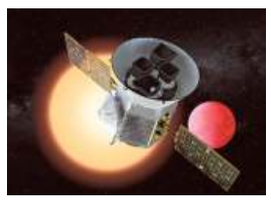
CAPSULE

Mould grows in space
The spores of two species of mould – *Aspergillus* and *Penicillium* – seem to have survived in the International Space Station despite being subjected to X-ray exposure 500 times as strong as what would kill a human being according to the American Geophysical Union. Astronomers spend hours trying to clean this; according to new research, the spores may have survived on the outer walls of the ISS too.

Hallucinogen in brains
From the pineal gland in the brain of rats, researchers extracted a sample that revealed the presence of dimethyltryptamine (DMT). DMT is the active ingredient in some drugs that causes psychedelic visions. Further research revealed that brain neurons with enzymes needed to make DMT are present in other parts of the brain such as the neocortex and hippocampus. The research was published in *Scientific Reports*.



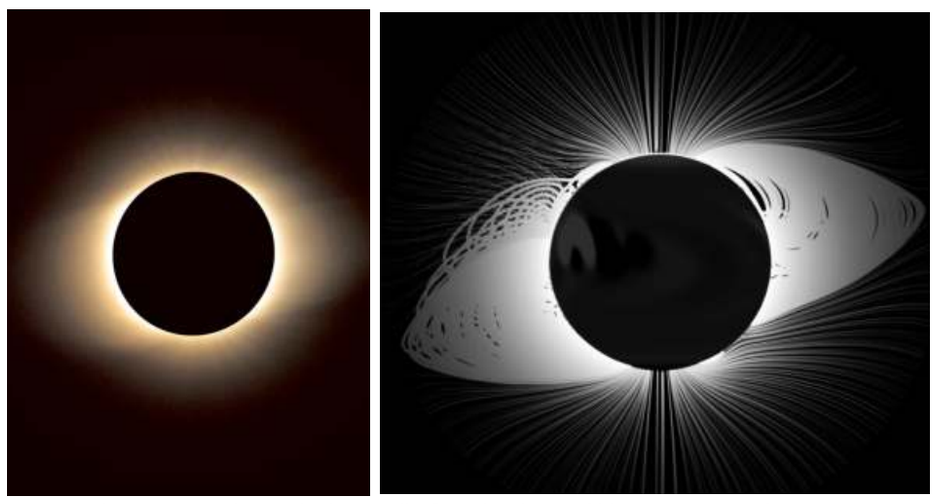
Satellite finds tiny world
The Transiting Exoplanet Survey Satellite (TESS) launched by NASA in 2018 has discovered an exoplanet orbiting a nearby star. It is the smallest exoplanet discovered by it so far and has two neighbours. Published in *The Astronomical Journal*, this discovery was a challenge both as engineering and scientific demands go. This exoplanet is about 80% the size of the Earth and 10% smaller than the previous smallest world discovered.

Entirely natural
On October 19, 2017, astronomers discovered the first interstellar object that had entered out solar system. Amid speculations as to what it was, the cigar-shaped object was named Oumuamua. A report in *Nature Astronomy* has now shown strong evidence that it is a natural object and not an alien spacecraft. This paper is mainly an analysis of previous research work.

Larger features of total solar eclipse match IISER Kolkata's prediction

The team predicted the shape of the Sun's atmosphere at the time of the eclipse using a two-step model

SHUBASHREE DESIKAN



Spot on: The team's prediction (right panel) of two bright petal like structures in the Sun's corona were confirmed by the observations of the eclipsed Sun (left panel). ▪ DURGESH TRIPATHI AND CESSI

Scientists from the Indian Institute of Science Education and Research (IISER) Kolkata were in for a pleasant surprise as the total solar eclipse on July 2 proved their prediction correct in its major features. They joined solar physicists from India and several international researchers who had gathered in Argentina to view the eclipse.

While their aim was to check whether their prediction of the shape of the corona had been realised, imaging the solar corona, or the Sun's atmosphere was the motivation for many others. The corona can only be viewed during a total solar eclipse. This total solar eclipse was visible only within a narrow strip of land stretching over Chile and Argentina.

Dibyendu Nandi's group, from IISER Kolkata, had used a two-step model to predict first the shape of the solar magnetic field on the day of the eclipse and then extrapolate it to describe what the corona would look like. "Our predictions of two cross-equatorial streamers, or bright petal like structures the Sun's Corona were confirmed by the observations," said Prof. Nandi in an email to *The Hindu*.

Space weather
The model built up by the IISER Kolkata team can be used to predict space weather. It will also be useful in analysing data from the proposed Indian space mission - Aditya-L1 - which is meant to study the Sun's corona. "We now know the basic theoretical premise of our computational modelling is correct. This work has given us confidence to utilise similar theoretical models for supporting the interpretation of data from India's Aditya-L1 solar space mission which is currently under development," says Prof. Nandi.

The path of the eclipse was known well in advance and hence a professional meeting was planned for solar physicists about a year earlier.

"The local organisers looked at possible locations near San Juan (which is situated at the edge of the path). One needs to go to the central line for maximum duration of totality," said Dipankar Banerjee, solar physicist from Indian Institute of Astrophysics who helped organise the meeting.

"Special permission was needed to reach this place; apparently tourists are not allowed to these locations," he added in his email to *The Hindu*.

This eclipse offered an excellent opportunity to view and image the corona. Despite being hotter than the layers of the Sun that lie within, the corona has lower density of photons. For this reason, the inner layers of the Sun such as the photosphere outshine the corona, rendering it practically invisible. Except, that is, when the Moon totally occults the Sun. But just before totality, light from the Sun reaches viewers, first as a brilliant spot of light known as the "diamond ring." At this stage, you can see the chromosphere and solar prominences. The next instant, when the Moon's disc covers the Sun, we see an uneven ring of light - the corona. This is seen only during the totality.

Details to be analysed
The broad features of the corona are as predicted by the IISER Kolkata team. "We have to perform a detailed analysis to ascertain which fine scale features of the corona we got right and what aspects we did not. For this we have to wait for technically processed images and other scientific observations acquired during the eclipse by teams from the US National Science Foundation, regional observatories in Chile and Argentina and space-based satellites," explains Prof. Nandi.

Based on constraints set by these observations, the group plans to refine their models before translating these into operational space weather forecasting tools.

University of Hyderabad's inhibitor increases effectiveness of malaria drugs

The inhibitor blocks an enzyme that is crucial in repairing DNA damage in malaria-causing parasite

R. PRASAD

Synergy: When the inhibitor is used along with the drug, less concentration of the drug is sufficient to kill the parasites, say Mrinal Kanti Bhattacharyya (right) and Pratap Vydyam.

A small inhibitor that blocks an enzyme (Rad51) that plays a crucial role in repairing DNA damage in malaria-causing parasite – *Plasmodium falciparum* – has been identified by researchers from the University of Hyderabad.

Both strands of the malaria parasite DNA get broken naturally. When DNA repair is prevented it can lead to the accumulation of several double-strand breaks causing death of the parasites. Also, certain anti-malaria drugs such as artemisinin are designed to kill the parasites by causing such breaks in the DNA. So when the inhibitor is used along with such drugs, the effectiveness of the drugs increases drastically in both drug-sensitive and drug-resistant malaria.

Plenty of DNA double-strand breaks occur naturally in malaria parasites due to errors during replication. Also, when the parasites infect the red blood cells, free radicals are generated (during haemoglobin detoxification). The free radicals produce numerous double-strand breaks.

"In an earlier study we found that the parasites use a particular mechanism – homologous recombination – to repair DNA double-strand breaks. In the present study we demonstrated that the inhibitor targets and prevents the Rad51 enzyme from functioning. The Rad51 enzyme is essential for the homologous recombination repair mechanism," says Prof. Mrinal Kanti Bhattacharyya from the Department of Biochemistry at the University of Hyderabad. Prof. Bhattacharyya is the corresponding author of a paper published in the *Journal of Biological Chemistry*. The work was done in collaboration with Dr. Sunanda Bhattacharyya from the Department of Biotechnology and Bioinformatics, UoH.

Double-strand breaks
The researchers created genome-wide double-strand breaks using a chemical. And they found that in the presence of the inhibitor the parasites were unable to repair the break, leading to death causing death. "The inhibitor blocks DNA repair in both drug-sensitive and drug-resistant malaria parasites," says Pratap Vydyam from the Department of Biochemistry at the University of Hyderabad and first author of the paper.

Artemisinin drug used for treating malaria is designed to generate more double-strand breaks. Similarly, chloroquine is also thought to produce more double-strand breaks by increasing the generation of free radicals inside red blood cells. "When the inhibitor is used together with the drugs the effect is pronounced leading to sharp reduction in parasite load," says Prof. Bhattacharyya. "The inhibitor has a synergistic effect and so less concentration of the drugs is sufficient to kill the parasites."

In the case of drug-sensitive malaria parasites, the effectiveness of artemisinin to kill the parasites increases sharply when used together with the inhibitor. The synergistic effect is so pronounced that a 15-fold less concentration of artemisinin is sufficient to kill 50% of parasites. Compared with artemisinin, the synergistic effect of the inhibitor and chloroquine in killing the parasites is relatively less -- there is an 8-fold reduction in drug concentration to kill 50% of the parasites.

In the case of drug-resistant parasites, when the inhibitor is used along with chloroquine, 6.48-fold less concentration of the drug is sufficient kill 50% of parasites, while it is only 4.6-fold reduction when the inhibitor is used together with artemisinin.

"Reducing the concentration of drug used for treating a disease is desirable. So achieving several-fold reduction in the concentration of the drug to kill the parasites in the presence of the inhibitor, we have enhanced the effectiveness of the drugs," says Prof. Bhattacharyya. "Importantly, we have increased the effectiveness of the drugs even in the case of drug-resistant malaria parasites."

There is increasing prevalence of malaria parasites that are resistant to artemisinin, a first-line drug. So increasing the effectiveness of the drug becomes important.

The researchers will soon start testing the inhibitor on mouse malaria model.

One porcupine burrow houses 22 different animals

While in most cases, the animals ignored each other and co-occupied, some like jackals were aggressive

ASWATHI PACHA

Competition: The researchers described an interaction between a python and jackals that lasted 30 minutes.

Hate sharing your flat with a room-mate? Maybe you should take a few lessons from the Indian crested porcupine which shares its burrow with 22 different species, including birds and reptiles.

Porcupines are known to be great engineers, and their burrows can go up to 13 metres in length with a number of side chambers of varying depths. A study conducted by researchers from the Salim Ali Centre for Ornithology and Natural History in Coimbatore used camera traps to understand the complex co-habitation.

At the study site of Keoladeo National Park in Bharatpur, Rajasthan (a UNESCO World Heritage Site), the temperatures can vary from 0.5 degrees Celsius to as high as 50 degree Celsius. So, burrows play an important role in giving refuge and protection against the weather and predators.

The researchers set up cameras around porcupine burrows and made note of the visitors. From October 2014 to December 2016, they tracked about 20 active burrows and studied the different occupants. The four major occupants were porcupines, jackals, rock pythons and bats. Some birds such as peafowl, robins and babblers also visited the burrows to feed on the insects that live there.

The team also noted the different interactions between the visitors. While in most cases, the animals ignored each other and co-occupied, some were aggressive.

Porcupines, pythons and bats co-occupy in peace whereas jackals are fierce.

The paper published recently in *Ethology Ecology and Evolution* described an interaction between a python and few jackals which lasted more than 30 minutes, The jackals growled while the python hissed and puffed its body. The python finally fled from the burrow site which was already occupied by jackals and pups. The camera also recorded a fierce fight where four jackals attacked a python, eventually killing and evicting it from the burrow.

Most of the animals used the burrows temporarily only. "During the winter days, the pythons bask in the Sun, and as the temperature drops, they crawl into the burrow at night. When we inserted a burrow video camera, we saw up to five pythons inside. Also in camera traps and during field surveys, 9 to 15 of them [pythons] were recorded basking and congregating in the same burrow," explains Dr. H.N. Kumara from the Conservation Biology Department of the Centre and the corresponding author of the work.

A paper published by the team in 2017 was able to point out the specific burrow characters each animal preferred. Jackals liked larger chambered burrows, while the pythons chose smaller compact ones and bats preferred the burrows with few branching and openings.

When asked if the decline of porcupine would affect the 22 species, Avadhoot D.V, a PhD scholar at the Centre and one of the authors of the paper explains, "It would be difficult to see a direct effect immediately. But of course, there will be a domino effect. The study has clearly shown that porcupines are a keystone species in the semi-arid region."

The Indian crested porcupine is accorded a status of 'Least Concern' under IUCN Red List.

"Our study attempted to shed light on the spatial and temporal activities of porcupines and the significance of their burrows in its Indian range. Since the study was restricted to one area, it would be interesting to understand its burrowing behaviour in other regions as well," adds Aditi Mukherjee in an email to *The Hindu*. She is the first author of the paper.

Students returning a wallet they found on the road to the owner. ▪ S. K. MOHAN

Individuals are more honest than they think they are

SPEAKING OF SCIENCE

D. BALASUBRAMANIAN

Honesty is essential for personal, social, economic and national development. Yet, we see how people, companies and national governments cheat for self-interest, Does this happen across the 205 countries across the globe? Do individual people value honesty in their personal dealings? This question has been the subject of a recent paper by a group of experts in information gathering and analysis, economists and management scholars (A. Cohn et al "civic honesty around the globe", *Science* 10.1126/science.aau8712, 2019). They decided to examine the trade-off between honesty and self-interest in over 17,000 people in 355 cities in 40 countries across the globe. The remarkable result of their experiments is what *The Economist* wrote about this paper: "Individual people are actually more honest than they think they are!"

The experiment
How did they do the experiment? They had volunteers who would drop a wallet (purse) near a bank, hotel or a police station. The wallet had a transparent cover on one side, where it had a card with the name and contact details of the owner, a shopping list for ordinary items to buy for home (say, milk, bread, medicine etc.). And in one set of wallets there was no money. Some others had some small money (about $14 or the equivalent in local currency), while some others had more ($95 or equivalent). And, in another set, the wallet also had a key in addition. Thus, they had set 1 (wallet with no money), set 2 (small money), set 3 (large money), set 4 (no money, but with key) and set 5 (money with key).

The volunteers dropped such wallets near a public place in the city, watched what a passerby does when he finds the wallet. Does he go to there, hand over the wallet and ask the person in the counter to send the wallet to the owner – what were the results ?

Citizens overwhelmingly turned in more often the lost wallet with money than without. This was seen across the 40 countries across the world.

What if the wallet had "high money"? Did people pocket some or all of the money before turning in the wallet? Did they turn it in because they were afraid of punishment? Or did they expect to get a reward from the owner, while turning in the wallet without pocketing any money? Or was it altruism? This experiment was done in 3 countries (US, UK and Poland) and the results were remarkable: Over 98% of the moneyed wallets were returned! (It would be interesting to do this experiment in the many other countries, which are economically less blessed.)

In the next experiment, they had put in three sets of wallets: one with small money but no key, another with small money plus a key and yet another "money plus key" one. Again the results showed that people turned in wallets with a key than without. It appears that they did not want the owner to suffer. This was fairly seen across the countries tried.

Indian cities
A point of interest to us in India is that these experiments were done using 400 citizens in Delhi, Mumbai, Ahmedabad, Hyderabad, Bengaluru, Coimbatore and Kolkata. The results in these cities matched those found elsewhere; notably similar results were found in the Thailand, Malaysia and China in Asia, and in Kenyan and South African cities.

To quote the authors: "We conducted field experiments in 40 countries to examine whether people act more dishonestly when they have a greater economic incentive to do so, and found the opposite to be true. Citizens were more likely to return wallets that contained relatively larger amounts of money. This finding is robust across countries and institutions, and holds even when economic incentives for dishonesty are substantial. Our results are consistent with theoretical models that incorporate altruism and self-image concerns, but also suggest modification in that non-pecuniary motivations directly interact with the material benefits gained from dishonest behavior. When people stand to heavily profit from engaging in dishonest behavior, the desire to cheat increases but so do the psychological costs of viewing oneself as a thief- and sometimes the latter will dominate the former ....Comparative analysis suggested that economically favourable geographic conditions, inclusive political institutions, national education, and cultural values that emphasize moral norms extending beyond one's in-group are positively associated with rates of civic honesty".

It would be valuable for us to do such wallet experiments in many parts across India ranging from big cites down to small towns, villages (poor and not so poor) and tribal areas so that we may see how well our results fit in with the general conclusion above. After all India is a mini-world representing much of the 40 countries studied above with comparable economic and social norms, ethical and belief systems.

dbala@lvpei.org