

Storks on the wing

Scientists know which animals will be overwintering in Africa and which will be staying in Europe shortly after they begin migrating



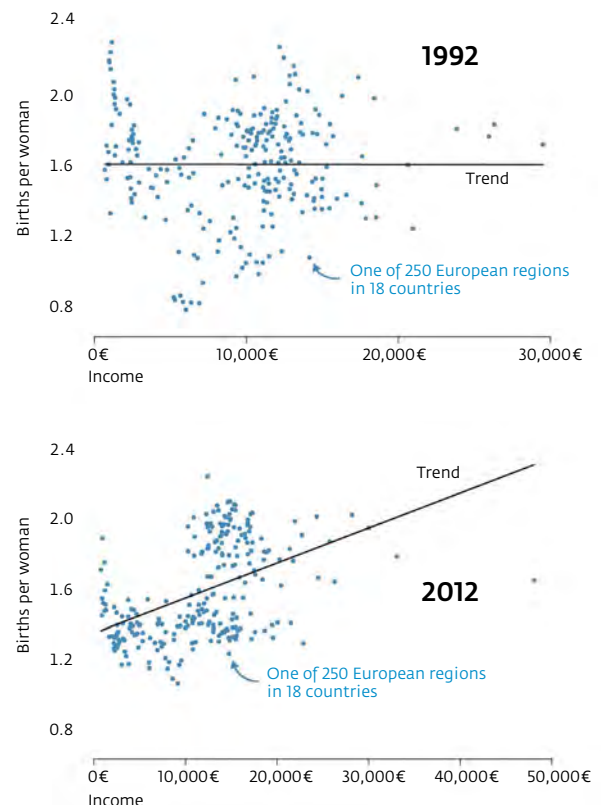
Young storks just a few weeks old in their nest; they have been fitted with transmitters. The devices weigh less than 60 grams and record the GPS coordinates and acceleration of each bird. The latter information tells the researchers whether the bird is flapping its wings or gliding.

Every year in the late summer and fall, a fascinating drama plays out around Lake Constance: the storks leave to spend the winter in South-West Europe, North Africa or West Africa. In the spring of 2014, scientists at the Max Planck Institute for Ornithology in Radolfzell strapped GPS transmitters to a number of young storks that were just a few weeks old and have been meticulously tracking their flight ever since. By performing sophisticated analyses of the GPS data, the researchers, working in cooperation with colleagues from the University of Constance, have discovered that there are leader birds within the groups of migrating storks. These leader birds guide the groups to regions with favorable thermals, where they are literally sucked up by the warm rising air. This means they can switch from active flight to gliding in order to save energy. The follower birds are poorer gliders and have to flap their wings more frequently on their journey. They benefit from the experience of the leader birds but fly more slowly and lose height more quickly. The length of time for which a stork can glide determines where it will spend the winter: the best gliders fly the farthest. Just a few minutes after each bird departs, the scientists can predict on the basis of its wingbeats whether it will be overwintering in Europe or flying on to West Africa. (www.mpg.de/12041435)

Higher income means more children

There is a good chance that rising incomes in Europe will no longer lead to lower birth rates in the future. As prosperity increased through the decades of the 20th century, the number of children born to each woman declined. However, data collected from 20 European countries over the last 30 years shows that this correlation no longer exists. Nowadays, the regions of Europe where incomes are higher tend to have higher birth rates. This conclusion is drawn in a study published by Sebastian Kluesener and Mikko Myrskylae from the Max Planck Institute for Demographic Research in Rostock in cooperation with Jonathan Fox from the Free University of Berlin. The researchers believe that this turnaround is mainly due to the expansion of childcare facilities and the increased flexibility of working conditions, which are making it easier to combine family and working life. "Even in areas with very low birth rates, people always wanted to have more children," says Myrskylae. "They now have the opportunity to have the bigger families they want." (www.mpg.de/12041447, in German)

Families trending: thanks to more flexible working conditions and support from the government, more children are being born, particularly in highly developed metropolitan areas.



Drummed speech

A tribe in the Amazon sends an astonishing variety of messages by drum beat

How can an entire language be translated into drum beats? An international team of researchers, including Frank Seifart and Sven Grawunder from the former Department of Linguistics at the Max Planck Institute for Evolutionary Anthropology in Leipzig, has found an answer to this question by analyzing drummed speech in the North-West Amazon. The Bora, an indigenous group, uses special drums to relay informal messages and public announcements over long distances. Drum messages are customarily sent to ask someone to bring something or announce the outcome of alcohol-free drinking competitions. What surprised the scientists was that rhythm is crucial when transmitting information. Although the Bora drums have four pitches, only two of them are used to send verbal messages, and even these pitches play a subordinate role. More important are the intervals between vowels, which are reproduced by drum beats. This suggests that the rhythm of language may play a more important part in processing language than previously assumed. (www.mpg.de/12017337)



Message center in the Amazon: the Bora indigenous group uses special drums to imitate the rhythm of their speech.

Light gets ions going

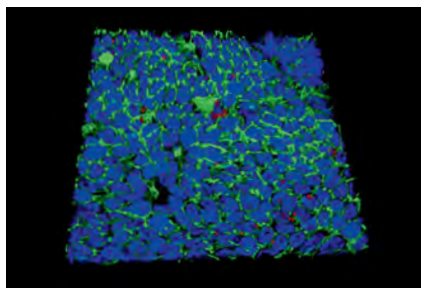
Light makes some materials conductive in a way that no one had previously imagined. In ordinary silicon solar cells, electrons flow when the sun shines. However, scientists at the Max Planck Institute for Solid State Research in Stuttgart have now made a surprise discovery: in one particular form of perovskite, another material used for solar cells, light releases not only electrons, but also ions, i.e. electrically charged particles. Moreover, this novel photo effect takes place on an extremely large scale: the conductivity of the ions is increased by a factor of one hundred. This high light-induced ion conductivity tends to damage solar cells made from the material under investigation as it can change their structure; however, systematic measures can now be taken to counteract this impact. The researchers in Stuttgart assume that this effect will facilitate the development of innovative, light-controlled electrochemical applications such as batteries that can be directly charged with light. (www.mpg.de/12009261)

Photos: GaiaMedia/Aexcrum (top), Rike Zietlow/MPI for Infection Biology (bottom)

Invisible pathogens

Stomach bacterium extracts cholesterol from the gastric mucosa to defend itself against attacks by the immune system

For a long time, stress and an unhealthy diet were believed to be the main causes of stomach inflammation (gastritis) and ulcers. The bacterium *Helicobacter pylori* was not identified as the actual culprit until the 1980s. Moreover, this pathogen, with which half of the world's population is infected, is seen as the biggest risk factor for stomach cancer. With the help of mini-organs grown in the laboratory, scientists at the Max Planck Institute for Infection Biology in Berlin have now discov-



ered how the bacterium is able to survive the immune system's attempts at defense: it extracts the fat molecule cholesterol from the membranes of gastric epithelial cells. This means that areas consisting of cholesterol can no longer be formed in the cell membrane. These lipid rafts are essential for the correct assembly of receptor molecules for cytokines in the immune system. In this way, the bacterium creates a niche in which it remains undetected by the immune system. This probably also explains why no one has yet succeeded in developing a vaccine against *H. pylori*. (www.mpg.de/11974260)

A mini-organ consisting of human gastric epithelial cells infected with *Helicobacter pylori* (red: *H. pylori*, blue: cell nuclei, green: cell membranes). Thanks to these so-called mucosoids, researchers can investigate inflammatory processes over a long period and obtain important information about how cancer starts.

Chimpanzees suffer from heat stress

Primates living in the savannah are at risk of overheating and dehydration, particularly during periods of drought



Heat and drought are the biggest problems facing savannah chimpanzees; in contrast, they appear to have enough food. They have adapted their behavior to prevent overheating: they bathe in water sources, spend time in caves and are also active at night.

stress, dehydration and lack of food. The results clearly show that the animals are particularly prone to heat stress and dehydration towards the end of the dry season, when temperatures reach around 45 degrees, and it has not rained for months. The biggest challenges faced by savannah chimpanzees are therefore finding enough water and not overheating. Lack of food appears to be less of a problem, although the savannah has relatively few food sources for the animals. The chim-

The climate in the grass savannah of Senegal is brutal. The dry season lasts no less than seven months, and the average temperature is 37 degrees. These conditions are apparently a major source of stress for the chimpanzees living there, as researchers from the Max Planck Institute for Evolutionary Anthropology in Leipzig have discovered. The scientists collected the chimpanzees' urine and analyzed the concentration of hormones produced to cope with heat

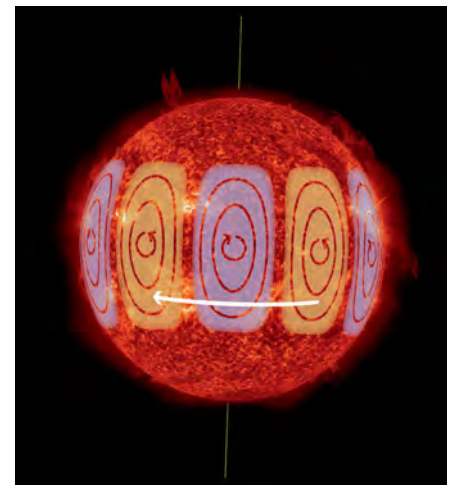
panzees have apparently expanded the range of foods they eat in order to adapt to their hostile environment. These results support the hypothesis that heat stress and dehydration were also serious problems for our hominin ancestors when they settled the open grasslands. These early humans probably adapted to the heat and drought by sweating more profusely and losing some of their body hair. (www.mpg.de/12039762)

Giant swirls on the sun

The waves that have now been found on the Sun are similar to those that control the weather in the Earth's atmosphere

A team of scientists led by the Max Planck Institute for Solar System Research and the University of Goettingen has discovered gigantic swirls on the Sun. These Rossby waves propagate in the direction opposite to rotation, have lifetimes of several months and maximum amplitudes (deflections of the vibration) at the equator. For forty years, scientists had speculated about the existence of such waves on the Sun, which should be present in every rotating fluid system. They have now been clearly identified

for the first time. For this, the scientists analyzed data that had been gathered by NASA's *Solar Dynamics Observatory* over a period of six years. The solar Rossby waves are closely related to the Rossby waves that occur in the Earth's atmosphere and oceans. On weather maps, they appear as meanders in the jet stream separating cold polar air in the north from warmer subtropical air further south. In principle, waves of this type arise on every rotating sphere due to the Coriolis force. (www.mpg.de/12032196)



Turbulent Sun: the Rossby waves move counter to the Sun's direction of rotation. Their amplitude (the maximum deflection of the vibration) is largest close to the equator.

Avatars for the virtual zoo

Using just a few photos, a new technique can create lifelike models of animals that are able to move just like their real-life counterparts

Filmmakers and computer game developers will in future have access to a new method of animating animals. A team of researchers from the Max Planck Institute for Intelligent Systems in Tuebingen has developed a technique that can create lifelike 3D avatars of almost all quadrupeds using nothing but photographs. These can be animated to realistically imitate the movements of real animals. The researchers can bring the avatars to virtual life with relatively little effort because, unlike previous methods, they

start with models that they already presented in an earlier work. These models include dogs, cats, horses, bovine animals, goats and hippos. The

new method also adapts the models for other quadrupeds: bears, rhinos and even the extinct Tasmanian tiger. (www.mpg.de/12106987)



The technique developed by the researchers in Tuebingen uses photos of animals (bottom row) to create 3D models (top row) that can reproduce different postures and whose surface is designed according to the original body cover (middle two rows).

Fewer genes, better adaptation

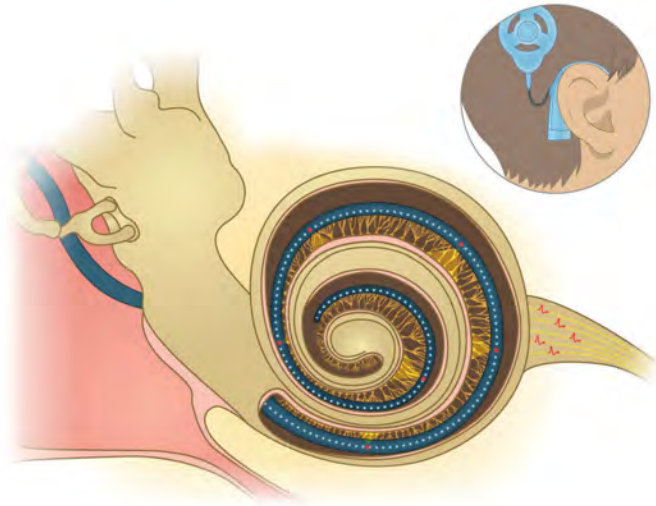
In evolution, new traits are often based on mutations and copies of existing genes or the development of new ones. However, the loss of genes can also trigger the development of attributes that are essential for survival. Scientists at the Max Planck Institute of Molecular Cell Biology and Genetics in Dresden have developed a method of determining gene loss. For this, they investigated the genomes of more than 60 mammals to find out which genes have been lost in each species. These analyses show that dolphins and whales have lost several of the genes that are needed for hair growth. Since these species live exclusively in water, hair can no longer serve to warm the organism and would make swimming slower. Fruit-eating bats, on the other hand, lack genes that suppress the secretion and effect of insulin. This enables the animals to extract energy from sugar more effectively – certainly an advantage for a species that consumes large quantities of sugar. Some species that have developed the same traits in order to adapt to their environment but are not closely related have lost exactly the same genes, such as the pangolins and armadillos, for example. Both have lost a gene that is involved in repairing DNA damage caused by UV light. The animals' scales apparently afford sufficient protection from UV light so that they no longer need the DNA repair gene. The loss of genes has therefore contributed towards the development of new traits in mammals during the course of evolution. (www.mpg.de/11994695)

Hostility is contagious

Aggressive behavior towards other ethnic groups can easily escalate and end in conflict. Jana Cahlíková from the Max Planck Institute for Tax Law and Public Finance and colleagues in the Czech Republic and Slovakia are collaborating in a new kind of experiment to test the influence of social environment on the dynamics of hostility. The researchers studied adolescents from schools in eastern Slovakia and their behavior towards the Roma people. For the experiment, two players each received two euros and had to decide simultaneously whether to pay 20 cents to reduce the other person's income by one euro. The players remained anonymous but were told whether their counterpart belonged to the Slovak majority or the Roma minority. Moreover, the scientists had three young people from the same class make the decision in quick succession, and the subsequent players knew of the decisions made by their classmates. It turned out that aggressive behavior on the part of the first players clearly incited the others to act equally aggressively. It was noted that this influence more than doubled when the hostility was directed at Roma rather than the players' own social group. (www.mpg.de/12033500)

Fast light channels fire hearing

Optogenetic cochlear implants may one day enable deaf people to listen to music



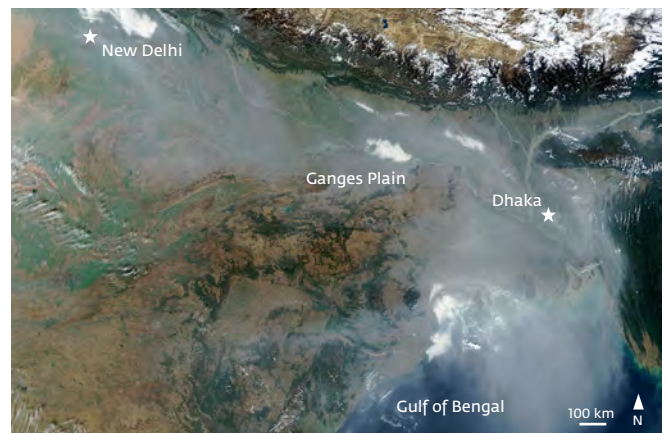
A conversation on the street, a concert visit – everyday things are often impossible for people with impaired hearing. Conventional electric cochlear implants stimulate the auditory nerve cells in the cochlea with twelve to 24 electrodes, thus circumventing defective or missing sensory cells in the cochlea. Since they do not convey enough information about pitch, the hard of hearing can understand speech in quiet surroundings but cannot hear the melodies in language and music. One alternative may be implants that initially convert sounds into light signals and thus trigger light-sensitive mol-

ecules in nerve cells. This would make it possible to stimulate the neurons temporally and spatially with greater precision. Until now, the ion channels, known as channelrhodopsins, have been too slow for the cells in the auditory nerve. Scientists at the Max Planck Institute of Biophysics in Frankfurt have now converted several channelrhodopsins into molecular light switches that are ultra-fast by means of mutation. Experiments with nerve cells from the brains and auditory nerves of mice have shown that the nerve cell channels can be fired at nearly their maximum natural excitation rate. Since nerve cells do not produce channelrhodopsins naturally, the scientists are using harmless viruses as gene “shuttles” to transport the gene for the molecules into the cells. Researchers at the Goettingen campus have been able to demonstrate that auditory nerve cells in mice produce large quantities of the channel proteins after the virus is injected into their cochleae. Laser pulses conducted into the cochlea along a 50-micrometer thick optical fiber trigger electrical impulses in the mice’s auditory nerves and brain stems. Optogenetic cochlear implants could one day enable profoundly deaf patients to understand speech in loud surroundings and enjoy music. However, further studies are necessary before such implants can be put to practical use. (www.mpg.de/12025243, in German)

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The Janus head of the South Asian monsoon

The same thing happens every year. During the dry season in winter, the combustion of fossil fuels and biomass causes a gigantic haze of pollution to form over South Asia: the *Atmospheric Brown Cloud*. An international team of scientists led by the Max Planck Institute for Chemistry has now discovered why it disappears as soon as the monsoon ushers in the rainy season in the spring. It appears that updrafts, storms and chemical reactions strengthen the atmosphere’s ability to clean itself. One crucial factor is that more hydroxyl radicals form in a circulation of winds above the monsoon. These molecules act as a kind of cleaning agent: they oxidize airborne particles and pollution, as a result of which some of the pollutants dissolve more easily in water and are washed out of the atmosphere by precipitation. However, the pollutants that are not washed away are driven into the upper troposphere by the monsoon and then distributed around the globe. (www.mpg.de/12104908)



Every year during the winter months, a huge haze of pollution forms over South Asia – and disappears again in March.

Chat with Lise, Albert and Otto.

At the beginning of the 20th century, Berlin-Dahlem was the German Oxford. Here, Lise Meitner, Albert Einstein and Otto Hahn convened to discuss nuclear fission, first uranium reactors and electron microscopes. The Foundation had the historical lecture hall restored at the Max Planck Society's Harnack House, enabling today's brightest minds to network and share their ideas here.



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