Earth System Science Panorama

(The News, Events, Discoveries Awareness and Researches on Earth, Climate, Planetary and Environmental Sciences)

Our objective for the presentation of this section is to summarise certain research findings, news, and events on Earth, climate, and Environmental sciences. Our global environment is under peril and needs specific remedial measures for the survival of the human race (briefly addressed in our Patron's message). The biggest question arises whether we shall survive or shall extinct by the fury of global warming and climate change. We have mentioned a few advanced research findings in the field of earth science, climate, and environmental science. We have tried to present some important aspects of these topics in this section for critical reading and analysis by our readers.

Few research findings on earth science are mentioned in this section for information of our readers. Earth scientists use repeatable observations and testable ideas to understand and explain our planet. Big Earth is 4.6 billion years old. and it is a complex system of interacting rock, water, air, and life and is continuously changing. Researchers Find Two Extraterrestrial Minerals in El Ali Meteorite. The El Ali meteorite, a 15.2-ton iron meteorite found in 2020 near the tiny town of **El Ali in Somalia, contains two new minerals: elaliite and elkinstantonite. These Two minerals were never seen on earth extracted from meteorite sample. The minerals have been named "elaliite," after the town where the meteorite crashed, and "elkinstantonite," after planetary scientist Lindy Elkins-Tanton**. Phosphate minerals such as those in the apatite group tend to be the dominant forms of phosphorus in minerals on the Earth's surface. Phosphates can be created from phosphides during high-energy events, such as lightning and impacts. **New research led by the University of South Florida shows that, in addition to the formation of metal phosphides, a new phosphite material was formed by lightning in a fulgurite from New Port Richey, Florida, USA. Geologists have discovered 1.2-billion-year-old groundwater** about 3 km below the surface in Moab Khotsong, a gold- and uranium-producing mine in South Africa. This ancient groundwater is enriched in the highest concentrations of radiogenic products yet discovered in the fluid. The discovery has implications beyond Earth, where on rocky planets such as Mars, subsurface water may persist on long timescales despite surface conditions that no longer provide a habitable zone. **Scientists Confirm Discovery of 'Hottest Rock on Earth'. The biggest implication is that we are getting a much better idea of how hot these impact melt rocks are, which initially formed when the meteorite struck the surface, and it gives us a much better idea of the history of the melt and how it cooled in this particular crater," said University of Western Ontario postdoctoral student Gavin Tolometti**.

We would like to categorise other news,events,discoveries and research findings into nineteen points as follows:

1. What led to the sinking of Joshimath, Chamoli, Uttarakhand?

Wide-spread cracks have appeared on many roads and hundreds of houses in Joshimath, Uttarakhand, and the authorities had declared it as a landslide and subsidence-hit zone. Families were evacuated to temporary relief centres while there are protests by those who do not want to move till there is certainty about where they will be rehabilitated. **Multiple factors including unplanned construction, over-population, obstruction of the natural flow of water, and hydel power activities are being cited as reasons for subsidence (sinking of the ground because of underground material movement) in Joshimath**. Perennial streams around the town and highly weathered rocks with low cohesive characteristics make the area vulnerable to landslides and subsidence. But **the unplanned construction activity as also NTPC's Tapovan-Vishnugad hydro project, Char Dham road project, and Helang bypass by the BRO have been going on despite warnings by experts**. All these projects have only now been halted when subsidence in Joshimath has reached a dangerous scale. Although the appearance of cracks on buildings is not a new phenomenon in Joshimath, this time they are deeper and wider, leaving crater-like holes in some places, fanning widespread anxiety and fear among the residents. The town, which has been built on loose soil deposited by landslides, loose, soft rocks, and moraine (material left behind by retreating glaciers), does not have systematic drainage. Unplanned construction halts the natural flow of water and creates pressure over and under the ground while simultaneously softening the porous, crystalline rocks. As it is a highly seismic zone, there are additional pressures created by tectonic shifts. All these factors led to apprehensions that the town might collapse under its own weight. Joshimath is situated in the middle slopes of a hill with the Dhaliganga and Alaknanda rivers on the south and the north and perennial streams on

the west and the east. It is simultaneously impacted by landslides and subsidence. In recent years, the flood events of June 2013 and the glacial lake burst of February 2021 that resulted in the loss of 204 lives of workers on a hydropower project also impacted the region. Extreme rainfall events have caused the mountain streams to expand their channels and change course, leading to more slope instability. Simultaneously, there are hydropower and road projects that are causing the already fragile ecosystem of the town to be threatened further. On the south of Joshimath, in Helang, the Border Road Organisation is building the Heland bypass using heavy machinery. The bypass is aimed at reducing the distance to Badrinath shrine by 30 kilometres but this too is impacting the region adversely. Despite the geological vulnerability of the area, hydropower projects have been sanctioned around Joshimath and Tapovan, namely the Vishnugad HE Project. A tunnel boring machine was employed to excavate the head race tunnel of this project. Additionally, there is indiscriminate construction activity to build hotels, rest houses, and multi-storied buildings which have further overburdened the town and caused sub-surface water pressure by blocking the natural flow of water. The town also lacks a proper drainage system. All these factors have combined to exacerbate an existing crisis. For about five decades since the MC Mishra Commission report in 1976, experts have warned about the vulnerability of Joshimath which is situated on an old landslide and seismic zone. The report, prepared by an 18-member expert committee headed by Garhwal Collector M.C Mishra, had warned against development and construction activity in the area. "Joshimath is a deposit of loose sand and debris — it is not the main rock — hence it was not suitable for a township. Vibrations produced by blasting, heavy traffic, etc., will lead to a disequilibrium in the natural factors," the report had said. Over the years and more recently, the Geological Survey of India and the Uttarakhand State Disaster Management Authority (USDMA) had warned against construction and big projects in the area. Besides an immediate halt to unplanned construction activity in the private domain that includes big resorts, hotels, and multi-storied buildings in ecologically sensitive zones, the environmental and technological hazards of tunneling, excavation, and construction involved in road and hydro-power projects need to be reassessed on an urgent basis.

Courtesy: *Purnima Joshi, Business line, January 2023*

2. Odisha is experiencing the country's worst forest fires, 642 incidents in March 2023

Forest fires continue to rage in Odisha after the state recorded 642 large fire incidents from March 2-9, 2023 — the highest in the country during the period, according to the Forest Survey of India (FSI) data. On March 9, the eastern state recorded 96 major fires in different jungles — also the highest in the country. From all the other states combined, 189 active fire incidents were reported on the same day, according to FSI. Odisha has recorded 871 large forest fires since November 1, 2022, the beginning of the forest fire season. This is also a national record for the season, official data showed. It was followed by Andhra Pradesh (754), Karnataka (642), Telangana (447), and Madhya Pradesh (316). A sudden jump in the incidents of fires across Odisha resulted in a massive loss of flora and fauna in the state's forests. A prolonged dry spell since October 2022 and the accumulation of inflammable materials such as dry leaves are some of the reasons that started these forest fires, said Debidutta Biswal, principal chief conservator of forests, Odisha. Some of the fires may have also been caused by human-made reasons, the expert added. The tribal people set fire to forests for shifting cultivation, and collection of mahula flowers and kendu leaves, he noted. Forests are set on fire to cultivate turmeric in Baliguda forest division in Kandhamal district, said Sudhakar Mohapatra, a senior retired forest officer. Regeneration of the forests will be affected due to the wildfires, said SN Patra, President of Odisha Environment Society. The seeds which are supposed to germinate in the monsoon rain get burnt due to ground fires in the forest areas, affecting the forest growth, added Patra, who is a botanist. Forest fires result in the loss of timber, fruit-bearing trees, and medicinal plants. They also pose a threat to wildlife and their habitat areas, said Biswajit Mohanty, a former member of the National Board for Wildlife. The forest department did not learn from the 2021 forest fires when a record 51,968 forest fire incidents occurred in the state. Massive fires had broken out in Similipal National Park in Mayurbhanj district, which is one of the major biospheres of Asia, he said. After that, the Odisha government constituted a nine-member task force, Mohanty added, to review the incidents of forest fire, its causes and suggest improvements in standard operating procedures for better fire management and containing the situation. "The task force report is yet to be made public." Since forest staff were unable to contain the forest fires, Mohanaty urged the government to entrust the Gram Sabhas with adequate funds to handle such crises. "The first hour of the forest fire is crucial to control the blaze. It can be possible only by the local people who live in the forest area," he said. Patra also called for the involvement of the local community and rejuvenating the existing water bodies inside the forests to control the fires. But the forest fires may abate soon with the oncoming rains, as predicted by the India Meteorological Department's regional centre in

Bhubaneswar, and an active western disturbance, a senior forest officer said. “A spell of rain is enough to check the rapid spread of fires.” The number of active fires has been on a decline in the last three days, he added. “While 203 forest fires were sighted in the state on March 7, the number was down to 121 and 96 on March 8 and 9, respectively.” Nearly 3,000 forest personnel have been engaged to control the state-wide fires, Biswal said. Besides, 16,000 Vana Surakshya Samitis and 280 special squads are also on the ground trying to douse the fires, he added. The members of women self-help groups have been organising awareness campaigns and involved in efforts to stop the fires, the official noted. Forests in Odisha’s Similipal was burning for the last two weeks, and while there are multiple means to track and monitor these fires, gaping holes exist in monitoring its public health impact. One of them is rather obvious — real-time air quality monitoring and public communication of bad air under the National Air Quality Index initiative intended to enhance public awareness to improve air quality. Wildfires have become a summer staple, thanks to climate change. These fires are an environmental catastrophe, but most of us fail to realise that they are a public health emergency as well. Smoke from these fires can travel beyond the fire lines and choke millions of people residing in cities. Similipal forest wildfire is similar to ones that are now an annual occurrence in Indonesia and California. The wind has been lowing north and east, so it is possible that the smoke from the Similipal wildfires would be impacting air quality in Jamshedpur in the north and Kharagpur in the east. Dedicated funds to combat air pollution in cities are linked with monitored air quality. People need to know the air quality in their areas to safeguard their health.
Courtesy: *Hrusikesh Mohanty, Avikal Somvansh, Down To Earth, March 2023*

3. Rudraprayag and Tehri Gharwal of Uttarakhand are most prone to landslides in India

Mizoram saw 12,385 landslides from 1988-2022, the highest; followed by 11,219 in Uttarakhand and 8,070 in Tripura. Rudraprayag and Tehri Garhwal in Uttarakhand are the most landslide-prone districts in the country, according to satellite data by the Indian Space Research Organisation (ISRO). A new report looked at landslide-vulnerable regions in 17 states and two Union Territories of India in the Himalayas and Western Ghats. Rajouri, Thrissur, Pulwama, Palakkad, Malappuram, South Sikkim, East Sikkim, and Kozhikode in Kerala, Jammu Kashmir, and Sikkim are other high-risk districts, found **Landslide Atlas of India 2023**. Hyderabad-based National Remote Sensing Centre created the all-India database of nearly 80,000 landslides that occurred from 1998 to 2022. The recent cases of land subsidence in Joshimath, Uttarakhand, captured the spotlight. On June 29, 2022, at least 79 people were killed in a landslide in the Noney district of Manipur. The risk analysis in the report was based on the density of human and livestock populations, which indicates the impacts on people due to these landslides. The disaster in Kedarnath in 2013 and the landslides caused by the devastating Sikkim earthquake in 2011 are also included in this atlas. Between 1988 and 2022, the maximum number of landslides — 12,385 — were recorded in Mizoram. Uttarakhand followed it at 11,219, Tripura at 8,070, Arunachal Pradesh at 7,689, Jammu and Kashmir at 7,280. Kerala saw 6,039, Manipur at 5,494 and Maharashtra recorded 5,112 incidents of landslides. **Globally, landslides rank third in terms of deaths in India among natural disasters. However, deforestation due to unplanned urbanization and human greed increases the risk of such incidents. India is among the four major countries where the risk of landslides is the highest**. If we look at the figures, about 0.42 million square kilometres in the country are prone to landslides, which is 12.6 percent of the total land area of the country. However, the figure does not include snow-covered areas. Around 0.18 million sq km of the landslide-prone areas in the country are in North East Himalaya, including Darjeeling and Sikkim Himalaya, the atlas said. Of the rest, 0.14 million sq km falls in North West Himalaya (Uttarakhand, Himachal Pradesh, and Jammu & Kashmir); 90,000 sq km in Western Ghats and Konkan hills (Tamil Nadu, Kerala, Karnataka, Goa, and Maharashtra) and 10,000 sq km in Eastern Ghats of Aruku in Andhra Pradesh, the atlas added. Sudden heavy rains due to climate change are also increasing landslides, according to experts. Around 73 percent of landslides in the Himalayan region are attributed to heavy rains and reduced water-absorbing capacity of the soil. Global climate change is causing heavy rainfall that erodes steep slopes with loose soil, a study found in 2020 by the Indian Institute of Technology in Delhi. Therefore, the increasing number of landslides can no longer be termed as just natural disasters, as human actions have also played a major role in it.
Courtesy: *Lalit Maurya, Down to Earth, March 2023*

4. El Nino – The warm phase of the water cycle in the Pacific Ocean that shapes storms, droughts, and record heat waves around the world.

Heat waves have already baked parts of Asia this year, and a looming El Niño is poised to add to the heat, threatening crops in places like Malaysia. “El Niño conditions are present and are expected to gradually strengthen into the Northern Hemisphere winter 2023-24,” the National Weather Service reported on June 8, 2023. El Niño is the warm phase of the Pacific Ocean’s temperature cycle, and this year’s El Niño is poised to be a big one, sending shock waves into weather patterns around the world. It’s likely to set new heat records, energize rainfall in South America, fuel drought in Africa, and disrupt the global economy. It may already have helped fuel early-season heat waves in Asia this year. “A warming El Niño is expected to develop in the coming months and this will combine with human-induced climate change to push global temperatures into uncharted territory,” said Petteri Taalas, secretary-general of the World Meteorological Organization, in a statement in May. “This will have far-reaching repercussions for health, food security, water management, and the environment. This El Niño will likely be costly to the global economy. The one in 1997-98, one of the most powerful in history, led to $5.7 trillion in income losses in countries around the world according to a study published earlier this month in the journal Science. That’s much higher than prior estimates of as much as $96 billion. It was also blamed for contributing to 23,000 deaths as storms and floods amped up in its wake. The 1997-98 El Niño led to severe rain and flooding in countries like Ecuador, killing hundreds. Rising average temperatures are poised to amplify these effects further. Even if every country met its existing pledges to cut greenhouse gas emissions to limit climate change, El Niño events could lead to $84 trillion in economic losses by the end of the century, according to a Science study.

Courtesy: *Vox, Umair Irfan Jun 8, 2023*

5. Environmental and Health Impacts of Air Pollution: A Brief Review

One of our era's greatest scourges is air pollution, on account not only of its impact on climate change but also its impact on public and individual health due to increasing morbidity and mortality. There are many pollutants that are major factors in disease in humans. Among them, Particulate Matter (PM), particles of variable but very small diameter, penetrate the respiratory system via inhalation, causing respiratory and cardiovascular diseases, reproductive and central nervous system dysfunctions, and cancer. Despite the fact that ozone in the stratosphere plays a protective role against ultraviolet irradiation, it is harmful when in high concentration at ground level, also affecting the respiratory and cardiovascular systems. Furthermore, nitrogen oxide, sulfur dioxide, Volatile Organic Compounds (VOCs), dioxins, and polycyclic aromatic hydrocarbons (PAHs) are all considered air pollutants that are harmful to humans. Carbon monoxide can even provoke direct poisoning when breathed in at high levels. Heavy metals such as lead, when absorbed into the human body, can lead to direct poisoning or chronic intoxication, depending on exposure. Diseases occurring from the aforementioned substances include principally respiratory problems such as Chronic Obstructive Pulmonary Disease (COPD), asthma, bronchiolitis, and also lung cancer, cardiovascular events, central nervous system dysfunctions, and cutaneous diseases. Last but not least, climate change resulting from environmental pollution affects the geographical distribution of many infectious diseases, as do natural disasters. The only way to tackle this problem is through public awareness coupled with a multidisciplinary approach by scientific experts; national and international organizations must address the emergence of this threat and propose sustainable solutions.

Courtesy: *Front. Public Health, 2020, Volume 8 - 2020 | https://doi.org/10.3389/fpubh.2020.00014*

6. Climate Change Takes Rajasthan's Favourite Staple 'Desert Berry' Off Menu

Ker and Sangri, also known as the "desert berry", is integral to any Rajasthani thaali. It grows on the Khejri tree and on the Ker plant. The Khejri tree is considered a lifeline of the desert in Rajasthan.

A fruit staple to Rajasthan that grows in the state's western arid regions is under threat from unusual weather phenomena, which experts say could be linked to climate change. Ker and Sangri, also known as the "desert berry", is integral to any Rajasthani thaali. It grows on the Khejri tree and on the Ker plant. The Khejri tree is considered a lifeline of the desert; it is worshipped by locals because the tree can still grow where there is no water and its fruit is packed with nutrition. But this year's unusual rainfall in Rajasthan has affected the tree's growth. Rajasthan's western districts recorded 39.4 mm of rainfall in March, April, and May when it should be 13.8 mm. The weather office said the rainfall was 185 percent above normal. The temperature, too, has been relatively cool in March - 3 degree Celsius below normal - which has affected the growth of the Khejri tree and the desert berry. High moisture in the air and unusual rain has led to the growth of fungus and pests and they

have infected the Khejri tree. This tree thrives in dry and arid weather; its fruit is picked in April and May and can be stored for the whole year. The pests and fungus has infected not only the tree's bark but also the leaves and shoots."Sangri growth this time has fallen by 60-70 percent due to unusual rain and climate change. The temperature was cool when it should have been hot as pests and fungus would die of heat. But they festered and started attacking the Khejri tree," said MR Baloch, director of Arid Research Zone, Jodhpur. Khejri's fruit, Sangri, when combined with Ker or the desert berry, makes a dish integral to Rajasthani cuisine, which is also a staple of the desert people. Steeped in buttermilk overnight, Sangri and Ker are stir-fried in mustard oil with spices. The fruit's price has sharply increased this year and it has vanished from menus in Rajasthan restaurants."Ker-Sangri is the king of vegetables. But they are in short supply, so we have had to remove them from our menus," said Anand Bhati, owner of Pokhar restaurant in Jodhpur. Farmers who would earn extra income from collecting the fruit of the Khejri tree and selling them in the market are also disappointed. "We have some 15,000 trees in our village. None are bearing fruit this year. Earlier, we would sell them for 700 per kilogram and make some extra money," said Mool Singh, a farmer from Shergarh in Jodhpur. Ker-Sangri prices have doubled from Rs.1,500 to Rs. 3,000 per kg this year.

Courtesy: *Harsha Kumari Singh, India News, May 2023*

7. Why the Arabian Sea has More Cyclones?

Cyclones are rapid inward air circulation around a low-pressure area. The air circulates in an anticlockwise direction in the Northern hemisphere and clockwise in the Southern hemisphere. There are two types of cyclones: Tropical cyclones; Extra-Tropical cyclones. Thus, cyclones are the most destructive weather conditions accompanied by strong winds and heavy rainfall. Cyclones are fast inward air circulation about a low-pressure zone. The reason why the Arabian Sea has more cyclones is due to increasing sea surface temperatures and global warming. The temperature has been 1.2-1.4 °C higher than before, which leads to intense cyclones and vigorous convection. The formation and initial development of a cyclonic storm depend upon the transfer of water vapour and heat from the warm ocean to the overlying air, primarily by evaporation from the sea surface. It encourages the formation of massive vertical cumulus clouds due to convection with condensation of rising air above the ocean surface. When a tropical storm intensifies, the air rises in vigorous thunderstorms and tends to spread out horizontally at the tropopause level. Once air spreads out, positive pressure at high levels is produced, which accelerates the downward motion of air due to convection. Warm-humid air masses from the tropics meet the dry-cold air masses from the poles and thus a polar front is formed. The cold air mass is denser and heavier and due to this reason, the warm air mass is pushed up. This interaction of cold and warm air masses creates instability and a low pressure is created at the junction, particularly in the center of interactions. Thus, a void is created because of the lessening of pressure. The surrounding air rushed in to occupy this void and coupled with the earth’s rotation a cyclone is formed. The Arabian Sea used to experience few extreme cyclones than the Bay of Bengal on India’s eastern coast. Cyclones release disastrous storm waves or tsunami-like flooding when they make landfall. The speed of the wind partly impacts them. The more enclosed shape of the Arabian Sea stimulates more evaporation and the formation of clouds. There has been an increase in cyclone intensity because of global warming, which has resulted in the rising temperature of seawater. Another reason why the Arabian Sea has more cyclones is because of the instantaneous warming of the ocean. Sea waters with roughly around 1.2-1.4 °C higher temperature allows the Arabian Sea to utilize plenty of energy to intensify cyclones. The rising temperature enables the Arabian Sea to supply abundant energy for strengthening the cyclones. Cyclone Tauktae evolved as a VSCS in just 2 days, as seawater up to depths of 50 meters has been very warm. The Arabian Sea also nourishes facilitative wind shear or wind gradients for cyclones. For illustration, a higher-level easterly wind pushed the crater of Cyclone Ockhi to the Arabian Sea from the Bay of Bengal. The last reason behind the increase in cyclone intensity in the Arabian Sea is the higher occurrence of El Nino Modoki. It is a climatic phenomenon favourable for the formation of cyclones in the Arabian Sea. Conversely, it does not encourage cyclone formation in the Bay of Bengal. Since 1930, there has been a six-fold increase in the anthropogenic emissions of aerosols. This has led to the weakening of upper-level easterly winds and lower-level south-westerly winds that determine the movement of precipitation over the Arabian Sea. Cyclones constitute 30 percent of all damages caused due to natural disasters in India. 13 coastal states and UTs in the country encompassing 84 coastal districts- Andhra Pradesh, Tamil Nadu, Puducherry, Gujarat, Odisha, West Bengal highly vulnerable -250 million people are exposed to cyclones in these states. With a coastline of 7517 km, India is exposed to nearly 10 percent of the world's tropical cyclones. A UN report suggests That cyclone frequency will double in India- ADB report suggests India will lose 2 percent of its GDP due to natural disasters by 2050.

8. Why More cyclones in the Bay of Bengal than in the Arabian Sea?

- The Arabian Sea is comparatively less prone to cyclonic storms than the Bay of Bengal due to cold sea surface temperature-usually extremely severe cyclones in 4-5 years.
- Geographical location
- The Bay of Bengal is more prone to cyclones than the Arabian Sea because it gets high sea surface temperature, low vertical shear winds, and has enough moisture in the middle layers of its atmosphere. The frequency of intensely severe cyclones has risen over the Arabian Sea since 1990, according to the research conducted by the India Meteorological Department over the North Indian Ocean (the Bay of Bengal and the Arabian Sea). Cyclones Kyarr and Maha in 2019 were extremely severe on the western coast. Increased carbon emissions have led to the warming up of Arabian Sea waters. The more enclosed nature of the sea is promoting more evaporation and cloud formation activities. Anthropogenic emissions of aerosols have increased six-fold since the 1930s, leading to a weakening of the south-westerly lower-level and easterly upper-level winds that define the monsoonal circulation over the Arabian Sea.
- **Indian Ocean Dipole** which is an irregular natural oscillation of **Sea Surface Temperatures (SSTs)** in which the western Indian Ocean becomes alternately warmer and then colder than the eastern part of the ocean-strongest IOD in 60 years.
- The increase in the frequency of cyclones over the Arabian Sea has not posed a corresponding increase in the coastal vulnerability along the west coast since most of such cyclones forming over the Arabian Sea were making landfall over the coasts of Oman, Yemen, etc. and hence the threat to Gujarat & Maharashtra coasts remains same.
- **Early warning systems and communication-Doppler weather radars** can provide a lead time of 3 to 6 hours - Developing local networks for real-time rainfall data collection with a 'Local Network Cell' in the IMD.
- **Vulnerability analysis**-classification of structures as per risk using hazard risk zoning.
- **Design and Management of Urban Drainage System**-Pre-monsoon desilting of all major drains to be completed by March 31 each year - Concept of Rain Gardens to be incorporated in planning for public parks.
- **Capacity development**, awareness generation-participatory urban flood planning and management involving both local government and community.

Courtesy: *Wikipedia.org*

9. Extremely severe cyclones Biporjoy (16 June 2023) and Morcha (May 2023)

Extremely Severe Cyclonic Storm Biparjoy is a long-lived, powerful tropical cyclone that formed over the east-central Arabian Sea and made landfall near the India-Pakistan border. This is the long-lasting system on record in the North Indian Ocean Cyclone Season. The third depression and the second cyclonic storm of the 2023 North Indian Ocean cyclone season, Biparjoy originated from a depression that was first noted by the India Meteorological Department (IMD) on 6 June, before intensifying into a cyclonic storm. The cyclone steadily weakened due to deep flaring convection. Biparjoy accelerated north-eastward, strengthening to a Category 3-equivalent tropical cyclone and to an extremely severe cyclonic storm. Gujarat's coastal areas experienced heavy rains and strong winds, resulting in the loss of three lives in the Kutch and Rajkot districts. Trees were uprooted, and a wall collapsed due to the severe weather conditions. Additionally, in Kutch, strong waves swept away tents situated on Mandvi Beach. As the cyclone approached the coast, the Dwarka region experienced high tides. The neighboring state of Maharashtra also witnessed heavy rains and high tidal waves A total of 23 people were injured as well as 4,600 villages were affected by power outages. The affected areas were Thatta, Badin, Sajawal, Tharparkar, Karachi, Mirpurkhas, Umerkot, Hyderabad, Tando Allah Yar Khan, and Tando Mohammad Khan districts. It is estimated that approximately 9,000 households (approx. 55,000 people) are at risk of direct impact. Widespread wind-dust, thunderstorm activity, and heavy rainfall are expected mainly in districts of Sindh. Tropical Cyclone Biparjoy has made landfall in India's western Gujarat state, close to the Pakistan border on 15th June 2023 unleashing powerful gusts of wind that ripped up trees and toppled electricity poles. At landfall, Biparjoy was equivalent to a strong tropical storm with winds of 65 mph (100 kph), according to the Joint Typhoon Warning Center. As it moves slowly inland, the winds and storm surge threats are expected to diminish, with flooding becoming the most significant impact for millions of people over the next 48 hours. Heavy rainfall warnings are expected to remain in place for northwest India through Saturday. Rainfall of 150

to 250 mm (6 to 10 inches) is likely with isolated amounts up to 500 mm (20 inches) possible. Roads were turning into rivers, trees bending in the wind, and people wading waist-deep in floodwater. In Pakistan, widespread dust storms and thunderstorms in the southern Sindh province, with very heavy rain and squally winds of 50-60 mph (80-100 kph) were observed. As of the 16th June morning, there have been reports of two deaths in India, bringing the total killed in the country to nine. Earlier this week four boys drowned off the coast of the country's financial hub, Mumbai, and three people died in Gujarat's Kutch and Rajkot districts after heavy rain and strong winds collapsed a wall. Before the storm, both India and Pakistan implemented mass safety measures to ensure minimal damage and loss of life. About 180,000 people have been evacuated from high-impact areas across both countries, according to authorities. Livestock were also moved to higher ground, some schools were shut, and fishing was suspended in Gujarat state. Two of India's largest ports have also stopped operations. A study published in 2021 by researchers at the Shenzhen Institute of Meteorological Innovation and the Chinese University of Hong Kong and published in Frontiers in Earth Science found that tropical cyclones in Asia could have double the destructive power by the end of the century, with scientists saying the human-made climate crisis is already making them stronger. Bare minimum terminal end equipment and communication backup equipment support. Lack of grass root participation in disaster management to **build resilience**. Lack of fully automated and state of art **OC** at **NDMA** and **MHA** with terminal end facilities and communication connectivity both for routine and disaster. Failure of even well-engineered structures such as communication and transmission after the cyclone. India **Meteorological Department** announced to launch a **dynamic, impact-based cyclone warning system** - it will use meteorological data in combination with geospatial and population data to assess the impact of the cyclone in a particular area. **Sagar Vani by INCOIS** to disseminate info to the fishermen community in local languages. **Government launches GEMINI** a portable receiver for fail-proof warning to fishermen-effective dissemination of emergency information and communication on **Ocean States Forecast** and mapping of Potential **Fishing Zone**.
***Courtesy**: Times of India 15 June and Wikipedia.org*

10. Extremely Severe Cyclonic Storm Mocha

Extremely Severe Cyclonic Storm Mocha was an extremely powerful tropical cyclone in the North Indian Ocean which affected Myanmar and parts of Bangladesh in May 2023. The second depression and the first cyclonic storm of the 2023 North Indian Ocean cyclone season, Mocha originated from a low-pressure area that was first noted by the India Meteorological Department (IMD) on 8 May. After consolidating into a depression, the storm tracked slowly north-north-westward over the Bay of Bengal and reached extremely severe cyclonic storm intensity. After undergoing an eyewall replacement cycle, Mocha rapidly strengthened, peaking at Category 5-equivalent intensity on 14 May with winds of 280 km/h (175 mph), tying with Cyclone Fani as the strongest storm on record in the north Indian Ocean, in terms of 1-minute sustained winds. Mocha slightly weakened before making landfall, and its conditions quickly became unfavorable. Mocha rapidly weakened once inland and dissipated shortly thereafter.Thousands of volunteers helped citizens of Myanmar and Bangladesh evacuate as the cyclone approached the border. Evacuations were also ordered in low-lying areas in Sittwe, Pauktaw, Myebon, Maungdaw, and Buthidaung. In Bangladesh, over 500,000 individuals were ordered to be relocated to coastal areas of the country due to the storm's approach. Several villages in Rakhine State townships were also damaged by the cyclone. Mocha injured 712 and killed at least 44 people and caused about $1.07 million in damages throughout Myanmar and Bangladesh.Local authorities in Rakhine have advised residents to evacuate low-lying and coastal areas in Sittwe, Pauktaw, Myebon, Maungdaw, and Buthidaung, and many are already beginning to leave ahead of the storm. Communities and aid agencies in Myanmar are preparing for Cyclone Mocha's potential arrival. The Myanmar Red Cross Society is preparing for a major emergency response with the support of the International Federation of Red Cross and Red Crescent Societies (IFRC). More than 78.25 people evacuated from at-risk areas, including 18,800 internally displaced persons in Rakhine. The nation's government prepped shelter stockpiles to accommodate 100,000 people. Roughly 4,000 people evacuated from Sittwe while 20,000 other residents sought refuge in local shelters. Large-scale search and rescue teams were placed on standby, consisting of 3,207 personnel equipped with 1,009 land and 242 water vehicles. Dozens of medical personnel and rapid response teams were deployed to Rakhine and Chin. Non-food items for more than 10,000 people were readied. According to ASEAN, Myanmar's government was better equipped to handle disasters since Cyclone Nargis in 2008.The World Food Programme (WFP) in Myanmar said it was preparing food and relief supplies to support over 400,000 people in Rakhine and nearby areas. According to the United Nations Office for the Coordination of Humanitarian Affairs (OCHA), Mocha is anticipated to reach Myanmar's Rakhine state and northwest region, where six million people require

humanitarian assistance and 1.2 million are displaced. The World Health Organization has positioned 500,000 water purification pills in Myanmar, along with additional supplies. The ASEAN Coordinating Centre for Humanitarian Assistance (AHA Centre) has warned of the possibility of a "catastrophic disaster" and stated that it is coordinating with Myanmar's military to fly essential supplies from warehouses in Thailand and Malaysia State TV reported that the military government is prepared to send food, medicine, and medical personnel. The UN refugee agency stated that "emergency preparations in the camps and on Bhasan Char are underway" in collaboration with the government and local humanitarian organizations. Heavy rains from the cyclone might cause landslides in Chittagong and Cox's Bazar, as well as three other hilly districts: Rangamati, Bandarban, and Khagrachhari, according to authorities in Bangladesh. A half-million people are being evacuated to safer areas in south-eastern Bangladesh ahead of a possibly catastrophic cyclone.[45] The WMO deployed 40 ambulances and 33 mobile medical teams in Cox's Bazar. In addition, Arjun Jain, the UN's principal coordinator for the Rohingya refugee response in Bangladesh, says that there are numerous ambulances and mobile health teams available to support Bangladeshis in need as well as refugees. These teams are highly trained to assist the elderly, children, and the disabled. The authorities suspended inland river transport in Bangladesh on 13 May and flight operations at Shah Amanat International Airport on 14 May. The Bangladesh government launched a large evacuation campaign to relocate almost 500,000 residents along the country's southern coastlines. By 14 May, approximately 1.27 million people evacuated from Cox's Bazar and over 100,000 from Chittagong. The India Meteorological Department (IMD) said that the southeast Bay of Bengal region of Tripura, Mizoram, Nagaland, Southern Assam, and portions of Manipur are expected to receive "heavy" to "very heavy" rainfall as a result of Cyclone Mocha. The state governments of Tripura, Mizoram, Nagaland, Manipur, and Assam have also requested that disaster management and all other relevant authorities take preventative measures to minimize casualties and property damage.The National Meteorological Centre (NMC) of the China Meteorological Administration (CMA) said that due to there was a risk of flash flooding, mudslides, and landslides in the southwestern provinces of Yunnan and Tibet especially in the Hengduan and Eastern Himalayan Mountain ranges. In response, the State Flood Control and Drought Relief Headquarters activated a Level IV response, the lowest level of response to flooding.

Courtesy: *WMO, Hindustan Times and Wikipedia.org*

11. Trans Bio-Filter Technology: A Decentralised wastewater treatment

Trans Bio Filter is a bed of organic material that supports hybrid earthworms and microbes that break down solids and converts them into carbon dioxide, water, and nutrients. The earthworms and beneficial microbes (transzyme) have the ability to reduce contaminants present in the wastewater and remove toxic matter by adsorption and filtration followed by biological degradation and oxygen supply by natural aeration to the treatment system. The technology works on the principle that wastewater with specific pre-treatment with Microbial culture is fed into the system. As the wastewater slowly percolates down, naturally occurring microbes and enzymes present in the media degrade the solids and other contaminants which leads to a considerable reduction in toxicity and concentration of COD and BOD present in the wastewater. The treated water depending upon the requirement of final effluent characteristics can be subjected to a polishing treatment.

Salient Features:

- Easy to handle, operate and maintain
- No sludge generation
- Better public participation and acceptance
- Cost savings in sewage collection and transportation
- Better adoption to local contexts and needs.
- Treated water can be used locally for horticulture/ washing/ flushing etc.
- Cost-effective and efficient technology
- Need a smaller area for implementation

Courtesy: *Centre for Science and Environment, New Delhi*

12. Spewing Fluids, Gas from Inside Earth': Underwater Volcano Found in Barents Sea Near Norway

Highlights:

According to media reports, scientists have noted the presence of active marine life in the vicinity of the newly discovered volcano. Eruptions from the volcano have been observed to contain methane-rich fluids, contributing

to greenhouse gas emissions and the overall warming of the planet. Geologists have discovered a never-before-seen volcano at the bottom of the Barents Sea off the coast of Norway, which is erupting with mud, fluids, and gas from the planet's interior. The volcano has been named The Borealis Mud Volcano. The remarkable discovery was made by utilising the piloted submersible vehicle ROV Aurora. The volcano is located in the Southwestern Barents Sea within the outer section of Bjornoyrenna.

Windows into the Earth's interior

The team believes these venting volcanoes are direct windows into the Earth's interior since they erupt predominantly water and fine sediments from several hundred meters to a few kilometres, providing a window into past environments. Scientists anticipate that studying these phenomena will enhance their understanding of localised, time-dependent occurrences and their broader impacts on the global methane budget and ecosystems. According to media reports, scientists have noted the presence of active marine life in the vicinity of the newly discovered volcano. Observations revealed sea anemones, sponges, carnivorous sponges, sea stars, corals, sea spiders, and crustaceans living on the seabed.

Courtesy: *Gursharan Bhalla, India Times, May 2023*

13. New York City (NYC) is sinking under the weight of its buildings, geologists warn

New geological research warns that the weight of New York City's skyscrapers is actually causing sink lower into its surrounding bodies of water. The city is plopping closer to the water at a rate of 1 to 2 millimetres a year, "with some areas subsiding much faster." While that may not seem significant to untrained eyes, the gradual descent makes NYC extremely vulnerable to natural disasters, according to lead researcher and geologist Tom Parsons of the United States Geological Survey. Lower Manhattan is particularly at risk, and there is concern for both Brooklyn and Queens as well, according to the study. Lower Manhattan is at a unique risk of flooding due to the sinking of NYC. The weight of NYC buildings puts the city at additional flood risk. Paul Martinka as awful as Sandy and Ida were — the more recent of the two hurricanes forcing people to abandon their cars on major roadways across the city — Parsons fears that the structural integrity of the city's many buildings could be at risk in the future. "The combination of tectonic and anthropogenic subsidence, sea level rise, and increasing hurricane intensity imply an accelerating problem along coastal and riverfront areas," he wrote. "Repeated exposure of building foundations to salt water can corrode reinforcing steel and chemically weaken concrete causing structural weakening." Not to mention, the threat of severe storms is more likely than it was years ago, according to Parsons. Greenhouse gas "appears to be reducing the natural wind shear barrier along the US East Coast, which will allow more frequent high-intensity hurricane events in the coming decades."

Courtesy: *Alex Mitchell, May 2023*

https://economictimes.indiatimes.com/industry/indl-goods/svs/metals-mining/india-to-auction-newly-found-lithiumreserve/articleshow/98605147.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst

14. July 2023 Is the Hottest Month Ever Recorded on Earth

Preliminary analyses show that this July is virtually certain to be the hottest month on record for the planet by a wide margin, largely because of global warming.

This July is set to be the hottest month ever recorded on Earth and likely the hottest in about 120,000 years based on evidence of past temperatures found in ancient sediments and layers of ice, as well as on other paleoclimate records. The World Meteorological Organization (WMO), the European Union–funded Copernicus Climate Change Service (C3S), and Leipzig University in Germany have combined temperature data for July 2023 so far with projections for the remainder of the month of July and have found it will be the hottest July by a wide margin. The WMO and C3S found that the first three weeks of this month were the hottest three-week period on record. The Leipzig University analysis determined that July 2023 will be 0.2 degree Celsius (about 0.4 degrees Fahrenheit) warmer than the previous warmest July, which was in 2019, according to the database used. This July has seen record-breaking heat waves in several spots around the world, notably in the U.S. Southwest, Mexico, and China and around the Mediterranean. The records are primarily linked to overall rising global temperatures from the excess heat trapped in the atmosphere by humans burning fossil fuels. The analysis by the World Weather Attribution group found that the heat waves in North America and Europe were "virtually impossible" without climate change. It also found that the heat wave in China was 50 times more likely to occur in our current warmer world. El Niño, which developed in May, also boosts global

temperatures—and this climate pattern's combination with climate change makes it highly likely that more months this year will set records, according to Karsten Haustein, a Leipzig University climate scientist. A release from Leipzig University and another from the WMO and C3S both noted that July was about 1.5 degrees C (2.2 degrees F) above preindustrial levels, the warming limit under the Paris climate accord. "The extreme weather which has affected many millions of people in July is, unfortunately, the harsh reality of climate change and a foretaste of the future," said the WMO's secretary-general Petteri Taalas in the WMO-C3S press release. "The need to reduce greenhouse gas emissions is more urgent than ever before. Climate action is not a luxury but a must."

Courtesy: *Scientific American, July 2023, Andrea Thompson on July 27, 2023*

15. Odisha braces for intense heat wave over next 3 days i.e., June 12 onwards

Several districts in Odisha are experiencing a scorching heatwave, disrupting normal life. The Indian Meteorological Department (IMD) has predicted the weather conditions to worsen over the next three days from 12 June with temperatures surpassing 45 degrees Celsius. Eight districts have been put on an orange alert. According to the IMD, Jharsuguda, Sambalpur, Baragarh, Sonepur, Boudh, Balangir, and Keonjhar districts are likely to face severe heatwave conditions. A heatwave is declared when temperatures exceed 45 degrees Celsius for five consecutive days, while it becomes severe when temperatures rise above 6.4 degrees Celsius. Bolangir recorded the highest temperature in the state, exceeding the normal average by 7.1 degrees Celsius. Jharsuguda followed closely with a temperature of 44.4 degrees Celsius, 6.2 degrees above normal. Bhubaneswar and Cuttack recorded temperatures of 42.6 and 41.6 degrees Celsius, respectively, both around 6 degrees above normal. The delay in the arrival of the monsoon has resulted in high humidity, adding to the discomfort. During the week the highest maximum temperature was observed as 46.0 degrees Celsius over Sambalpur on 18th June 2023 in the plains of Odisha. The Odisha government had confirmed its first heat wave-related death and sanctioned ex-gratia of Rs 50,000 for the deceased's family. The victim is a middle-aged person from the Balasore district. A senior official at the Special Relief Commissioner's (SRC) office told PTI that the state has so far received allegations of 20 deaths due to heat waves. Union Health Minister Mansukh Mandaviya had asked a team of experts to visit the affected areas in UP and Bihar, and Odisha. The minister then chaired a high-level meeting on public health preparedness for heatwave management across the country.

Courtesy: *The Times of India, Minati Singha, Jun 12 and June 21, 2023*
With inputs from PTI, ANI, AP

16. India to auction lithium reserves found in Jammu and Kashmir by December 2023

Auction of lithium reserves found in Jammu and Kashmir's Reasi will be started by December of this year said Secretary of Ministry of Mines Vivek Bharadwaj. Speaking at an industry event on May 2, the secretary said the ministry has written to the Jammu and Kashmir administration for the transaction advisor for the lithium auction. "We have completed the consultation process with stakeholders on the amendment of the Offshore Mining Act. Hopefully, we will soon bring it in the parliament for discussion," Mr. Bharadwaj said." We have been lucky to **discover 5.9 million tonnes of Lithium**. We were looking for limestones that are available in Jammu and Kashmir. We found limestone, bauxite, and lithium together. There has been renewed interest in exploration in these minerals," he said. The Union Government in February this year said that 5.9 million tonnes of lithium reserves had been found for the first time in the country in Jammu and Kashmir. Lithium is a non-ferrous metal and is one of the key components in EV batteries, among other industries. "Geological Survey of India (GSI), an attached office of the Ministry of Mines, carried out a G3 stage mineral exploration project during Field Season 2020-21 and 2021-22 in Salal-Haimna areas of Reasi district, Jammu & Kashmir and estimated an inferred resource (G3) of 5.9 million tonnes of lithium ore and the report has been handed over to the Government of Union Territory of J&K," the Ministry of Mines earlier said. The Geological Survey of India proposes more exploration activities in Jammu and Kashmir for identifying lithium resources.

Importance of energy minerals

It is time for India to take a decisive step in rare earth mineral exploration, Mr. Bharadwaj said. Speaking at the launch of the Federation of Indian Chambers of Commerce and Industry's (FICCI) Report on "New Age Energy Minerals", Mr. Bharadwaj expressed his enthusiasm for the potential of India's energy mineral sector. Mr. Bharadwaj highlighted the importance of energy minerals in the transition towards a net-zero future and cited the example of Ilmenite, a mineral abundant in India. Despite holding 11% of the world's deposits, India imports

a billion dollars worth of titanium dioxide yearly, which the secretary attributed to technological inefficiencies and litigations. To unlock the sector's potential, Mr. Bharadwaj emphasized the need to open the sector to private players, encourage domestic exploration, and adopt efficient technologies. "I think the government, which is very decisive, very proactive, is in the process of amending the Offshore Areas Act that was put in the public domain for consultations. The consultations are now over, and it will be shortly debated by the Parliament," said Mr. Bharadwaj. In his speech, Mr. Bharadwaj also drew comparisons between India and other nations like the U.K., Canada, and China to illustrate the significance of critical minerals on the global stage. He mentioned that each country identifies its critical minerals based on its resource endowments, citing the U.K.'s 18 identified minerals and Canada's 31. He highlighted the importance of developing India's critical minerals sector, leveraging the country's vast resources, and modernising policies to create a sustainable and competitive industry.

Courtesy: *The Hindu, May 2023*

17. The Geological Survey of India discovers the second lithium reserve in Rajasthan

While the capacity of the reserve has not been disclosed, media reports are citing Rajasthan's government officials stating the state's reserves to be even larger than the previous find. In yet another boost for India's net zero emissions, the Geological Survey of India (GSI) has discovered lithium reserves in Rajasthan's Degana (Nagaur). The find comes three months after the 5.9 million tonnes of lithium reserves in J&K. While the capacity of the reserve has not been disclosed, media reports are citing Rajasthan's government officials stating the state's reserves to be even larger than the previous find. Often pegged as the 'white gold', lithium has emerged as a metal of priority even for India given its ambitious targets of achieving 30 percent electric vehicle sales of total new vehicle sales and increasing non-fossil energy capacity to 500 GW by 2030. "India's annual lithium-ion battery market is expected to grow to 116 GWh by FY2030 from 2.6 GWh in FY2021, with EVs accounting for 90 percent of the overall market (according to a report by JMK Research and The Institute for Energy Economics and Financial Analysis)," said Prahalathan Iyer, Chief General Manager – Research & Analysis, India Exim Bank. According to the information available, lithium reserves that have been found in Rajasthan are in the same Renvat hill of Degana and its surrounding area, from where the Tungsten mineral was once supplied to the country. But this confirmation of the discovery of lithium reserves isn't new. In India, lithium was first discovered in Jammu & Kashmir in 1999. But back then, lithium was a non-glamourous metal. As lithium was used in sectors like chemicals, glass, and pharmaceuticals, it made sense to import lithium for these various needs instead of further progressing with the finding and venturing into mining. But now with the major push towards electric vehicles to reduce carbon emissions, lithium has become the most sought-after material. Another reason why the Indian government didn't pursue the mining of lithium was that lithium mining is a resource devourer and not profitable. "As India discovers significant lithium reserves in Rajasthan, in addition to the previously discovered reserves in Jammu and Kashmir, the country is well positioned to become the 3rd largest market for EVs in the next 4 years," said Varun Goenka, CEO & Co-Founder, Chargeup. Goenka added that batteries, being the single largest cost and supplies dominated by China, have been a major obstacle for India's EV industry. However, with the 'Make in India' initiative and the discovery of lithium reserves, India is now able to reduce its dependence on foreign countries and control the fluctuating price of lithium. This development not only enables India to meet its domestic requirements but also allows it to supply lithium to other countries, creating a promising future for the country's EV industry. Currently, China dominates lithium mining and processing, even without having the largest lithium reserves and to reduce India's this dependence on neighboring countries, the GSI carried out 14 projects on lithium and associated elements in Bihar, Chhattisgarh, Himachal Pradesh, Jammu & Kashmir, Jharkhand, Madhya Pradesh, Meghalaya, Karnataka and Rajasthan between 2016-17 to 2020-21. During 2021-22, GSI has taken up five projects on lithium and associated minerals in Arunachal Pradesh, Andhra Pradesh, Chhattisgarh, Jammu & Kashmir, and Rajasthan. Result of Ministry of Mines has finally confirmed the 5.9 million ton of lithium reserve in J&K. "The discovery of lithium (inferred) reserves in J&K, India is strategically important for the country as it improves India's energy security by securing the critical minerals supplies and build self-sufficiency," explained Anish Mandal, Partner, Deloitte India.

Courtesy: *Business Today, Nidhi Singal, May 2023*

17. NASA, China Rovers Find Signs of Soaked Sand Dunes, Rushing Rivers on Mars

NASA's Perseverance Rover and China's Zhurong rover have found signs of soaked sand dunes and rushing rivers on the red planet. China's rover found evidence that frost may have cemented dunes together as recently as 400,000 years ago. NASA's Perseverance found signs that a fast, powerful waterway once carved its way into Jezero crater, dumping water at a fantastic rate, according to a National Geographic report. The findings were published in Science Advances. Zhurong which landed on Mars in May 2021 after it failed to wake up after a planned hibernation period, likely due to accumulation of dust on its solar panels.NASA's Perseverance found the largest-ever river on Mars. The river was more than 66 feet deep in some places based on the height of rock formations. Scientists believe that these are preserved sandbars. Jani Radebaugh, a researcher at Brigham Young University in Utah said that both findings "highlight the fact that it's really valuable to put things on the surface of the other planets. "China's rover discovered signs of water on the Martian surface. Sand dunes near the rover have developed a crust that likely formed as water interacted with the minerals. That water could have come from frosts that formed on the dunes in the past, or it might have fallen as snow hundreds of thousands of years ago when the planet's tilt may have allowed for snowfall in this region, reported Nat Geo. The crusts suggest polygonal features that shrunk and expand over time. "To have these sort of shrinking and expanding features, there is relatively recent or modern or ongoing wetting and drying that's happening in these dune regions. Ralph Milliken, a planetary scientist at Brown University and member of NASA's Mars Curiosity mission told Nat Geo that the dust of Mars is enriched with minerals that can absorb water vapor from the air. If that material covers the sand dunes, humidity changes through the season could cause the dust to absorb water vapour and release it again without it ever becoming liquid." These are likely things that are forming in lots of different places on Mars," Milliken says. "This might be a process that could be occurring over a large chunk of the planet in the recent geologic past." While China's rover investigated the dune soakings, Perseverance explored the remains of a powerful torrent. The NASA rover showed evidence that ancient rivers that once flowed over the planet ran much deeper, and flowed much faster than researchers previously thought. The river was part of a network of waterways that flowed in Jezero Crater. Notably, it's the area the rover has been exploring since landing more than two years ago in the hopes of eventually seeking out signs of ancient microbial life." Those indicate a high-energy river that's truckin' and carrying a lot of debris. The more powerful the flow of water, the more easily it's able to move larger pieces of material. It's been a delight to look at rocks on another planet and see processes that are so familiar," said Libby Ives, a postdoctoral researcher at NASA's Jet Propulsion Laboratory, in a NASA release. For two years, Perseverance has been examining a top of an 820-foot-tall pile of sedimentary rock that stands 820 feet (250 meters) tall and features curving layers suggestive of flowing water. One location within the curvilinear unit, nicknamed "Sprinkle Haven," is captured in one of the new Mastcam-Z mosaics.

Courtesy: *Science Advances*

https://www.ndtv.com/science/nasas-perseverance-chinas-zhurong-rovers-find-signs-of-soaked-sand-nesand-rushing-rivers

19. Chandryaan-3 launch - A new chapter in India's space odyssey

ISRO plans a soft landing on August 23, with payloads RAMBHA, ILSA to help understand Moon better.

ISRO launched India's third lunar mission Chandrayaan-3 perched on GSLV Mark 3(LVM-3) heavy-lift launch vehicle, named 'Bahubali' rocket, at 2.35 p.m. of 14th July 2023 from Satish Dhawan Space Centre-SHAR, Sriharikota in Andhra Pradesh. This is India's second attempt at soft-landing robotic instruments on the lunar surface after the previous attempt, Chandrayaan-2, failed in 2019.Thus, so far, only three countries, the U.S., Russia, and China, have successfully soft-landed on the moon. Speaking to reporters after the successful launch, ISRO Chairman S. Somanath said the next 42 days are crucial. "As per the nominal programme, we will have five earth-bound manoeuvres that will end on July 31. After that, we have the trans-lunar insertion, which will take place on August 1. After that, it will be captured by the moon. This will be followed by the separation of the propulsion module and the lander module on August 17. "The landing is currently planned on August 23 at 5.47 pm IST, if everything goes as per plan," he added. Hailing the launch, Prime Minister Narendra Modi tweeted: "Chandrayaan-3 scripts a new chapter in India's space odyssey. It soars high, elevating the dreams and ambitions of every Indian. This momentous achievement is a testament to our scientists' relentless dedication. I salute their spirit and ingenuity! Around 16 minutes after the LVM-3 lifted off, the spacecraft separated from the rocket. It was an integrated module comprising the propulsion module (Propulsion means to push forward or drive an object forward. A propulsion system is a machine that produces thrust to push an object forward)

the lander module and the rover. It entered into an elliptic parking orbit (EPO). This orbit's closest approach to Earth was around 170 km and farthest, at 36,500 km. The Chandrayaan - 3 consists of an indigenous propulsion module (PM) and a lander module (LM). **The mission's objective is to develop and demonstrate new technologies required for interplanetary missions**. The propulsion module will carry the lander (containing the rover) from the EPO around Earth to a circular orbit around the moon, at an altitude of 100 km. **This module also carries an instrument called 'Spectro-polarimetry of Habitable Planetary Earth' (SHAPE), to study spectral emissions coming from Earth**. According to ISRO, the lander can soft-land at a specified lunar site and deploy the rover. **The rover will perform in-situ chemical studies of the lunar surface as it moves around. The lander also has scientific instruments to study the lunar surface and subsurface**. The propulsion module will execute a series of manoeuvres over the next month to sling itself towards the moon and be caught there by the moon's gravity. Once it has been captured into a lunar orbit, the lander will detach itself and attempt to soft-land on the moon's surface. The Chandrayaan-3 carries six payloads that would help ISRO understand the lunar soil and also get the blue planet's photographs from the lunar orbit. The payloads, which include RAMBHA and ILSA, would perform a series of path-breaking experiments during the 14-day mission. They would study the moon's atmosphere and dig the surface to understand its mineral composition. Lunar lander Vikram will click photos of the rover Pragyaan as it studies the seismic activity on the moon by dropping some instruments. Using laser beams, it would try to melt a piece of the lunar surface -the regolith- to study the gases emitted during the process. "We know the moon does not have any atmosphere. But this is not exactly true because gases do come out of it. Rather they get ionised and stay very close to the surface. This changes with day and night," ISRO Chairman S Somanath told PTI. The Radio Anatomy of Moon Bound Hypersensitive ionosphere and Atmosphere (RAMBHA) on the lander will measure the near-surface plasma density and its changes with time. The rover will study how this small atmosphere, atomic atmosphere, and the charged particles vary, Somanath said. We also want to find out whether the regolith has electric or thermal characteristics," he said. The Instrument for Lunar Seismic Activity (ILSA) will measure seismicity around the landing site and delineate the structure of the lunar crust and mantle. "We will drop an instrument and measure the vibration -what you call the 'moonquake' behaviour or the internal processes - the movements happening there," the ISRO chief said. The Laser-Induced Breakdown Spectroscope (LIBS) will determine the elemental composition of lunar soil and rocks around the landing site, while the Alpha Particle X-Ray Spectrometer (APXS) will derive the chemical composition and infer the mineralogical composition of the moon's surface. The Spectro-polarimetry of Habitable Planet Earth (SHAPE) will study the spectro-polarimetric signatures of the earth in the near-infrared wavelength range which could be used in the search for life on exo-planets beyond the solar system. Greetings and best wishes pour in from NASA, European Space Agency (EPA), French Embassy, the UK Space Agency etc, on India's successful Chandrayaan-3 launch.

Courtesy: *The Hindu,14th July 2023*

Compilation and Revampification

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