

Science and technology

SNAPSHOTS



Role of 'scars' in current earthquakes

A study suggests that ancient geologic events may have left deep 'scars' that can come to life to play a role in earthquakes, mountain formation, and other processes on our planet.



Perovskite solar cells with improved efficiency

Efficiency of larger-size perovskite crystals can be increased to 20 per cent to match conventional thin-film solar cells of similar sizes by briefly reducing the pressure during fabrication.



Faster reaction time after exposure to blue light

A study showed that a short single exposure to blue light for half an hour suffices to produce faster reaction times and more efficient responses during conditions of greater cognitive load.



Copper essential for burning fat

Researchers show copper is essential to breaking down fat into smaller lipids that can circulate in the blood and be burned for energy. So, copper deficiency can lead to obesity or diabetes.



Environmental impacts on species number

The number of species that can exist on Earth depends on how the environment changes. The limit to the number of species that can co-exist on Earth changes with climate and geology.

Why Indians, SE Asian Malays respond differently to some drugs

R. PRASAD

A couple of years after successfully mapping the genetic variants associated with differential responses to two widely used drugs — warfarin (an anti-coagulant drug) and clopidogrel (an antiplatelet drug) — in 2,000 people from Delhi, Haryana, Uttar Pradesh, Bihar and Punjab, Dr. Vinod Scaria and Ambili Sivasdas studied the pharmacogenetic markers in a cosmopolitan population of Malays (southeast Asian Malays). Dr. Scaria is from the Delhi-based Institute of Genomics and Integrative Biology and Sivasdas is a Research Scholar at IIGB.

The results of the study were published recently in *The Pharmacogenomics Journal*.

The duo used the recently released whole genome sequences of 100 South East Asian Malay individuals from Singapore Sequencing Malay Project for the study. Using this data, they checked if the pharmacogenetic markers in the Malay population were similar or different from those seen in the rest of the world and looked for percentage of people who had these markers. Differences in the markers and how frequently they were seen in a population will result in differences in drug response in the population.

Genetic variation in absorption and metabolism of the drug can affect the concentration of the drug and in turn the effect of the drug. Also, genetic variation in the drug target can change the effect of the drug. For instance, they found poten-



"It is important to capture the sub-population data within India to optimise drug dosing," says Ambili Sivasdas. PHOTO: SPECIAL ARRANGEMENT.

tial deleterious effects in the gene VKORC1, which is the enzymatic target of the commonly used anticoagulant, warfarin. The genetic variation in the gene meant that in the SE Asian Malay population the amount of warfarin required for the desired effect is lower than the rest of the world.

"In the case of India, different populations have different frequencies of the marker connected with warfarin metabolism. Therefore, it is important to capture the sub-population data within India to optimise drug dosing," said Sivasdas. "In general, the Asian population requires a lower warfarin dose to achieve stable anticoagulation."

Similarly, as a result of predominance of polymorphism in the gene GRIK4, the response to antidepressants was

Genetic variation in the drug target can change the effect of the drug.

So the drug dosage should be lower to avoid toxicity.

"The real impact of the study is that this information could lead to a change in dosage of a certain drug for a particular population to achieve the same effect. And in future, the dosages can be modified before undertaking any clinical trial in this population," they noted.

This information is particularly useful as dosages of most of the drugs in the market are based on information derived from clinical trials carried out on Caucasians. "Asian subpopulations including Indians and Malays are still not sufficiently represented in comprehensive pharmacogenetic research and drug development and so the efficacy of the drugs in these minority populations is not known," he said. The varied response to drugs both by Indi-

ans and SE Asian Malays compared with Caucasians would mean that future trials have to necessarily include a few volunteers from these countries to know the precise dosing. The earlier study carried out in India revealed significant differences in the percentage of people in the five States who had the markers for the drug warfarin and clopidogrel. "Given the ethno-linguistic diversity represented by India, these studies further emphasize the need to profile more Indian subpopulations in order to build a comprehensive pharmacogenetic map for the entire Indian subcontinent," Dr. Scaria stressed. "We are very keen on creating such comprehensive pharmacogenetic maps for all known ethnic groups in the Indian populations which will immensely benefit safe drug dosing in our populations, provided we have adequate funding."

While the Indian studies were limited by the availability of low-resolution genotype microarray datasets which allows one to profile only a set of known common variants, the latest study on Malays used the more powerful whole genome sequencing. Whole genome sequencing helps in identifying the common genetic variants when performed for a population as well as the very rare and personal variants that are found unique to an individual.

The SE Asian Malay study has helped build one of the most comprehensive pharmacogenetic maps including 227 common and 466 rare potentially functional variants in 437 genes in the population.

QUESTION CORNER

THE MASSLESS PHOTON

According to Einstein, a particle moving at the speed of light reaches infinite mass. Then why is a photon massless?

- Sivaranjani Senthilvel

There is a fundamental difference between a photon and other material particles. The word 'particle' means that it has a measurable rest mass. It could even have a rest mass nearly equal to zero. It has been clearly established that the photons, if at all at rest, would have zero mass and hence, zero momentum. However, photons can never be arrested. This would mean that photons do possess definite momentum by virtue of their motion. They always keep moving with a velocity equal to that of light.

Quantum physicists have tried to visualise light as photons because such a notion helped them appreciate the phenomena such as Compton effect, photoelectric effect, etc. Because a photon has a definite energy and definite momentum, which are typically the properties of any particle, photon is considered to represent the particle nature of any electromagnetic radiation. Nonetheless, the claim that a particle moving at the speed of light reaches infinite mass (an impossible feat indeed for a material particle as it can never pick up a speed equalling the speed of light) simply does not apply to photons as, at the first instant, they do not have rest mass at all. The rules of relativity apply to particles or objects (with a definite rest mass) travelling at a speed comparable to that of light (photons).

- Dr. P. Ramesh Babu, Professor of Physics, VIT University, Vellore, Tamil Nadu

THIS WEEK'S QUESTION

They say "Do not drink water right after an operation". Why is that?

- Samhitha K, Hyderabad

Why do we sometimes suffer from sore throat after having ice cream or cold drinks?

- Neerad Tharini, Bikaner, Rajasthan

Readers may send their questions/answers to questioncorner@thehindu.co.in

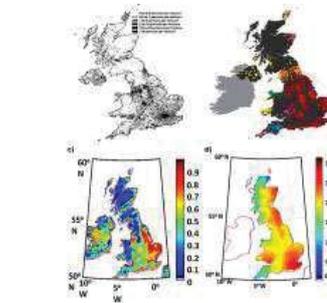
A simulation of early human migration

SHUBASHREE DESIKAN

Modelling population migration in early times (prehistoric) as a diffusion process using current topographical data, scientists from Tata Institute of Fundamental Research, Mumbai, have simulated the diffusion of prehistoric population through the British Isles. Cross-checking their results, published in *PLOS One*, with known genetic data, they find that the pathways of migration derived from their simulation match with those observed in the genetic data.

This method can now be used to understand the early migration of populations in any place in the world and to predict where archaeological remains could exist. "We chose England because it is isolated and also because good genetic map of the island is available," Dr Mayank Vahia of TIFR, the first author of the paper, said in an email.

In the model, people enter the islands from five points: Cornwall, Wales, Scotland, North England and South England. The input for this comes from Prehistorical and Prehistorical sites in England. Then the populations diffuse through the country, or move along a gradient of "habitability," which it-



ENGLAND MAPPED (From top right, clockwise) the present population; the genetic map; simulation of population distribution and habitability. The red regions indicate more comfortable places to live. PHOTO: SPECIAL ARRANGEMENT

self is defined as a function of geographical factors such as altitude and those relevant to survival such as availability of food, game etc. The premise is that migration of the bulk of people would have been motivated more on the need to settle and survive than on seeking adventure. Since the topography changes only on geological scales while the timescale they

are looking at is more on the order of ten thousand years, the authors can justify the use of current topographical data in their study.

On the use of genetic data to validate their results, Dr Vahia says, "Each isolated group has its own unique genetic signal and where the populations merge, we get mixed signals. In our simulation, we assume that the people

enter England as specific locations (with unique genes) and check where they meet. At the meeting points, you will get mixed genetic signals. This agrees with direct observations." However, the model does not include human conflict or technological advancements and is limited to that extent. This still makes it possible to study early population migration, when vast tracts of open country would have been available to the population. "We can predict how people must have moved and suggest where one is most likely to find ancient archaeological remains will be found. The model can also be used to understand cross cultural influences etc," he says.

Now that the model has been validated by the observed correlation with genetic data,

it can go further and pinpoint places where populations merged and parted, even in places like India where the tracking of migration patterns using genetic data yields very broad features, for instance.

To the authors, the model "probably explains a lot about how nature humans have been more accommodative of each other and we have been wrong in assuming that two groups coming against one another will fight."

Space technology to safeguard thatched roofs

K. S. SUDHI

The technology that protects rocket launch vehicles from high-temperature fire could protect the thatched roofs and even prevent water seepage in concrete buildings.

The scientists of the Vikram Sarabhai Space Centre (VSSC), Thiruvananthapuram, have showcased the ceramic-polymer hybrid (CAS-POL), a spin-off product that could protect public transport systems and poor men residing in thatched homes from fire accidents. Technology transfer is yet to be concluded. Caspol is an indigenously developed, easy-to-use flame-proof coating, from the VSSC stable. The water-based ready-

to-coat product was originally developed to protect the rockets from high temperature and fire to which they are exposed during the initial moments of launch.

"Huge exhaust plumes of high temperature engulf a rocket when it lifts off from the launch pad. The protective pads that cover the rockets are coated with Caspol to save them from fire and high temperature to which they are exposed to," explained K. Sivan, director of VSSC.

According to Dr. Sivan, Caspol can withstand up to 800 degree Celsius. Seats in automobiles, public transport systems and seat cushions of railway coaches can be made fireproof when Caspol is applied. The ceramic-



Caspol is an indigenously developed, easy-to-use flame-proof coating. PHOTO: SPECIAL ARRANGEMENT

polymer hybrid will affect the cushioning characteristics significantly of seats once it is applied, the scientists vouch. Besides its ability to pro-

tect against fire and high temperature, Caspol can also make surfaces waterproof. When applied over the concrete surface of buildings, fill up the micro cracks and holes, concrete to prevent water from seeping in. When applied over concrete surface of buildings, the high emissivity of the product reduces the temperature inside the building by at least 5 to 6 degree Celsius, the researchers stressed.

It can be used on a variety of substrates such as masonry surfaces, textiles, paper, thatched leaves and wood to advanced materials like polyurethane and phenolic-based thermal insulation foam pads, VSSC says.

The centre has described

the product as one which is eco-friendly as it is free of toxic materials. It could be applied either by brushing or spraying on the desired surface. The economic, water-based formulation with self-extinguishing properties could cure in room temperature and has good adhesion and water repellent characteristics, according to researchers.

The materials coated with Caspol will be self-extinguished within four seconds after removal of flame. It can adhere well with the substrate surface both in dry condition and after exposing the coated foams to water. Foam materials can be impregnated with Caspol by dip coating," notes the centre.

Light pollution hampers view of Milky Way

The Milky Way is invisible to more than one-third of humanity, a new world atlas of light pollution suggests, as reported in *Science Advances*.

The new light-pollution atlas, based on high-resolution satellite data and precision sky brightness measurements, documented a world that is in many places awash with light.

The most light-polluted country is Singapore, where the entire population never experiences conditions resembling true night, it found. In Western Europe, only small areas of night sky remain relatively undiminished, mainly in Scotland, Sweden, Norway, and parts of Spain and Austria.

On the other hand, countries with populations least affected by light pollution are Chad, the Central African Republic, and Madagascar, with more than three quarters of their people living under pristine, inky-black night sky conditions. Residents of India and Germany are most likely to be able to see the Milky Way from their homes, while those in Saudi Arabia and South Korea are least likely. Overall, more than 80 per cent of people on Earth live under light-polluted skies.

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