SNAPSHOTS

Mosquito resistance
New research shows that proteins in the legs of malaria carrying mosquitoes help them develop resistance to insecticides, an advance that may lead to new strategies against the disease which kills nearly 4,00,000 people each year. The study was published in the journal *Nature*.

Brain simulation
Researchers have developed a brain-like network composed of ultrasmall metallic wire. This may lead to new ways for understanding the brain's processes. They used the metallic nanowire network to simulate the human brain's electrical activity unique to processes like memorising, learning and forgetting.

Towards clean energy
Stanford scientists have outlined new steps that 143 countries around the world can take to attain 100% clean, renewable energy by 2050. The roadmap, published in the journal *One Earth*, uses the latest energy data available in each country to offer more precise guidance on how to reach those commitments.

Chewing gum trail
Archaeologists have found a 5,700 year old 'chewing gum' made from birch pitch and managed to extract ancient human genome from the same. In the *Nature Communications* article, they write that the person who chewed it was a woman closely related to the hunter gatherers of Europe. She was dark with blue eyes.

Biomarkers for glioma brain tumour found in peripheral blood

These can be used for prognosis and early diagnosis of the most aggressive glioblastoma

R. PRASAD

Researchers have found potential gene biomarkers that can be used for prognosis and early diagnosis of the most aggressive form of primary brain tumour called glioblastoma. The biomarkers can help in knowing if the tumour is at an initial stage (low-grade) or advanced stage (high-grade).

The multi-institutional research work carried out by a team led by Javed N. Agrewala from Institute of Microbial Technology (CSIR-IMTECH), Chandigarh, now at IIT Ropar, looked at immune cells called macrophages in the tumour microenvironment to understand their role in suppressing or boosting the immune system to keep the tumour under check. The role of certain macrophages in suppressing the immune system leading to progression of cancers such as breast, prostate, bladder and cervical cancers is already known.

Multipurpose: Besides indicating whether the tumour is low- or high-grade, the macrophages can also indicate the chances of survival of patients with glioma, says Aurobind Vidyarthi ▪

Two macrophages
Based on patient tissue samples the researchers identified two macrophages – M1 and M2 – that were associated with the tumour. These were identified using hallmark gene markers (CCL3 gene for M1 macrophage and CD163 for M2 macrophage). The M1 macrophage is protective for glioma while the M2 macrophage is not. The M2 macrophage control the immune response and intimately interacts with the tumour and supports tumour progression.

"We observed that as the glioma progresses from low-grade to high-grade, the amount of M1 macrophages reduced and the amount of M2 macrophages increased," says Prof. Agrewala. "Thus the ratio of M2 macrophage marker CD163 versus M1 macrophage marker CCL3 can ascertain the glioma progression."

Making a prognosis
In the low-grade glioma, the ratio of M2/M1 macrophages (or CD163/CCL3) is less while it is high in the case of high-grade glioma tumour.

"Besides indicating whether the tumour is low- or high-grade, the macrophages can also indicate the chances of survival of patients with glioma," says Aurobind Vidyarthi from CSIR-IMTECH, the first author of a paper published in *Cancer Immunology, Immunotherapy.* He is currently a post-doc at Yale University, New Haven, U.S. "In low-grade glioma patients we see both M1 and M2 macrophages. But if there are more M2 macrophages (as indicated by the gene marker expression) than M1 macrophages, the survival is less. Likewise if there are more M1 macrophages then the patient has better chances of survival."

Most studies have looked at only the local immune response in the tumour region. But these researchers went a step ahead and looked for macrophage phenotypes and different T cells in peripheral blood samples collected from glioma patients.

Markers in blood
"Interestingly, compared with healthy individuals, there was elevated level of M2 macrophages in peripheral blood too. This indicates that the influence of glioma is so prominent that M2 macrophages can be found in the blood," says Dr. Vidyarthi. Besides M2 macrophages, the researchers also found in the blood PD-1 expressing CD4 T cells. During chronic infection and tumour, the T cells become exhausted. "So instead of promoting, the exhausted CD4 T cells end up suppressing the immune system at the systemic level. Consequently, both CD4 T cells and M2 macrophages suppress the immune system at the systemic level," says Prof. Agrewala. "Thus the gene biomarkers in blood samples can be used for early diagnosis and prognosis of the gliomas. We need to carry out studies on more samples before being certain."

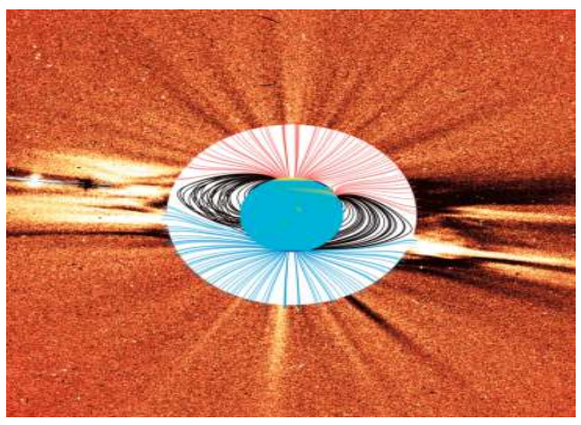
Researchers from Postgraduate Institute of Medical Education and Research, Chandigarh were also a part of the study.

Shape of Sun's corona accurately predicted

The advance prediction gives a large window of preparedness for space weather variations

SHUBASHREE DESIKAN

Solar physicists from Centre for Excellence in Space Sciences (CESSI), IISER Kolkata, have succeeded in predicting the shape of Sun's corona at the time of the annular eclipse on December 25. The corona is the outermost part of the Sun's atmosphere. This is the second successful prediction, counting the last solar eclipse that was viewed from South America on July 2 this year. While the earlier prediction differed slightly from the actual image, this time, it has been pretty close to the real thing. This was imaged by NASA and European Space Agency's space-based Solar and Heliospheric Observatory (SOHO) using the LASCO instrument. "For the South American Eclipse of 2 July, our predicted streamer tilts were slightly larger than observed at large distances from the Sun. This time, it is far better. We are still trying to figure out why this worked so well this time," says Dibyendu Nandi, who is a professor and Principal Investigator at CESSI.



Good match: The LASCO instrument's observation overlaid on the large scale coronal magnetic field lines predicted by the team. ▪SOHO-CESSI

Predicting in advance
The Predictive Solar Surface Flux Transport model developed by the CESSI team can predict the shape of the corona well in advance. Prantika Bhowmik, now at Durham University, UK, developed this model with Dr Nandi. "Our previous research indicates that we can predict the large-scale structure of the Sun's corona up to two months in advance. This is great, because this gives advance knowledge and a large window of preparedness for space weather driven by coronal magnetic fields," says Dr. Nandi. Space weather consists of the varying conditions such as solar wind and is different from weather on earth.

Space weather
"The dynamic events on the Sun can affect Earth's outer atmosphere and our technologies, leading to disruption in communication and navigation networks (GPS). These are more frequent during solar maxima and pose a threat to space reliant technology and astronauts," says Soumyaranjan Dash, PhD student at IISER Kolkata who works on this model.

This time, they had used inputs and made the prediction 43 days ahead of the eclipse. "The only way to verify these models is to either have photographs taken during the eclipse which captures the Sun's corona or use space- or ground-based instruments which use an artificial disc to occult the Sun's surface to make the faint corona visible," Dr Nandi adds in an email to *The Hindu*.

This time, since this was an annular eclipse with a ring of bright solar surface visible, the corona was not directly observable. The only option was to use a coronagraph with an occulting disc. "The only functional one in the world is in Hawaii in Mount Mauna Loa which has been having bad weather. Also it was night in Hawaii when the eclipse happened," he adds. So the researchers used the images generated by the space based coronagraph instrument LASCO on board the SOHO satellite.

Prime indicator: Underweight is highly correlated with child morbidity and reflects the nutritional status. ▪BLOOMBERG

Need a different approach to address child malnutrition

Though it is declining in India, the rate of decrease is very slow

ASWATHI PACHA

Globally over 200 million children below five years of age are chronically malnourished causing persistent problem in middle- and low-income countries. Though India's National Family Health Surveys (NFHS) show that there has been a decline in child malnutrition numbers in the country, various studies show that the rate of decline is very slow, and India is still fighting a tough battle.

District level trends
Now, a team from Harvard and Cambridge University has assessed district-level trends in the prevalence of malnutrition and how wealth disparity plays a role in five important malnutrition indicators such as stunting, underweight, wasting, low birth weight, and anaemia. The researchers analysed the NFHS-4 data of 2015-16 and noted that among the four indicators, anaemia was highly prevalent at 54.6%, across the poorest of the poor in Rajasthan, Gujarat, Madhya Pradesh and Telangana.

The team also placed each district under four categories – disparity, pitfall, intensity or prosperity – based on the overall burden and wealth disparity.

Wealth disparities in underweight children were seen across all districts with Gujarat, Jharkhand and Bihar having the worst disparities and Mizoram, Nagaland and Manipur having the least. "Underweight is highly correlated with child morbidity and is reflective of the current environmental and nutritional status of the child. Hence, underweight is arguably a more relevant and straightforward indicator to monitor for progress in child malnutrition," explains Dr. Rockli Kim from the Harvard Center for Population and Development Studies, U.S. in an email to *The Hindu*. She is the corresponding author of the paper recently published in *SSM- Population Health*.

The paper adds that for stunting and underweight, the north and central region of India which includes Uttar Pradesh, Bihar and Jharkhand were composed primarily of "pitfall" and "intensity" districts.

The team explains that though the Government of India's new initiative National Nutrition Mission (NNM) has led to a progressive decline in child malnutrition, the decline has been slow and the improvements have not been equally distributed across the population. "Our work provides estimates to inform policies and interventions to target areas with the highest overall burden and the worst wealth disparity in child nutritional status. Even within well-performing districts, there can be gross inegalitarian malnutrition outcomes," explains S.V. Subramanian from the Department of Population Health and Geography at Harvard University in an email to *The Hindu*. He is one of the authors of the paper.

Different strategies
"Districts where the prevalence of malnutrition is uniformly high likely require a different intervention strategy compared with districts where prevalence is high but disproportionately shouldered amongst poorer households within the district. It is important to make sure progress on child nutrition is made both effectively and equitably," he adds.

Question Corner

Safety of buildings on stilts

Q ***Are buildings with stilt parking (without a wall joining the stilts) at greater risk of collapsing due to earthquake?***

A **PROF. DEVDAS MENON,** IIT Madras

In general, yes – unless the buildings have been designed structurally to mitigate the risk.
Typically, in multi-storey, reinforced concrete framed buildings on stilts, masonry infill walls (between columns) are present in all upper storeys, except in the ground storey. This introduces a sudden reduction in lateral stiffness in the building in the open ground storey, relative to the upper storeys, under the action of lateral loads during earthquake.
The lateral inter-storey movement ('drift') in the ground storey is likely to be very high, compared with the upper storeys, inducing local high stresses in the ground storey columns. In an extreme seismic event, the vertical steel reinforcement can yield at the top and bottom locations of the ground storey columns, making the building vulnerable to a 'soft storey mechanism' collapse: the building can simply 'cave in', with the upper storeys coming down. (flattening the cars parked in the ground storey – as witnessed during the 2001 Gujarat earthquake).
Such sudden failure can be avoided by proper structural design such as providing reinforced concrete shear walls at appropriate locations, or at the very least, adequately stiffening and strengthening the ground floor columns. Existing open ground storey buildings most at risk can be retrofitted to make them safe.

This week's question

Why do two parallel lines appear to be meeting at an infinite distance?

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

Musth does not necessarily give younger, male Asian elephants an edge

Going into musth is a roving strategy primarily advantageous to old males not to young males

SHUBASHREE DESIKAN

A seven-year study of Asian elephants from Nagarahole-Bandipur, a population centred around the Kabini region, yields interesting patterns of male elephant behaviour when in musth. Hormonal levels give musth males high energy and aggression levels and this state is often correlated with a propensity to mate. In two papers published in *Journal of Mammology* and *Gajah,* the team from Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bengaluru, probes how this works in the Kabini population.

Roving male: Ghatotgaja, a male aged above 45 years, sighted in musth. Temporal gland secretion is visible as a dark stain behind and slightly above the eye. ▪T. REVATHE

Elephants in musth
When an elephant is in a musth state, its urine shows increased testosterone levels. Also, temporin, a thick secretion, flows from the temporal ducts situated midway between their eyes and ears. Sometimes, the elephant dribbles urine as well. They hardly feed during musth and are more focussed on finding fertile females. They move from female to female, checking if she is fertile or not. Males enter into musth (show signs of musth) when there are in good body condition, and lost body condition over the time they are in musth because they are hardly feeding. Moreover, males can also mate when they are not in musth (they do not have to enter musth in order to mate). Therefore, people have been interested in finding out how exactly musth helps as a reproductive strategy since it is a very expensive strategy.

One way in which musth might give an advantage is that it might help to break a "queue" so to say of which male elephant is allowed to mate. It is also possible that musth allows for males to have greater energy and to rove (roam) over larger areas, which then gives males the opportunity to sample more females than nonmusth males.

Data were collected by a seven-member team. The team members drove along pre-selected routes for nearly 12 hours starting early morning and took photos and videos whenever they sighted elephants on these paths. "We aged all the elephants based on relative height, and ratio of head size to body size, and identified all the individuals based on ear, back and tail characteristics since we have a database based on long-term monitoring," says P. Keerthipriya, a research associate at the Evolutionary and Integrative Biology Unit, JNCASR. Which individual male whether in musth or not was associated with which female was recorded.

No apparent advantage
The key findings of the group are that young (15-30 years old) males in musth did not have an advantage over older (over 30 years) nonmusth males in terms of access to females. Old musth males had an advantage over old non-musth males, and also showed a roving strategy which allows for searching for multiple females. Therefore, musth seems to be a roving strategy that is primarily advantageous to old males and not to young males.

They also found that Kabini has a lower proportion of musth sightings compared to earlier studies from Kaziranga and Mudumalai. "Kabini has fewer males in the over-45 age class than Kaziranga and Mudumalai.... Hence the number of males of the 45 plus age-class seems to influence the occurrence of musth," says Dr. Keerthipriya.

Female elephants have a four-month oestrous cycle in which they are ovulating for three or four days only. Thus, for a male to find an ovulating female and mate with her is, even normally, a rare occurrence. Further, if the female should get pregnant, she is out of circulation for about five years, because the pregnancy lasts two years and then she is lactating for over two-and-half years. Therefore, females are a rare resource for males seeking to produce offspring. Therefore, male mating strategies become very important in such a species.

Competing males
In this context, the obvious feature is the high degree of competition that exists among males to select and mate with the few available females. This study analyses how musth might affect this competition.

"The young males probably have to wait it out and invest in growth rather than reproduction while the competition is mostly among the old males," says T.N.C. Vidya of the Evolutionary and Integrative Biology Unit, JNCASR, under whose leadership the work was done. "The low occurrence of musth in Kabini brings up interesting questions about how paternity will be distributed among males in Kabini, which is now being studied," says Dr Vidya.