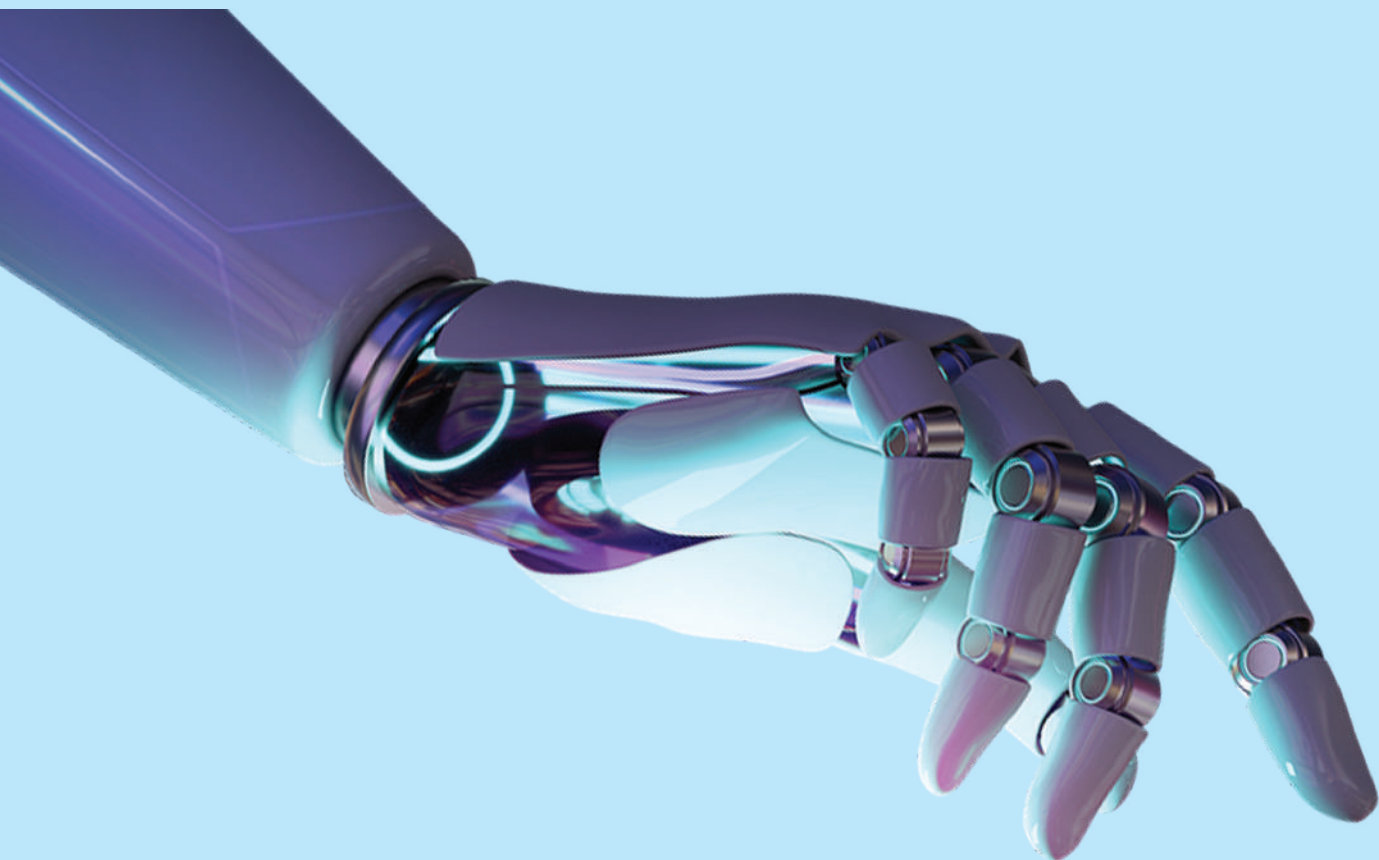




A SNAPSHOT FROM THE YEAR *2022*

S&T Breakthroughs

Sonali Nagar

Science Reporter brings to its readers some of the major S&T highlights from around the world.

Space Exploration

Artemis-I – Moon to Mars Mission

As part of NASA's Artemis-I mission, Space Launch System (SLS), the world's most powerful rocket, launched the Orion spacecraft on 16 November 2022 from Launch Complex 39B at NASA's Kennedy Space Center in Florida. This is NASA's first integrated flight test of its Moon-to-Mars exploration approach. Artemis missions will enable NASA to land the first lady and the first person of colour on the moon's surface serving as a stepping stone for a long-term lunar presence.



Image credit: nasa.gov (NASA/Joel Kowsky)

New study finds evidence of the presence of the first star

A distant quasar's spectrum has been found to contain evidence of the earliest stars in the universe, called Population III (Pop III) stars, according to an international group of researchers. "Stars that undergo a PISN (Pair-instability Supernova) explosion may be among the first to have been born, and be responsible for the rapid enrichment of distant galaxies now being studied with the James Webb Space Telescope," says Grace-Rupley Professor of Physics at Notre Dame in a news release by the University of Notre Dame. The paper was published in the *Astrophysical Journal*.



Image credit: NOIRLab/NSF/AURA/J. da Silva/Spaceengine

An asteroid killing dinosaurs sparks a global tsunami

Earth lost nearly all dinosaurs and about three-quarters of its plants and animals due to an asteroid that struck Earth 66 million years ago. A study led by the University of Michigan has found that the impact site on Mexico's Yucatan Peninsula caused a devastating tsunami with waves that reached mile heights, scouring the ocean floor thousands of miles away from the impact site. The lead author Molly Range says in a news release, "This tsunami was strong enough to disturb





Image credit: needpix.com

and erode sediments in ocean basins halfway around the globe, leaving either a gap in the sedimentary records or a jumble of older sediments.”

IIT Madras and NASA JPL researchers study microbial interactions on International Space Station

Researchers from the Indian Institute of Technology Madras and NASA Jet Propulsion Laboratory are studying interactions between microbes on the International Space Station (ISS). Researchers hope that the study will contribute to developing strategies for disinfecting space stations so microbes do not harm astronauts' health. Observations of *Klebsiella pneumoniae*, which causes pneumonia, and other nosocomial infections dominate the surfaces of the ISS, motivating this study. It was of great interest to the researchers to understand how this bacteria affects the growth of other microbes in the area and what implications this might have.



Image credit: iitm.ac.in

ISRO's multi-satellite mission with 36 OneWeb Satellites to the LEO

On its maiden commercial mission in October 2022, the Indian Space Research Organisation's heaviest rocket LVM3-M2 was launched from the Satish Dhawan Space Centre (SDSC-SHAR) in Sriharikota. The launch successfully deployed 36 broadband communication satellites for OneWeb, a UK-based customer. In terms of commercial orders, this is one of the biggest launches by ISRO and NSIL (NewSpace India Limited).



Image credit: ISRO website

“The mission is very critical to meet the customer's expectations to launch 36 satellites in 9 phases with precision. The mission was designed in such a way that the C25 stage was to handle this operation using in-house built inertial navigation systems. The injection of the satellites was precise to the expectation of the customer. NSIL, the commercial arm of ISRO, entered into this contract and executed the same in a record time,” said Shri Somanath S, Secretary, Department of Space and Chairman, ISRO, in an official release.

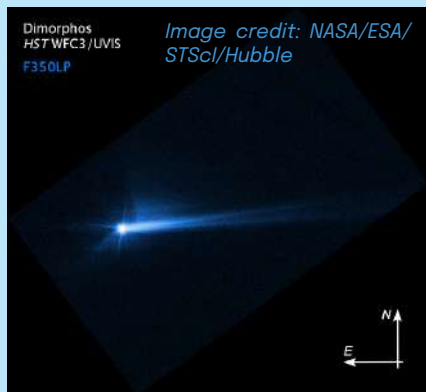
Chandrayaan-2 maps the abundance of sodium on Moon

Chandrayaan-2, using its large area X-ray spectrometer with high sensitivity and performance, CLASS, mapped the abundance of sodium on the Moon for the first time. According to a study published in the *Astrophysical Journal Letters*, part of the signal could be the result of sodium atoms weakly bound to the lunar grains. “An interesting aspect that widens the interest in this alkali element is its presence in the wispy atmosphere of the Moon, a region so thin that the atoms there rarely meet,” says an ISRO press release.

NASA's First Planetary Defense Test Mission, DART, changes asteroid's motion in space

A DART (Double Asteroid Redirection Test) investigation team reported that the spacecraft's impact with the target asteroid, Dimorphos, successfully changed the asteroid's orbit. The deflection of an asteroid is the first demonstration of asteroid deflection technology on a large scale. This is the first time humans have purposely changed the motion of an object in space. “DART has given us some fascinating

data about both asteroid properties and the effectiveness of a kinetic impactor as a planetary defense technology,” says Nancy Chabot, the DART coordination lead from the Johns Hopkins Applied Physics Laboratory (APL) in Laurel, Maryland, in a release.



Joint mission to solve the mystery of black hole jets

In a study published in the journal *Nature*, scientists have finally figured out the mysterious mechanism behind the brightest light shows in the universe, which had baffled them for decades. The study reveals that explosive galaxies, called blazars, emit highly energetic beams that create these displays. This breakthrough was achieved by an Italian-NASA collaboration on IXPE (Imaging X-ray Polarimetry Explorer) which made it possible to acquire data on polarization that had never been obtained before from space.



NASA's Webb probe reveals exoplanet's atmosphere

Using NASA's James Webb Space Telescope, scientists have tracked the chemistry and molecular composition of the atmosphere of a distant world for the first time. Unlike previous observations from Hubble and Spitzer, Webb's readings provide a complete picture of this boiling planet's atmosphere, complete with atoms, molecules, and even clouds. As seen in the latest data, these clouds are broken up instead of covering the planet uniformly. "Having such a complete roster of chemical ingredients in an exoplanet atmosphere also gives scientists a glimpse of the abundance of different elements with relation to each other, such as



carbon-to-oxygen or potassium-to-oxygen ratios. That, in turn, provides insight into how this planet – and perhaps others – formed out of the disk of gas and dust surrounding the parent star in its younger years,” says NASA's release.

Researchers confirm the existence of a rare hexagonal form of diamond, lonsdaleite

Scientists from Monash University, RMIT University, CSIRO, the Australian Synchrotron, and Plymouth University reported in the *Proceedings of the National Academy of Sciences (PNAS)* journal that rare diamonds from a dwarf planet may have formed about 4.5 billion years ago when it collided with a large asteroid in our solar system. "We have also discovered the largest lonsdaleite crystals known to date that are up to a micron in size – much, much thinner than a human hair," says Professor Dougal McCulloch, Director of the RMIT Microscopy and Microanalysis Facility, in a release of RMIT.



Medical Science & Health

Lab-made tendon grafts made by robotic shoulders could be the next big thing

A team of researchers from the University of Oxford along with engineers from Germany and Switzerland have used a robotic shoulder joint to grow human tendon tissues which could be helpful in providing patients with improved tissue grafts. As reported in *Communication Engineering*, for several years, robotic bioreactor systems have enabled the growth of tissue-engineered constructs. The production of functional grafts that could be used in clinical settings is still a long way off. The use of humanoid robots has the potential to provide physiologically-relevant mechanical stimulation to grafts and implants, which could accelerate their clinical placement.



Transplanting human brain cells into rat brains, a breakthrough in neuropsychiatric research

The study of neurodevelopmental disorders is possible due to the implanting of human neurons into the brains of newborn rats' brains, a feat Stanford Medicine investigators have achieved. By doing so researchers were able to investigate the molecular and circuit underpinnings of neurodevelopmental disorders. "Our platform provides, for the first time, behavioural readouts for human cells and could, we hope, accelerate our understanding of complex psychiatric conditions," says Sergiu Pasca from the Stanford School of Medicine in a release by Stanford Medicine. The study was published in *Nature*.



Fingerprint-based technique to detect nanoplastics

Researchers at the University of Eastern Finland have developed a novel, metallic fingerprint-based technique to detect and measure nanoplastics in organisms. Their study used this technique to examine a food chain with three trophic levels: lettuce as the primary producer, black soldier fly larvae as the primary consumer, and insectivorous fish (roaches) as the secondary consumer. According to the study, lettuce can absorb nanoplastics from the soil transferring them to the food chain. As concluded in a news release by the lead author, Dr Fazel Monikh, "Our results show that lettuce can take up nanoplastics from the soil and transfer them into the food chain. This indicates that the presence of tiny plastic particles in soil could be associated with a potential health risk to herbivores and humans if these findings are found to be generalizable to other plants and crops and field settings. However, further research into the topic is still urgently needed." The study was published in *Nano today*.



Synthetic mouse embryo models

A paper published in *Cell* describes how researchers were able to grow synthetic embryos of mice outside the womb by starting solely with stem cells cultured in a petri dish without using fertilized eggs. In the future, the method could help grow organs and tissues for transplantation, opening new horizons for scientists to study stem cell development in embryos. "Until now, in most studies, the specialized cells were often either hard to produce or aberrant, and they tended to form a mishmash instead of well-structured tissue suitable for transplantation. We managed to overcome these hurdles by unleashing the self-organization potential encoded in the stem cells," explains Prof. Jacob Hanna of Weizmann Institute in a release.



Discovery of oldest DNA breaks the record by a million years

A new chapter in the evolution story has been opened with the discovery of DNA dating back two million years in the Ice Age sediment in northern Greenland. In a study published in *Nature*, using cutting-edge technology researchers found the fragments are one million years older than previously recorded DNA from the Siberian mammoth bone. Using ancient DNA, researchers mapped an ecosystem that endured extreme climate change two million years ago. The results could aid in predicting the long-term environmental effects of global warming.



Ecological Revelations

Scotland's 1907 fossil finds shed light on the origins of flying vertebrates

Scientists have discovered that a Triassic fossil reptile that was discovered over a century ago in northeast Scotland is a close relative of the dinosaur-era flying reptiles known as pterosaurs. The study was published in *Nature*. "Pterosaurs were the first vertebrates to evolve powered flight and for nearly two centuries we did not know their closest relatives. Now we can start filling in their evolutionary history with the discovery of tiny close relatives that enhance our knowledge about how they lived and where they came from," says Prof. Sterling Nesbitt at Virginia Tech in a news release by the University of Birmingham.



Scleromochlus taylori (Image credit: Gabriel Ugueto)

Three years after its discovery and after four failed attempts, scientists finally reach the tallest tree

Angelim vermelho (*Dinizia excelsa*) holds the record for being the tallest tree ever found in the Amazon rainforest. It took scientists three years of planning and five expeditions to reach it, as well as an arduous trek through a dense forest for two weeks. Iratapuru River Nature Reserve in northern Brazil is home to the 88.5-metre-tall *Angelim vermelho*, which measures 9.9 metres in circumference.



Image credit: Wikipedia

Increase in climate change may increase the risk of spillovers of viruses in the Arctic

Warming climate could expose viruses in the Arctic to new environments and hosts, increasing the risk of "viral



Image credit: Wikimedia commons

spillover", according to research published in Proceedings of the *Royal Society B: Biological Sciences*. When viruses replicate, they need hosts to spread. However, occasionally they move onto an immune deficient one, as was the case with the COVID-19 outbreak. However, further research is required to determine what level of difference between viruses and hosts is required for a serious spillover risk to occur.

Thiomargarita magnifica – Giant bacteria found

A macro-microbe found in the mangroves of Guadeloupe shows the morphological and genomic traits of a giant filamentous bacterium composed of a single cell. They also observed membrane-bound compartments containing DNA clusters dubbed 'pepins' using different microscopy techniques. This bacterium belongs to *Thiomargarita* and is named *Thiomargarita magnifica*. A scientist Jean-Marie Volland said in a news release by Berkeley Lab that "it's 5,000 times bigger than most bacteria. To put it into context, it would be like a human encountering another human as tall as Mount Everest."

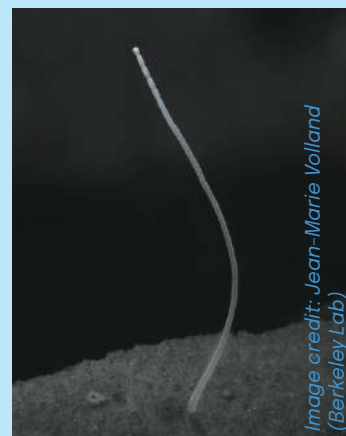


Image credit: Jean-Marie Volland (Berkeley Lab)

Scientists develop the first comprehensive classification of the world's ecosystems

In a study led by UNSW (University of New South Wales), Sydney researchers have developed the first comprehensive classification of the world's ecosystems on land, in rivers and wetlands, and in the ocean. "For the first time, we have a common platform that identifies, defines and describes the full suite of the whole planet's ecosystems," says Professor Keith, UNSW's Centre for Ecosystem Science, in a news release by UNSW. The study was published in *Nature*

Researchers reveal the tiniest ever ancient seawater pockets

In a surprising discovery, in North America, the tiniest liquid remnants of an ancient inland sea have been revealed after



Image credit: pnnl.gov

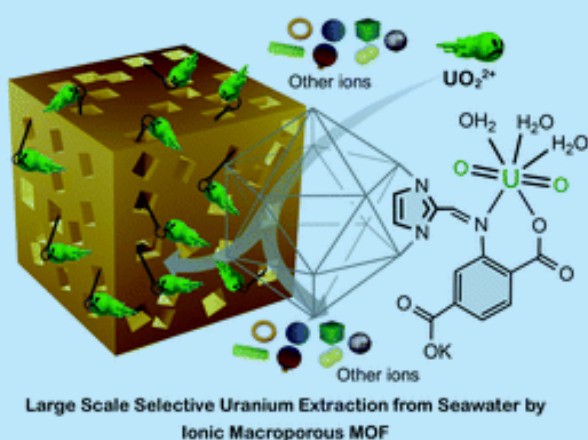
information from these mineral features that could help inform geologic studies, such as the seawater chemistry from ancient times,” says the lead author Scientist Sandra Taylor in a news release by Pacific Northwest National Laboratory.

Earth's largest volcanic events were timed by slowing continental plate movement

Trinity College Dublin scientists led an international team of scientists in revealing the timing and likely cause of volcanic eruptions millions of years ago. There were several devastating extinctions caused by these eruptions, due to their impacts on the climatic and biological systems. According to the research published in *Science Advances*, a slowing of continental plate movement triggered magma to rise to the surface causing devastating knock-on effects on the planet. “Crucially, further assessment shows that a reduction in continental plate movement likely controlled the onset and duration of many of the major volcanic events throughout Earth’s history, making it a fundamental process in controlling the evolution of climate and life at Earth’s surface throughout the history of this planet,” says Micha Ruhl, Assistant Professor, in a news release by Trinity College Dublin.

Benchmark uranium extraction from seawater by Indian researchers

Using seawater as a fuel source, scientists at the Indian Institute of Science Education and Research (IISER), Pune, have extracted uranium from seawater that could



Large Scale Selective Uranium Extraction from Seawater by Ionic Macroporous MOF

Image credit: Energy & Environmental Science by the Royal Society of Chemistry

being trapped for millennia. The findings provide insight into how the ocean changes and adapts to climate change. It may also provide insight into how hydrogen can be stored underground and transported for use as a carbon-free fuel. The research was reported in *Earth and Planetary Science Letters*. “We discovered we can actually dig out

power nuclear reactors. The team developed an adsorbent metal-organic-framework (MOF) capable of extracting uranium with high efficiency. The findings were reported in the journal *Energy & Environmental Science* by the Royal Society of Chemistry. For the new benchmark uranium adsorbent, the paper says that “it satisfied the preset target of the UES (uranium extraction from seawater) standard (6 mg g^{-1}) within 2 days and achieved a record uranium uptake capacity of 28.2 mg g^{-1} from natural seawater only in 25 days, which is a significant breakthrough in UES.”

There is a lot to think about in the world's oldest meal

Researchers from Sydney's Australian National University (ANU) have uncovered new clues about our earliest animal ancestors' physiology based on the final meal consumed by the earliest known animals on Earth 550 million years ago. “This was a Eureka moment for us; by using preserved chemical in the fossils, we can now make gut contents of animals visible even if the gut has since long decayed. We then used this same technique on weirder fossils like Dickinsonia to figure out how it was feeding and discovered that Dickinsonia did not have a gut,” says Prof. Jochen Brocks in a release by ANU. The findings were published in *Current Biology*.



Image credit: Ilya Bobrovskiy/ANU

Researchers discover a new ecosystem, The Trapping Zone

Researchers from the University of Oxford involved in the Nekton Maldives Mission have discovered an oasis of life 500 meters beneath the Indian Ocean's surface that is creating an ecosystem that has not been described before — The Trapping Zone. “We’re particularly intrigued at this depth - why is this occurring? Is this something that’s specific at 500 meters, does this life go even deeper, what is this transition, what is there, and why? That’s our critical question we need to ask next. Why are we seeing the patterns that we have observed on this expedition? This will enable us to understand the deep ocean in much better terms,” Lucy Woodall, Associate Professor, University of Oxford and Principal Scientist at Nekton, says in a release.



Image credit: ox.ac.uk

Technological Developments

World's most durable Hydrogen Fuel Cell

It is now possible for green energy to be applied to a wider range of applications to achieve a carbon-neutral world in the future because of new hydrogen fuel cells developed at the Hong Kong University of Science and Technology (HKUST). These new hydrogen fuel cells are not only the world's most durable but also the most cost-effective in the world. As a clean energy option, hydrogen fuel cells generate electricity by converting hydrogen and oxygen into electricity, without releasing carbon dioxide and particulate matter causing health issues and smog. The research was published in the journal *Nature Catalysis*.



Image credit: seng.hkust.edu.hk/news

Battery design breakthrough in electric vehicles

Fast-charging batteries have always been in demand, therefore, achieving a breakthrough in battery design, researchers have come up with the latest technology that charges an electric vehicle battery in ten minutes. With the record-breaking combination, charging takes less time and more energy is gained, resulting in longer travel distances. "The smaller, faster-charging batteries will dramatically cut down battery cost and usage of critical raw materials such as cobalt, graphite and lithium, enabling mass adoption of affordable electric cars," says Chao-Yang Wang, Penn State, in a news release. The study was published in *Nature*.



Image credit: EC power

Thinner than ever, the world's whitest paint

It is thinner and lighter than ever before, thanks to a paint developed at Purdue University. Consequently, it is suitable for cooling vehicles like planes or cars, allowing air conditioning to be less reliant. "Now this paint has the potential to cool the

exteriors of airplanes, cars or trains. An airplane sitting on the tarmac on a hot summer day won't have to run its air conditioning as hard to cool the inside, saving large amounts of energy. Spacecraft also have to be as light as possible, and this paint can be a part of that," says George Chiu, in a release by Purdue University.

Image credit: Purdue University
photo/Andrea Felicelli

Nanoparticle sorting is possible with "Virtual Pillars"

Using sound waves, Duke University engineers have developed a device that separates and sorts the tiniest particles found in blood within minutes. A concept called "virtual pillars" underpins the technology, which could be of benefit to scientific research as well as a medical practice. The study was published in the journal *Science Advances*. "These nanoparticles have significant potential in medical diagnosis and treatment, but the current technologies for separating and sorting them take several hours or days, are inconsistent, produce low yield or purity, suffer from contamination and sometimes damage the nanoparticles," says Tony Jun Huang, Duke University in a release.

Highlights from India

India's first privately developed rocket, Vikram-S

As part of a mission, 'Prarambh', on 18 November 2022, the Vikram-S suborbital launch vehicle developed by Skyroot Aerospace Pvt. Ltd was successfully launched from Satish Dhawan Space Centre, Sriharikota, by the sounding rocket launch complex. The launch marks the first private launch by an Indian company.

Landing planes with new Indian navigation tech is a major milestone for India

The Airports Authority of India (AAI) made history on 28 April 2022 by successfully conducting a trial using the latest technology developed by a Satellite-based Augmentation System named GAGAN (GPS Aided GEO Augmented Navigation) at the Kishangarh airport in Rajasthan. This successful trial represents a major milestone in the history of Indian Civil Aviation in the field of Air Navigation Services. Being first in the Asia Pacific, India's achievement is a milestone for the entire region.

Image credit: PIB



First private launchpad & mission established in the country

A private launchpad and mission control centre were established on the ISRO campus at Satish Dhawan Space Center (SDSC), SHAR, Sriharikota and inaugurated on 25 November 2022. A space-tech start-up based in India, Agnikul, designed and operated the launchpad. With the establishment of this private launchpad, ISRO/DOS have demonstrated their commitment to facilitating private participation in the Indian space sector.



Image credit: isro.gov

Gaganyaan Parachute System passes major development test

ISRO has successfully conducted the major development test of its Gaganyaan Parachute System. The various activities of Gaganyaan are underway at Vikram Sarabhai Space Centre, where a major development test "Integrated Main Parachute Airdrop Test (IMAT)," has also been conducted of its crew module deceleration system at the Babina Field Fire Range (BFFR) in Jhansi UP. An important milestone has been reached in the nation's ambitious Gaganyaan project with the passing of this test.



Image credit: isro.gov

At VSSC, the Trisonic Wind Tunnel undergoes its first blowdown test

Indian aviation is becoming more self-reliant with the Trisonic Wind Tunnel. On 8 December 2022, the new Trisonic Wind Tunnel underwent its first blowdown test at Vikram Sarabhai Space Centre, Thiruvananthapuram. By evaluating forces, moments, load distribution, unsteady pressures, and acoustic levels, a scaled model was characterized by the Trisonic Wind Tunnel for the aerodynamic design of rockets and re-entry spacecraft. As the name implies, the Trisonic Wind Tunnel is capable of testing various spacecraft at three different speeds: below, at, and above sound speed.

ISRO and Social Alpha join hands to launch SpIN

An MoU between the Indian Space Research Organisation (ISRO) and Social Alpha paves the way for the establishment of India's first dedicated platform for innovation curation and venture development for enhancing the space business ecosystem, the SpaceTech Innovation Network (SpIN). With its unique public-private collaboration, India's recent space reform policies will be further bolstered. The goal is to identify and unleash the market potential of Indian space technology innovators. "Space applications cut across various domains from earth to sky. Innovative technologies are expected to bring a paradigm shift in utilising space applications to maximise the economic, social and environmental benefits for the larger society. I wish the SPIN platform would be useful for various stakeholders to collaborate and contribute to the space ecosystem in the country", says Shri S. Somanath, Chairman, ISRO in a release.



Image credit: isro.gov

India's first indigenous aircraft carrier

On 2 September 2022, India commissioned India's first aircraft carrier, the Indian Navy Ship (INS) Vikrant, from Cochin Shipyard Limited (CSL). It is an aircraft carrier and a true testament to the principle of "Make in India" and the country's determination to rely on its own strength. This commissioning puts India in a select group of countries with niche capabilities to design and build aircraft carriers indigenously.



Image credit: Wikipedia

AI technologies launch during the first-ever 'AI in Defence' (AIDef) symposium and exhibition

Ministry of Defence, New Delhi, organised the first-ever 'AI in Defence' (AIDef) symposium and exhibition on 11 July 2022 during which 75 newly-developed Artificial Intelligence (AI) technologies were launched as part of Azadi ka Amrit Mahotsav. The launched products fall under various domains including AI Platform Automation; Autonomous/Unmanned/Robotics systems; Block Chain-based Automation; Command, Control, Communication, Computer & Intelligence, Surveillance & Reconnaissance; Cyber Security; Human Behavioural Analysis; Intelligent Monitoring Systems; Lethal Autonomous Weapon Systems; Logistics and Supply Chain Management, Operational Data Analytics; Manufacturing and Maintenance; Simulators/Test Equipment and speech/voice analysis using Natural Language Processing. This launch marks a big step towards self-reliance in defence.

Formal induction of Light Combat Helicopter (LCH) by the Indian Air Force

On 3 October 2022, LCH (Light Combat Helicopter), indigenously developed and named as "Prachand" was officially inducted by the Indian Air Force (IAF) at Jodhpur Air Base. India's capabilities will improve as a result of this induction, and defence production will be enhanced. Hindustan Aeronautics Ltd (HAL) developed this multipurpose attack helicopter which is tailored to the needs of the Indian Army for operations in both desert and high mountain areas. The LCH is the world's only attack helicopter capable of taking off and landing at altitudes of 5,000 meters making it ideal for high-altitude operations.



For the first time US Navy ship repaired in India

An important milestone in strengthening Indo-US strategic cooperation was marked by the arrival of the US Navy Ship (USNS) Charles Drew at L&T's Kattupalli Shipyard in Chennai on 7 August 2022 for repairs and related services. It is the first time a US Navy ship was in Indian shipyards for repairs.



India's first indigenous Overhauser Magnetometer

An autonomous research institution under the Department of Science and Technology (DST), the Indian Institute of Geomagnetism (IIG), has developed the country's first Overhauser Magnetometer to reduce dependence on imports. This instrument allows geomagnetic sampling experiments to be conducted at a lower cost. The sensor is installed at the Alibag Magnetic Observatory. One of the world's most accurate magnetometers, the Overhauser Magnetometer is widely used around the world by all magnetic observatories.



Image credit: dst.gov

India's first 3D-printed human cornea

In a medical breakthrough, a group of scientists and clinicians at Hyderabad's LV Prasad Eye Institute (LVPEI), IIT Hyderabad, and CSIR-Centre for Cellular and Molecular Biology (CCMB) has developed India's first 3D printed human cornea which was transplanted into a rabbit's eye. Donor corneal tissue was used for the cornea, which would otherwise have been discarded due to its non-compliance with optical standards.

Indian Ocean, northern Arabian Sea, and central Bay of Bengal likely to experience rough wave days due to climate change

In a study published in the journal '*Climate Dynamics*', Springer, scientists from the Delhi Institute of Technology, the Indian Institute of Technology Kharagpur, and the National Centre for Ocean Information Services, Hyderabad, predicted that extreme wave heights in the Indian Ocean would likely change in the future. Researchers found that the large-scale distribution of future waves may differ significantly from today's based on COWCLIP2.0 datasets. Based on the projection of the Southern Annular Mode (SAM) for the twenty-first century, it appears that the amplitudes of high-frequency extreme wave events will change as a result of changes in sea level pressure gradients in the Southern hemisphere.

Researchers from IIT Kanpur develop artificial muscles that can be used in next-generation medical devices and space robots

IIT Kanpur researchers have developed a bio-inspired artificial muscle for medical prostheses and next-generation space robots. Since the demand for miniature, lightweight, non-magnetic gear-free actuators has grown in the industry, Shape Memory Alloy (SMA) based actuators have emerged as a suitable alternative to conventional actuators due to their good power-to-weight ratio. "Shape Memory Alloy (SMA) based actuators are considered better alternatives to the conventional actuators, although they have some limitations.



Researchers at the SMSS Lab at IIT Kanpur worked on these limitations and developed this unique shape memory alloy-based bio-inspired muscle design that holds the potential to revitalize the Space Robotics and bio-medical technology industry. This invention will not only result in the development of the Next Gen Space Robots and Medical Prostheses but will also help aviation and some other industries. In a way, it will help make multiple sectors self-reliant and more advanced in the long run,” says Prof. Abhay Karandikar, Director, IIT Kanpur in a release. This was published in *Nature Scientific Reports*.

TiHAN: First-of-its-kind “Autonomous Navigation Facility”

On the IIT Hyderabad campus, a state-of-the-art auto-navigation facility known as TiHAN (Technology Innovation Hub on Autonomous Navigation) was inaugurated with the purpose of developing unmanned ground and aerial vehicles. In the next five years, the vision of this hub is to become a global destination for next-generation smart mobility technologies with effective and reliable autonomous navigation and data acquisition systems.

India’s largest floating solar plant

The country’s largest 100 MW floating solar power plant is fully operational at NTPC-Ramagundam, Telangana. The plant is equipped with advanced technology and environment-friendly features.

Image credit: PIB



First indigenously developed Hydrogen Fuel Cell Bus

India’s first truly indigenously developed Hydrogen Fuel Cell Bus developed by KPIT-CSIR in Pune was launched on 21 August 2022. In a *PIB* release Dr Jitendra Singh, Minister of S&T, said, “The high efficiency of fuel cell vehicles ensures lower operational costs per kilometre than diesel-powered vehicles and can bring about a freight revolution in India.”



Image credit: PIB

India’s First Steel Slag Road

A new road constructed from processed steel slag (industrial waste) was completed in Surat, based on technology developed at the CSIR-Central Road Research Institute (CRRI), New Delhi, and in collaboration with the Union Ministry of Steel, NITI Ayog, and ArcelorMittal-Nippon Steel (AM/NS). The use of processed steel slag reduces the need for perishable natural aggregates and fosters sustainable waste management. Steel-making slag is an impurity created through melting ore. In a press release by PIB, Union Minister of S&T, Hon’ble Dr Jitendra Singh said, “India has entered into an era of ‘Steel’ roads, by moving from concrete to steel slag. It is worth mentioning that construction cost of this road is 30% less than the conventional road constructed with natural aggregates, while it has 3 to 4 times higher strength,”

India’s First Night Sky Sanctuary

A first-of-its-kind initiative has been undertaken by the Department of Science & Technology (DST), Government of India to establish a "Night Sky Sanctuary" in Ladakh. Hanle in Ladakh will host the Dark Sky Reserve as part of Changthang Wildlife Sanctuary. Among the highest-located optical, infrared, and gamma-ray telescopes in the world, it will give a boost to Astrotourism in India.



Compiled by Ms Sonali Nagar, Assistant Editor,
Science Reporter