In this issue

Understanding the Past

From charred rice grains

Rice grains from archaeological sites of the Harappan civilization were used to reconstruct the hydroclimatic condition and to deduce the source of water for agricultural practices of those times. For evidence to support such conclusions, scientists use the composition of carbon isotopes. Often, the grains that archaeologists find are well-preserved, but charred due to partial oxidation. The process of charring may also lead to changes in the isotope composition, which, in turn, can introduce uncertainty in source water composition deductions.

Researchers from IISc Bengaluru and IISER Kolkata double-checked the veracity and validity of the method for estimating the source of water and time when rice grain was formed, by examining the differences in carbon isotopes in charred rice grains in the lab under different experimental conditions. They find that charring at 230 degrees centigrade for 16 hours leads to rice grain morphology similar to what was found in archaeological sites. The charring process did not change the carbon isotope composition of rice grains significantly – in fact, it was lower than seen in charred wheat, barley and peas.

Despite the widespread availability of rice in archaeological sites, it has not been leveraged to delve into the reconstruction of climatic conditions of the past, say the authors of the Research Article on **page 1052**, in this issue.

Sporosarcina to Stabilise Soils

Calcite to cement sand

The soils on which houses, flyovers and other structures are constructed have implications on the stability of infrastructure against earthquakes. Loosely bound sand particles are easily liquefied under pressure and the waves that are created by earthquakes lead to destruction of property and deaths due to collapse. Cement routing to bind sand particles and thus stabilise soils is a costly proposition.

There are more 'natural' ways to stabilise soils leveraging on bacteria that secrete urease enzymes into the soil which then break up urea into ammonium and carbonate ions. The carbonate ion will displace chlorine from calcium chloride to form calcite. Calcite can cement loose sand particles together, reduce soil porosity, increase soil density and thus make it less susceptible to liquefaction.

But what should be the bacterial concentration? The best way to apply? For how long? How do we optimise the use of urea and calcium chloride?

Sangeeta Shougrakpam and Ashutosh Trivedi from the Delhi Technological University inquire into the matter in a Research Article in this issue. For their experiments, they take *Sporosarcina pasteurii*, a urease-producing bacterium and the soils of the Yamuna river basin – soil that supports most buildings in the national capital region. Read on from **page 1060**.

Lightning Detection Sensors

For forecasting and forewarning

When there is lightning, electromagnetic waves of very high and ultrahigh frequencies are generated. These signals are detected by sensors that respond to frequencies from 50 Hz to 500 MHz, set up by the National Remote Sensing Centre, ISRO. The antenna of the lightning detection sensor has an interface with GPS. It uses a gating magnetic direction finder to estimate the direction of lightning occurrences. The system is connected to a PC and is controlled by NextStorm software that collects multiple samples of data on individual strikes to calculate the distances and to track the storm. Using data mining and unsupervised learning techniques, the system can be used for predicting storm tracks and to warn people of potential dangers.

The researchers at NRSC analysed data from June to July 2017 from sensors at Kolkata, Ranchi and Visakhapatnam. The geolocation of the storm had a precision that was better than 0.02°. The researchers found that, using the system, it is possible to provide warning of lightning strikes more than half an hour in advance.

Now NRSC has only six lightning detectors with a frequency response of 1 Hz to 30 MHz. A system of 64 having a range of more than 300 kilometres can provide nationwide monitoring and forecasting of lightning strikes, the researchers claim in a Research Communication on **page 1112**, in this issue.

Fighting COVID-19

With food and spices

In a Research Article in this issue, researchers from the University of Agricultural Sciences, Bengaluru and the Indian Institute of Integrative Medicine-CSIR, Jammu examine the binding of 15 natural products on two proteases of COVID-19, using molecular docking analysis. The binding affinities of some of the products are comparable to those of Saquinavir, the anti-HIV drug. Secondary metabolites found in vegetables such as cabbage, broccoli, sponge gourd and spiny gourd, peels of fruits such as apple, and spices such as mustard, clove, fennel, rosemary and thyme are good candidates for testing against COVID-19. Read more in the Research Article on **page 1087**, in this issue.

Concern over COVID

In Scientific Correspondence on **page 1023**, in this issue, biomedical researchers from India and the US provide retrospective first estimates of the virus in India during March 2020. They also argue that it is nearly impossible for any large country however developed to conduct national level tests for COVID-19 in a quick manner based on a random sample of the general population. Social distancing and other prevention, treatment policies currently implemented should, therefore, continue until new cases are not seen.

They also stress the urgent need to control the spread of the virus from urban to rural populations.

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