loss of the smallest microplastics from surface seawater, and highlights the need of further research to understand the real fate of plastic waste in the oceans.

The researchers also discovered that the greatest abundance of microplastics of this small size was polypropylene, a common polymer which is used in packaging and food containers - demonstrating that our consumer habits are directly affecting the oceans.

Large plastic objects are known to fragment over time due to weathering processes, breaking down into smaller and smaller particles termed ‘microplastics’.

Microplastics are the most prevalent type of marine debris in our oceans, and their impact or potential harm to aquatic life is not yet fully understood, researchers said.

Previous reports suggest that the amount of plastic waste found in the oceans only amounts to one per cent of what was estimated, so new methods like this are desperately needed to find and identify the missing 99 per cent of ‘lost’ plastic waste in our oceans, they said.

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### **LIGHT POLLUTION RISING RAPIDLY WORLDWIDE: STUDY**

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Artificial lighting at night is contributing to an alarming increase in light pollution, both in amount and in brightness, affecting places all over the world, including India, a study has found.

Municipalities, enterprises, and households are switching to LED lights in order to save energy.

However, these savings might be lost if their neighbours install new or brighter lamps, researchers said.

Scientists fear that this “rebound effect” might partially or totally cancel out the savings of individual lighting retrofit projects, and make skies over cities considerably brighter.

An international study led by Christopher Kyba from the GFZ German Research Centre for Geoscience lends proof to this hypothesis.

According to the study published in the journal *Science Advances*, the artificially lit surface of Earth at night increased in radiance and extent over the past four years by two per cent annually.

The scientists used data from the first-ever calibrated satellite radiometer designed especially for night-lights (VIIRS for Visible/Infrared Imager Radiometer Suite).

The data also showed increase in the night-lights over India between 2012 and 2016.

The VIIRS Day-Night Band is mounted on the National Oceanic and Atmospheric Administration (NOAA) satellite Suomi-NPP and has been circling our planet since October 2011. Their time series comprises the years 2012 to 2016.

Globally, the increase in light emission closely corresponds to the increase of the Gross Domestic Product (GDP), with the fastest growth occurring in developing countries.

“What is more, we actually see only part of the light increase,” said Christopher Kyba whose research was done both at GFZ and the Leibniz Institute for Freshwater Ecology and Fisheries IGB.

Comparisons of the VIIRS data with photographs taken from aboard the International Space Station (ISS) show that the instrument on Suomi-NPP sometimes records a dimming

of some cities even though these cities are in fact the same in brightness or even more brightly lit.

The reason for this is that sensor cannot “see” light at wavelengths below 500 nanometres (nm), ie blue light, researchers said.

When cities replace orange lamps with white LED lights that emit considerable radiation below 500 nm, VIIRS mistakes the change for a decrease.

The Earth’s night-time surface brightness and especially the skyglow over cities is increasing, probably even in the cases where the satellite detects less radiation.

“Other studies and the experience of cities like Tucson, Arizona, show that well designed LED lamps allow a two-third or more decrease of light emission without any noticeable effect for human perception,” Kyba said.

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### **UNATTRACTIVE MEN NOT SEEN AS DATING MATERIAL: STUDY**

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Unattractive men are not viewed as potential dating material by women and their mothers even when they possess the most desirable traits, a study claims.

Researchers at the Eastern Connecticut State University in the US assessed the mate preference of 80 women between the ages of 15 and 29 years old, and 61 mothers.

The women were presented with colour photographs of three male targets varying in attractiveness. Each photograph was paired with one of three trait profiles.

The “respectful” profile included the traits “trustworthy and honest”, and the “friendly” profile included being “friendly, dependable and mature”.

The “pleasing” profile meant that the man was “of a pleasing disposition, ambitious, and intelligent,” according to the study published in the journal *Evolutionary Psychological Science*.

The women had to rate the photographs and trait descriptions in response to how attractive they found the man, how favourably they rated his personal description, and whether they would consider the person as a dating partner for themselves or their daughters.

Physical attractiveness strongly influenced how women and their mothers saw the target men. The attractive and moderately attractive ones came up trumps.

Men with the most desirable personality profiles were rated more favourably than their counterparts only when they were also at least moderately attractive.

Even when unattractive men possessed the most desirable traits, the mothers and daughters did not view them as potential dating material.

“We conclude that a minimum level of physical attractiveness is a necessity for both women and their mothers,”

said Madeleine Fugere, from the the Eastern Connecticut State University.

It was also found that daughters are pickier than their parents when it comes to choosing between potential mates.

Mothers rated all men, even the least attractive ones, as potentially desirable partners for their daughters, while the younger women did not.

“This may signal that unattractiveness is less acceptable to women than to their mothers,” she said.

“It might also mean that women and their mothers may have different notions of what constitutes a minimally acceptable level of physical attractiveness, with mothers employing a less stringent standard than their daughters,” she added.

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### **WORLD’S SMALLEST TAPE RECORDER BUILT FROM BACTERIA**

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Researchers have converted a natural bacterial immune system into the world’s smallest data recorder, laying the groundwork for a new class of technologies that use bacterial cells for everything from disease diagnosis to environmental monitoring.

The researchers at the Columbia University Medical Center (CUMC) in the US modified an ordinary laboratory strain of the ubiquitous human gut microbe *Escherichia coli*, enabling the bacteria to not only record their interactions with the environment but also time-stamp the events.

“Such bacteria, swallowed by a patient, might be able to record the changes they experience through the whole digestive tract, yielding an unprecedented view of previously inaccessible phenomena,” said Harris Wang from the CUMC.

Other applications could include environmental sensing and basic studies in ecology and microbiology, where bacteria could monitor otherwise invisible changes without disrupting their surroundings, according to the study published in the journal *Science*.

Wang and his team created the microscopic data recorder by taking advantage of CRISPR-Cas, an immune system in many species of bacteria.

CRISPR-Cas copies snippets of DNA from invading viruses so that subsequent generations of bacteria can repel these pathogens more effectively.

As a result, the CRISPR locus of the bacterial genome accumulates a chronological record of the bacterial viruses that it and its ancestors have survived. When those same viruses try to infect again, the CRISPR-Cas system can recognise and eliminate them.

To build their microscopic recorder, the researchers modified a piece of DNA called a plasmid, giving it the ability to create more copies of itself in the bacterial cell in response to an external signal.

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A separate recording plasmid, which drives the recorder and marks time, expresses components of the CRISPR-Cas system. In the absence of an external signal, only the recording plasmid is active, and the cell adds copies of a spacer sequence to the CRISPR locus in its genome.

When an external signal is detected by the cell, the other plasmid is also activated, leading to insertion of its sequences instead. The result is a mixture of background sequences that record time and signal sequences that change depending on the cell's environment.

The researchers can then examine the bacterial CRISPR locus and use computational tools to read the recording and its timing.

"Now we are planning to look at various markers that might be altered under changes in natural or disease states, in the gastrointestinal system or elsewhere," said Wang.

Synthetic biologists have previously used CRISPR to store poems, books, and images in DNA, but this is the first time CRISPR has been used to record cellular activity and the timing of those events.

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### **HIGH-INTENSITY EXERCISE MAY BOOST MEMORY: STUDY**

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Just 20 minutes of high-intensity exercise may help improve memory, suggests a study which could have implications for ageing populations grappling with diseases such as dementia and Alzheimer's.

Scientists at McMaster University in Canada found that six weeks of intense exercise - short bouts of interval training over the course of 20 minutes - showed significant improvements in what is known as high-interference memory, which, for example, allows us to distinguish our car from another of the same make and model.

In the study, published in the *Journal of Cognitive Neuroscience*, memory performance of the participants, who were all healthy young adults, increased over a relatively short period of time.

They also found that participants who experienced greater fitness gains also experienced greater increases in brain-derived neurotrophic factor (BDNF), a protein that supports the growth, function and survival of brain cells.

"Improvements in this type of memory from exercise might help to explain the previously established link between aerobic exercise and better academic performance," said Jennifer Heisz, assistant professor at McMaster.

"At the other end of our lifespan, as we reach our senior years, we might expect to see even greater benefits in individuals with memory impairment brought on by conditions such as dementia," said Heisz.

For the study, 95 participants completed six weeks of exercise training, combined exercise and cognitive training or no

training (the control group which did neither and remained sedentary). Both the exercise and combined training groups improved performance on a high-interference memory task, while the control group did not.

Researchers measured changes in aerobic fitness, memory and neurotrophic factor, before and after the study protocol.

The results reveal a potential mechanism for how exercise and cognitive training may be changing the brain to support cognition, suggesting that the two work together through complementary pathways of the brain to improve high-interference memory.

Researchers have begun to examine older adults to determine if they will experience the same positive results with the combination of exercise and cognitive training.

"One hypothesis is that we will see greater benefits for older adults given that this type of memory declines with age," said Heisz.

"However, the availability of neurotrophic factors also declines with age and this may mean that we do not get the synergistic effects," she said.

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### **LIFE ON EARTH MAY HAVE ARRIVED ON COSMIC DUST: STUDY**

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Life on Earth may have originated from biological particles brought to our planet in streams of space dust, according to scientists, including one of Indian origin.

Fast-moving flows of interplanetary dust that continually bombard our planet's atmosphere could deliver tiny organisms from far-off worlds, or send Earth-based organisms to other planets, researchers from the University of Edinburgh in the UK said.

The dust streams could collide with biological particles in Earth's atmosphere with enough energy to knock them into space, they said.

Such an event could enable bacteria and other forms of life to make their way from one planet in the solar system to another and perhaps beyond.

"The proposition that space dust collisions could propel organisms over enormous distances between planets raises some exciting prospects of how life and the atmospheres of planets originated," said Professor Arjun Berera.

"The streaming of fast space dust is found throughout planetary systems and could be a common factor in proliferating life," said Berera.

The finding, published in the journal *Astrobiology*, suggests that large asteroid impacts may not be the sole mechanism by which life could transfer between planets, as was previously thought.

Researchers calculated how powerful flows of space dust – which can move at up to 70 kilometres (km) per second - could collide with particles in our atmospheric system.

It found that small particles existing at 150 km or higher above Earth's surface could be knocked beyond the limit of Earth's gravity by space dust and eventually reach other planets.

The same mechanism could enable the exchange of atmospheric particles between distant planets.

Some bacteria, plants and small animals called tardigrades are known to be able to survive in space, so it is possible that such organisms - if present in Earth's upper atmosphere - might collide with fast-moving space dust and withstand a journey to another planet.

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### **HUMAN PILOT BEATS AI IN NASA'S DRONE RACE**

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An expert human pilot was successfully able to beat flying drones controlled by artificial intelligence (AI) systems in a race organised by NASA. However, the AI-driven drones were more consistent in their performance, scientists said.

Drone racing is a high-speed sport demanding instinctive reflexes. Researchers at NASA's Jet Propulsion Laboratory (JPL) in the US put their work to the test recently.

Timing laps through a twisting obstacle course, they raced drones controlled by AI against world-class drone pilot Ken Loo. The team built three custom drones - dubbed Batman, Joker and Nightwing - and developed the complex algorithms the drones needed to fly at high speeds while avoiding obstacles.

The drones were built to racing specifications and could easily go as fast as 129 kilometres per hour in a straight line.

However, on the obstacle course set up in a JPL warehouse, they could only fly at 48 to 64 kilometres per hour before they needed to apply the brakes.

"We pitted our algorithms against a human, who flies a lot more by feel," said Rob Reid of JPL, the project's task manager.

"You can actually see that the AI flies the drone smoothly around the course, whereas human pilots tend to accelerate aggressively, so their path is jerkier," Reid said.

Compared to Loo, the drones flew more cautiously but consistently. Their algorithms are still a work in progress.

For example, the drones sometimes moved so fast that motion blur caused them to lose track of their surroundings.

Loo attained higher speeds and was able to perform impressive aerial corkscrews. However, he was limited by exhaustion, something the AI-piloted drones did not have to deal with.

"This is definitely the densest track I've ever flown. One of my faults as a pilot is I get tired easily. When I get mentally fatigued, I start to get lost, even if I've flown the course 10 times," Loo said.

While the AI and human pilot started out with similar lap times, after dozens of laps, Loo learned the course and became more creative and nimble.

For the official laps, Loo averaged 11.1 seconds, compared to the autonomous drones, which averaged 13.9 seconds. However, the latter was more consistent overall.

While Loo's times varied more, the AI was able to fly the same racing line every lap.

Without a human pilot, autonomous drones typically rely on GPS to find their way around. That is not an option for indoor spaces like warehouses or dense urban areas. A similar challenge is faced by autonomous cars.

Camera-based localisation and mapping technologies have various potential applications, Reid added.

These technologies might allow drones to check on inventory in warehouses or assist search and rescue operations at disaster sites. They might even be used eventually to help future robots navigate the corridors of a space station.

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### **WORLD'S OLDEST DRAWINGS OF PET DOGS FOUND**

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Scientists have found the world's oldest drawings of pet dogs in 8,000-year-old hunting scenes etched into rock walls in Saudi Arabia, suggesting that humans were training canines even before they settled down into farming communities.

While documenting thousands of rock-art panels from the sites of Shuwaymis and Jubbah in Saudi Arabia, researchers from the Max Planck Institute for the Science of Human History in Germany, counted 156 dogs at Shuwaymis and 193 at Jubbah.

The dogs in the engravings have pricked ears, short snouts and curled tails - similar to the modern Canaan breed in their appearance. They look distinct from the hyenas and wolves depicted elsewhere in the rock-art panels, according to a study published in the *Journal of Anthropological Archaeology*.

The dogs are often shown helping humans hunt lions, ibexes, gazelles, horses and other prey. Some dogs in the hunting packs are on leashes, tethered to the waists of hunters, whose hands are then free to shoot arrows. The researchers speculated that these leashed dogs might represent young dogs in training, older ones at risk of injury or valuable scent dogs.

"This suggests not only are some human populations controlling their hunting dogs by the Pre-Neolithic, but that some dogs may perform different hunting tasks than others," researchers said.

"Some may be used only to track prey scents, while others are used to corral and attack prey, protect human hunters, or help haul meat back to camp," they said. Genetic and archaeological evidence suggests that dogs were domesticated from a grey wolf ancestor at least 15,000 years ago, and perhaps as early as 40,000 years ago.

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### **DARK MATTER, DARK ENERGY MAY NOT EXIST: STUDY**

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Dark matter and dark energy may not actually exist, according to a study which suggests that accelerating expansion of the universe and the movement of the stars in the galaxies can be explained without these concepts.

For close to a century, researchers have hypothesised that the universe contains more matter than can be directly observed, known as “dark matter”.

They have also posited the existence of a “dark energy” that is more powerful than gravitational attraction.

These two hypotheses, it has been argued, account for the movement of stars in galaxies and for the accelerating expansion of the universe respectively.

However, according to a researcher at the University of Geneva (UNIGE) in Switzerland, these concepts may be no longer valid: the phenomena they are supposed to describe can be demonstrated without them.

The research, published in *The Astrophysical Journal*, exploits a new theoretical model based on the scale invariance of the empty space, potentially solving two of astronomy’s greatest mysteries.

The way we represent the universe and its history are described by Einstein’s equations of general relativity, Newton’s universal gravitation and quantum mechanics.

The model-consensus at present is that of a Big Bang followed by an expansion.

“In this model, there is a starting hypothesis that has not been taken into account, in my opinion,” said Andre Maeder, professor in UNIGE’s Faculty of Science.

“By that I mean the scale invariance of the empty space; in other words, the empty space and its properties do not change following a dilatation or contraction,” said Maeder.

The empty space plays a primordial role in Einstein’s equations as it operates in a quantity known as a “cosmological constant”, and the resulting universe model depends on it.

Based on this hypothesis, Maeder is now re-examining the model of the universe, pointing out that the scale invariance of the empty space is also present in the fundamental theory of electromagnetism.

When Maeder carried out cosmological tests on his new model, he found that it matched the observations.

He also found that the model predicts the accelerated expansion of the universe without having to factor in any particle or dark energy.

In short, it appears that dark energy may not actually exist since the acceleration of the expansion is contained in the equations of the physics, researchers said.

In a second stage, Maeder focused on Newton’s law, a specific instance of the equations of general relativity.

The law is also slightly modified when the model incorporates Maeder’s new hypothesis.

It contains a very small outward acceleration term, which is particularly significant at low densities.

This amended law, when applied to clusters of galaxies, leads to masses of clusters in line with that of visible matter: this means that no dark matter is needed to explain the high speeds of the galaxies in the clusters.

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### **HUMAN FORM OF “MAD COW” DISEASE MAY SPREAD THROUGH SKIN**

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The deadly Creutzfeldt-Jakob disease - human form of the ‘mad cow’ disease - may spread through touch, say scientists who found that an abnormal protein linked to the fatal infection can be detected from the skin of patients.

Scientists from National Institutes of Health and Case Western Reserve University in the US have detected abnormal prion protein in the skin of nearly two dozen people who died from Creutzfeldt-Jakob disease (CJD).

The scientists also exposed a dozen healthy mice to skin extracts from two of the CJD patients, and all developed prion disease.

The study, published in the journal *Science Translational Medicine*, raise questions about the possible transmissibility of prion diseases via medical procedures involving skin, and whether skin samples might be used to detect prion disease.

Researchers from NIH’s National Institute of Allergy and Infectious Diseases (NIAID) stress that the prion-seeding potential found in skin tissue is significantly less than what they have found in studies using brain tissue.

CJD is an incurable and ultimately fatal transmissible, neurodegenerative disorder in the family of prion diseases.

Prion diseases originate when normally harmless prion protein molecules become abnormal and gather in clusters and filaments in the human body and brain.

The reasons for this process are not fully understood. The accumulation of these clusters has been associated with tissue damage that leaves sponge-like holes in the brain.

Human prion diseases include fatal insomnia; kuru; Gerstmann-Straussler-Scheinker syndrome; and variant, familial and sporadic CJD.

Sporadic CJD is the most common human prion disease, affecting about one in one million people annually worldwide.

Other prion diseases include scrapie in sheep; chronic wasting disease in deer, elk and moose; and bovine spongiform encephalopathy, or mad cow disease, in cattle.

Most people associate prion diseases with the brain, although scientists have found abnormal infectious prion protein in other organs, including the spleen, kidney, lungs and liver.

Using a test for prion diseases, scientists analysed skin tissue from 38 patients - 23 who had died from CJD, and 15 who died of other causes.

They also collected brain tissue from the 23 CJD patients and from seven individuals who died of other causes.

The test correctly detected abnormal prion protein in each CJD patient sample tested and in none of the non-CJD group.

The scientists then exposed humanised laboratory mice to either brain or skin extracts from two of the CJD patients.

All 12 mice inoculated with brain tissue developed prion disease, as did all 12 inoculated with skin extracts, though disease in the skin group took about twice as long - roughly 400 days - to develop. The group also reported that brain degeneration in both groups of infected mice was similar.

The study authors say the results should generate discussion about potential surgical instrument contamination and risk associated with procedures involving CJD patients.

"This study used humanised mice with tissue extracts directly inoculated into the brain, so the system was highly primed for infection," said Byron Caughey, NIAID's Rocky Mountain Laboratories (RML).

"There is no evidence that transmission can occur in real-world situations via casual skin contact. However, the results raise transmission questions that warrant further study," said Caughey.

The study also raises the possibility of using skin tissue samples to test for human and animal prion diseases.

The test is widely used with samples of brain and spinal-fluid for the diagnosis of CJD, but such samples are not always available.

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## SOFT ROBOTIC SYSTEM TO PREVENT HEART FAILURE IN CHILDREN

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Scientists have designed a soft robotic system with artificial muscles that can assist cardiac function in children who have one-sided heart conditions.

Soft robotic actuators, designed and programmed to perform lifelike motions, have recently emerged as an attractive alternative to more rigid components that have conventionally been used in biomedical devices.

Earlier this year, researchers at Boston Children's Hospital in the US had developed a proof-of-concept soft robotic sleeve that supports the function of a failing heart.

However, the researchers recognised that many paediatric heart patients have more one-sided heart conditions.

These patients are not experiencing failure of the entire heart - instead, congenital conditions have caused disease in either

the heart's right or left ventricle, but not both.

"We set out to develop new technology that would help one diseased ventricle, when the patient is in isolated left or right heart failure, pull blood into the chamber and then effectively pump it into the circulatory system," said Nikolay Vasilyev, a researcher at Boston Children's.

Researchers including those from Harvard University in the US revealed their soft robotic solution.

Although other existing mechanical pumps can help propel blood through the heart, they are designed so that blood must run through the pump itself, exposing blood to its unnatural surface.

"Running blood through a pump always requires a patient to be placed - permanently - on anticoagulant medication to prevent blood clotting," said Vasilyev.

"It can be very difficult to keep the right balance of medication, especially in paediatric patients, who are therefore at risk of excessive bleeding or dangerous clotting," he said.

Using external actuators to help squeeze blood through the heart's own chamber, researchers designed a system that could theoretically work with minimal use of anticoagulants.

"We've combined rigid bracing with soft robotic actuators to gently but sturdily help a diseased heart chamber pump blood effectively," Vasilyev said.

In animal studies, the soft robotic system contributed significantly to the diseased ventricle's ability to eject blood.

The researchers speculate that the system's effectiveness is due in part to its integration with the septum, which plays a key role in the heart's ability to pump blood.

The system also made significant improvement in its ability to draw blood into the ventricles, which is just as important as the heart's ability to pump it out.

Based on these initial proof-of-concept results, researchers are working on key design modifications that can bring this system closer to use in humans, such as portability and miniaturisation of the components.

They also need to do longer tests in animals to see how the system impacts the heart over prolonged periods of time.

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## RIBBED MUSSELS COULD HELP IMPROVE URBAN WATER QUALITY

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Ribbed mussels could help improve water quality in urban and coastal locations by filtering out nitrogen, bacteria, microalgae and other contaminants, according to a study.

Researchers at The National Oceanic and Atmospheric Administration (NOAA) in the US began a two-year pilot project in 2011 to improve water quality in the Bronx River Estuary in New York.

They used a 20 x 20-foot raft with mussel growing lines hanging below as their field location in an industrial area near

Hunt's Point in the South Bronx, not far from a sewage treatment plant. The waters were closed to shellfish harvesting because of bacterial contamination.

Scientists monitored the condition of the ribbed mussels (*Geukensia demissa*) and the water quality over time to see how each responded.

"Ribbed mussels live in estuarine habitats and can filter bacteria, microalgae, nutrients and contaminants from the water," said Julie Rose, a research ecologist at NOAA's Fisheries Milford Laboratory.

"Ribbed mussels are not sold commercially, so whatever they eat will not be eaten by humans," said Rose, co-author of the study published in the journal *Environmental Science and Technology*. Farming and harvesting shellfish to remove nitrogen and other excess nutrients from rivers, estuaries and coastal waters is known as nutrient bioextraction, or bioharvesting.

Mussels and other shellfish are filter feeders, and as the organisms grow, they take up or assimilate nutrients in algae and other microorganisms filtered from the surrounding waters.

Nitrogen, phosphorus and other nutrients occur naturally in the environment and are needed by plants and animals to grow, but too much of any of them is harmful.

Excess amounts from human activities often end up in rivers, streams and coastal environments, causing algal blooms, loss of sea grass and low oxygen levels in the water, which can kill large numbers of fish and other organisms.

Researchers found that the Bronx River mussels were generally healthy, and their tissues had high amounts of a local nitrogen isotope, indicating that they removed nitrogen from local waters.

They also had lower amounts of trace metals and organic contaminants than blue mussels (*Mytilus edulis*) collected from the seafloor nearby. An estimated 138 pounds of nitrogen was removed from the river when the animals were harvested.

The researchers estimate that a fully populated 20 x 20 foot mussel raft similar to the one used in the study would clean an average of three million gallons of water and remove about 350 pounds of particulate matter, like dust and soot, daily.

When harvested, the animals could be used for fertiliser or as feed for some animals, recycling nutrients back into the land.

"Management programs to reduce the effects of excess nutrients in the water have largely focused on land-based sources, such as human and livestock waste, agriculture, and stormwater runoff," said Gary Wikfors, Milford Laboratory Director and co-author of the study.

"They really have not looked much at recovering the excess in the water itself. Nutrient bioextraction using shellfish is becoming more common, and this study demonstrated that it could be an additional tool for nitrogen management in the coastal environment," Wikfors said.

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### **NASA UNVEILS STUNNING 'FAREWELL IMAGE' OF SATURN**

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NASA has released a stunning view of the Saturn and its splendid rings and moons, captured by the Cassini spacecraft during the final leg of its 20-year-long epic journey in space.

The probe snapped a series of images that has been assembled into a new mosaic.

Cassini's wide-angle camera acquired 42 red, green and blue images, covering the planet and its main rings from one end to the other on September 13 this year. Imaging scientists stitched these frames together to make a natural colour view. The scene also includes the moons Prometheus, Pandora, Janus, Epimetheus, Mimas and Enceladus.

"Cassini's scientific bounty has been truly spectacular - a vast array of new results leading to new insights and surprises, from the tiniest of ring particles to the opening of new landscapes on Titan and Enceladus, to the deep interior of Saturn itself," said Robert West, Cassini's deputy imaging team leader at NASA's Jet Propulsion Laboratory in the US. The Cassini imaging team had been planning this special farewell view of Saturn for years. For some, when the end finally came, it was a difficult goodbye.

"It was all too easy to get used to receiving new images from the Saturn system on a daily basis, seeing new sights, watching things change," said Elizabeth Turtle, an imaging team associate at the Johns Hopkins University Applied Physics Laboratory in the US. For others, Cassini's farewell to Saturn is reminiscent of another parting from long ago.

"For 37 years, Voyager 1's last view of Saturn has been, for me, one of the most evocative images ever taken in the exploration of the solar system," said Carolyn Porco, former Voyager imaging team member and Cassini's imaging team leader at the Space Science Institute in the US.

"In a similar vein, this 'Farewell to Saturn' will forevermore serve as a reminder of the dramatic conclusion to that wondrous time humankind spent in intimate study of our Sun's most iconic planetary system," said Porco.

Launched in 1997, the Cassini spacecraft orbited Saturn from 2004 to 2017. The mission made numerous dramatic discoveries, including the surprising geologic activity on Saturn's moon Enceladus and liquid methane seas on Saturn's largest moon, Titan. Cassini ended its journey with a dramatic plunge into Saturn's atmosphere on September 15, this year, returning unique science data until it lost contact with Earth.

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### **NEW DIPSTICK TECHNOLOGY COULD BOOST DISEASE DIAGNOSIS**

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Scientists have developed a new dipstick technology that enables pathogen detection and the rapid diagnosis of

human, animal and plant diseases in even the most remote locations. The technology developed by researchers from the University of Queensland in Australia could extract DNA and RNA from living organisms in as little as 30 seconds without specialised equipment or personnel.

“We have successfully used the dipsticks in remote plantations in Papua New Guinea to diagnose sick trees, and have applied it to livestock, human samples, pathogens in food, and in detecting environmental risks such as E coli- contaminated water,” said Jimmy Botella, Professor at Queensland.

“This technology will give people in developed and developing nations a new way of tackling a range of agricultural, health and environmental problems,” said Botella, who led the research published in the journal PLOS Biology.

Current commercial kits could isolate DNA and RNA through a long and cumbersome process requiring specialised laboratory equipment that was impractical in the field.

The research team initially developed the dipstick technology for particular plants and later found it could purify DNA from many agriculturally important species.

“We found it had much broader implications as it could be used to purify either DNA or RNA from human blood, viruses, fungi and bacterial pathogens from infected plants or animals,”.

The technology eliminates the need for a specialised laboratory for sample preparation, and is a lot simpler, faster and cheaper than anything else available, making diagnostics accessible to everyone, Botella said.

“Our dipsticks, combined with other technologies developed by our group, mean the entire diagnostic process from sample collection to final result could be easily performed in a hospital, farm, hotel room or even a remote area such as a tropical jungle,” he said.

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### **MARTIAN FEATURES CARVED OUT BY FLOWING SAND, NOT WATER: STUDY**

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Dark features on Mars, that were thought to be evidence of liquid water flowing on the red planet, were created by moving sand and dust, a study suggests.

The findings indicate that present-day Mars may not have a significant volume of liquid water. The water-restricted conditions that exist on Mars would make it difficult for Earth-like life to exist near the surface of the planet.

Scientists, including those from the University of Arizona in the US and Durham University in the UK analysed narrow, down-slope trending surface features on Mars that are darker than their surroundings, called Recurring Slope Linea (RSL).

These RSL features grow incrementally, fade when inactive and recur annually during the warmest time of year on Mars. RSL are mostly found on steep rocky slopes in dark regions

of Mars, such as the southern mid-latitudes, Valles Marineris near the equator, and in Acidalia Planitia on the northern plains.

The appearance and growth of these features resemble seeping liquid water, but how they form remains unclear, and this research demonstrated that the RSL flows seen by HiRISE are likely moving granular material like sand and dust.

“We’ve thought of RSL as possible liquid water flows, but the slopes are more like what we expect for dry sand,” said Colin Dundas, scientist at US Geological Survey.

“This new understanding of RSL supports other evidence that shows that Mars today is very dry,” said Dundas, lead author of the study published in the journal Nature Geoscience.

The terminal end of the RSL slopes are identical to the slopes of sand dunes where movement is caused by dry granular flows, he said. Water almost certainly is not responsible for this behaviour, which would require the volume of liquid to correspond to the length of slope available, producing more liquid on longer slopes.

Instead, the 151 RSL examined by the study authors all end on similar slopes despite very different lengths.

According to the scientists, water is unlikely to be produced only near the tops of slopes at these angles and if it were, it should be able to flow onto lower slopes.

This new research finds that these RSL features are flows of granular material and thus, align with the long-standing hypothesis that the surface of Mars lacks flowing water. Small amounts of water could still be involved in their initiation in some fashion, as hydrated minerals have been detected at some RSL locations. Researchers conclude that liquid on present-day Mars may be limited to traces of dissolved moisture from the atmosphere and thin films of water.

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### **UNIQUE CIGAR-SHAPED OBJECT IS FIRST INTERSTELLAR ASTEROID**

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A dark, reddish and cigar-shaped object that zipped through our solar system from outer space last month is nothing like any cosmic body seen before, say scientists who have classified it as the first interstellar asteroid. Last month the Pan-STARRS 1 telescope in Hawai’i picked up a faint point of light moving across the sky. It initially looked like a typical fast-moving small asteroid, but additional observations over the next couple of days allowed its orbit to be computed fairly accurately.

The orbit calculations revealed beyond any doubt that this body did not originate from inside the solar system, like all other asteroids or comets ever observed, but instead had come from interstellar space.

Although originally classified as a comet, observations from revealed no signs of cometary activity after it passed closest

to the Sun in September. The object was reclassified as an interstellar asteroid and named 'Oumuamua.

The name, which was chosen by the Pan-STARRS team, is of Hawaiian origin and reflects the way this object is like a messenger sent from the distant past to reach out to us, researchers said.

The asteroid is up to 400 metres long and highly-elongated - perhaps 10 times as long as it is wide. That aspect ratio is greater than that of any asteroid or comet observed in our solar system to date, scientists said.

While its elongated shape is quite surprising, and unlike asteroids seen in our solar system, it may provide new clues into how other solar systems formed. When the 'Oumuamua was spotted, it had already passed its closest point to the Sun and was heading back into interstellar space, researchers said.

European Southern Observatory (ESO)'s Very Large Telescope (VLT) was immediately called into action to measure the object's orbit, brightness and colour more accurately than smaller telescopes could achieve.

Combining the images from various telescopes, astronomers led by Karen Meech from Institute for Astronomy in the US found that 'Oumuamua varies dramatically in brightness by a factor of ten as it spins on its axis every 7.3 hours.

"This unusually large variation in brightness means that the object is highly elongated: about ten times as long as it is wide, with a complex, convoluted shape," said Meech.

"We also found that it has a dark red colour, similar to objects in the outer Solar System, and confirmed that it is completely inert, without the faintest hint of dust around it," .

These properties suggest that 'Oumuamua is dense, possibly rocky or with high metal content, lacks significant amounts of water or ice, and that its surface is now dark and reddened due to the effects of irradiation from cosmic rays over millions of years. It is estimated to be at least 400 metres long.

Preliminary orbital calculations suggested that the object had come from the approximate direction of the bright star Vega, in the northern constellation of Lyra.

However, even travelling at a breakneck speed of about 95,000 kilometres per hour, it took so long for the interstellar object to make the journey to our Solar System that Vega was not near that position when the asteroid was there about 300,000 years ago.

'Oumuamua may well have been wandering through the Milky Way, unattached to any star system, for hundreds of millions of years before its chance encounter with the Solar System.

Astronomers estimate that an interstellar asteroid similar to 'Oumuamua passes through the inner Solar System about once per year, but they are faint and hard to spot so have been missed until now. It is only recently that survey telescopes, such as Pan-STARRS, are powerful enough to have a chance to discover them.

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### **MAN DEVELOPS RARE INFECTION 30 YEARS AFTER FIRST EXPOSURE**

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An uncommon fungal infection lingered in a man's body for 30 years before making itself known in his brain, The 70-year-old man was diagnosed with histoplasmosis, an infection caused by inhaling the spores of a fungus called *Histoplasma capsulatum*.

However, not everyone who inhales the spores gets sick. The patient, whose case was reported in the journal *BMJ Case Reports*, may have been more vulnerable to the infection because he was a heart-transplant recipient.

The transplant may have reactivated the histoplasmosis infection, said Carol Kauffman, an infectious-disease expert at the Veterans Affairs Ann Arbor Healthcare System in the US.

Medications taken after the organ transplant - that prevents the body from attack the new organ - lowered the man's immunity and allowed the fungal spores that lay dormant in his body to grow again, Kauffman told *Live Science*.

The man learned of his infection when he went to see infectious-disease experts at the University of Arizona Health Sciences Center in Tucson because he had been feeling confused for four days, according to the case report.

Brain scans of the man's head revealed abnormal tissue, leading doctors to think that he might have had a tumour.

The doctors then performed a biopsy of the adrenal glands located on top of a person's kidneys and found areas of inflamed, dead tissue, which can be a symptom of histoplasmosis, according to the case report.

Lab tests and a fungal culture confirmed the man's diagnosis of disseminated histoplasmosis, the more severe and rarer form of the disease.