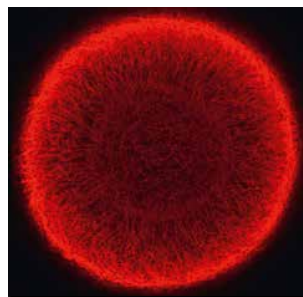
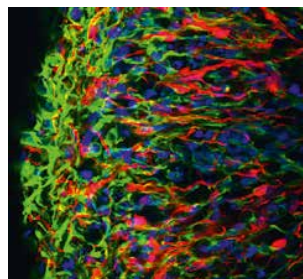


Top: midbrain organoids under the microscope. Bottom: whole organoid (red: young neurons).

GRAPHIC: MPI FOR MOLECULAR BIOMEDICINE/HENRIK RENNER, JAN BRÜDER



ORGANOIDS FROM A MACHINE

Sometimes, hundreds of thousands of active substances have to be tested in time-consuming, costly experiments to identify just one therapeutic. However, the automated production of organ-like tissues, known as organoids, promises to accelerate the development of new therapeutics in the future. Organoids are generated when precursor cells derived from body cells form three-dimensional tissue aggregates in special culture conditions. These mimic the tissue's characteristic properties better than conventional cell cultures. This organoid production process was developed by a team at the Max Planck Institute for Molecular Biomedicine in Muenster, and the technology transfer company Max Planck Innovation has now licensed it to the American bio-

tech company StemoniX. The process facilitates the automatic generation of organoids that resemble the human midbrain – the part of the brain which produces the dopamine-producing neurons that are the first to die in patients with Parkinson's disease. Researchers can use it to generate and test up to 20,000 brain organoids a day. In comparison, manual processes only allow for the generation of a couple of hundred organoids in a day; moreover, these vary considerably and are therefore unsuitable for drug testing. StemoniX aims to use these automatically generated organoids to guarantee that its partners only develop the safest, most effective active substances for treating diseases such as Parkinson's.

www.mpg.de/15969879

8

AWARD-WINNING ★

ASIFA AKHTAR

The Director of the Max Planck Institute of Immunobiology and Epigenetics in Freiburg is to be awarded one of the German Research Foundation's Leibniz Prizes. The award recognizes her cell biological work on the mechanisms of epigenetic gene regulation and her contribution to the scientific understanding of chromosome regulation, also known as "dosage compensation". Asifa Akhtar has also held the post of Vice President of the Max Planck Society since July 2020.



PHOTO: WOLFRAM SCHEIBLE FOR MPG

VOLKER SPRINGEL

Another Leibniz Prize is to be awarded to the Director of the Max Planck Institute for Astrophysics in Garching. Springel is being honored for his work in the field of numerical astrophysics. He has developed new methods that can help to explain, amongst other things, how the diversely structured cosmos could have emerged from an early, almost uniform universe.



PHOTO: HEIDELBERG INSTITUTE FOR THEORETICAL STUDIES (HITS)

FIRST NATURE INDEX FOR GERMANY

The scientific journal Nature has now published its own evaluation of scientific achievements in Germany for the first time. The report states that Germany is maintaining its position as one of the world's research giants. The journal cites strong, steady scientific funding and long-term investment in basic research as keys to the country's success. However, a lack of diversity and slow adaptation to contemporary research directions could challenge Germany's prolific research record going forward. The Nature Index Germany is determined by counting the number of articles published by an institution in prestigious scientific journals. In Germany, the top positions in the Nature Index are held by three non-university research facilities – the Max Planck Society, followed by the Helmholtz and Leibniz Associations – while the two universities in Munich rank fourth and fifth.

PHOTO: WABENO/ISTOCK



A long way: the fall of 2015 saw many people fleeing on foot through the Balkans to central Europe. Since then, the EU member states have been struggling to agree on a joint course of action for their asylum policy.

FACING FACTS

Five years after the “long summer of migration” in 2015, the Max Planck Society’s scientific initiative “Challenges of Migration, Integration and Exclusion” has published its research report. The researchers have made eight recommendations based on their findings and summarized them in a position paper on migration policy. In this paper, they argue that given the global challenges associated with climate change, globalization and demographic shifts, it is not only regrettable but actually quite dan-

gerous for current discussions about migration to revolve primarily around irregular migration and asylum. Migration policy should instead be guided by facts. At the national level, the researchers suggest standardizing the fragmented legal framework and increasing the involvement of local authorities. Within the European Union, it is important to overcome the impasse regarding asylum and to shape a policy that is in accord with human rights.

www.mpg.de/16169506

GREEN LIGHT FOR MUNICH QUANTUM VALLEY

A quantum computer, tap-proof communication methods, and fundamental elements of quantum technology are just some of the goals that scientists will be pursuing in Munich Quantum Valley. Bavarian Minister President Markus Söder, Minister Hubert Aiwanger, Minister Bernd Sibler, President Thomas O. Höllmann (Bavarian Academy of Sciences and Humanities), President Reimund Neugebauer (Fraunhofer-Gesellschaft), President Bernd Huber (Ludwig Maximilian University of Munich), President Martin Stratmann (Max Planck Society), and President Thomas F. Hofmann (Technical University of Munich) gave the green light for the research initiative by signing a declaration of intent. Over the next two years, the State of Bavaria will provide start-up financing to the tune of € 120 million, some of which will be used to set up a technology park. With this backing, Munich Quantum Valley also intends to apply for funding from the federal government, which is making € 2 billion available for the development of quantum technologies as part of its stimulus package for the future.

www.mpg.de/16258573

AN HOURGLASS IN THE MILKY WAY

Astronomers have made a remarkable discovery in the first comprehensive sky map produced by the X-ray telescope eRosita – a huge circular structure of hot gas below the plane of the Milky Way that occupies most of the southern sky. Scientists have long known of a similar cloud structure in the northern sky, known as the “North polar spur”. This cloud was thought to have been created by the explosion of a massive star (supernova). Viewed together, the northern and southern structures both appear to emerge from the center of the galaxy in a shape reminiscent of an hourglass. The enormous amount of energy required to power the formation of these gas bubbles could have come from a period of intensive star formation or from an outburst from a supermassive black hole at the center of the galaxy.

www.mpg.de/16140198

Gas from the galaxy: this schematic diagram shows the newly discovered eRosita bubbles (yellow), which extend further from the center of the Milky Way into space than the Fermi bubbles observed before.

~ 50,000 light years

~ 35,000 light years

eRosita bubbles

Galactic center

Fermi bubbles

GRAPHIC: GCO BASED ON DATA FROM THE MPI FOR EXTRATERRESTRIAL PHYSICS

A RISK CALCULATOR FOR COVID-19

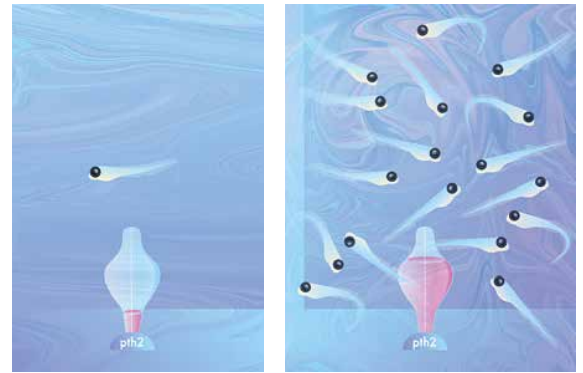
A computer program can now be used to determine the risk of becoming infected with the coronavirus Sars-CoV-2 following exposure to aerosol particles in an enclosed space. The model developed by researchers at the Max Planck Institute for Chemistry in

Mainz uses parameters such as the size of the room, the number of people in it, and their activity in order to estimate the risk of infection, not only for everyone in the room but for specific individuals as well. The algorithm also calculates how much the risk is reduced

when people wear masks or when the room is regularly ventilated. However, it cannot assess the risk of becoming infected by larger droplets transmitted over a short distance. The algorithm is publicly available on the Institute's website.

www.mpg.de/16015780

Measuring sociability: the levels of a hormone produced in the brains of zebrafish indicate whether or not an individual fish is surrounded by many others of its kind.



GRAPHIC: MPI FOR BRAIN RESEARCH/ J. KÜHL

BUILDING BLOCKS FOR SOCIAL UNDERSTANDING

Being able to feel empathy and adopt the other person's point of view enables us to understand what is going on in their mind. However, it is still not clear what these skills constitute. Based on previous studies, researchers at the Max Planck Institute for Human Cognitive and Brain Sciences and other institutions have developed an explanatory model which shows that both skills are made up of many individual factors that vary depending on the situation. In the case of empathy, a primary network that can recognize critical situations – e.g. by processing fear – cooperates with other specialized regions, such as those responsible for face or speech

recognition. When changing perspectives, the regions used to remember the past and imagine the future become the active core network. Here too, additional brain regions are activated for each specific situation. Complex social problems in particular require both empathy and a shift in perspective. Analyses have shown that a lack of one or the other of these two skills does not necessarily limit the individual's social competence as a whole. It may be that only one specific sub-factor is affected, such as the ability to understand facial expressions or speech melody.

www.mpg.de/16024611



PHOTO: SHUTTERSTOCK

A deep understanding: our ability to empathize with other people depends on numerous individual factors. These can vary depending on the situation.

SOCIAL DISTANCING IN FISH BRAINS

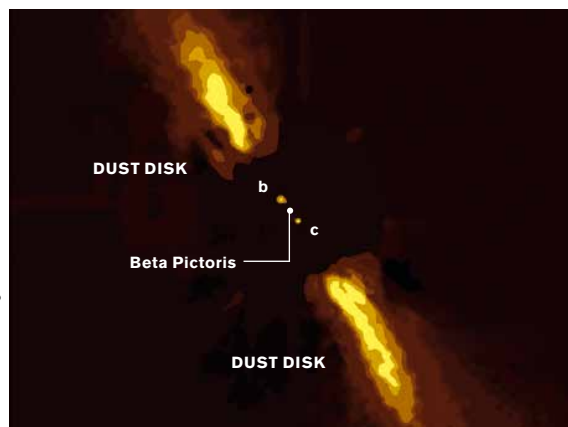
Social isolation can have dire effects on both humans and animals. An international research team that includes scientists from the Max Planck Institute for Brain Research has investigated the effects of isolation on the brains of zebrafish by measuring the activity of thousands of genes. The few genes that displayed changes in activity included the gene for “parathyroid hormone 2” (pth2). This acts like a barometer of the social environment: the more members of its species that are present in an individual zebrafish's environment, the more pth2 hormone is produced in its brain. If a zebrafish kept in isolation is placed in a tank with others of its species, the levels of this parathyroid hormone rise within a short time. According to the researchers, the production of this neurohormone is controlled by the lateral line organ, a band of sensory cells that react to mechanical stimuli and are used by the fish to sense the swimming movements of their kin.

www.mpg.de/16105035/1202

12 PORTRAIT OF AN EXOPLANET

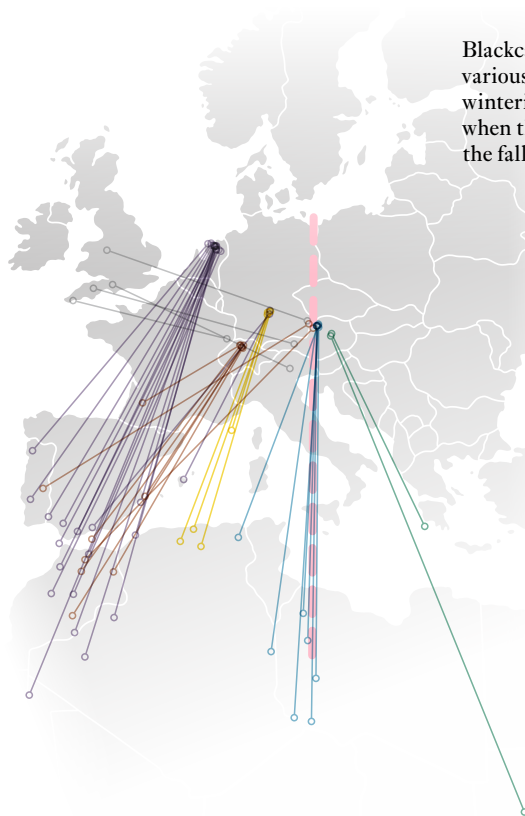
Astronomers discover the vast majority of the planets orbiting distant stars with the help of sophisticated methods. These exoplanets do not appear in images, but reveal themselves indirectly. One of the most popular methods of discovery is the measurement of radial velocity. Because a planet pulls at its much brighter parent star like a dog on a leash pulls at its master or mistress, the star “sidesteps”, i.e. makes periodic movements at a specific velocity. These cause minute shifts in the spectral lines, enabling conclusions to be drawn regarding the planet’s existence. A team of researchers from the Max Planck Institutes for Astronomy and Extraterrestrial Physics has now succeeded in making the first direct observations of an exoplanet previously discovered using this method. They viewed the faint light from the planet β (Beta) Pictoris c, some 63 light years from Earth, using the GRAVITY instrument, which combines the four large telescopes at the European Southern Observatory to form a single super telescope with a diameter of 130 meters.

www.mpg.de/15473085



Strange worlds: this schematic image shows the β Pictoris system with the two planets b and c embedded in a dust disk. This image was created using actual observation data.

Blackcaps take various routes to their wintering grounds when they migrate in the fall.



FLEXIBLE FLIGHT PATHS

Like many other migratory birds, blackcaps fly south in the fall, covering thousands of kilometers to reach their wintering grounds. Birds living in the eastern regions of central Europe migrate toward the southeast, while those that live further west migrate toward the southwest. Cross-breeding experiments have shown that parent birds pass on the direction of migration to their offspring. Researchers at the Max Planck Institute for Evolutionary Biology in Ploen have now tracked the flight paths of 100 wild blackcaps and discovered that birds living in the zone between the western and eastern groups choose an “intermediate route”. They fly directly south, successfully crossing the Alps, the Mediterranean and in some cases the Sahara, before returning to their breeding grounds in the spring. The “migratory divide” in which both groups of birds mingle is, at 30 kilometers, surprisingly narrow. It runs in a north-south direction through Europe, spanning the distance between Berlin and Prague. The results also show that blackcaps that spend the winter in Britain – a behavior that has been observed more and more often since the 1960s – come from all over Europe. These birds probably benefit from the increasingly mild winters and the food provided in British gardens.

www.mpg.de/15987699

TEETH WITH PREDETER- MINED BREAKING POINTS

Biting down on a cherry stone can have severe consequences. At worst, a tooth breaks and a visit to the dentist becomes unavoidable. For the Port Jackson bullhead shark, on the other hand, splintering teeth are perfectly normal, as a team led by Shahrouz Amini at the Max Planck Institute of Colloids and Interfaces in Potsdam discovered. The researchers can now explain why the shark's teeth stay sharp: its tooth enamel consists of inner and outer layers, both made of apatite. In the outer layer, which covers the sides of the teeth, all the apatite bundles run parallel to the tooth surface. This means there are predetermined breaking points between the bundles. In the inner layer, which surfaces at the tip of the tooth, the apatite bundles are stacked crosswise so that the material does not splinter. The tip of the tooth is gradually ground down but remains sharp, because the enamel on the sides of the tooth is constantly breaking off. This knowledge could serve as an inspiration for new types of material.

www.mpg.de/16060198



A conveyor belt of teeth: the Port Jackson bullhead shark has several rows of teeth that are constantly being renewed. The red coloration comes from sea urchins, one of the shark's most common prey.

PHOTO: MPI OF COLLOIDS AND INTERFACES/NATURE COMMUNICATIONS 2020

LARGE FAMILY OR NO CHILDREN

A study of female academics in the U.S. conducted by Natalie Nitsche from the Max Planck Institute for Demographic Research and one of her colleagues has found surprising correlations between the desire for children expressed in younger years, their level of education, the time of their first marriage, and the number of children to whom they had given birth by the age of 43. Female academics who originally wanted to have at least three children were more likely to remain childless than less educated women who expressed the same desire – and than female aca-

demics who only wanted two children. The time of their first marriage also influenced the number of children, a finding that also applies to men. Men who do not embark on their first long-term relationship before the age of 35 are less likely to become fathers, even though they are able to procreate until a more advanced age than women. Another finding: female academics who want a lot of children and who become mothers at a relatively young age had more children than other groups in the study.

www.mpg.de/0420202en

The decreased use of transport as a result of the coronavirus pandemic was the main factor that caused global CO₂ emissions to fall by seven percent.



PHOTO: RICARDO GOMEZ/UNSPLASH

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CORONAVIRUS IS REDUCING CO₂ EMISSIONS

The coronavirus pandemic has caused a record decline in fossil CO₂ emissions. In 2020, global greenhouse gas emissions from coal, oil and gas combustion were down 2.4 billion tons compared to 2019. At seven percent, this is the sharpest drop since the early days of industrialization. These findings were published by the Global Carbon Project, in which scientists from the Max Planck Institute for Biogeochemistry in Jena are involved. The decline in emissions was particularly marked in the transport sector. The total CO₂ emissions for 2020, i.e. the

emissions from fossil fuel combustion and changes in land use such as the deforestation of rainforests, amounted to approx. 39 billion tons. This means that the atmospheric concentration of CO₂ did not rise as sharply as in previous years, which – with a few exceptions – saw greenhouse gas emissions increase every year. If the Paris Climate Agreement's goal of limiting global warming to 1.5 degrees Celsius is to be achieved, global emissions of CO₂ must be reduced by one to two billion tons a year by 2050.

www.mpg.de/16175501 (in German)

If a person's pupils dilate only slightly when there is a prize to be won, this could be a sign of depression.

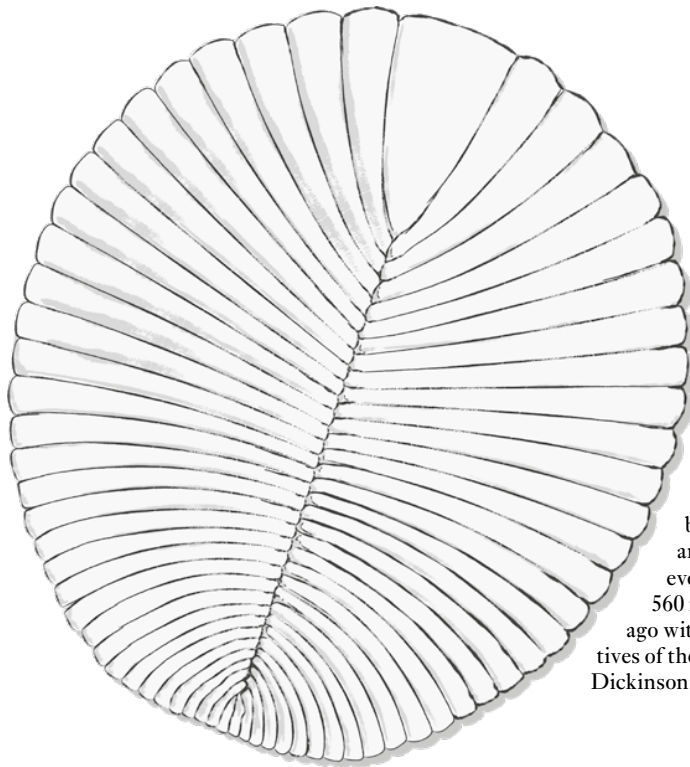


PHOTO: KALEA JERIELLE/UNSPLASH

DETECTING DEPRESSION IN THE EYE

People with depression often find it hard to motivate themselves. However, this lethargy is difficult to measure. Researchers at the Max Planck Institute of Psychiatry in Munich have taken advantage of the fact that even the possibility of a reward causes the pupils to dilate. Test subjects participating in a study were offered the chance to win a small amount of money, an incentive that causes the pupils of healthy subjects to dilate. The researchers measured the study participants' pupils with great precision and at an extremely high speed. Using a special set-up, they were able to take 250 images per second; by comparison, we only blink every four to six seconds. The measurements revealed that the more severe the patients' symptoms of depression, the weaker the dilation response of their pupils. The researchers assume that the nervous system of patients with depression is unable to activate as strongly even when they are given a positive expectation. This may partially explain the lethargy frequently observed in these patients. In the future, it may become possible to classify psychiatric diseases in diagnostic groups according to measurable biological factors, such as pupil size. Patients with depression whose pupils do not react as strongly would form a subgroup and could be treated with more precisely targeted medication.

www.mpg.de/16073488



The oldest animal: it is currently believed that animal life began evolving some 560 million years ago with representatives of the genus Dickinsonia.

ILLUSTRATION: HENNING BRUER

ANIMALS EVOLVED MORE RECENTLY THAN ONCE THOUGHT

A longstanding controversy surrounding the origins of animal life on Earth now appears to have been resolved. Researchers at the Max Planck Institute for Biogeochemistry in Jena have discovered that fossilized fat molecules found in stones dating back 635 million years are not the earliest evidence of animal life. Chemical experiments have shown that these fossilized molecules, which resemble the steroids of sponge-like organisms, are more likely to have evolved from precursor molecules of

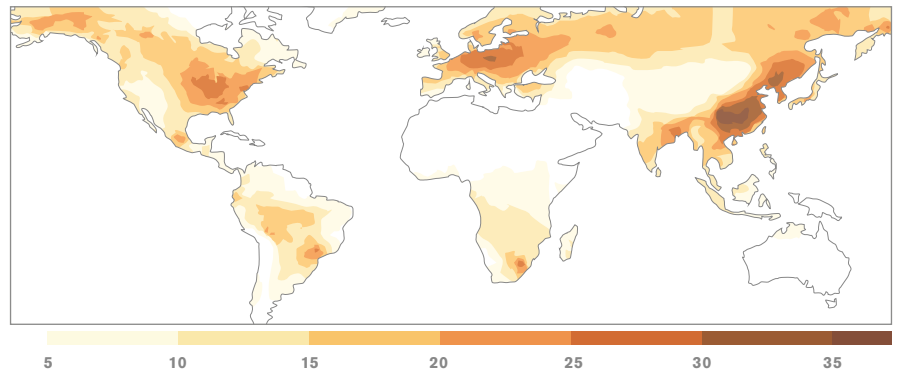
common algae as the result of geological processes. In terms of the Earth's history, they are significantly older than animal life forms, so it is currently believed that animal evolution only began around 560 million years ago. The researchers' latest work also resolves the dichotomy that animals appear to have developed before the oxygen content in the oceans began to rise some 540 million years ago, even though this was vital for the evolution of animal life.

www.mpg.de/16048936

NO FALSE SENSE OF SECURITY

During the COVID-19 pandemic, both politicians and the general population are having to come to terms with the fact that scientific knowledge invariably comes with a degree of uncertainty. But should the public be explicitly informed about this? Researchers at the Max Planck Institute for Human Development and the Charité University Hospital in Berlin have now looked into this question. During a representative study, they presented the test subjects with four different scenarios, placing varying degrees of emphasis on the uncertainty of the predictions. In the scenario that emphasized the element of uncertainty most strongly, they communicated the from-to figures, e.g. the estimated number of persons currently infected, the estimated number of deaths, or the estimated R number. They also stressed that “the differences observed [could] be caused by random fluctuation or be the first signs of a second wave of coronavirus infection.” In contrast, the scenario that paid the least amount of attention to the uncertainty provided specific figures and stressed that their development “leaves no doubt that a second wave of infection has already begun.” Each of the scenarios ended with an appeal to comply with protective measures. In response to the question of which scenario would be best suited for informing the public about the progression of the pandemic, more than half of the participants cited a preference for formats that conveyed a sense of uncertainty; in fact, the majority preferred the scenario in which the uncertainty was clearest. In contrast, the scenario that glossed over the scientific uncertainty only convinced 21 percent of the participants. People who take a critical view of the current measures also seem more likely to comply with them if scientific uncertainty is clearly communicated.

www.mpg.de/0420201en



GRAPHIC: GCO BASED ON DATA FROM MPI FOR CHEMISTRY

MORE COVID-19 DEATHS DUE TO AIR POLLUTION

Air pollution appears to increase the risk of dying of COVID-19. This conclusion was drawn by an international team that included scientists from the Max Planck Institute for Chemistry in Mainz. The researchers calculated the percentage of COVID-19 deaths that could have been prevented if there was no man-made particulate matter in the air, e.g. from fossil fuel

combustion. It was found that 15 percent of COVID-19 deaths worldwide were caused by this pollutant. In Germany, the figure is no less than 26 percent. It appears that particulate matter makes it easier for the virus to infect cells in the lungs, and it also damages the blood vessels in a manner similar to Sars-CoV-2.

www.mpg.de/15952279

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HIGH-SPEED MODEL FOR THE FIGHT AGAINST CORONAVIRUS

Before treatments for the coronavirus Sars-CoV-2 can be tested in human clinical trials, they have to be intensively studied in animals. One suitable model organism for testing treatments to be administered to humans is the mouse. However, Sars-CoV-2 cannot infect mice, because they have different ACE2 receptors. The virus cannot bond with these receptors and is therefore unable to penetrate the rodents' cells. In the record time of just one month, researchers at the Max Planck Institute for Molecular Biomedicine in Muenster, working with colleagues in China, have now

bred genetically modified mice that carry a human variant of the ACE2 receptor on their cells – thanks to CRISPR Cas9 genetic scissors and a technique used in stem cell research. The results show that Sars-CoV-2 infection in these genetically modified mice causes similar symptoms to COVID-19 in humans. These new techniques will now enable researchers to investigate the effects of antibodies and therapeutics on the coronavirus, which means they will be able to react more quickly than before to the threat of new pathogens.

www.mpg.de/16164102

DEMOCRACY AMONG GUINEA FOWL

Guinea fowl in the East African savannah live in a multi-level society in which social groups of between 15 and more than 60 individuals interact. There is a clear hierarchy within these individual groups, whereby alpha animals can dominate other group members and completely monopolize food supplies. Researchers from the Max Planck

Institute of Animal Behavior in Radolfzell spent several years tracking the movements of various groups of guinea fowl on foot and by utilizing video and high-resolution GPS sensors; this enabled them to determine the birds' social ranking within their hierarchy. When dominant individuals chase other members of the group away from a particu-

larly rich food patch, the excluded subordinates band together and induce the dominant group to move on. This behavior ultimately forces the alpha animals to leave the patch and follow the group. This shows that the leaders have to bow to the majority if they abuse their power and monopolize resources for themselves. www.mpg.de/16034177



THE STONE AGE LASTED LONGER THAN PREVIOUSLY THOUGHT

The earliest techniques employed by humans to make stone tools remained in use in the westernmost regions of Africa 20,000 years longer than was previously assumed. This is the result of investigations carried out under the direction of Eleanor Scerri, Research Group Leader at the Max Planck Institute for the Science of Human History in Jena, and Khady Niang from the University of Cheikh Anta Diop in Senegal. Until now, it was assumed that stone tools dating from the Mesolithic or Middle Stone Age, such as the hand ax, had been replaced by a completely different set of smaller-scale tools no later than 30,000 years ago. The research team has now discovered that groups of hunter-gatherers in modern-day Senegal were still using Middle Stone Age techniques until around 11,000 years ago. One reason for this could be that the region was fairly isolated due to its proximity to the Sahara in the north and the rainforests of central Africa. It is possible that climate changes in this region were less extreme than in other parts of Africa, which meant that there was no need to make radical changes to tool-making techniques.

www.mpg.de/16237767

ILLUSTRATION: HENNING BRUER



PHOTO: GEOFFREY REYNAUD/ISTOCK

Caribou migrate long distances over the course of a year. A study has shown that climate change is causing northern caribou to give birth earlier in the spring than populations further south.

ARCHIVE OF ANIMAL MIGRATION IN THE ARCTIC

Warmer, shorter winters, melting ice, and increased human activity mean that the Arctic is undergoing dramatic changes that are impacting animals and their migration patterns. Researchers around the world have now set up an online data archive for documenting animal movements in the Arctic and Subarctic, which is hosted on the Max Planck Institute of Animal Behavior "Movebank" platform. The "Arctic Animal Movement Archive" enables scientists to share their knowledge and work together to

find out how animals are reacting to changes in the Arctic. The archive currently contains more than 200 research projects with movement data from more than 8,000 aquatic and terrestrial animals dating from 1991 to the present. Three new studies from the archive testify to far-reaching changes in the behavior of golden eagles, bears, caribou, elk, and wolves in the region. They demonstrate how the archive can be used to identify significant changes in the ecosystem.

www.mpg.de/15976863