Listen Carefully

Shorter attention spans are one cause of hearing loss in old age

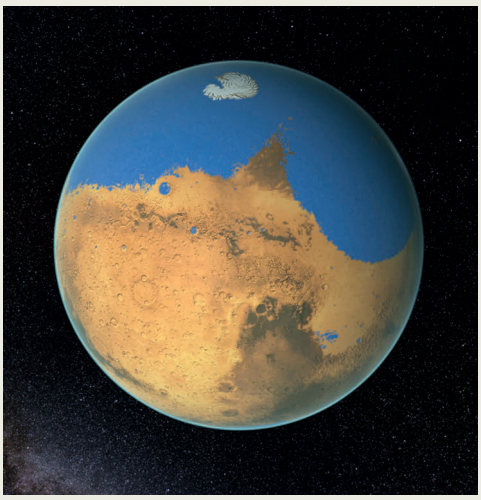
Older people often complain of hearing difficulties, particularly when several people are speaking at once. According to researchers at the Max Planck Institute for Human Cognitive and Brain Sciences in Leipzig, the ears alone aren't the only cause. The scientists assigned hearing tasks to both young and old participants in their study and measured the voltage fluctuations across the surface of the skull that were triggered as the brain went to work. The intensity of so-called alpha waves shows how attentively the subjects are listening. And the scientists were able to observe how alpha-wave activity declines faster among older test subjects than among younger ones. Older people apparently don't remain attentive for so long. The intensity of the alpha waves in the brains of the elderly also increases more strongly when speech quality is poor, indicating that listening under poor acoustic conditions demands greater attention as one grows older. These findings might soon enable hearing aids to be individually and dynamically adapted according to how active the brain is, bringing improved speech comprehension in demanding situations. (Journal of Neuroscience, January 28, 2015)

Older people often have poor hearing. One reason lies in their decreasing attention spans in old age.

Mars – The Blue and Red Planet

At least 20 percent of this heavenly body was once covered with water

Around 4.5 billion years ago, Mars was a water-rich planet. A team including scientists from the Max Planck Institute for Solar System Research estimates that 20 million cubic kilometers of water once flowed over the surface of the red planet. They arrived at this conclusion by measuring the ratio of hydrogen isotopes in the Martian atmosphere and in the soil. "We were able to reconstruct how the balance of water on the planet developed over millions of years and how much water was able to seep away into space," says Paul Hartogh. The resulting figure shows that at least 20 percent of Mars was once covered with water. Another conventional method involved analyzing the traces this water left behind in the surface geology of the planet, with the results pointing to a somewhat greater primordial volume of water. It's possible that the missing water lies hidden deep beneath the planet's surface. There, it would have no interaction with the atmosphere, and so would remain inaccessible to the latest investigation described above.
(Science online, March 5, 2015)



Planet of oceans: This is how Mars might have looked 4.5 billion years ago, with at least 20 percent of its surface covered with water

Photos: Kerstin Flake (top), NASA/GSFC (bottom)

Nature's Medicine Cabinet

Active ingredient sourced from plant kills renal cancer cells

The shrub *Phyllanthus engleri* grows mainly in dry savanna areas in southern Africa. Its bark contains Englerin-A – a substance that causes renal cancer cells to die off.

Nature offers many valuable ingredients for medical use. *Phyllanthus engleri*, for example, has long been recognized in its southern African homeland as a medicinal plant for coughs, stomach pains and even infectious diseases. Some years ago, US scientists succeeded in extracting a substance from the shrub called Englerin-A, which has proven to be particularly effective against renal cancer cells, as well as a few other forms of cancer. Researchers from the Max Planck Institute of Molecular Physiology in Dortmund have now discovered how Englerin-A works: it increases the calcium concentration in the cancer cells so dramatically that they die within minutes. Englerin-A has the advantage that it exclusively activates the calcium channels in cancer cells. As a drug, it might therefore possibly have fewer side effects on healthy cells than many other cancer drugs. The researchers, in cooperation with the Lead Discovery Center in Dortmund, now intend to investigate whether Englerin-A is suitable for use as a cancer treatment. The Center assists in translating the findings of basic research into medical applications. (Angewandte Chemie, March 16, 2015)

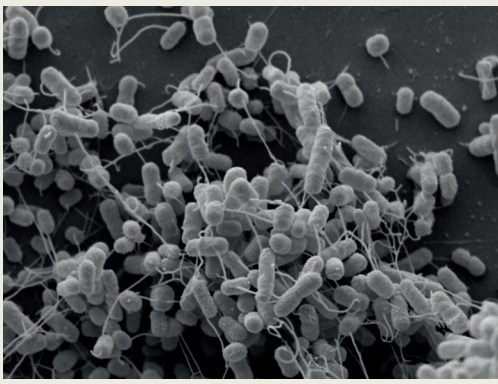
By Computers, for Computers

Researchers used simulations to develop materials that can be strongly magnetized

The information technology of the future will need new materials, for instance for magnetic storage media, that will support a higher data density than today's hard disks. A team of researchers headed by Claudia Felser, Director at the Max Planck Institute for Chemical Physics of Solids in Dresden, has taken a big step forward in the search for suitable alloys. They began by using computers to design alloys based on a family of particularly magnetic materials known as Heusler compounds. In this way, the scientists developed an alloy that becomes more strongly magnetized by an external magnetic field than any previously known compound. The alloy of manganese, platinum and gallium also retains its magnetic charge when the external magnetic field is shut off, thus meeting one of the preconditions for a high-performance storage material. However, the effect occurs in this material only at very low temperatures. The researchers in Dresden have also magnetized a compound of manganese, iron and gallium at room temperature – but not so strongly. (Nature Materials, March 16, 2015)

Food in Tubes

In bacterial communities, it can be an advantage for individual species to specialize in certain specific biochemical processes and outsource others. Scientists at the Max Planck Institute for Chemical Ecology in Jena have discovered that some bacteria form nanochannels to other bacteria to facilitate the direct exchange of nutrients. For their experiments, the scientists used two genetically modified species of bacteria, each of which were no longer able to produce a different amino acid. Where the modified bacteria grew side by side, they nourished one another in order to compensate for the lack of amino acids. A look through the electron microscope revealed that one of the two species formed tiny tubes through which both were then able to exchange nutrients. The scientists now want to fully investigate whether the ostensibly simple bacteria structures represent a form of multicellularity. They were able to increase their complexity by joining together with other bacteria and combining their abilities. Whether individual bacteria species are also able to parasitize other bacteria and extract their content also remains unclear. (Nature Communications, February 23, 2015)



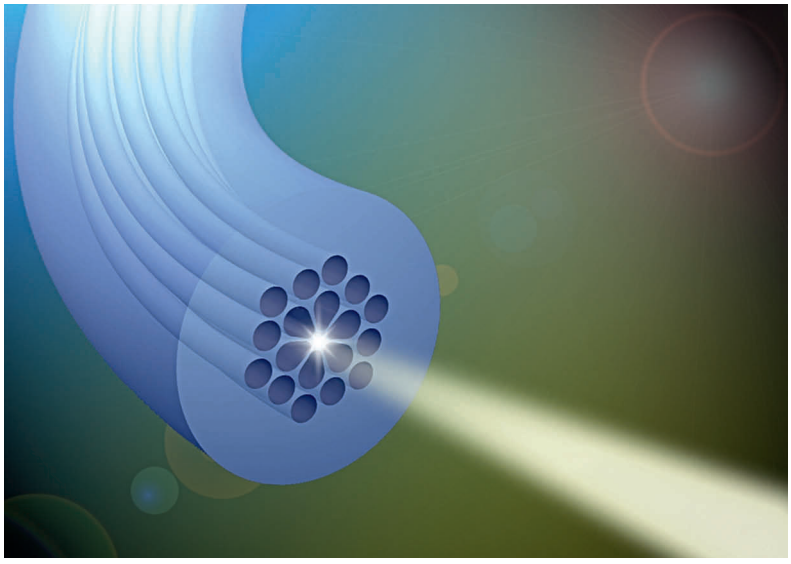
Bacteria can exchange nutrients between themselves via tubular links. This photo, taken with an electron microscope, shows the genetically modified strains of the bacteria *Escherichia coli* and *Acinetobacter baylyi*.

Photos: Bart Wursten/www.zimbabweflora.co.zw (top), University Clinic Jena/Martin Westermann (bottom)

World Record in Color

A photonic crystal fiber generates light from the ultraviolet to the mid-infrared range of the spectrum

Researchers from the Max Planck Institute for the Science of Light in Erlangen have created light that is more colorful than a rainbow. They did so by passing a low-energy infrared laser pulse through a photonic crystal fiber (PCF) that they had customized in such a way that, as it interacts with the fiber, the spectrum of the pulses widens and emerges from the fiber as bright white light. The spectrum extends from a particularly short-wave ultraviolet to the infrared range – a world record. Photonic crystal fibers are permeated along their entire length by hollow channels arranged symmetrically around the core of the fiber. The researchers in Erlangen have now, for the first time, created glass fibers using a material that, unlike conventional quartz glass, is particularly resistant to ultraviolet radiation, but is difficult to handle. Light with this world-record spectrum could simplify – or even make possible – numerous investigative processes in biomedical research, physics and chemistry. (Nature Photonics, January 19, 2015)



A brilliant source of white light: Max Planck researchers in Erlangen have custom-made a photonic crystal fiber that enables them to convert an infrared laser pulse into light with a particularly broad spectrum.

Ceres – A Mysterious World

After a five-week break in transmission, the space probe *Dawn* is once again beaming images of the dwarf planet back to Earth

It was both an arrival and a farewell: Just as the NASA space probe *Dawn* finally reached Ceres on March 6 of this year after a two-and-a-half-year flight through the asteroid belt, the spherical dwarf planet slipped into darkness. With the vehicle approaching its destination from the dark side, the scientific camera system on board was unable to record any new pictures. Then in mid-April, *Dawn* got in touch once again – with a first glimpse of the dwarf planet's north pole. The photos show only a small detail of the surface, as large areas of the northern hemisphere remain in shadow. Ceres is littered with craters, a striking number of which feature striking central mountains. The planet is also revealing itself to be far less dense than, for example, its stony counterparts in the inner solar system. Subterranean water – whether in frozen or liquid form – could account for such measurements. This would also tie in with the scattered lighter-colored patches observed on Ceres' surface, where impacts may possibly have exposed hidden ice.

A view of the north pole: This image of Ceres shows a surface pitted with craters, similar to that of Earth's moon. The photo was taken at a distance of 22,000 kilometers.

Photos: Xin Jiang – MPI for the Science of Light (top), NASA/JPL-Caltech/UCLA/MPS/DLR/IDA (bottom)

Babies Learn while Snoozing

Sleep improves the ability to remember, and structures the child's memory

Not really inactive: While sleeping, a baby's brain consolidates and generalizes what it has just learned.

For our brains, sleep is more than just a chance to recuperate. Most brain researchers today believe that, while we are asleep, our brains review what we have previously experienced and consolidate new content, which is integrated into our existing memories. This is evidently the case for babies, too. Scientists at the Max Planck Institute for Human Cognitive and Brain Sciences in Leipzig showed babies aged between 9 and 16 months a series of pictures of objects and taught them what the objects were called. An analysis of brain activity using an electroencephalogram (EEG) showed that the babies were better able to remember the names of the objects if they slept after learning them. In addition, they were able to associate the names with new but similar objects only after a brief nap. In other words, their brains formed generalized categories while they were asleep – translating experience into knowledge. (Nature Communications, January 29, 2015)

Poison Sprays Return to Haunt Us

Climate change will intensify the concentration of DDT in the Arctic

Some poisons are persistent, popping up even in unexpected places. In the last century, the long-lasting insecticide DDT, for example, as well as the polychlorinated biphenyls (PCBs) used until the 1980s as plasticizers were carried mainly by air currents as far as the Arctic, where they became concentrated in the atmosphere, then making their way through precipitation into water, soil and ice. Ever since they were largely banned, they have been gradually disappearing at the North Pole and elsewhere on Earth. Climate change, however, could lead to a renewed increase at least in DDT in the Arctic, starting from around 2075 – even though in our latitudes, the subtropics and most tropical parts of the world, it is likely to be present in only minimal amounts. According to calculations by an international team headed by Gerhard Lammel at the Max Planck Institute for Chemistry in Mainz, it is to be expected that global warming in the northern hemisphere will lead to an increase in the constellations of juxtaposed areas of high and low pressure that favor the transport of DDT to the North Pole. The resulting volumes of air flowing into the Arctic contain a relatively high proportion of the poison that is otherwise distributed across the world in varying concentrations. For people in countries where fish from the northern polar seas is consumed, there will then in turn be an increase in the health risk posed by DDT. (Environmental Science & Technology, February 16, 2015)

Gathering point for long-lasting organic pollutants: DDT and PCBs degrade particularly slowly in the Arctic chill.

Language Roots on the Steppe

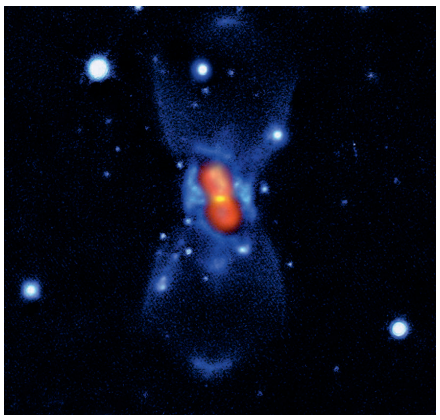
Herdsmen in Eastern Europe may have contributed to the dissemination of Indo-European languages 4,500 years ago

Today, almost three billion people speak one of the 445 Indo-European languages. An international research team including scientists from the Max Planck Institute for the Science of Human History in Jena analyzed genetic material in search of insights into the origin of this language family. The researchers analyzed the genomes derived from the skeletons of over 90 individuals who lived in Europe between 6000 and 1000 B.C. The results indicate that the present European genome is composed of three essential parts: genes deriving from original hunter-gatherer populations, and genes from the first farmers who migrated from the Middle East and settled in Europe around 5500 B.C. The research team also identified the age and origin of the third component: it derives from people of the Yamna culture – herdsmen from the Eurasian Steppe. These people evidently progressed around 2500 B.C. from what is now the Ukraine to Central Europe. In Germany, the third component appears for the first time among the so-called Corded Ware people, a cultural group whose name reflects its characteristic method of decorating pots and who flourished at the transition between the Neolithic and the Bronze Ages. From their genetic relationship, the researchers conclude that the people of the Eurasian Steppe also influenced the language spoken in Central Europe, and thus also made their mark on the Indo-European language family. This partially contradicts the idea that the forerunner of the Indo-European languages was brought to Europe by the first farmers from the Middle East. (Nature, March 2, 2015)

A quadruple burial including father, mother and two sons from the Corded Ware culture in Saxony-Anhalt from around 2600 B.C.

Solving the Puzzle of Nova Vul 1670

In 1670, a new star shone in the skies above Europe that was visible even to the naked eye. Up to now, astronomers have assumed that the brightness of the star was attributable to a nova that occurred as a white dwarf sucked in matter from a neighboring sun, resulting in a cataclysmic explosion. However, the eruption was caused by a far rarer phenomenon: a violent collision between two stars. The traces that still remain are so weak that, after 345 years, it required a careful analysis of observations using modern submillimeter telescopes to solve the puzzle of Nova Vul 1670. A team headed by scientists from the Max Planck Institute for Radio Astronomy in Bonn has now found the answer with the aid of the APEX telescope in Chile. The radiation emitted by molecules in the gas cloud that still remains after the collision put the researchers on the right track. Following this lead, they discovered that the mass of the cold gas that remains as a residue of the stars is too great to be the result of a conventional nova. Nor did the isotope ratios they measured or the mixture of molecules fit this picture. However, a cosmic collision – a very rare event in which one star explodes after colliding with another – offers a near perfect explanation of these observations. (Nature online, March 23, 2015)

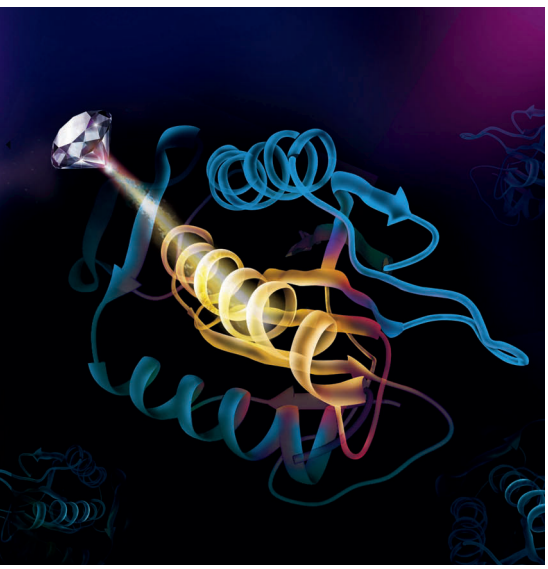


All that remains of the collision: The residue of the new star observed in 1670. This image was created by superimposing a visible light photo taken with the Gemini telescope (blue) and a map courtesy of APEX and the Submillimeter Array (orange).

Photos: LDA Saxony-Anhalt/D. Menke (top), ESO/T. Kaminski (bottom)

Using Nuclear Spin to Study Individual Proteins

Form and movement of biomolecules can now be observed with the aid of a particularly sensitive magnetic sensor



A brilliant view of a protein: A German-Chinese team used an NV center at which a nitrogen atom is located in a diamond as a highly sensitive sensor to study the form and movement of an individual molecule of the protein MAD-2.

Nuclear spin tests greatly simplify the work of medical doctors and biologists. Not only is this technique the instrument of choice for many medical diagnoses, but it also yields an increasing amount of detail about the chemistry of life. A joint German-Chinese team including researchers from the Max Planck Institute for Solid State Research in Stuttgart has now, for the first time, employed nuclear spin technology to observe the movements of an individual protein molecule at room temperature and in a milieu that resembles the interior of a cell. The biophysicists followed the same principles that underlie nuclear spin testing in the medical field, but used a sensor that was much more sensitive: a point in a diamond at which a nitrogen atom takes the place of a carbon atom. This defect, or more accurately, the spin of an unpaired electron, creates a magnetic moment that is measurably affected by the magnetic moments of the nuclear spin of, for example, a protein. Nuclear spin can therefore be used to track individual proteins and their interaction within cells in order to identify both the causes of disease and potential treatments. (Science, March 6, 2015)

Learning with All the Senses

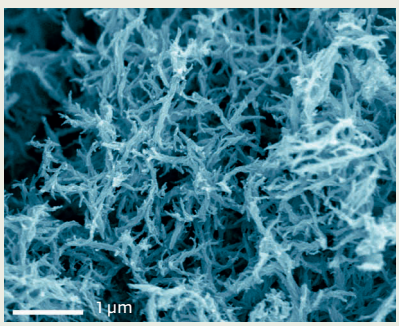
Images and movements make learning vocabulary easier

"Atesi" – which sounds like a word in the language of Middle Earth spoken in the film "Lord of the Rings," is in fact "Vimmish" for "thought". Scientists from the Max Planck Institute for Human Cognitive and Brain Sciences in Leipzig used Vimmi, an artificial language developed specifically for scientific studies, to investigate how people can best memorize and retain foreign-language vocabulary. According to the researchers, it is easier to learn vocabulary when the brain is able to associate a word with various sensory perceptions. The movement system in the brain appears to be of particular importance: Learners who not only hear words in a foreign language, but also repeat them with an accompanying gesture are better able to remember them. This brings the brain's movement system into play. Using images that match the word is another useful adjunct to learning. This also activates regions of the vision system. (Current Biology, February 5, 2015)

Customized Carbon

Thanks to a new process of synthesis, various carbon nanostructures can now be specifically manufactured

The evidence left in the oven that attests to a failed attempt at baking a cake – carbonization – could now serve as an effective nanotechnology resource. Using a sophisticated new variant of this process, in which the carbon content of organic materials is increased, a team headed by Tim Fellinger at the Max Planck Institute of Colloids and Interfaces in Potsdam has specifically created various spherical and layered, as well as fiber-like carbon nanostructures, and has even succeeded in integrating metal, sulfur or nitrogen atoms into the structures. Conventional carbonization lends itself only to the production of spherical nanoparticles. However, the researchers were able to create different shapes by carbonizing organic liquids – a unique achievement that chemists had previously believed to be impossible. The Potsdam-based scientists achieved their breakthrough by injecting the organic liquids into a molten salt bath heated to 500 degrees. These nanostructures are attractive candidates for various applications. For example, a nickel-carbon nanomaterial could serve as a low-cost catalyst in the process of electrolytically splitting water, which currently requires the use of precious metal catalysts. (Angewandte Chemie, March 4, 2015)



A recipe for nanofibers: Various organic liquids can be carbonized to create spherical, layered or fiber-like nanostructures.

Photos: University of Science and Technology of China, Hefei (top), MPI of Colloids and Interfaces (bottom)