

HIGH-RANKING VISITORS HIGH ABOVE THE GROUND

During a trip to Brazil at the beginning of January 2023, German Federal President Frank-Walter Steinmeier and Federal Minister for the Environment Steffi Lemke visited the Amazon Tall Tower Observatory (Atto), a joint project between two Max Planck Institutes and two Brazilian research facilities. Researchers at Atto are studying the com-

plex interactions between the world's largest tropical rain forest, the atmosphere, and the global climate. Susan Trumbore, Director at the Max Planck Institute for Biogeochemistry, the German coordinator of the Atto project, took the delegation on a tour of the research station. As part of the tour, Steinmeier and Lemke visited the 325-meter

tower that gives the observatory its name and climbed 54 meters to the first platform. Both guests were impressed by this state-of-the-art technology situated in the heart of the Brazilian rain forest. The Federal President summarized his thoughts by saying, "This is the place to check the pulse, so to speak, of the world's climate." www.mpg.de/19713821



Above the trees: on the Atto platform 54 meters up, Max Planck researcher Stefan Wolff explains to the Federal President the questions that are being investigated at the research station.

WENDELSTEIN 7-X SETS RECORD

Despite being restarted only recently, it has already achieved a milestone. The Wendelstein 7-X reactor has spent the last three years being rebuilt. Among the additions were a more powerful heater and a water-cooling system. Now, researchers at the Max Planck Institute for Plasma Physics have succeeded in holding plasma stable for eight minutes within the reactor. Prior to the rebuild, it had only been possible to maintain the plasma for 100 seconds. Ultimately, the goal is to maintain plasma for 30 minutes to prove that Wendelstein 7-X is capable of continuously sustaining nuclear fusion. In the process, the researchers will heat the plasma to 60 million °C. This would correspond to the 100 million °C required in a larger facility to start a nuclear fusion reaction. In the current experiment, they heated the plasma to 17 million °C, and in shorter experiments had already achieved 30 million °C. Wendelstein 7-X is a stellarator, a type of fusion reactor used to generate energy by fusing light atomic nuclei. In addition to the stellarator, the Max Planck Institute for Plasma Physics also studies the tokamak, an alternative type of fusion reactor. ITER, the world's largest fusion experiment to date, is an example of this type of reactor.

www.ipp.mpg.de/5322229/01_23

OUTSTANDING ★

BRENDA SCHULMAN

This year, one of the most prestigious honors in biomedical research, the Louis-Jeantet Prize for Medicine, is being awarded to Brenda Schulman, Director at the Max Planck Institute of Biochemistry. She receives this honor alongside Ivan Đikić from Goethe University in Frankfurt for her contributions to research into the protein ubiquitin, which is crucial for the health of our cells.

Ubiquitin attaches to other proteins to ensure that a variety of cell processes take place in the correct sequence. If the protein does not function correctly, this can cause illnesses such as cancer and lead to infections. Brenda Schulman and Ivan Đikić discovered ubiquitin's important function in controlling such processes.



PHOTO: MPI FOR BIOCHEMISTRY / DAVID AUSSERHOFER



PHOTO: ANNA SCHROLL FOR MPG

Joachim Gauck, former Federal President of Germany and Max Planck Senator, spoke at the 75th anniversary of the Max Planck Society.

LOOKING BACK WITH A FOCUS ON THE FUTURE

On February 26, 2023, the Max Planck Society celebrated its 75th anniversary. More than 200 guests came to a ceremony at the Deutsches Museum in Munich, including German Federal Research Minister Bettina Stark-Watzinger, Lower Saxony's Minister of Science and Culture Falko Mohrs, and U.S. Consul General Timothy Liston. The opening speech was made by Joachim Gauck, former Federal President of Germany, and Senator of the Max Planck Society, who spoke about how we are more reliant on research today than ever before in the history of humanity. He also emphasized how our current crises, with climate change first among them, had clearly demonstrated the importance of science,

even outside the scientific community. In his speech, historian Jürgen Kocka, member of the research committee "History of the Max Planck Society," presented scientific development as part of contemporary history. You can read an abridged version of the speech starting on page 48. Max Planck President Martin Stratmann shared his wishes for the Society's anniversary, including the courage to make something of our own talents, the ability to forge new paths, a healthy dose of independence, and the yearning for intellectual fulfillment and curiosity. The exhibition "Pioneers of Science – the Nobel Laureates of the Max Planck Society" was opened after the ceremony.

www.mpg.de/19903234

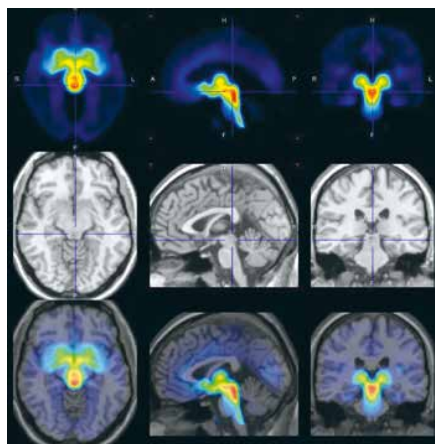
EFFECTIVE TEST

Reliably diagnosing latent tuberculosis, an asymptomatic and noninfectious form of the disease, would be an important milestone in fighting the pathogen, since people with this latent form are a reservoir for tuberculosis bacteria. The illness can also emerge when the immune system is weakened, meaning patients must be tested for latent tuberculosis before immunosuppressive therapies, such as before an organ transplant or chemotherapy. The available tests often show false positives in people who have been vaccinated against tuberculosis or have had tuberculosis in the past. The Swiss startup Clemedi is now working to develop better tests. They are using a method that was developed at the Max Planck Institute for Infection Biology in Berlin and the Medical University of Vienna, which allows the pathogen *Mycobacterium tuberculosis* to be extracted from the blood of patients with a latent infection. In December 2022, Clemedi concluded a licensing agreement with the Max Planck Society and the Medical University of Vienna for the use of this technology.

www.mpg.de/19677532

Strong fluctuations: some women suffer from considerable psychological distress in the days before menstruation. The cause is a relatively rapid change in the transport of the neurotransmitter serotonin in the brain.

IMAGE: MPI FOR HUMAN COGNITIVE AND BRAIN SCIENCES



PERIOD OF DEPRESSION

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Many of us are aware of premenstrual syndrome. The more serious form, premenstrual dysphoric disorder (PMDD), has a particularly negative impact on those who suffer from it. Symptoms include insomnia, depression, aggressive behavior, and difficulty concentrating. Up to eight percent of women of childbearing age are affected. A research team from the Max Planck Institute for Human Cognitive and Brain Sciences and the University of Leipzig Medical Center have discovered that the level of the neurotransmitter serotonin in the brains of women with PMDD declines shortly before menstruation. This discovery is surprising, because it was previously thought that the regulation of serotonin was an individual characteristic that did not change in a period of time as short as two weeks. Typically, slight changes were seen over a timeframe of ten years. This knowledge can now be used to treat PMDD by providing patients with antidepressants for just a few days. These drugs inhibit the reuptake of serotonin, keeping the serotonin level more consistent.

www.mpg.de/19818475

THE MENTAL TOLL OF MUSIC

Many people believe intuitively that making music is good for the soul. But it turns out this may not be the case. In 2019, a team of researchers identified a connection between musical engagement and psychological problems for the first time. According to the study, musically active people reported symptoms of depression, burnout, and behavioral issues at a higher rate than people who did not make music. The team, which now conducts its research at the Max Planck Institute for Empirical Aesthetics, has another study examining the genetic correlation between musicality and the predisposition for mental illnesses. Their work has shown that people with a

higher genetic risk of depression and bipolar disorder were on average more likely to be musically active, practiced more, and achieved a higher level of artistry. These correlations occurred regardless of whether these individuals were actually suffering from mental illness. At the same time, participants with a higher genetic predisposition for musicality had on average a somewhat higher risk of developing depression, regardless of whether they actually played a musical instrument or not. These results support the hypothesis that some of the same genes influence musical engagement and mental health.

www.mpg.de/2023011en

NO WEEDS WITHOUT AGRICULTURE

Intensive agriculture exerts a strong selective pressure on wild plants, leading them to develop into weeds that are difficult to control. This has been demonstrated in a study sup-

ported by researchers from the Max Planck Institute for Biology in Tübingen. The scientists compared the genomes of hemp agrimony from today with examples in museums from 200 years ago. In the present day, the plant is a pest feared by farmers in North America. In today's plants, genes responsible for fast growth and protecting the plants from drought and herbicides exhibited a particularly high rate of mutations. In addition, the frequency of gene variants that allow the plants to adapt to modern agriculture has risen quickly since the intensification of agriculture in the 1960s. Of the seven genes in today's hemp agrimony that provide resistance to herbicides, five of them were not found in the historical examples. Plants that have one of these seven mutations produce almost 20 percent more offspring than plants from 1960.

www.mpg.de/19623601



PHOTO: UNIVERSITY OF BRITISH COLUMBIA / JULIA KREINER

Corn plants growing alongside hemp agrimony (right) fare worse than they would in the absence of the weed (left).

THE RIGHT DROPLET

Proteins in a cell often collect into droplets known as condensates, similar to droplets of oil in salad dressing. In this concentrated form, the proteins can do their jobs better. Special sections of the amino acid chain of a protein act as a type of address label and guide the protein to the right droplet. If a protein ends up in the wrong droplet, this can lead to illness. Researchers from the Max Planck Institute for Molecular Genetics and other institutions have found the sec-

tions in protein molecules that function as labels. They have also discovered that mutations in the gene for the protein HMGB1 change the part of the protein that hangs off it like a loose rubber band. The protein then mistakenly wanders to a condensate in the nucleus, clumps up, and can no longer do its job. This causes BPTA syndrome, a rare genetic condition that results in malformation of limbs and the brain.

www.mpg.de/19845284



PHOTO: XUE ZHANG/MPI FOR POLYMER RESEARCH

Solid-state batteries could offer many advantages in the future, including for the use in electrically powered cars.

METAL TREES IN BATTERIES

They could be the next generation of battery: so-called “solid state” batteries. They are made entirely of solid materials and have no liquid medium between their poles, as today’s batteries do. These types of batteries could extend the range of electric cars and make them safer, as they can store more electricity and are less flammable and more robust. So far, however, they have suffered from limited lifetimes, because lithium dendrites grow between the positive and negative poles of the battery during each charging process. A team from the Max Planck Institute for Polymer Research has now observed that the lithium dendrites start growing mostly at the negative pole. They also clarified that the growth process is initiated by electrons, which assemble at the grain boundaries of the solid electrolyte. These findings could help to prevent or at least delay the growth of the metal trees in batteries.

www.mpg.de/19995577



PHOTO: MPI FOR CHEMICAL ECOLOGY / DINESHKUMAR KANDASAMY

A newly hatched bark beetle surrounded by fungal spores in its cell.

ATTRACTIVE FUNGI

Bark beetle infestations are increasingly damaging Germany’s forests, which are already being weakened by high temperatures and prolonged periods of drought. One of the most significant pests is the spruce bark beetle, also known as the typographer beetle. Once the beetles have found a suitable tree, they release pheromones to attract other members of their species. The beetles then team up with fungi

in the bark in order to reproduce inside the trees. The fungi provide the beetles with nutrients and protect them from pathogens. They also help the beetles overcome the tree’s defenses. An international research team led by the Max Planck Institute for Chemical Ecology has found that the typographer beetles are attracted to substances that the fungi release when breaking down spruce resin. The in-

sects detect the gaseous compounds with special sensory cells on their antennae. Infestations are presumably more likely in trees that are home to specific fungi that are beneficial to the bark beetle. The researchers are now testing whether the pheromone traps used to defend against the bark beetles are more effective if they contain substances from the fungi’s metabolism.

www.mpg.de/19883184

AN EXOPLANET MIGHT PERMIT LIFE

A newly discovered exoplanet could be worth searching for signs of life. Analyses by a team led by astronomer Diana Kossakowski of the Max Planck Institute for Astronomy describe a planet that orbits its home star, the red dwarf Wolf 1069, in the habitable zone. This zone includes distances around the star for which liquid water can exist on the surface of the planet. In addition, the planet named Wolf 1069 b has an Earth-like

mass. Very likely, this planet is a rocky planet that may also have an atmosphere. This makes the planet one of the few promising targets to search for life-friendly conditions and biosignatures. Whether the conditions on Wolf 1069 b actually permitted life, however, is subject to some uncertainties. And only in a few years astronomical research will be able to study exoplanets closely enough to clarify this. www.mpg.de/19798012/

STEEL FOR LIGHTER CARS

In the future, car bodies could become lighter and still be safe. A team from China's Northeastern University and the Düsseldorf-based Max Planck Institute for Iron Research have created a new type of steel that makes this possible. It allows sheet metal for cars to be rolled thinner, thus reducing their fuel consumption. By forging the steel several times and processing it at low temperatures, the researchers modified the microstructure of so-called medium manganese steel in such a way that it became both strong and ductile, allowing it to absorb a lot of energy in the event of an accident. Until now, steel producers have only achieved this combination of properties by adding relatively large amounts of expensive manganese. Alongside the low manganese content, the newly introduced steel contains only a few readily available components and is also easy to process.

www.mpg.de/19761404

Exoplanet systems of red dwarf stars hosting Earth-mass planets. The green rings indicate the habitable zones.

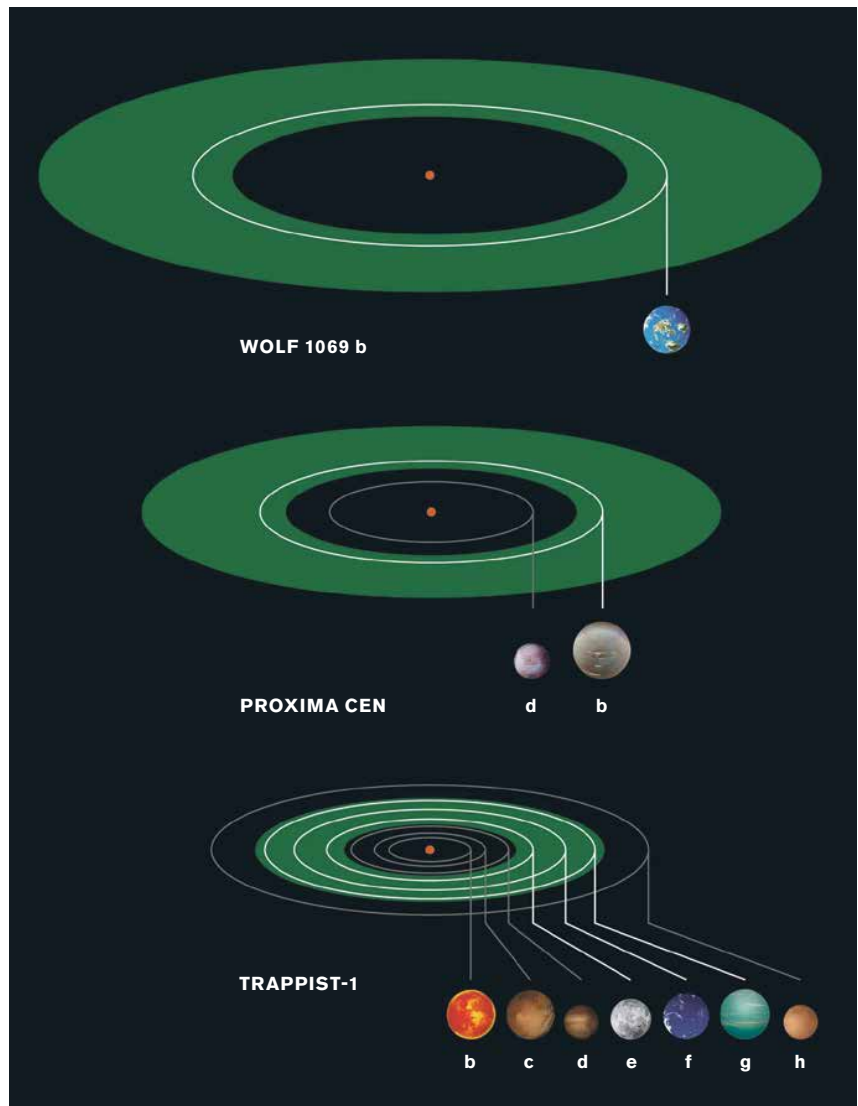


IMAGE: MPA-GRAPHIC DEPARTMENT/J. NEIDEL

PROTECTION FROM THE CUCKOO

The cuckoo lays its egg in the nest of another bird, and then lets this other bird incubate it and raise it once it hatches. The brood parasite is a great danger for the host parents, because it usually causes them to lose their entire clutch of eggs. Together with colleagues from China, researchers at the Max Planck Institute for Biological Intelligence have discovered a behavior that allows Daurian redstarts to avoid becoming victims of a cuckoo. Once cuckoos arrive in the redstarts' breeding territory, potential hosts build their nests closer to human settlements than before their arrival. Presumably, this is how they try to keep the parasites away from their nests, because cuckoos avoid contact with humans. The cuckoo, in turn, does not lay its eggs in the nest of every Daurian redstart, because some pairs lay blue eggs, others pink. The researchers were able to show that the cuckoos lay their – also blue – eggs twice as often in host nests containing blue eggs. This means that their eggs go virtually unnoticed by the host parents and often remain completely undetected. www.mpg.de/19913030



PHOTO: MPI FOR BIOLOGICAL INTELLIGENCE / JINGGANG ZHANG



PHOTO: DGHAYES/ISTOCK

With their enigmatic honeycomb patterns, salt deserts have even served as backdrops for alien planets.

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HONEYCOMB IN THE DESERT

The structures look so exotic that they even served as an alien backdrop in the Star Wars movie “The Last Jedi”. Salt deserts around the globe are covered by honeycomb networks of bead-shaped salt deposits. A team featuring researchers from the Max Planck Institute for Dynamics and Self-Organization in Göttingen is now using simulations, laboratory experiments, and field studies to explain how the structures form. These show that convection beneath the surface drives roll-shaped circular

currents of water containing varying amounts of salt. Water evaporates at the surface, causing the salt concentration to increase and the water to sink, while less saline water rises next to it at the same time. The closely spaced convection rolls arrange themselves in a honeycomb pattern, as this is the most physically efficient form. In places where a particularly large amount of salt accumulates underground, more salt also crystallizes and forms the distinctive beads on the ground. www.mpg.de/19957475

A cuckoo egg (right) in a nest with a clutch of blue Daurian redstart eggs.