In This Issue

Highlight | Accurate Measurement of Nebular Magnetic Field Reveals New Scenario of Star Formation

How nebulae give birth to stars has remained a mystery; particularly the role of magnetic field has fascinated scientists for long. It is generally believed that prior to the star formation, the mostly charged particles in a molecular cloud are supported by the cloud's magnetic field; while they aggregate together to form dense cores, the magnetic field could diminish and fail to support them anymore. In this case, the particles would fall on their own gravity and heat up to become plasma. Under prime conditions, the temperature and pressure can increase to a critical level to trigger a fusion reaction – the signature powerhouse of a star.

How and why the magnetic field diminishes to allow such an avalanche, however, has been elusive. To unravel this mystery, accurate measurement is necessary for such extremely weak magnetic field from light years away. So far only one direct probe is available for this unimaginable mission – Zeeman effect. In this phenomenon, spectral lines from such remote nebulae can break down into several components in the presence of magnetic fields, and hence give information about the latter. Zeeman effect observation can help astronomers reconstruct the magnetic fields of celestial bodies.

However, nebulae in transition from a starless to a proto-stellar state are molecular clouds, and their particles mostly produce very weak Zeeman effect; and the complex chemistries between the component particles make the spectra very hard for astronomical instruments to track.

With the aid of FAST, the Five-hundred-meter Aperture Spherical Telescope of China, a team of scientists from the National Astronomical Observatories, Chinese Academy of Sciences (NAOC) reported early January in *Nature* their successful detection of a coherent magnetic field from a molecular cloud located in Taurus. Their accurate measurement reveals a new scenario of star formation.

For detail, please refer to page 75.

Highlight | Confining the Bouncing Electrons to Get Better Catalysts

Chemical bonds are formed through the sharing of electrons between two atoms. Catalysts act as facilitators of this process, acting as 'matchmakers' to bring atoms together to form a bond. Researchers at the CAS Dalian Institute of Chemical Physics (DICP) have discovered that the function of catalysts can be modified or enhanced when they are confined at nanoscales, such as within nanotubes or in the presence of other atoms at interfaces. This nano-confinement changes the electron status and energy distribution around the atoms, allowing scientists to control a catalyst's activity. Based on this concept, a team led by Professor BAO Xinhe has developed a number of superior catalysts. For further information, read page 78.

Highlight | A Treasure Hunt for New Antibiotics with Deep Learning

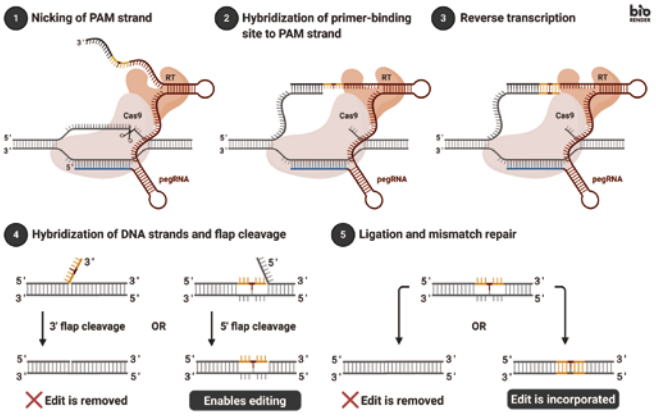
Significant progress has been made in the development of artificial intelligence (AI) algorithms for protein structure prediction, including AlphaFold and Rosetta. These algorithms utilize machine learning techniques, such as neural networks, to recognize patterns in protein structures and predict the 3D structure of a new protein based on its sequence. However, with the availability of numerous comprehensive datasets, research institutes and pharmaceutical

companies are now competing to analyze this data for new discoveries. In a report published in *Nature Biotechnology*, Ma *et al*. from the CAS Institute of Microbiology describe an AI strategy for identifying novel peptide-based antibiotics from the datasets of human gut bacteria and a collection of known antimicrobial peptides. For more information on this treasure-hunting approach, read page 81.

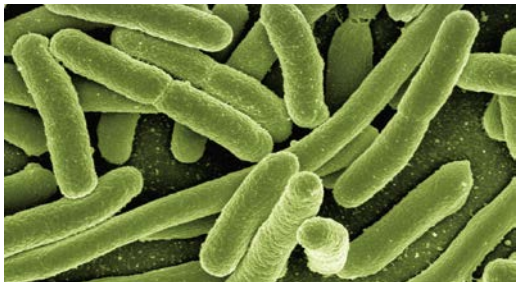
Highlight | Revolutionizing Crop Improvement with Prime Editing

Prime editing, a "search-and-replace" CRISPR-based genome editing technique developed by Dr. David R. Liu and his team in 2019, has advanced the field of genome editing to a new level.

Since its development, Dr. GAO Caixia of the CAS Institute of Genetics and Developmental Biology (IGDB) and her team have actively used this new editing technique for plant genome editing. Their committed efforts have greatly improved its editing efficiency from 2.1% to 11.3% without compromising precision. It is expected that the improved prime editing tools may play a crucial role in crop improvement in the future. For more information, read page 83.



Prime editing mechanism. (Credit: Ldinatto/Wikipedia)



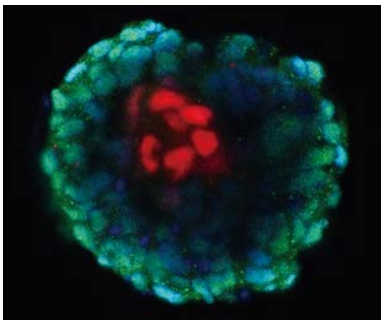
Scientists can now engineer the outer membrane vesicles (OMVs) secreted by *Escherichia coli*, a ubiquitous bacterium, as shown, into tumor vaccines. (Image: Pixabay)

Highlight | Engineering Bacteria into Oral Tumor Vaccines

Humans have always used tools to transform and make use of their environment to accomplish their goals. As a highly innovative population, scientists constantly look for new ways to combat human diseases by learning from other organisms. Turn to page 86 to discover how researchers harness the power of one type of ubiquitous bacteria, *Escherichia coli*, or *E. coli*, in their efforts to improve human health.

Highlight | Groundbreaking Research Sheds Light on Organ Regeneration

A groundbreaking study conducted by CAS scientists has made a significant discovery in stem cell research, successfully transforming human pluripotent stem cells into fully functional 8-cell totipotent

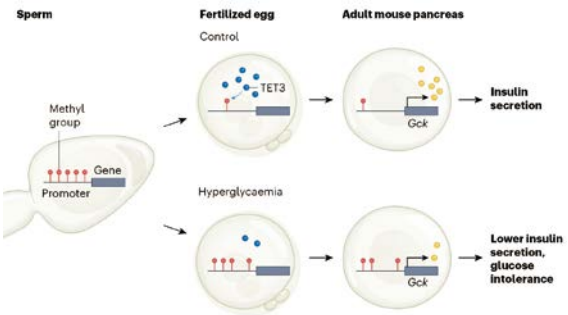


Blastocyst-like structures or blastoids generated *in vitro* represent a promising *in vitro* model of early human embryogenesis. (Credit: CAS)

embryo-like cells for the first time. Published in *Nature*, this new technique has the potential to revolutionize the field of organ regeneration and provide a valuable model for studying early human placental development and related diseases in a laboratory setting. This development marks a significant step forward in the quest to understand and treat various medical conditions. For more information, refer to page 88.

Highlight | Uncovering the Link Between Maternal Health and Offspring Well-being

A new study published in *Nature* has shed light on how the health of a pregnant woman can impact the long-term health of her children. Led by researchers from the CAS Shanghai Institute of Biochemistry and Cell Biology and Fudan University, the study found that pregestational hyperglycemia (high blood sugar) can increase the risk of offspring developing glucose intolerance in adulthood.



The enzyme TET3 mediates the inheritance of metabolic disorders. (Credit: *Science*)

The research also identified a specific enzyme, TET3, that is essential for removing methyl marks on paternal DNA in fertilized embryos and is influenced by maternal hyperglycemia. These findings suggest that there may be a critical period in oocyte growth and maturation that is susceptible to disruption by high glucose levels and underscore the importance of pre-conception care, including regular screening and glucose control, for women of reproductive age. For more information, read page 89.

Article | Trajectory Tracking of COVID-19 Epidemic Risk Using Self-Organizing Feature Map

On page 91, researchers used the self-organizing feature map (SOM) to follow the path of COVID-19 epidemic risk in 237 countries over the course of one year. The SOM, a vector quantization method, was used to map time series data and monitor changes in the number of new confirmed cases and deaths per day. A hybrid clustering method combining SOM and K-means was used to generate a risk map, which showed the daily risk trajectory. The results of this study demonstrate the effectiveness of SOM in tracking epidemic risk and provide valuable insights into the dynamic changes in COVID-19 risk.

ThinkTank Report | Consultative Report on China's Graphene Industry

Graphene, a material with the potential to revolutionize the high-tech industry, has garnered significant global attention and investment. Notably, China has invested a lot and hustled to the forefront of the field. However, China's efforts to become a leader in the graphene industry have been hindered by challenges such as a lack of strategic planning and a fragmented innovation system, according to the Consultative Group of CAS Academic Divisions. As the graphene industry reaches a crucial point, it is imperative for China to develop a comprehensive strategy to maximize its chances of success. For more information, please refer to page 101.

Huawei used graphene in the cooling systems of its Mate 20 X model, released in 2018. (Image: Pixabay)