

Vanishing Geo Heritage Site – Bhojunda Stromatolite Park

CHITTAURGARH in the state of Rajasthan is located on the banks of rivers Gambhiri and Bedach (a tributary of Banaas). At the foothills of this UNESCO World Heritage site is Chittaurgarh town, and on the eastern periphery of which there is yet another Heritage site – a Geo Heritage site near the village Bhojunda. This site is a Stromatolite Park, which was declared as a National Geological Monument in the year 1976 by the Geological Survey of India.

Stromatolites are bio-chemical forms of rocks occurring in different shapes akin to the sedimentary rocks that can be found in shallow water by trapping, binding and cementation of sedimentary grains by biofilms of microorganisms. These provide fascinating evidence of the emergence and evolution of life on the Earth. A small piece of Stromatolite encodes biological activity spanning thousands of years. So much so that they can be termed as Earth's oldest fossils dating back to 3.5 billion years.

The Bhojunda Stromatolite Park is an exposure within the massive Bhagwanpura Limestone of Lower Vindhyan age. In Indian geology, the Vindhyan Formations (~900 Mya) were vigorously but unsuccessfully searched for life (naturalheritage.intach.org, 2016). However, the discovery of these life forms in still older rocks provided the indisputable proof that life

existed in these Precambrian rocks of Rajasthan.

Stromatolites are perceived in the form of structured carbonated mats created by the blue-green algae in the shallow water due to constant tidal activity. Development of these distinctive carbonate rocks is an outcome of the combination of life activity and sediment trapping, binding ability of algal assemblages, and preying bacteria. The rocks have been obtained in various forms of carbonated bonding including the strati-form, columnar and nodular structures (Rahmani, Kulshreshtha and Sharma, 2013)

The original park had an area of about ~3.5 ha, now reduced to ~0.5 ha. Today, with no signage or information displayed, the remaining part of the park is in a state of great shambles due to gross neglect. The Stromatolite bearing limestone has a very convenient accessibility making it vulnerable to fast urbanisation and has become a victim of unconcerned developers and district administrators. It should be safeguarded so that no further encroachment takes place.

Tourists (as also the locals) are unaware of this monument of scientific, historical and international significance. To prevent it from vanishing, certain measures can be undertaken, such as campaigning for creating awareness in and around the town involving educational institutions and local administration,



Circular cross-section of Stromatolite along bedding plane of limestone



Limestone block showing growth of Stromatolites



A block displaying columnar growth of Stromatolites



The site overlooking the National Highways



Columns of Stromatolite rising across the bedding plane of limestone

putting up display boards on highways, and setting up of a permanent information centre on the site.

Promoting the Bhojunda Stromatolite Park as a part of Science Tourism, highlighting the significance of the Vindhyan rocks, would not only attract the scientific community but tourists as well.

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Study Pinpoints How Salmonella Sneaks into Plant Roots

IN recent years, contamination of salad vegetables by *E. coli* and *Salmonella* bacteria — the most common causes of food poisoning — have led to large-scale recalls. Although most *Salmonella* outbreaks are linked to contamination from post-harvest handling and transportation, this infectious bacterium can also enter the plant earlier, from contaminated soil.

But how exactly does it enter from the soil? A new study from the Indian Institute of Science (IISc) and the University of Agricultural Sciences (UAS), Bengaluru, has found the answer. Unlike other disease-causing bacteria that enter the root, fruit or leaf by producing enzymes to break down the plant's cell wall, *Salmonella* sneaks in through a tiny gap created when a lateral root branches out from the plant's primary root, the study shows.

"This is the first time we have shown how different it is from other plant pathogens based on its ability to colonize the roots," says Kapudeep Karmakar, PhD student in the Department of Microbiology and Cell Biology, IISc, and first author of the paper published in *BMC Plant Biology* (December 2018).

Karmakar and colleagues studied how different types of bacteria including *Salmonella* colonize the roots of tomato plants. While other bacteria were spread across the root, *Salmonella* bacteria clustered almost exclusively around areas where lateral roots emerge. When a lateral root pierces open the wall of the primary root to spread across the soil, it leaves behind a tiny opening. Using fluorescent tagging and imaging, the researchers figured out that *Salmonella* bacteria were using this gap to enter the plant.



The researchers also noticed that, under the same conditions, a plant with a greater number of lateral roots harboured a greater concentration of *Salmonella* than one with fewer lateral roots. Similarly, when plants were artificially induced to produce more lateral roots, the *Salmonella* concentration increased. Tomatoes plucked from these plants also tested positive for *Salmonella* infection, revealing its ability to travel all the way up to the fruit. "It is just like a systemic infection in humans," says senior author Dipshikha Chakravorty, Professor, Department of Microbiology and Cell Biology, IISc.

There are several possible sources from where *Salmonella* can reach the soil, such as manure containing animal faeces or contaminated irrigation water, points out Karmakar. Environmental factors also appear to aid its infiltration.

"*Salmonella* is increasingly becoming a notorious pathogen," says Chakravorty. "It can cause a diverse range of infections in diverse hosts, from birds to reptiles to humans, to poultry and livestock. Mortality is high, because it is now known to cross the blood-brain barrier."

IISc Press Release

Saturn's Rings will Fade into Oblivion in a Few Million Years from Now

THERE is a buzz among astronomers that Saturn's rings might someday shed themselves into oblivion. Thanks to a phenomenon called 'ring rain', the icy rings of Saturn could disappear in 300 million years, or even sooner. This is the conclusion reached by a research team led by James O' Donoghue of NASA's Goddard Space Flight Centre in Greenbelt, Maryland. The findings of the team were published in the journal *Icarus* on 17 December 2018.

In early 2017, O' Donoghue and his team looked at the measurements of a charged molecule H₃⁺ (a kind of charged hydrogen molecule that glows in the infrared light), taken by a group of astronomers in the upper reaches of the Saturn's yellowish atmosphere, using the Keck II telescope in Hawaii in 2011. The molecule H₃⁺ (which is made up of three hydrogen atoms, minus an electron) is created in abundance

when minuscule charged particles escape the Saturn's C-ring (discovered in 1850 having a width of 17,500 km), spiral into the planet along the magnetic field lines and collide with the atmospheric atoms, causing what is called "ring rain". It is a dusty storm of ice particles.

After measuring the amount of H₃⁺ in the Saturn's upper atmosphere, O' Donoghue's team concluded that as much as 2,000 kg of water is falling onto Saturn each second. "What we're seeing is something of the order of about a ton and a half per second," said O' Donoghue. Assuming a constant rate of ring rain, the team calculated that Saturn's rings could mostly shed themselves into oblivion within 300 million years.

Data from the Cassini spacecraft has revealed that colossal amounts of organic molecules and water ice (of the order of 10,000 kg per second) are falling onto the planet through a different, potentially transient process that could help hasten the rings' demise. That could mean the rings might disappear even sooner, in less than 100 million years, O' Donoghue said.

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Ingestible Drug Trucks for Diabetics

DIABETES is a metabolic disorder with elevated blood sugar levels in human body. It happens because either the body cannot secrete enough insulin or secreted insulin is not efficiently utilised. Hence, such patients depend on external insulin supply. Researchers have established efficient insulin delivery systems, all with their own advantages and disadvantages. A wide range of drugs is available in market that can be administered orally in treating diabetes mellitus.

Researchers have developed microneedle pills for drug delivery ensuring perfect localization and permeation that are necessary essentials of orally administered drugs. A team of researchers from MIT and Novo Nordisk have developed a self-orienting millimetre scale applicator called SOMA in short.

SOMA is an ingestible pill having a single micro needle with its tip made of purest and freeze dried insulin. The newly developed pill is capable of injecting insulin into the interior lining of the stomach wall avoiding the attack of digestive enzymes. The needle shaft is made of biodegradable polymer and does not enter the stomach lining.

The needle is attached to a compressed spring with a sugar disk. So when the pill is swallowed, water dissolves the sugar disk allowing the needle to inject into the stomach lining. Since the stomach walls are devoid of pain receptors the new pill does not induce any pain.

SOMA has been tested successfully in pigs. It has been designed ensuring that the needle perfectly injects into the



stomach lining. The capsule is the size of a blue berry and components are harmless and can pass through the digestive tract.

The self orientation is designed as a mimic of leopard tortoise reorientation ability. Leopard tortoise (*Stigmochelys pardalis*) has a large dome-like shell that is highly curved enabling it to stand proper even if the animal is flipped over. SOMA is designed with a low centre of mass hence it can orient in a manner to attach the stomach wall on action of gravity.

Once the pill adheres to the gastric lining the sugar disc dissolves and provides enough force for the needle to inject into stomach wall hence localized delivery is assured. Hopefully the new drug trucks would pass human trials too and would be a boon to diabetics by replacing the conventional injectable insulin.

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Vertical Farming in Urban Households

WITH rapidly increasing populations, cities of the future may need to generate their own food supply.

Indoor vertical farming has been emerging as a new alternative farming method in different parts of the world. Even the Food and Agriculture Organization (FAO) now accepts this has the potential to strengthen urban food security.

A vertical farm usually grows plants in a vertical orientation, maximizing the use of the location's square footage. It can grow 75 times more food per square foot than a traditional farm. It can also use around 90 per cent less water than outdoor farms. Vertical farms produce crops in stacked layers or often vertically inclined surfaces in controlled environments (light, temperature, humidity, CO₂) integrated with other structures (such as skyscrapers or multi-storied buildings).

The use of LED light allows farmers to control the size, shape, texture, colour, flavour, and nutrition of the plant with precision and increased productivity. LED lights also use 50% less energy compared to traditional indoor growing systems. Sun-reflectors, frost-protection unit, wetland drainage, slope-terracing forms an added advantage to the vertical farming system. Vertical farms can be commercially viable because of the scale, low-cost base, falling LED costs and green leafy

vegetable market. In the years to come, the vertical farming will be helpful to grow strawberries, rice, coffee and vanilla mitigating the daily household demand.

In the U.S., vertical farming is projected as a business of \$ 8-50 billion in the coming years. In Europe, the establishment of *AeroFarms* in Newark and financing of *Plenty*, a San Francisco-based vertical farm business, has raised \$200 million US in startup funds. *Infarm*, a Berlin-based vertical farm opened with big ambitions. The city of Shanghai is going to be the epicenter of vertical farming in the near future. Las Vegas has a 30 million dollar vertical farm that produces over a million pounds of produce every year. In the deserts of Port Augusta, Australia, the Sundrop farms produce 17,000 tons of fruits and vegetables in a 49-acre indoor farm. In Kyoto, Japan a soilless and sunless robotic-operated vertical farm has been established which produces 21,000 heads of lettuce per day.



Conserve Wildlife because Extinction Means Forever

ACCORDING to a recent report by WWF, humanity is responsible for wiping out as much as 60% of the wildlife. Conservationists have also issued a warning that current efforts to protect nature are not enough.

India submitted the Sixth National Report (NR6) to the Convention on Biological Diversity (CBD) on 29 December 2018. At the 13th National meeting of the State Biodiversity Boards (SBBS) organised by the National Biodiversity Authority (NBA), Union Minister Dr Harsh Vardhan said that, “India is among the first five countries in the world, the first in Asia and the first among the biodiversity-rich mega diverse countries to have submitted NR6 to the CBD Secretariat.”

Dr Harsh Vardhan further said, “I am also happy to note that India is on track to achieve the biodiversity targets at the national level and it is also contributing significantly towards the achievement of the global biodiversity targets. As a responsible nation, India has never reneged on its International commitments and had earlier submitted on time five national reports to the CBD. The NR6 provides an update of programmes towards the achievement of the 12 National Biodiversity Targets (NBTs) developed under the convention.”

The report highlights that while India has exceeded/overachieved two NBTs, it is on track to achieve eight NBTs and with respect to the two remaining NBTs, the country is striving to meet the targets by the stipulated time of 2020. According to the report, India has exceeded the terrestrial component of 17% of Aichi target 11, and 20 per cent of corresponding NBT relating to areas under biodiversity management.

Different types of vertical farms employ the techniques of hydroponics, aeroponics and aquaponics for production. Hydroponics has the advantage of yielding more plants without soil in water with less time. In this system, the nutrient solutions are pumped directly to the plant-roots. The system is also cleaner without the use of any pesticides and fertilizers. Farming can be done throughout the year using this system whereas the conventional farming system is season-specific. It allows producing more high-quality vegetables and fruits and saves water and nutrients.

Aquaponics is a combination of aquaculture and hydroponics where plants can use fish waste as fertilizer and the hydroponic system filters water before returning into the fish-system.

In an aeroponic system, a mist of nutrients, water and oxygen is usually sprayed at the root of each plant and is

The report reveals that the number of animal species in critically endangered, endangered & vulnerable categories in the year 2009 was 413, which rose to 643 in the year 2014 and stood at 683 in 2018. The report also says that “India has nearly two thirds of the population of wild tigers in the world. Lion population has risen from 177 in 1968 to over 520 in 2015, and elephants from 12,000 in 1970s to 30,000 in 2015.”

Further, while globally over 0.3 per cent of total recorded species are critically endangered, in India only 0.08 per cent of the species recorded are in this category. The causes of this decline in wildlife can be understood by a short acronym HIPPCO – Habitat destruction & fragmentation, Invasive alien species, Poaching, Population explosion, Climate change and Overexploitation.



It needs to be understood that the concern for wildlife is the concern for humans. As all forms of life are interlinked, disturbance in one will give rise to imbalance in the other. It is time we stood together to be the voice of the voiceless before it's too late. Remember, extinction means forever.

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filtered for reuse, eliminating runoff water. Installation of anaerobic digesters with anaerobic bacteria is quite helpful to compost the generated organic waste. These can convert the generated waste to biogas.

The overall aim of vertical farming is to produce high-value crops. There will be less chances of crop damage due to droughts or storms. There will be less access of insects and pests to these plants. Women and children may be involved in this agricultural practice. It can be a good source of income generation. It will strengthen the poor urban household food security.

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