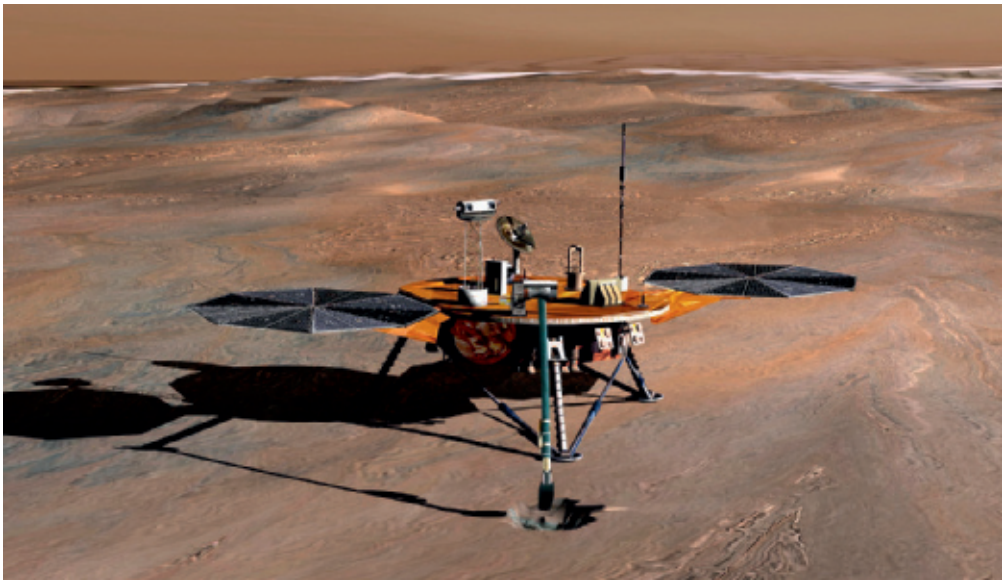
RESEARCH in Brief



A good landing: The 350-kilogram stationary *Phoenix* probe investigates its surroundings on Mars.

PHOTO: NASA/JPL-CALTECH/UNIVERSITY OF ARIZONA

PLANETOLOGY

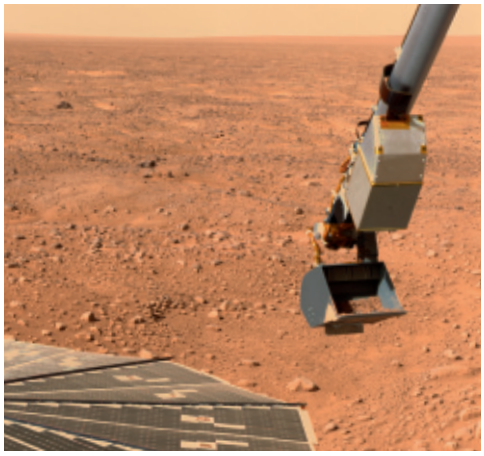
Phoenix Rises from Ice

Since May, *Phoenix* has been using its extending arm to dig in the red sands of Mars and, in the process, has encountered ice. Contact with the probe was lost in early November – as expected, it literally froze with the approach of the Martian winter. *Phoenix* was the first landing vehicle ever to investigate the polar regions of the Red Planet. The color camera on the robotic arm was developed at the Max Planck Institute for Solar System Research, where the mission is being tracked with great anticipation.

The discovery came as anything but a surprise, since ice was already predicted under the surface of Mars years ago based on observations by the *Odyssey* spacecraft. The orbiter's gamma ray spectrometers found indications of ground ice over broad areas, less than a meter below the surface. Particularly large quantities of ice were discovered at higher latitudes, where it is buried only a few centimeters deep. The *Phoenix* landing site is approximately 68 degrees north latitude, comparable on Earth to the town of Kiruna in northern Sweden.

More recently, Mars satellites had sent photos of surface areas with characteristic polygonic landscapes. "That's why this particular area was chosen for the *Phoenix* landing," explains Horst Uwe Keller from the Max Planck Institute for Solar System Research. Geologists are familiar with similar structures from permafrost regions on Earth, and large quantities of ice are found below these arctic landscape forms, too.

At the Max Planck Institute on the edge of the Harz mountains, the mission is being watched



Robots on the red planet: The digging arm on the *Phoenix* probe has just taken a soil sample. The Robotic Arm Camera from the Max Planck Institute for Solar System Research is attached just in front of the scoop. The solar cells for the probe are visible on the left in the foreground.

PHOTO: NASA/JPL-CALTECH/UNIVERSITY OF ARIZONA / MPI FOR SOLAR SYSTEM RESEARCH

with a great deal of excitement; after all, the institute is involved in the *Phoenix* mission. Keller is responsible for the Robotic Arm Camera (RAC). This color camera is attached to the front end of the robotic arm and records excavations and the transfer of samples to the analysis equipment on board the probe.

The 520-million-euro project has put a lander on the Mars surface without damage for the sixth time. However, unlike the mobile vehicles Spirit and Opportunity, which have been active for five years, this 350-kilogram three-legged probe is stationary. The *Phoenix* mission is headed by the University of Arizona, which was commissioned by NASA.

"The first indications that ice is indeed concealed below the landing site were delivered just a few days after our RAC landed," recalls Mars expert Walter Goetz, who is analyzing the data from *Phoenix* at the Max Planck Institute in Lindau. The exhaust blast from the engines disturbed loose material on the ground and revealed light-colored layers of icy soil directly under the landing vehicle. "The panorama cameras weren't able to observe it, but the RAC on the moveable arm found the telltale light patches in the ground – a fantastic image," says Goetz.

Light-colored, in some cases white patches in the trenches excavated by the robotic arm support the ice theory. "The ice doesn't look the same everywhere, which is possibly due to variations in the salt content of the ice patches," explains the physicist. Under the current climatic conditions, the water ice on the surface of the landing area is not stable over long periods. Both *Phoenix* cameras showed that it began to change once it had been dug up. "It evaporates without first thawing. The duration of this sublimation is an interesting parameter that supplements the information about the ground material supplied by the other instruments," describes Walter Goetz.

However, the ice is not the only interesting aspect. Researchers speculate that there could be habitable zones in the polar ground layers – places where primitive organisms could exist. Liquid water is necessary for this; currently, however, it is probably too cold. But variations in the orbit of Mars around the Sun could also allow periods with a milder climate, during which the ground would thaw out for some time. Microbes could use warm periods like these and would survive through cold phases in a kind of hibernation.

Was the Martian arctic once actually "habitable"? *Phoenix* examined the polar soil with several pieces of equipment. For example, on multiple occasions, the TEGA instrument (Thermal Evolved Gas Analyzer) gradually heated samples to 1,000 degrees and used a mass spectrometer to analyze the gases released in the process. Not surprisingly, this process also revealed the signature of water ice. The Wet Chemistry Laboratory also already delivered some preliminary findings: in this device, the Martian soil is mixed with water

A worm's eye view of *Phoenix*: The Robotic Arm Camera discovered water ice close to the surface of the Martian soil just a few days after landing.

brought along from Earth in order to find soluble components.

The researchers found an alkaline pH level, which was not the case with soil samples from the equator and the middle latitudes. Furthermore, they identified calcium carbonate and perchlorate. In Horst Uwe Keller's words, particularly the latter compound is rather surprising: perchlorate could indicate that the ground had once thawed.

In November, NASA declared the mission finished. The robotic arm, which penetrated the soil to almost 20 centimeters, had not been working for some time. In the late arctic summer, the solar cells in the *Phoenix* were no longer delivering sufficient electricity for digging. Thick clouds of water ice crystals had since covered the landing site, and wind speeds of up to 4 meters per second were measured on the surface. Temperatures fell from minus 45 degrees Celsius during the day to minus 96 degrees at night.

At the time of going to press, analysis of the various data was still in progress. However, there are already indications that the chemistry of the arctic soil of Mars is different. "Apart from the pH value, there are also the salts that were found in the soil. This is likely to have consequences for the picture that we have of Mars and of its history," predicts Horst Uwe Keller. The first academic publications are already enthusiastically anticipated. ●

@ Contact:
DR. HORST UWE KELLER
Max Planck Institute for Solar System Research, Katlenburg-Lindau
Tel.: +49 5556 979-419
Fax: +49 5556 979-240
e-mail: keller@mps.mpg.de

ECOLOGY

The Push and Pull of Pollination

The nectar of the tobacco plant is both sweet and bitter. The bitter note of the nicotine not only deters pests and nectar robbers, but also secures the plant the most success in reproduction. Scientists at the Max Planck Institute for Chemical Ecology in Jena have found that an accurately dosed quantity of the poison nicotine, together with the attractant benzyl acetone, optimizes the frequency with which the plant is cross-pollinated by visitors to the flower. (SCIENCE, August 29, 2008)

Seduced: The colorful flowers of wild tobacco plants tempt the Rufous hummingbird, *Selasphorus rufus*, to take a sip of nectar (left). The mixture of bitter nicotine (N) contained in the nectar in the receptacle (right) and benzyl acetone (BA) ensures optimum fertility.

PHOTO/COLLAGE: DANNY KESSLER, MPI FOR CHEMICAL ECOLOGY

Without the services of hummingbirds, moths and other pollinators, the tobacco plant would have to pollinate itself. And with inbreeding, genetic errors would become exposed, and inbred plants are less likely to survive in the ever-changing conditions of the real world. Since these plants can't move, they use a postal service of sorts to exchange gametes. They attract potential pollinators to their white flowers with a bouquet scented with benzyl acetone, and reward the visitors with a drink of nectar.

While these flower visitors would rather loiter at a flower drinking nectar than transporting pollen, the tobacco plant spikes their sugary nectar with a bitter-tasting poison. This forces the pollinators to only sip the nectar and fly to another flower. While moving from flower to flower searching for better nectar, they distribute the pollen they gathered as they sampled the nectar.

Using genetically engineered variants of the tobacco plant, the Jena-based biologists uncovered the ecological effects of the nectar recipe. One version of the plant with a control gene makes natural nectar, one produces no nicotine at all, another makes no benzyl acetone, and a fourth produces neither nicotine nor benzyl acetone. "Without benzyl acetone, the plants attracted fewer hummingbirds and moths," says Danny Kessler. He used video cameras to observe the traffic to the flowers in an experiment conducted outdoors at the institute's field station in Utah, USA. The winged visitors soon moved away from the nectar containing nicotine. In contrast, they enjoyed large quantities of the nicotine-free nectar, frequently emptying the flowers completely.

The evolutionary fitness of an organism can be estimated by the number of grandchildren it produces. For plants, this can be realized by producing seeds (female fitness) or by siring seeds (male fitness). The biologists tested the effects of flower chemistry on female fitness by removing the pollen-producing filaments from their test plants to prevent self-fertilization. The hummingbirds and the moths brought pollen to the test plants from the wild tobacco plants growing in the area. The test plants produced natural quantities of seeds only if their flowers produced benzyl acetone and their nectar was laced with nicotine. The plants without the repellant and the attractant were fertilized only half as often.

Test plants with genetically marked pollen and neighboring emasculated wild tobacco yielded similar results for male fitness: the pollen from plants with naturally formulated nectar was distributed almost five times more than that from plants that produced neither benzyl acetone nor nicotine.

"Interestingly, the rate of successful fertilization in plants without the attractant fell during the growing season, while the plants without nicotine became more successful," says Danny Kessler. As the videos show, hummingbirds visit more at the beginning of the year, being attracted more by the color rather than the scent of the flowers. If they drink too much nectar, the fertilization rate falls. At the end of the growing season, the plants are frequented mainly by moths that require the floral scent to help them locate the flowers.

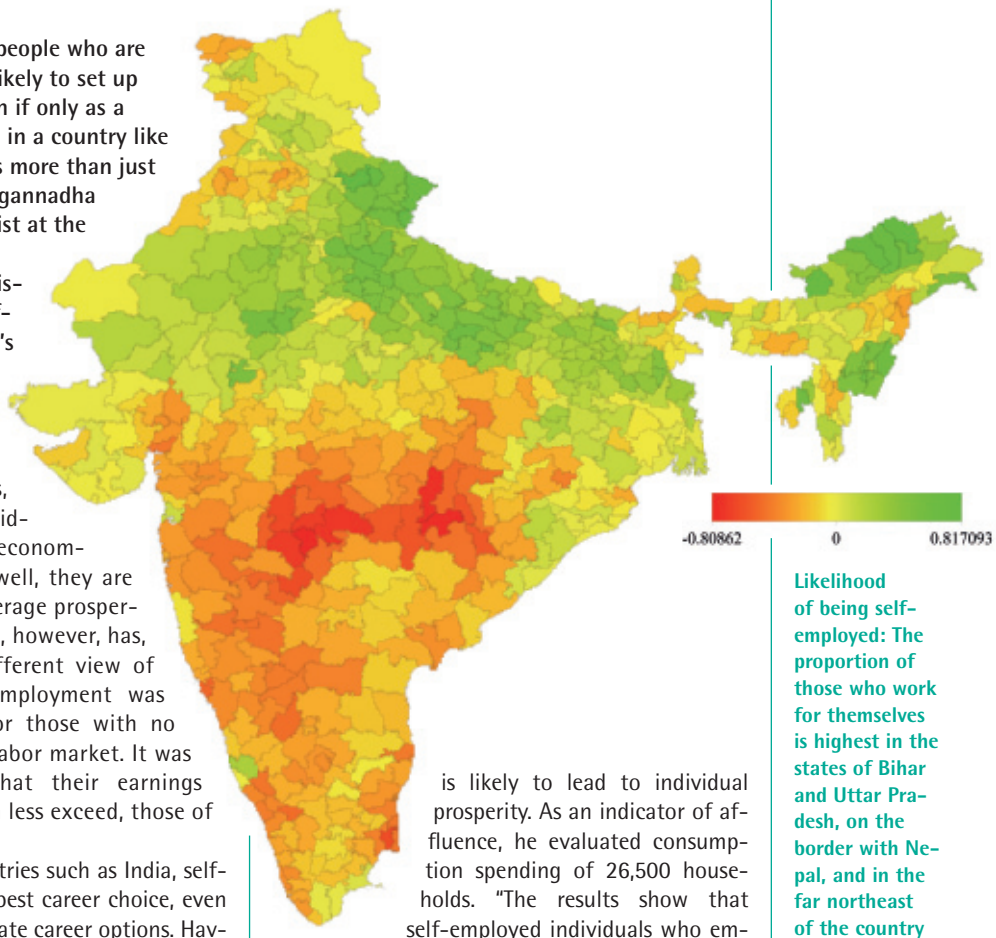
Ian T. Baldwin, who headed the study, concludes from the experiments that, "just as the manufacturers of soft drinks protect their formulas and strive for constancy in order not to lose market share, altering their recipes only in response to the dictates of global sales, so plants have evolved and incorporate ingredients into their nectar recipes in response to the dictates of Darwinian fitness." ●

@ Contact:
PROF. IAN T. BALDWIN
Max Planck Institute for Chemical Ecology, Jena
Tel.: +49 3641 57-1100
Fax: +49 3641 57-1102
e-mail: baldwin@ice.mpg.de

ECONOMICS

The Indian Dream

In developing countries, people who are unable to find a job are likely to set up their own business – even if only as a rickshaw driver. However, in a country like India, self-employment is more than just a stopgap solution. As Jagannadha Pawan Tamvada, a scientist at the Max Planck Institute for Economics in Jena, has discovered, many of the self-employed people in India's urban areas are better off than those who earn a salary.



Likelihood of being self-employed: The proportion of those who work for themselves is highest in the states of Bihar and Uttar Pradesh, on the border with Nepal, and in the far northeast of the country (dark green).

In industrialized nations, entrepreneurs are considered to be the drivers of economic growth. If things go well, they are rewarded with above-average prosperity. The developing world, however, has, in the past, taken a different view of entrepreneurship: self-employment was seen as a last resort for those with no prospects in the formal labor market. It was traditionally thought that their earnings would never reach, much less exceed, those of salaried employees.

But in developing countries such as India, self-employment may be the best career choice, even for those who have alternate career options. Having analyzed data on 90,000 workers between 15 and 70 years of age, Jagannadha Pawan Tamvada found interesting results. Many of the trends he uncovered are similar to those found in industrialized countries. Men are more likely to be self-employed than women, and older people are more likely to set up businesses of their own. As individuals complete work at higher and higher levels of schooling, the odds of self-employment increase. Earning a university degree, however, decreases those odds.

"Individuals with a university degree have more employment opportunities and can, in some cases, command very high salaries," explains Jagannadha Pawan Tamvada. The study also revealed marked regional differences: Bihar and Uttar Pradesh, the country's two poorest states, have the greatest proportion of self-employed individuals. The self-employed in these states are also more likely to work in agriculture than those in more economically prosperous regions. Using data covering 150,000 new firms, he found that the size of the new firms here is significantly smaller than those in other states.

Jagannadha Pawan Tamvada also investigated the extent to which the path of self-employment is likely to lead to individual prosperity. As an indicator of affluence, he evaluated consumption spending of 26,500 households. "The results show that self-employed individuals who employ others are the most prosperous," explains the Max Planck researcher. They are followed by salaried employees, self-employed individuals without employees, and finally, casual workers. The self-employed without employees are only marginally less well off than salaried workers, and in urban areas, the gap between the two groups is closing. In urban areas, the self-employed individuals are found in nearly every sector – from rickshaw drivers to company founders. Those with driving licenses offer their services to businesses or hospitals as drivers. Freelance teachers educate the children of affluent families. "Most self-employed individuals are found in retail and in craft trades," adds Tamvada.

The choice of self-employment is also linked to religion, as Jagannadha Pawan Tamvada and his colleagues in Jena, David B. Audretsch and Werner Bönte, have discovered: Hindus in India are significantly less likely to be self-employed than Christians or Muslims. "Hinduism and its intrinsic caste system have a huge influence on the social status of the individual," explains Tamvada. As a result, the members of the socially rearward castes are less likely to become self-employed than those in the forward castes. ●

@ Contact:
DR. JAGANNADHA PAWAN TAMVADA
Max Planck Institute for Economics, Jena
Tel.: +49 3641 686-730
Fax: +49 3641 686-710
e-mail: tamvada@econ.mpg.de

GRAPHIC: TAMVADA

ANTHROPOLOGY

No Sex with Homo Sapiens

Results from new research undertaken at the Max Planck Institute for Evolutionary Anthropology have revealed that Neanderthals and modern humans apparently began to evolve separately around 660,000 years ago and did not propagate with each other. The scientists have published the full gene sequence of the mitochondria, the cellular powerhouse, of a 38,000-year-old Neanderthal man. Understanding this gene sequence has made it possible to make a detailed comparison with known gene sequences in human mitochondria. (CELL, August 8, 2008)

When modern man colonized Europe around 35,000 years ago, he encountered a different species of human – the Neanderthal. At the Max Planck Institute for Evolutionary Anthropology, research is currently underway into whether the two groups fought each other, lived side by side, or even lived together. An international team working with department head Svante Pääbo is decoding the Neanderthal genome (Neanderthal Genome Project). Many millions of base pairs have already been found. In addition, the scientists have now sequenced the entire mitochondrial DNA (mtDNA), which includes 13 protein-encoding genes.

"For the first time, we have been able to sequence the entire Neanderthal mitochondrial DNA by piecing together many fragments," explains Richard Green, who headed the study. In total, the researchers used so many fragments that the genome was created 35 times. "This means that the sequence can be considered practically error-free," says Green. Together with his colleagues, he examined the bones of a Neanderthal man who died around 38,000 years ago, and whose remains were discovered in 1980 in Vindija Cave in Croatia. These bones were special because, unlike other samples, they were comparatively uncontaminated by any other DNA.

The researchers focused on the DNA of the mitochondria, which, as a basic part of the egg cell, is inherited only from the mother. From 300 mg of bone material, the researchers were able to isolate 8,341 fragments of DNA ranging in length from 30 to 278 base pairs. Assembled like a jigsaw puzzle, these fragments yielded a mitochondrial genome with 16,565 elements – almost exactly as long as that of modern man.

The scientists then compared this gene sequence to that of Homo sapiens. This revealed that the Neanderthal mtDNA did not match any of the variants that researchers have found in living humans. The investigations thus offered no proof that Neanderthals and modern humans had interbred. It appears that their ancestors started to evolve separately around 660,000 years ago (give or take 140,000 years).

These results also confirm the assumption that the Neanderthal population was relatively small. "Most paleoanthropologists assume that, 40,000 years ago, there were just a few thousand Neanderthals wandering around Europe," says Johannes Krause, a co-author of the study.

Decoding the mitochondrial genome is merely a preliminary to decoding the entire Neanderthal genome – including the DNA in the cell nucleus. "We are very pleased to be able to use the full genomic analysis to research human evolution. This result is just the tip of the iceberg in fully sequencing the Neanderthal genome," says Svante Pääbo.

In 1980, the 38,000-year-old bones of a Neanderthal man were found in Vindija Cave in Croatia. Max Planck researchers have now fully decoded his mitochondrial DNA.

PHOTO: MPI FOR EVOLUTIONARY ANTHROPOLOGY – JOHANNES KRAUSE

@ Contact:
RICHARD E. GREEN
Max Planck Institute for Evolutionary Anthropology, Leipzig
Tel.: +49 341 3550-544
Fax: +49 341 3550-555
e-mail: green@eva.mpg.de

CHEMISTRY

Fueling with Wood

Plant waste is anything but garbage. It has a potential future use as a raw material for biomass fuel that will not compete with foodstuff. Through a new process, cellulose – the main, energy-rich component of wood, straw and other plant matter – can now be split relatively easily into glucoses, its smallest elements. The method was developed by scientists at the Max Planck Institute of Coal Research. (ANGEWANDTE CHEMIE, September 2008)

The paper on which you are reading this text consists mainly of cellulose: long chains of sugar molecules that give plant cells their stability. As sugar contains a lot of energy and can be fermented to create alcohol, cellulose is suitable not only as a raw material for the paper industry, but also for renewable fuels. Up to now, however, it has not been possible to break down cellulose (the most common organic compound on Earth) easily to create separate sugar molecules that can be used in industrial applications. The bonds between the sugar molecules – or more precisely, the glucose molecules – have resisted all chemical and biotechnological attempts to break them down effectively. There has thus been little hope of success on a large scale.

Max Planck researchers have developed the previously elusive process needed to turn organic waste, such as waste wood, into gas.

Roberto Rinaldi, Regina Palkovits and Ferdi Schüth, scientists at the Max Planck Institute für Kohlenforschung (Coal Research) in Mülheim an der Ruhr, have now found a way to deal with this problem. Using a special catalyst and an ionic liquid as the solvent, in just a few hours, they selectively split the long chains of sugar into shorter sections that can then be processed with existing methods. This procedure creates scarcely any byproducts that might otherwise cause problems in subsequent stages.

The scientists first dissolve the cellulose in an ionic salt that is liquid at room temperature. "This makes the long sugar chains accessible to subsequent chemical reactions," explains Ferdi Schüth, who headed the study, "allowing the solid catalysts to attack the cellulose."

The catalyst plays an extremely important role, as he and his colleagues have discovered: in order to break down the bonds between the sugar molecules, it must be acidic – that is, like acetic acid, it must give up protons easily. It must also be solid so the chemical industry can separate it easily. Finally, it must have many large pores into which the viscous solution of sugar chains can penetrate. Since the pores increase the surface area, the cellulose is converted more efficiently. "We have established that an acidic resin is an excellent catalyst under these conditions," says Ferdi Schüth.

After the reaction, the scientists add water to the mixture so that the short sugar chains settle. "Enzymes then easily split these short chains into glucose, the sugars that make up cellulose," says Ferdi Schüth. His team's method also allows very stable plant parts containing microcrystalline cellulose to be broken down. Usually, these remain as insoluble components after cellulose processing.

"We can even use wood at the beginning of the process," explains the scientist. "Which means that we can actually say that our process can break wood down into sugar." In order to create biomass fuel in this way, however, the researchers now need to optimize the process and find a less expensive alternative to the expensive ionic liquids. ●

@ Contact:
PROF. FERDI SCHÜTH
Max Planck Institute für Kohlenforschung, Mülheim an der Ruhr
Tel.: +49 208 306-2373
Fax: +49 208 306-2995
e-mail: schueth@mpi-muelheim.mpg.de

PHOTO: DPA–PICTURE ALLIANCE

NEUROBIOLOGY

Nerve Cells Offer a Helping Hand

They are the kind of employees every boss would like to have: when they have free capacity, they step in to help out their colleagues. Scientists at the Max Planck Institute of Neurobiology and at Ruhr University in Bochum have found that, although this is not always the case in the working world, it is what actually happens in the brain. Nerve cells in the cerebral cortex that cease to receive information from their partner cells in the retina help neighboring cells. (NATURE NEUROSCIENCE, August 31, 2008)

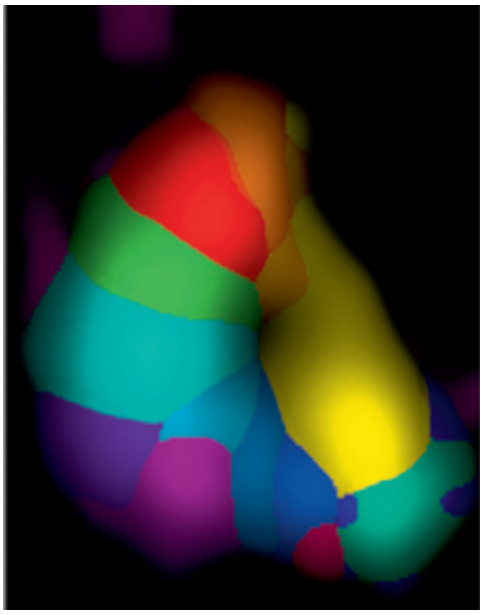


PHOTO: MPI OF NEUROBIOLOGY/TARA KECK

Post-injury networking: Scientists are amazed at how painstakingly even an adult brain can rewire itself after a breakdown. The photo shows a colored map of the visual cortex seven days (left) and twelve days (right) after a small retinal lesion (center).

The human brain consists of around one hundred billion nerve cells. Each of these cells is linked to neighboring cells through 10,000 to 20,000 contact points. It is this complex network that makes it possible for us to receive impressions and process them. But what happens in the brain when one of the sense organs suddenly fails to deliver information? This can happen, for instance, if an accident destroys the touch-sensitive cells in the skin, if hair cells in the ear cease to function, or if the retina is damaged.

In all of these cases, the nerve cells in the brain that are responsible for the damaged area no longer receive information. They become, in a manner of speaking, unemployed. Do these cells then atrophy? Not at all, as Tara Keck and her colleagues at the Max Planck Institute of Neurobiology in Martinsried, together with Ulf Eysel at Ruhr University in Bochum, have now established. It can be said of the brain that free capacity is not allowed to go to waste – but the experts are astonished at the enthusiasm with which the nerve cells embrace this philosophy.

After a retina sustained damage in the form of a small, dot-like lesion, the scientists examined nerve cells in those parts of the cerebral cortex that enable visual perception. For the first time, they were able to observe how the neurons that had previously been responsible for this area were being completely rewired. After just a few days, nerve cells that, due to the injury, had stopped receiving information from their retinal cells were forming three times as many extensions as neighboring cells that had not been affected. These extensions allow nerve cells to find and identify suitable neighbor cells to contact with the intention of exchanging data.

Barely two months later, the scientists marveled at the results of this increased activity: the nerve cells had replaced almost all the previous contacts that had become useless as a result of the lesion. "It is well known that young brains can adapt," says Tara Keck. "However, we were surprised that rewiring on this scale can take place in an adult brain." This extensive restructuring of cell contact points allowed the nerve cells that had become unemployed to process incoming signals from other areas of the retina, thus compensating for the damage to a certain degree.

Neurologists recently observed similar activity in the nerve cells of the spinal cord, where adult nerve cells also have the flexibility to grow into new nerve cables. This unexpected ability of the brain to adapt has provided new food for thought about the potential for regeneration after injury and could, in the long term, lead to new therapeutic approaches.

@ Contact:
DR. TARA KECK
Max Planck Institute of Neurobiology, Martinsried
Tel.: +49 89 8578-3684
Fax: +49 89 8995-0046
e-mail: keck@neuro.mpg.de

Panorama

THE MALICIOUS DOWRY OF OLD GENES: Most of the known genes that can contribute to the emergence of diseases have been in existence since the formation of the first cells – so for more than a billion years. This finding was made by scientists at the Max Planck Institute for Evolutionary Biology in Plön using a statistical procedure that allowed them to trace every gene currently in existence back to its origins – or to be more precise, to the last shared ancestor in which the gene in question could be shown to exist. This genetic "family history" showed that most of the more than 2,000 known genes that can trigger disease in humans arose during the evolution of multicellular organisms more than a billion years ago, and during the development of bony fish 400 million years ago. Surprisingly, subsequent mammal evolution saw the emergence of hardly any potentially disease-triggering genes. This indicates that genetic diseases primarily affect biogenetically old cellular processes, and that today almost every organism, including the human one, is afflicted by similar ancient diseases. This, in turn, means that many of these diseases can be studied in simple model organisms – although this stands in contrast to the view that these diseases are inseparably bound up in fundamental cell processes and will therefore never be completely eliminated.

MOTH'S EYE VIEW might well be used in the future to describe optical devices of all kinds, as well as spectacles, screens, window panes and solar cells. Researchers at the Max Planck Institute of Metals Research in Stuttgart have succeeded in creating anti-reflective glass surfaces on the same principle as moths' eyes. They have developed a process that etches bumpy nanostructures on the surface of lenses or other glass. This bumpiness is more effective in preventing light from reflecting off of these surfaces than any traditional non-reflective coating, costs little to manufacture, and is also durable. The biological inspiration for these bumps was found on moth eyes, which protect the moths from discovery by enemies. There is a wide range of suitable applications for this technical imitation in every area of optical, display and solar technology, as well as on car windshields and buildings – in short, everywhere where it is important to prevent light loss or to eliminate disruptive reflections.

A NEW APPROACH TO COMBATING TB: For the first time in more than 80 years, a very promising live tuberculosis vaccine has reached the clinical trial stage in Germany. "Tuned up" with genetic engineering, it is a variant of the BCG vaccine that has been used worldwide, but that has now lost much of its efficacy. The basis for the new vaccine was researched at the Max Planck Institute for Infection Biology in Berlin. A gene implanted in the bacteria used to create the vaccine enables them to escape from the digestion chambers of "scavenger cells" after vaccination. In this way they do not disappear from the immunological scene, which was the case with traditional vaccines, but can continue to stimulate the immune system. Whether and to what extent the new vaccine will prove to be tolerated and effective in humans will not be established until after numerous test phases have been completed – which could take around ten years.

GAMMA FLASHES expose pulsars: For the first time, a rotating neutron star has been detected by its gamma radiation. This evidence was found by scientists at the Max Planck Institute for Extraterrestrial Physics in Garching in collaboration with an international team – and with the aid of the Fermi *Gamma Ray Space Telescope*, which was launched into space in 2008 and orbits the Earth at an altitude of 560 kilometers. The pulsar, which has been given the designation "CTA 1," is around 4,600 light-years from Earth and is the remains of a supernova in the Cepheus constellation that must have flared up 10,000 to 15,000 years ago.

As it rotates around its axis about three times every second, an intense gamma ray sweeps across the Earth like the beam from a lighthouse. These recently discovered relics of a supernova represent a very young high-energy pulsar, making it a member of a very small family that currently consists of around ten known objects. Researchers are hoping that studying these objects will provide them with new insight into the mechanisms of star development and the chemical evolution of the Milky Way.

The pathogen that causes tuberculosis, *Mycobacterium tuberculosis*, divides every 16–20 hours. Compared with other bacteria, which divide once every minute, this is extremely slow.

www
Further information is available at www.maxplanck.de

Photo: Brinkmann/Schaible, MPI for Infection Biology