

uni wissen 02 2015

The research magazine of the University of Freiburg | www.wissen.uni-freiburg.de



Up and Down

Sensors on the wrist capture movements, make it possible to reconstruct daily routines, and thus support treatment of patients with bipolar disorders



Materials of the future:
What efficient and sustainable materials need to achieve



Images of inequality:
How poverty is depicted in contemporary America



Keepers of order:
What functions microglia perform in our brains

**UNI
FREIBURG**



Wir messen es. **testo**

Zwischen Theorie und Praxis liegt nur das Höllental.

Informieren Sie sich über die Einstiegsmöglichkeiten für Studierende und Absolventen bei der Testo AG.

www.testo.de/jobs

Bund Deutscher Blasmusikverbände e.V. **BDB**
Musikakademie

BDB-Musikakademie



treffen tagen erholen

Der Veranstaltungsort für Tagungen, Freizeitveranstaltungen, Orchesterproben und Freundestreffen

Alois-Schnorr-Straße 10 | 79219 Staufen
Telefon 076 33 92 31 30 | info@bdb-musikakademie.de
www.bdb-musikakademie.de



Bundesweit für Sie da: Mit Direktbank und wachsendem Filialnetz.

Für mich: das kostenfreie Bezügekonto¹⁾

¹⁾Voraussetzung: Bezügekonto; Genossenschaftsanteil von 15,- Euro/Mitglied

Banken gibt es viele. Aber die BBBank ist die einzige bundesweit tätige genossenschaftliche Privatkundenbank, die Beamten und Arbeitnehmern des öffentlichen Dienstes einzigartige Angebote macht. Zum Beispiel das Bezügekonto mit kostenfreier Kontoführung.¹⁾

Informieren Sie sich jetzt über die **vielen weiteren Vorteile** Ihres neuen Kontos unter Tel. 0 800/40 60 40 160 (kostenfrei) oder www.bezuegekonto.de



BB Bank

Die Bank für Beamte und den öffentlichen Dienst

Contents

Light, Safe, Sustainable 4

Stefan Hiermaier is developing and testing materials for use in cars and airplanes

The Precarious Look 8

How poverty and social inequality are depicted in contemporary American literature, media, and art

Gardeners for Nerve Cells 12

Microglia keep house in the brain – when damaged, however, they can cause severe diseases

In the Tree Archive 16

Wood allows archaeologists to reconstruct historical environmental conditions and use the results for social history

Sensors for Psychology 20

Kristov Van Laerhoven has developed a technical aid to support treatment of patients with bipolar disorders

Diverse Alliance 24

Jürgen Rüländ is studying the example of Southeast Asia to determine how international politics can become more democratic

A Penchant for Extremes 28

Sonja-Verena Albers is studying the molecular surface structure of unicellular organisms that live in unusual habitats

Letting Patients Have Their Say 32

The website www.krankheitserfahrungen.de provides valuable information for people with illnesses and their families

Surveillance and Its Consequences 36

Why public perception should play an important role in the development of new technologies





Test track: Tests at the full-car crash test facility show how a car's materials and components react in an accident.
Photo: Thomas Ernsting



Photo: MO:SES/Fotolia

Light, Safe, Sustainable

Stefan Hiermaier is developing and testing materials for use in cars and airplanes

by Nicolas Scherger

Rails run straight through the 42-meter-long hall. On them is a car, covered with round markings and illuminated with spotlights. Behind the car waits an acceleration sled that runs along the rails, the front of which is fitted with a wall. The hall is empty; all doors are closed. The scientists in the adjacent control center give the starting signal. The sled is catapulted forward by

at this full-car crash test facility at the Fraunhofer Institute for High-Speed Dynamics, Ernst Mach Institute (EMI), in Erfringen-Kirchen near Freiburg are studying how materials and parts hold up in an accident. The goal is to “develop and test new materials to make cars lighter, safer, and more sustainable to manufacture,” says Prof. Dr. Stefan Hiermaier, Director of the EMI.

“We are preparing in advance for what can happen.”

compressed air and smashes at a speed of 30 kilometers per hour into the rear of the car. The test is documented by up to seven high-speed cameras. The images show how the car crumples and the markings shift on impact. Scientists

As professor of sustainable engineering systems, Hiermaier is responsible for coordinating the establishment of the “Department of Sustainable Systems Engineering” (INATECH) at the University of Freiburg’s Faculty of Engineering. The department is the engineering core of the “Performance Center for Sustainability” of the university and the city’s five Fraunhofer institutes. “I want to test visions for sustainability from the materials side,” says Hiermaier of his research

approach. One example is electromobility: Electric cars have to be light to achieve a long range – but not at the cost of safety. They need batteries that do not present any danger in the case of an accident. The automobile industry needs other materials for electric cars than for conventional

“I want to test visions for sustainability from the materials side.”

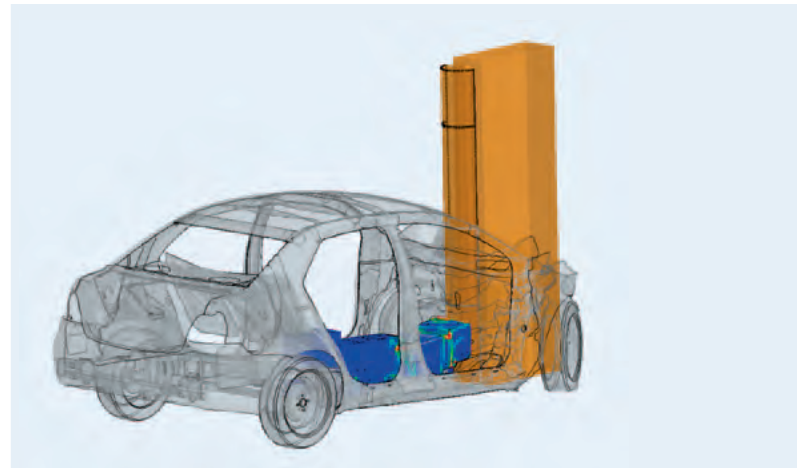
cars, such as rare earth elements like neodymium or lanthanum. “How do we find and extract these materials, how do we process them efficiently, and how do we recycle them?” asks Hiermaier. “We want to make the entire manufacturing process efficient and sustainable, from the raw material to the finished product.” To reach this goal, he is cooperating with industrial partners, especially in the automobile and aeronautical industry.

Pushing and Pulling

The purpose of the materials tests is to simulate the complexity of a real accident as faithfully as possible. “We have developed a test rig that allows us to push and pull material in several directions at the same time,” Hiermaier reports. He uses the data from the experiments to create a mathematical description of the material’s behavior. In this way, he aims to improve simulations on the computer – which for their part serve as the starting point for new tests. “The goal is a program that allows precise predictions,” the researcher explains. This goal has already been achieved in large part. For example, automobile makers simulate full-car crashes for new models on the computer long before they build a prototype. “The quality of the predictions is high, so the computer models make it clear where problem zones can be expected and how they might be solved. That is also sustainable, because you don’t have to destroy a car to get this data.” All the same, it is still necessary to conduct real crash tests at a later point in development – a crash simulation that achieves the validity of an experiment has yet to be made.

The list of materials Hiermaier is studying ranges from steel and aluminum plates and glass for windshields to textiles for airbags. Among

them are many so-called composite materials made up of a combination of several materials. One area he is focusing on is carbon fiber composite materials for the bodies of cars or airplanes. It is important for him to take a comprehensive approach, says the researcher – and this can make things complex. In a project with an automobile maker, for example, he developed a material made of carbon fibers and resins whose mechanical properties seemed promising at first. However, an analysis of the entire production process revealed that the production would be expensive and the recycling problematic, since separating the materials used to make it again would involve a great amount of energy. In another project, his task was to integrate lightning protection into a carbon fiber



composite material for airplanes. The current method for achieving this is to include thin metallic threads in the material. The objective of making the material “light and safe” is only partially realized in this case, because the metal threads make the material heavier. There has been little research on alternatives like graphene. Graphene is a two-dimensional form of carbon with good thermal and electrical conductivity as well as great strength, but it will be necessary to develop new processing methods and conduct further studies before it is fit for use.

Efficient and sustainable – this also means that the materials and parts need to be robust. That is the job of so-called resilience research, which will also be conducted at INATECH. “Resilience means that a system is capable of performing its task as quickly as possible after a

natural or man-made disaster,” says Hiermaier – regardless of whether the system is intended for a car, a building, or an energy or communication network and whether the failure was caused by an earthquake, a terrorist attack, or a technical defect. The significance of sustainability research, which takes this aspect into account, should not be underestimated at the moment. It is a given for Hiermaier that climate change and the resulting catastrophes will happen; the questions are only when and to what degree. This is where resilience research comes in: “We are preparing in advance for what can happen and developing measures to rapidly overcome critical situations.” The integration of engineering components makes the Performance Center for Sustainability unique, says Hiermaier. But just as important as techno-

logical feasibility is acceptance: The center will need to gain the approval of society, a task in which ecological, legal, ethical, and economic aspects are decisive. Taking all of this into account will require a comprehensive approach. “That is the scope within which the research conducted at the center will need to operate.”

www.leistungszentrum-nachhaltigkeit.de

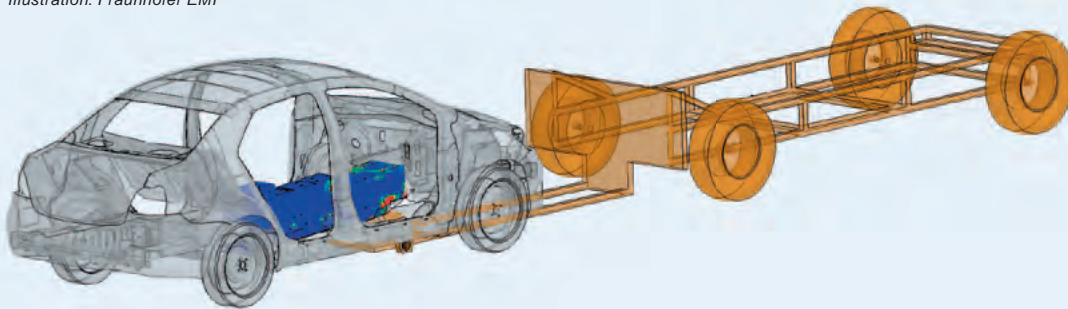


Prof. Dr. Stefan Hiermaier studied aeronautical and aerospace engineering at the Bundeswehr University Munich, where he stayed on to complete his doctorate and habilitation and accept a position in 2008 as adjunct professor of high dynamics. In 1998 he became deputy director of the Fraunhofer Institute for High-Speed Dynamics, Ernst Mach Institute, EMI. Since the end of 2014 he has served as one of two coordinators of the “Performance Center for Sustainability” of the University of Freiburg and the city’s five Fraunhofer institutes. As professor of sustainable engineering systems, he is also coordinating the establishment of the university’s “Department of Sustainable Systems Engineering” (INATECH). In his research, he studies and models the behavior of materials at high load speeds.

Photo: Fraunhofer EMI

The researchers aim to improve future cars that run on alternative energy sources with the help of simulations.

Illustration: Fraunhofer EMI



logical feasibility is acceptance: The center will need to gain the approval of society, a task in which ecological, legal, ethical, and economic aspects are decisive. Taking all of this into account will require a comprehensive approach. “That is the scope within which the research conducted at the center will need to operate.”

One of the topics Hiermaier himself aims to focus on at INATECH is bio-based composite materials. And he hopes that the full-car crash test facility at the EMI, which he also plans to use for projects at INATECH, will soon afford new insights: An x-ray apparatus will enable the researchers to view the interior of the car during the impact. “It will produce sharp images, even at high speeds, that show even more closely how the safety-related parts behave during an accident.” This can be particularly informative in the

Further Reading

May, M. / Hesebeck, O. / Marzi, S. H. / Böhme, W. / Lienhard, J. / Kilchert, S. / Brede, M. / Hiermaier, S. (2015): Rate dependent behavior of crash-optimized adhesives. Experimental characterization, model development, and simulation. In: Engineering fracture mechanics 133, pp. 112–137.

Hiermaier, S. (Ed.) (2012): Characterization, modelling and simulation of materials at high strain rates. Berlin / Heidelberg (= European physical journal special topics 206).

Hiermaier, S. (2008): Structures under crash and impact. Continuum mechanics, discretization and experimental characterization. Berlin.



The Precarious Look

How poverty and social inequality are depicted
in contemporary American literature, media, and art

by Rimma Gerenstein

The air shimmers in the heat. The impression from the distance is of a range of small glowing hills. Below the horizon is a sea of crumpled blue and gray tarps: the 65 tents all look alike. On the edge of the camp are portable toilets, and somewhere in the middle are two showers that only emit cold water. To the left and right freight trains rumble by, and overhead airplanes from the nearby airport plough through the air with an incessant low roar.

“If you want to understand poverty, you always have to include categories like age, gender, race, and region.”

The tent city in the US town of Ontario, 50 kilometers east of the metropolis Los Angeles, is surrounded by a two-meter-high fence. Above the entrance gate hangs a warning sign: “Entry for authorized persons only. The occupants may be criminals, rapists, or infected with diseases.” As Prof. Dr. Sieglinde Lemke stands before “Camp Hope,” she wonders where hope might be found in this place. No money, no prospects for temporary work, no social contacts – for the occupants of the tent city, the “American dream” and the “pursuit of happiness,” the foundations of American identity, are no longer anything more than empty words. “Since the last financial crisis, this has also become true of the majority of the population,” says Lemke.

The Freiburg American studies professor travels to Los Angeles in 2009 to do research for her book on poverty in contemporary American culture at the University of California. She wants to study how media, art, literature, and politics negotiate and depict inequality. Her intention is actually only to work at the library, but one day she decides to drive to “Camp Hope,” founded by the town in 2008 to get the homeless off the streets. In the last ten years, tent cities like these have shot up like mushrooms in the USA – there are currently over 100 of them scattered throughout the country. “The camp felt like a cage, a cross between a campsite and a detention camp,” the

researcher remembers. She conducts interviews, speaks with the guards, the volunteers distributing food, and the occupants of the site. Although Lemke’s encounters do not end up making their way into her book, she describes them as the driving force behind her cultural studies contribution to the current debate on inequality.

“The life histories of the people are a reflection of the common model for explaining the reasons for poverty,” says Lemke. “Individuals seek the blame for their own failure in themselves and fail to see the larger socioeconomic and political structures that have contributed to mass poverty for decades in the USA.” For example, a homeless person in the camp explains that she’s “down on her luck”; a man worked his entire life in a factory until he was finally “let go”; another regrets that she is “not blessed with many opportunities.” These vague explanations show that there is no clear language for the phenomenon of poverty in the English language.

The Plight of the Middle Class

Six years later, the American studies professor is just finishing up the last pages of her book, which is due to come out in 2016. Up to now, the topic of poverty has been a taboo in cultural studies: “For decades, most researchers avoided the category of ‘class.’ Grappling with this term meant dealing with literature of low literary value or even being branded as a Marxist,” she says.

Lemke has no fear of this danger: She analyzes everything from novels, films, comics, political speeches, and photographs to articles from newspapers, blogs, YouTube videos, and social scientific studies. Her findings reveal that people at the margins are no longer the only ones to experience inequality but that it has reached the middle of society. However, the media still tends to portray poverty from two angles: either the people themselves are at fault for their plight or they are plagued by bad luck and were never given the chance to earn a good living. “This limited view elevates poverty from a merely economic problem to a topic for cultural studies.”

Homeless mother: Dorothea Lange's photograph "Migrant Mother" is a symbol for poverty in the years of the Great Depression. In addition to misery, however, the portrait also evokes optimism and determination.

Photo: Library of Congress, Prints & Photographs Division, FSA/OWI Collection, LC-USF34-9058-C

For Lemke, the either-or pattern is too simplistic. She has developed a multi-level concept of inequality that combines approaches from literary and cultural studies, sociology, political science and economics, media culture studies, and the relatively new field of precarization research. "If you want to understand poverty, you always have to include categories like age, gender, race, and region."

Icons of Misery

The researcher wanted to know how precarious living conditions are portrayed in the present: Do the images evoke old clichés of romanticized

beggars? Why do some of the portraits move us, and why do others leave us cold? She sees an outstanding example in Dorothea Lange's 1936 photograph "Migrant Mother" – for Lemke "an icon of misery": reproduced millions of times, printed in every high school history book, a symbol of the despair in the years of the Great Depression. The black-and-white photograph shows a woman with two small children, their faces buried in their mother's shoulders. The woman's skin is weather-beaten, her brow lined with deep wrinkles. Her eyes betray fear. A piece of tarp in the background reveals that the family is homeless.

And yet there is something else there as well: "The woman is desperate as well as strong and tough. The position of her arm shows that she can work. Her eyes are turned forward and signalize optimism." Such images and texts, which aroused tension in people because they sensed a dual message in them, gave rise to the "precarious look," says the researcher – precarious in the sense of the Latin word "precarius," meaning uncertain, unstable, or pleading. "The picture demands our sympathy, as every documentary image tries to do, but it does this in a risky and refined way."

This possibility to enter into a dialogue with a work of art captures the extended attention of the viewer or reader, explains Lemke, whereas images that only evoke clichés are forgotten again immediately: "When we see a starving child in Africa begging with an outstretched hand, we recognize in an instant that this is poverty, that it's horrible, and then we look away again." If the viewer does not know what she has before her eyes or if a reader is unable to assign a text to a particular category right away, on the other hand, their attention span will be increased. "That is the privilege of art: it allows us to explore areas that we would otherwise find unpleasant. In this way, it can make a connection that is not possible or wanted in the social world." Lemke sees Dorothea Lange's work as a forerunner of a new depiction of poverty. Contemporary artists like the Canadian Jeff Wall or the American photographer Tom Stone play even more strongly with the "precarious look": When one views Stone's stylish black-and-white portraits, it's not always clear whether one is looking at a resigned homeless person or a smug hipster with a hat and designer stubble.



The ruins of the American dream: Camp Hope, one of more than 100 tent cities in the USA, takes in people who have lost their homes, for example due to the last financial crisis. Photo: Sieglinde Lemke



In the television series *Breaking Bad*, Walter White, a chemistry teacher who has been diagnosed with cancer, deals drugs to save his family from bankruptcy after his death. Source: Sony Pictures Home Entertainment

Television series, the most American medium of all, have also changed in the way they portray social and economic inequality in the past ten years. The once so tirelessly propagated American dream appears through the lens of “precarious television” as a wasteland that has become the setting: The series *Breaking Bad*, for instance, tells the story of the antihero Walter White,

“That is the privilege of art: it allows us to explore areas that we would otherwise find unpleasant.”

a chemistry teacher diagnosed with cancer who becomes a drug lord to save his family from financial ruin; in *Undercover Boss*, to take another example, millionaire corporate managers dirty their hands for a few hours conducting pseudo-sensitive social studies in the underbellies of their own companies; finally, *Girls* chronicles the struggles of four young women from wealthy families to gain a foothold in trendy Brooklyn – their temporary existence on the brink of poverty appearing as a sexy alternative to their comfort-

able upbringing. Film studies has yet to tackle such topics, until now: the anthology *Class Divisions and Serial Television*, co-edited by Lemke, is set to appear in 2016.

www.pr.uni-freiburg.de/go/lemke



Prof. Dr. Sieglinde Lemke studied English and history in Constance. After earning her PhD at the Free University of Berlin, she went on to complete her habilitation thesis at the same institution in 2003, in which she developed a transcultural approach to literary studies. Lemke then taught and conducted research at several American universities, including Harvard University; the University of California, Irvine; the University of California, Berkeley; New York University; and Georgetown University. Since 2006 she has served as professor of American studies at the University of Freiburg. She is currently preparing her fourth monograph for publication. Her research interests include gender studies, film, cultural class studies, African American literature, modernism, and cultural theory. Photo: private

Further Reading

Lemke, S. (2016): Poverty and inequality in contemporary American culture. New York (in preparation).

Lemke, S. / Schniedermann, W. (Eds.) (2016): *Class divisions and serial television*. London (in preparation).

Lemke, S. (2013): Poverty and Class Studies. In: Fluck, W. / Redling, E. / Sielke, S. / Zapf, H. (Eds.): *American studies today: New research agendas*. Heidelberg, pp. 71–99.



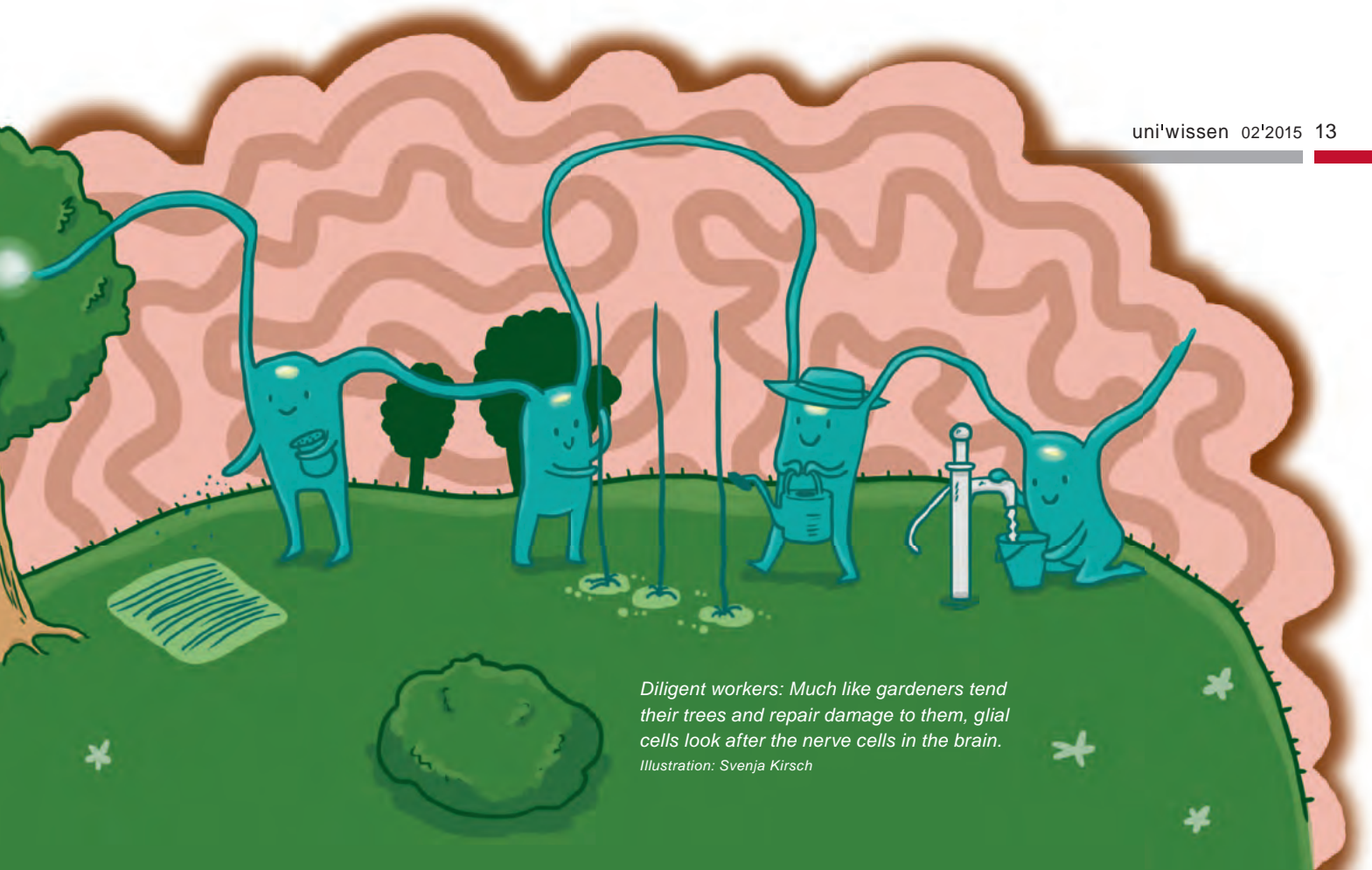
Tending the Nerve Cell Garden

Microglia keep house in the brain – when damaged, however, they can cause severe diseases

by Claudia Fübler

Imagine your brain is a garden,” says Prof. Dr. Marco Prinz. That might seem far-fetched, but the neuropathologist speaks in such enthusiastic terms of his work that you want to understand what he is so excited about, so you envision the following: Shrubs and trees flourish in the fertile humus of your head, the fields are a deep green, and the flowers bloom in the most vibrant colors. The trees, says Prinz, are the nerve cells. And they need to be tended. Sometimes they grow uncontrollably in one direction, sometimes individual branches fall off, and sometimes the entire tree dies. Were one to simply allow things to take their course in the brain’s garden, there would soon be chaos.

Preventing this from happening is the job of the scavenger cells, the macrophages, which are found everywhere in the human body. A part of the immune system, macrophages play an important role in all immune defense reactions, the fight against tumor cells, and the healing of wounds. In connective tissue they are called histiocytes, in the bones osteoclasts, and in the skin Langerhans cells. In the brain, where they are known as microglia, they take on the function of a gardener, trimming the branches of the nerve cell trees and chopping them down altogether when they die off. In the case of major damage, for instance after a fall or an accident, there is



Diligent workers: Much like gardeners tend their trees and repair damage to them, glial cells look after the nerve cells in the brain.

Illustration: Svenja Kirsch

always a troop of microglia on hand to clean up in the brain of a healthy person.

Marco Prinz is medical director of the Institute for Neuropathology at the Freiburg University Medical Center and has been studying microglia for many years. He first became fascinated with the brain in the anatomy seminars he took while studying medicine at the Charité teaching hospital in Berlin, where he wrote his dissertation on nerve cells in the brain at the Institute of Anatomy. He then accepted a position at the Institute of Neuropathology of the University of Zurich, Switzerland. It was there that he began focusing more closely on microglia. "They have not been known for very long, and we are only learning little by little what function they have in the brain."

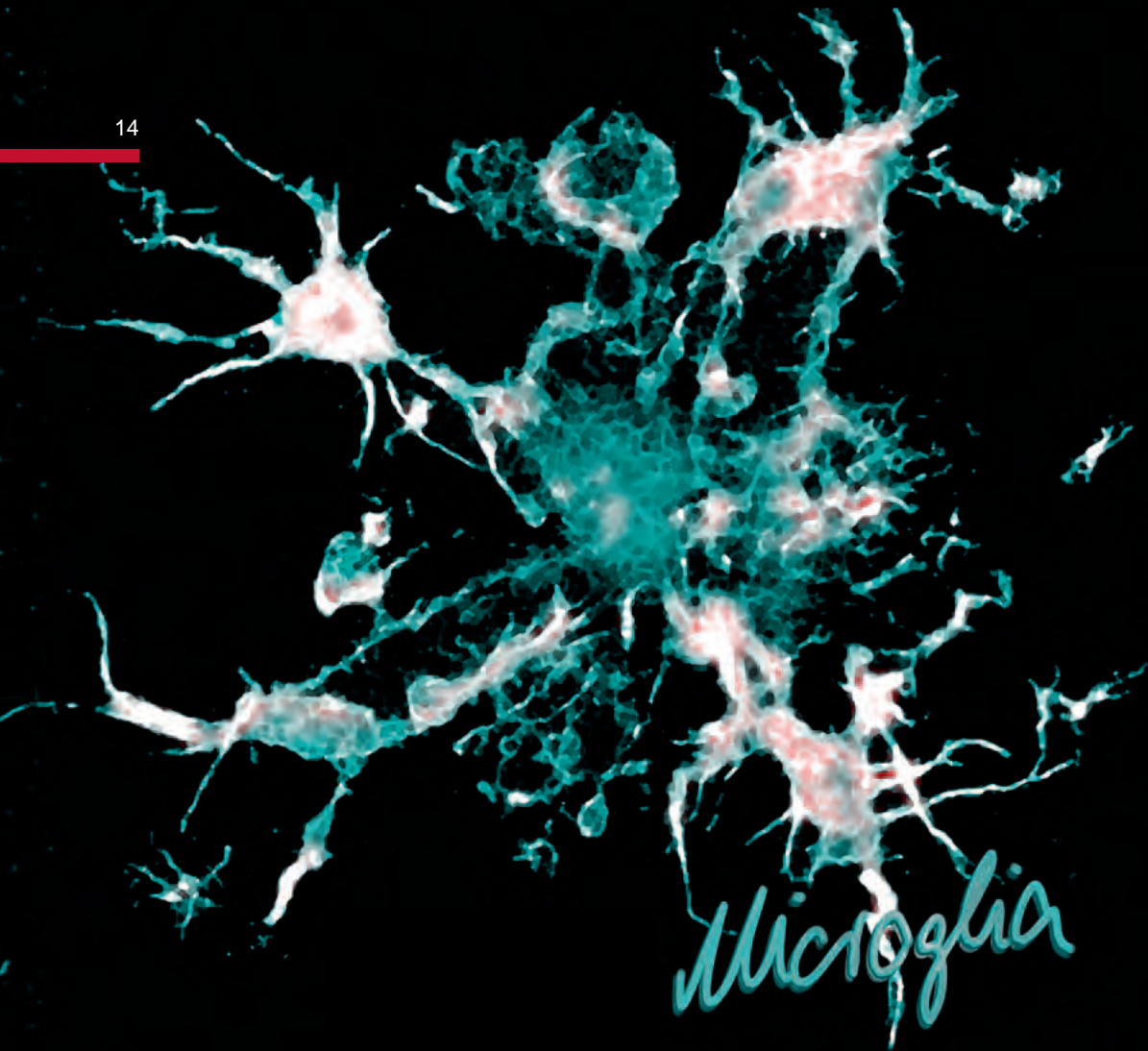
“It’s a bit like cleaning up after a party.”

The Greek word “glia” literally means “glue.” The brain gardeners owe their name to the doctor Rudolf Virchow, who saw them as a kind of support substance for nerve cells that holds them in place or glues them together. Only gradually was it discovered that glial cells in general and microglia

in particular also serve other, entirely different purposes.

Microglia are diligent gardeners. They take their job seriously and spend all of their time looking after the nerve cells. They are constantly scavenging through the brain with their little arms, always on the lookout for undesirable changes and removing them immediately. The tiny housekeepers are even mobile: if a part of the brain gets injured, the surrounding microglia travel to the spot and repair it. “It’s a bit like cleaning up after a party,” explains Prinz. “The microglia try to restore the brain to its original state, in which it works best, as quickly as possible.”

Approximately 10 to 15 percent of all brain cells are microglia. That might not seem like much, but their work is essential. This becomes particularly evident when they are damaged: “When microglia can no longer fulfill their duties and the nerve trees grow uncontrollably in the brain or the gardeners chop off healthy and useful branches instead of sick ones, that of course has consequences for the brain,” says Prinz. There is an increasing amount of evidence that microglia can not only potentially cause inflammations of the brain and its protective membranes, but that they can even play an important role in diseases



Glial cells are scavenger cells, which play an important role in immune defense reactions as part of the immune system.

Illustration: Christiane Menzfeld

like Alzheimer's, Parkinson's, or multiple sclerosis. Together with colleagues from Freiburg and Israel, Prinz succeeded in demonstrating for the first time how microglia influence the degeneration of the nerve cells in patients with multiple sclerosis. "They produce certain inflammatory markers, which are actually designed to kill off bacteria. However, these markers are evidently also toxic for the nerve cells." Prinz received the Sobek Prize for Multiple Sclerosis Research in 2014 for his contribution to the understanding of this disorder.

Old Cells are Exhausted

Microglia are also suspected to play a role in psychiatric disorders like autism or schizophrenia, although there are not yet enough studies to back this suspicion up. In the case of Alzheimer's disease, on the other hand, there is a relatively reliable body of data. Fragments of a certain protein embed themselves between the nerve cells in the brain. In a healthy brain, the microglia fulfill their task and free the nerve cells of these fragments. In Alzheimer's patients, however, the

protein fragments accumulate until they finally form hard, insoluble plaques. "The old microglia are evidently exhausted and can no longer consume the fragments as well as the young ones," explains Prinz. In addition, his team also discovered that microglia live as long as the person they belong to. They are already present in the yolk sac before birth and age as the person ages. "The more we understand about the scavenger cells and their function, the better our chances to develop therapies for the various diseases one day."

A study Prinz and his colleague published in the journal *Nature Neuroscience* in June 2015 will undoubtedly contribute to this understanding. The study investigates the extent to which the intestinal flora cooperates with the microglia. Not at all, would seem the obvious answer, due to the blood-brain barrier. It serves as a kind of filter, separating the circulating blood from the

"The microglia show a real reaction to what happens in the intestines."

central nervous system and protecting it from germs and toxins. The idea that messages from the intestines could be important for processes in the brain therefore sounds absurd at first – and yet, precisely this seems to be the case. Prinz's team studied mice whose intestines were either populated with bacteria as normal or completely bacteria-free. "The microglia in the bacteria-free mice were much larger than those with an intestinal flora, and they were also more numerous." In addition, the external arms of the microglia in the bacteria-free mice suddenly touched each other. The researchers had previously only known microglia networks in which the cells respect each other and do not get in each other's way. This led the scientists to conclude that the maturation of the microglia must be dependent on the intestinal bacteria. And on top of that, there seems to be constant communication of sorts between the intestines and the microglia.

Signals from the Intestines

"We removed the bacteria from mice that initially had a normal intestinal flora and then later added just a few strains of bacteria," explains Prinz. "We were able to see the effect this had: the microglia show a real reaction to what happens in the intestines." Carbohydrates and fibers in particular seem to have a positive effect on the function of the microglia – they are converted into short-chain fatty acids in the intestine. But how can the brain receive constant signals from the intestines? Prinz and his team suspected certain kinds of receptors to be the cause, but this turned out not to be the case: "So now we are back to square one." The scientists are also interested in the potential link between the breakdown of nerve cells in the brains of multiple sclerosis patients and the intestinal bacteria. If they succeed in substantiating their findings, it would mean that anyone can influence the function of their microglia through a change in diet.

How do the microglia communicate with each other and with the intestines? What happens with the gardeners responsible for keeping house in the brain when they themselves die? Do they die at all, or do they just go into a state of rest? Where do the microglia come from if

they are already there before we are born but multiply throughout our lives, as scientists have observed? Is there a kind of mother line? "There remains much to be discovered," says Marco Prinz, "and we're happy to be at the forefront of the developments."

www.neuro.uni-freiburg.de



Lentils for the brain: Carbohydrates and fibers seem to have a positive effect on the function of the microglia.

Photo: Printemps/Fotolia



Prof. Dr. Marco Prinz


studied medicine and earned his doctorate in Berlin and completed his habilitation qualification in neuropathology in Göttingen. He was a postdoctoral research fellow at the Institute of Neuropathology of the University of Zurich, Switzerland, and has served since 2008 as medical director of the Institute for Neuropathology at the Freiburg University Medical Center. Prinz is also an associate member of the Cluster of Excellence BIOS Centre for Biological Signaling Studies of the University of Freiburg. He has received a number of awards for his research, including the H. G. Creutzfeld Prize, the Young Investigator Award from the International Cytokine Society, and, most recently, the 100,000-euro Sobek Research Prize. Photo: private

Further Reading

Erny, D. / Hrabec de Angelis, A. L. / Jaitin, D. / Wieghofer, P. / Staszewski, D. E. / Keren-Shaul, H. / Mhlahkoiv, T. / Jakobshagen, K. / Buch, T. / Schwierzeck, V. / Utermöhlen, O. / Chun, E. / Garrett, W. S. / McCoy, K. D. / Diefenbach, A. / Staeheli, P. / Stecher, B. / Amit, I. / Prinz, M. (2015): Host microbiota constantly control maturation and function of microglia in the central nervous system. In: *Nature Neuroscience* 18, pp. 965–977.

Prinz, M. / Priller, J. (2014): Microglia and brain macrophages in the molecular age: from origin to neuropsychiatric disease. In: *Nature Review Neuroscience* 15/5, pp. 300–312.

Hanisch, U.K. / Kettenmann, H. (2009): Mikroglia: Hausmeister mit Lizenz zum Töten. In: *Gehirn & Geist* 5/2009, pp. 54–59.

A polar bear is walking on a sandy beach, looking towards a large, weathered log that has washed onto the shore. The background shows a blue body of water with ice floes and distant mountains under a clear sky.

Snapshot from Greenland: Willy Tegel roused the curiosity of a polar bear while studying a tree trunk washed onto the Arctic shore. Photo: Willy Tegel

In the Tree Archive

Wood allows archaeologists to reconstruct historical environmental conditions and use the results for social history

by Verena Adt

“The growth rings of trees are as precise and individual as a barcode.”

The photograph shows a stately polar bear strolling along an Arctic beach in front of the deep-blue Arctic Ocean. Dr. Willy Tegel has this picture in mind when he sits at his computer at the University of Freiburg's Institute of Forest Sciences. The archaeologist encountered the polar bear in Greenland in the summer of 2010, and this meeting was so unpleasant that he immediately evacuated the small camp he shared with other scientists and ran for shelter. And the bear wasn't even what he was interested in: what Tegel was after was the gray trunk of driftwood visible in the foreground of the snapshot. The wood that washes ashore on the Arctic coasts is “a unique archive of the climate and environment,” says the scientist. In a long-term research project, he determined the origin and age of trunks, great numbers of which are washed onto the beaches of the virtually treeless islands of the North Atlantic. So much wood from Siberia and North America reaches the shores of Greenland and Iceland that the sawmills don't work with any other wood.

Precise Dating

Tegel began specializing in tree-ring dating as a student. The scientific name for this young discipline, dendrochronology, is derived from “dendron,” the Ancient Greek word for tree. Dendrochronology is a method for determining the precise age of wood and is used among other things to date valuable historical musical instruments. By analyzing archaeological finds made of wood, dendrochronologists can also reconstruct the climactic conditions of the time in which they were made.

“Traces left by tools and the cross section of woods provide information about the woodworking process. Growth rings and anatomical features are used for dating and paleoecological analyses,” summarizes Tegel. What he produces in the end can be seen on a computer screen. Maps of Europe shaded in green and brown flash in rapid succession over the screen: one map for each of the past 2500 years. Each of them shows precisely where in Europe there was too much rain, where it was dry, where it was warm, and where it was cold. The year 1315, for example, was unusually rainy, while at the beginning of the 15th century there was a drought of dramatic proportions that lasted more than 20 years. The catastrophic consequences for humans are documented by written records, but the trees provide much more precise information on the weather conditions.



Growth ring research, also known as dendrochronology, is a method for determining the precise age of wood.

From the Late Glacial to the Present

Tegel's research material is scattered all over his laboratory: pieces of wood from various epochs and in various formats. There are thick discs from Black Forest pine trunks and drill core samples of ancient oak wood, thin as a cotton swab and fit into narrow rails to protect them from damage. These samples were taken from beams and posts built into houses, fences, and well shafts hundreds or even thousands of years ago.

Tegel works with wood from epochs ranging from the Late Glacial – the last period of the last ice age or circa 12,500 to 10,000 before Christ – to the present. His research material comes

primarily from Northern France and Southern Germany: from the medieval towns, the remains of ancient and prehistoric settlements, trenches from the First World War, gravel pits, or sawmills. His most important tool besides the computer is

ring calendars is being done at the University of Hohenheim and currently goes back 12,500 years into the past – to the end of the last ice age, long before humans began to adopt a sedentary lifestyle.

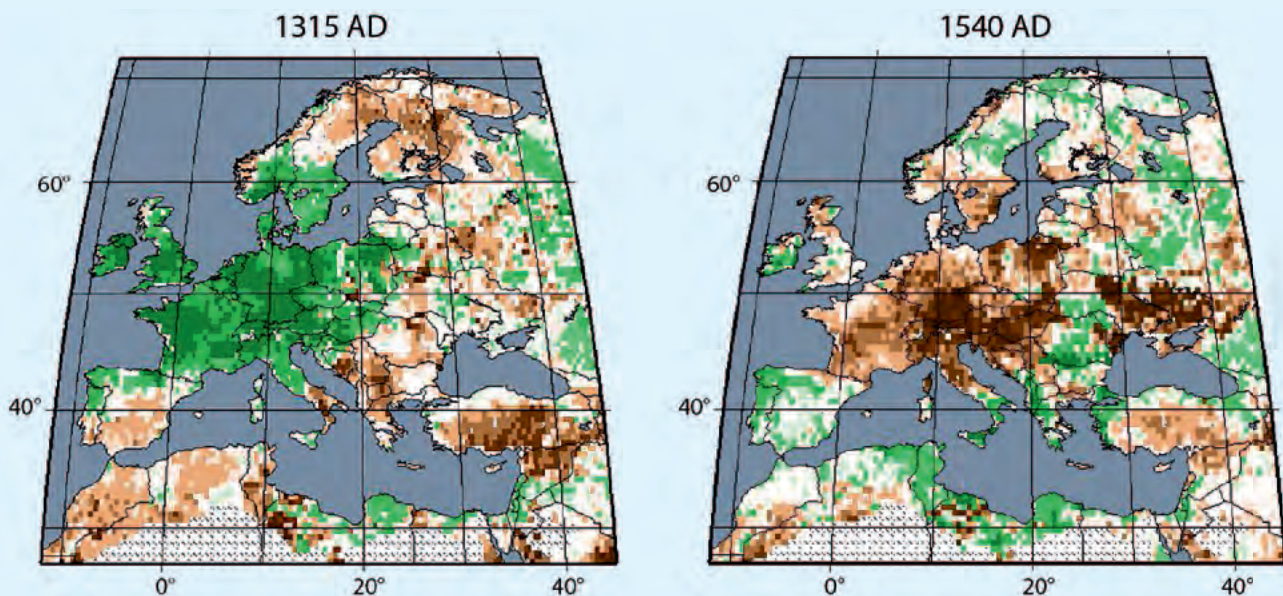
“We are at the interface between the social and natural sciences.”

a microscope. He uses the instrument to count growth rings and measure their width. Damp and mild years lead to wide rings, because favorable weather conditions stimulate tree growth. Dry years, on the other hand, manifest themselves in narrow rings. Other features that provide valuable information include the anatomy and the chemical composition of the wood. Along with climatological data garnered from ice core drilling, growth rings are the richest data source for modern paleoclimatological research.

Dendrochronology works with reference chronologies compiled over the course of thousands of analyses: taking the present as a starting point, researchers initially study younger wood and then move on to older wood from trees with overlapping life spans. The longest of these growth

“The growth rings of trees are as precise and individual as a barcode,” says Tegel. When was the tree used for the roof beams of a medieval house in the northeastern French town of Troyes chopped down? How many days of sunshine did the oak built into a well pit 7000 years ago near modern-day Leipzig see? How extensive were the climactic fluctuations in the area, and how sudden were these changes? It is essential for climate research to find answers to such questions, because they provide precise information on prehistoric times, of which we have no written records whatsoever. Our body of reliable data from meteorological instruments only covers the past 150 years.

Wood built into above-ground structures is decomposed by microorganisms and therefore does not usually last longer than a thousand years. However, much older constructions made of wood have been preserved because they were embedded in a damp environment, such as



A map for each year: Willy Tegel has created maps showing climactic conditions over the past 2500 years. In 1315, for instance, large parts of Europe were rainy (green), while 1540 was a dry year (brown). Source: Willy Tegel



Oak wood from the Late Stone Age: A Freiburg research team used dendrochronology to determine the age of four wells near Leipzig – they are regarded as the world's oldest known wooden structures.

Photo: Sächsisches Landesamt für Archäologie, Dresden

the remains of the Late Stone Age stilt houses on Lake Constance or the approximately 15,000-year-old pine trees from the Late Glacial Period discovered by construction workers several years ago in the middle of Zurich, Switzerland. In these cases the wood was protected from decomposition. Several-thousand-year-old well shafts and the wooden foundations of long-since collapsed buildings preserved underground thus often yield important findings for Tegel. Other valuable sources of climactic data include tree trunks from gravel pits that were able to survive for centuries or even millennia in river sediments.

The Craftsmanship of Farmers

The work of dendrochronologists is not only of interest for climate researchers. “We are at the interface between the social and natural sciences,” says Tegel. Complex woodworking and mortising techniques on the Leipzig well shaft from 5000 before Christ reveal, for example, that the first farmers were much better craftsmen than their tools made of stone and bone might suggest. The precise dating of construction measures down to the year enables researchers to draw conclusions on settlement dynamics in particular areas and times. Historians are also interested in the question of how climactic conditions influenced waves of migration. At the time of the Migration Period of the fourth century AD in Europe, for instance, the climate was especially cold and

dry. However, Tegel warns against equating temporal coincidence with causality and seeing climate as “the sole determining factor for human behavior and social development processes.”

www.dendro.de

Further Reading

Hellmann, L./Tegel, W./Eggertsson, O./Schweingruber, F.H./Blanchette, R./Gärtner, H./Kirdyanov, A./Büntgen, U. (2013): Tracing the origin of arctic driftwood. In: *Journal of Geophysical Research: Biogeosciences* 118/1, pp.68–76.

Tegel, W./Elburg, R./Hakelberg, D./Stäubli, H./Büntgen, U. (2012): Early neolithic water wells reveal the world's oldest wood architecture. In: *PLoS ONE* 7/12, e51374.

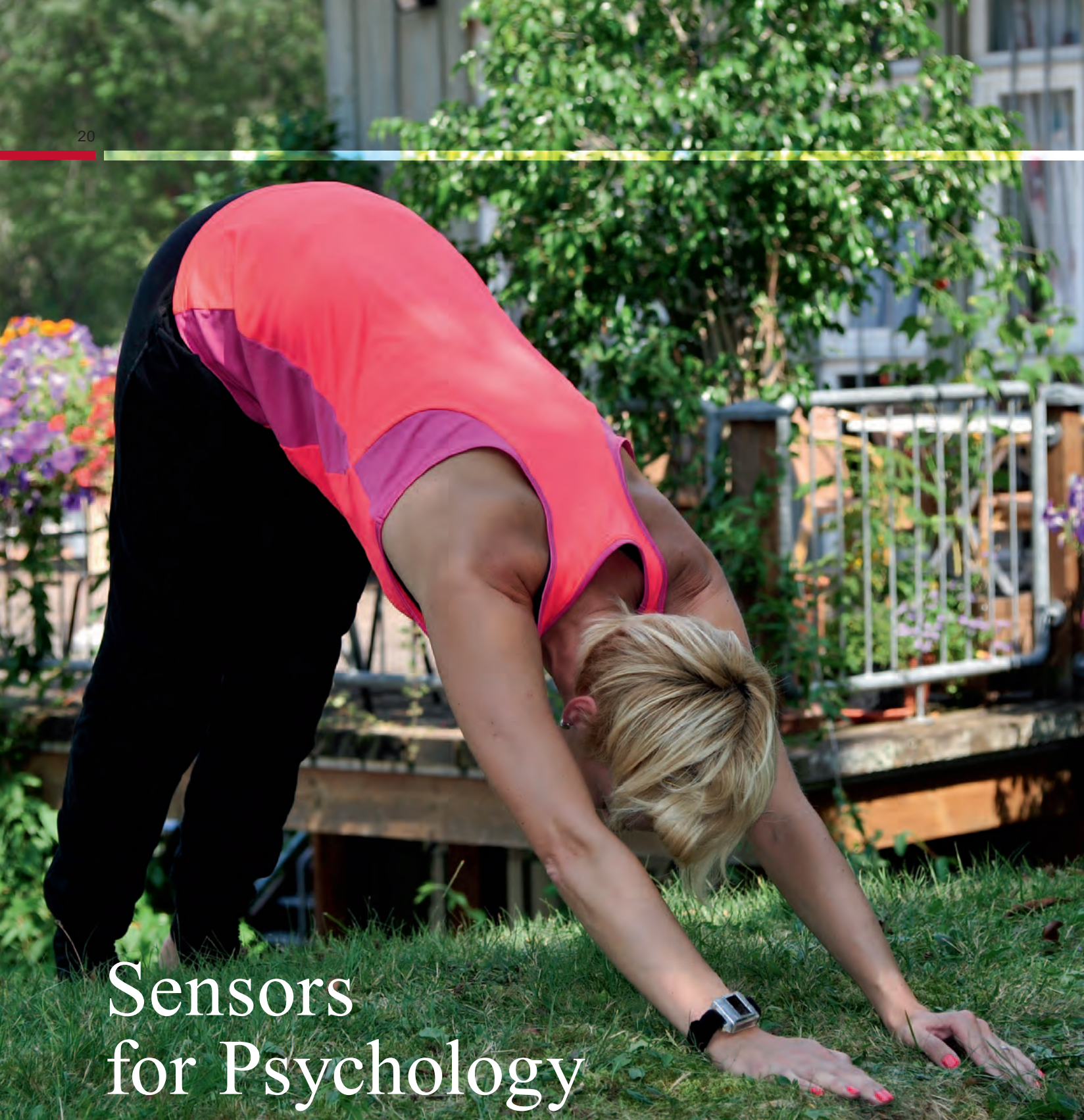
Büntgen, U./Tegel, W./Nicolussi, K./McCormick, M./Frank, D./Trouet, V./Kaplan, J./Herzig, F./Heussner, U./Wanner, H./Luterbacher, J./Esper, J. (2011): 2500 years of European climate variability and human susceptibility. In: *Science* 331/6017, pp.578–582.



Dr. Willy Tegel

studied prehistoric archaeology at the French *École des Hautes Études en Sciences Sociales* in Paris and Toulouse. He then worked as a research assistant at the Stilt House Conservation Site in Hemmenhofen on Lake Constance and in Bern, Switzerland, and took several research trips to France. In 2008, Tegel accepted a position at the former Institute of Forest Growth of the University of Freiburg, where he completed his PhD with a dissertation on growth rings, climate, and society in 2013. Tegel has focused since early in his academic career on dendrochronology, a dating method based on the analysis of the growth rings of trees that has applications in climate research, social sciences, art history, and historic preservation.

Photo: Thomas Kunz



Sensors for Psychology

Kristov Van Laerhoven has developed a technical aid to support treatment of patients with bipolar disorders

by Annette Kollfrath-Persch

The patient's day includes a bike ride to the office, three cups of coffee, regular games of tennis, yoga to wind down, and peaceful sleep at night – but several days later he finds himself canceling the sport, smoking cigarettes with his coffee, and sleeping longer but less peacefully. The daily routine of patients with bipolar disorders can change in the transitions from manic and depressive phases. This is information the psychologists treating the illness need to know. A detailed record of the patient's activities enables them to analyze these transitions, determine which activities were stopped and which were started, and to help their patients better.

“An astounding amount of activities can be identified from typical hand movements.”

Up to now, psychologists have had to rely on their patients' journal entries to reconstruct the transition between these phases. This type of diagnosis and analysis depends for its success on the self-perception and reliability of the patient, and it is thus not always possible for the therapist to create a precise record of the patient's activities in this way. Prof. Dr. Kristof Van Laerhoven from the Faculty of Engineering of the University of Freiburg has found a new means of recording activities without interruption: The computer scientist and his team are building tiny sensors that can be worn like wristwatches and capture all movements of the arm and hand. A special computer program then identifies which motion patterns stand for which activities and compiles a detailed weekly summary. “We want to develop a diagnostic instrument to support psychologists in their work,” explains Van Laerhoven. The Freiburg researcher sees a close link between his field of research and psychology: “In computer science and microsystems engineering we are concerned with developing systems that can collect and manage data. That is an important tool for empirical research in psychology. On the

other hand, we need the expert knowledge of psychologists to develop our systems because they're made for people.”

In cooperation with the Dresden University Medical Center, Van Laerhoven has been working since 2014 on a study with 24 test subjects suffering from bipolar disorders who have agreed to wear a sensor on their wrist day and night. The device consists of a battery, acceleration, light, and temperature sensors, and a memory card that records 100 data sets per second over the course of two weeks. Every day it records a total of approximately 25 million data sets. The data on arm and hand movements provide information on the wearer's actual activities, because even bicycle riding and sleeping are associated with characteristic arm movements and postures. “Since an astounding amount of activities can be identified from typical hand movements, the sensor can reconstruct an entire daily routine,” explains Van Laerhoven. “Yoga exercises, for instance, are very easy to analyze, because they always involve particular arm movements.” Smoking is also associated with a certain posture of the wrist and the equally typical repetitive movement with which the cigarette is raised to the mouth. Combined with the data from the included light and temperature sensors, this data can be used by the software to create a daily and nightly activity log.

Nonstop Operation

Once the patients have put the sensor on their wrist, they don't need to do anything more: they don't need to turn it off or recharge it, because the battery has a life of several weeks. This also means that there aren't any gaps in the data – as long as the test subjects don't take off the sensor again. The compact size and light weight of the sensor are also helpful: “The patients confirm that they didn't even notice the tiny device anymore after a short time. This makes the recorded movements very realistic.” That is also the sensor's main advantage over video recordings: For one thing, it is not possible to record all of a patient's activities nonstop with a video camera. In addition,

Yoga with a wearable sensor: The tiny wrist-worn device records the typical motion patterns for this activity.

Photo: Thomas Kunz

Van Laerhoven says patients would feel like they're being watched, which could lead them to move less naturally.

The sensors have no connection to the internet or other devices. They can only be connected to a computer by cable. This guarantees data protection, assures the researcher. Moreover, the patients can decide for themselves whether to hand over the stored data to their therapist. Every two to four weeks the data stored on the sensor are transferred to a special program on

“The patients confirm that they didn't even notice the tiny device anymore after a short time.”

the computer and made anonymous in the process. In this way, only the patients' psychologists know which data set belongs to whom.

When the data is transferred for the first time, the software developed by Van Laerhoven has to learn which motion patterns stand for which activities. In the beginning, the therapist and the software still have to rely on the classical written records of the patient. The recorded data are named on the basis of the journal entries. From then on, the software identifies patterns in the motion, light, and temperature data and links them to the activities designated after the first data transfer. For example, particular repeated patterns like fore- and backhands suggest a tennis match, while very few movements in combination with darkness and low room temperatures indicate sleep. The analysis of a week's worth of data currently takes five to ten minutes, but Van Laerhoven is working on making his software even faster and more efficient.

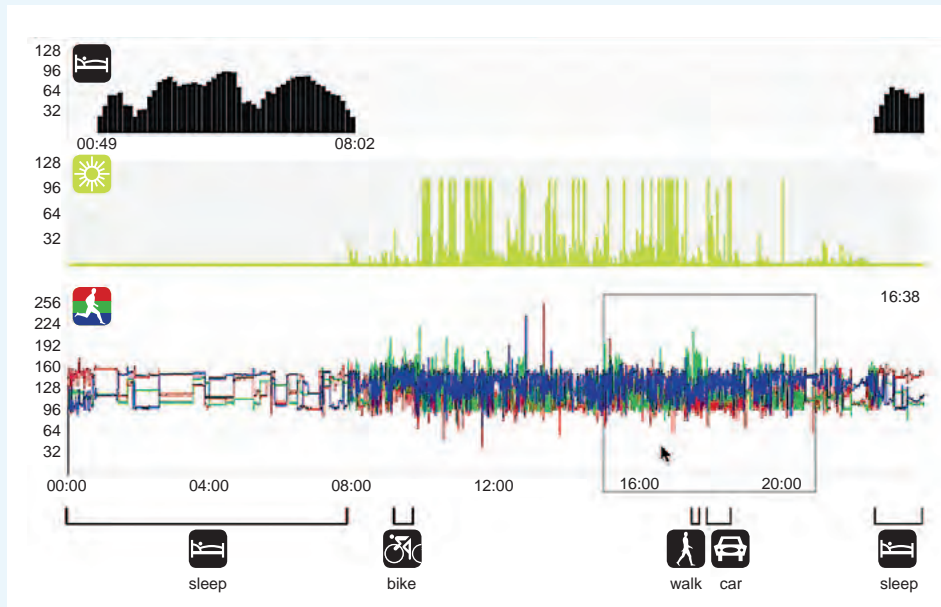
Self-Produced Sensors

Sensors like those Van Laerhoven needs cannot be bought. “Smartwatches are not useful for

Unlike a smartwatch, the sensor's display shows very little information. This improves battery life.
Photo: Sandra Meyndt



The computer program creates a detailed activity log: It uses the light and temperature data as well as the wearer's arm and hand movements to determine when he or she was sleeping, riding a bike, walking, or driving a car. Illustration: Arbeitsgruppe Embedded Systems/Universität Freiburg



our purposes: They are wireless, have too much content, and thus deplete the battery too quickly. We need sensors that can collect data over the course of several weeks.” He therefore produces the systems himself with his team and sells them for the production price of 40 euros. The researchers have already built almost 1000 sensors, 100 of which are currently in use – both by patients with bipolar disorders and in sleep laboratory studies as well as by patients with diabetes or Huntington’s disease. “I actually see myself as a computer scientist,” the scientist says, “but on account of my research area I’ve become something of a cross between a microsystems engineer and a computer scientist.” He wears one of his sensors day and night himself to test the system and develop it further. Up to now, the results from practice have been very good and the feedback from patients positive without exception, and this strengthens Van Laerhoven in his conviction that he is on the right track: “We want to eventually convince all psychologists that we can offer them a valuable analysis instrument to replace the traditional written records.”

<http://earth.informatik.uni-freiburg.de>

Further Reading

Scholl, P. M./Wille, M./Van Laerhoven, K. (2015): Wearables in the wet lab: A laboratory system for capturing and guiding experiments. The 2015 ACM International Joint Conference on Pervasive and Ubiquitous Computing (UbiComp 2015). www.pr.uni-freiburg.de/go/wearables

Borazio, M./Berlin, E./Kücükyildiz, N./Scholl, P. M./Van Laerhoven, K. (2014): Towards a benchmark for wearable sleep analysis with inertial wrist-worn sensing units. Healthcare Informatics (ICHI). www.pr.uni-freiburg.de/go/sensingunits

Scholl, P. M./Kücükyildiz, N./Van Laerhoven, K. (2013): When do you light a fire? Capturing tobacco use with situated, wearable sensors. First Workshop on Human Factors and Activity Recognition in Healthcare, Wellness and Assisted Living (Recognize2Interact). www.pr.uni-freiburg.de/go/tobaccouse

For more information on how the sensor is built and what else it can be used for, watch our video interview with Prof. Dr. Kristof Van Laerhoven on the research portal Surprising Science: www.pr.uni-freiburg.de/pm/surprisingscience



Prof. Dr. Kristof Van Laerhoven

studied computer science at the University of Brussels, Belgium. He then worked at a research institute in Belgium, cooperating with companies like Nokia, Philips, and Epson. He earned his PhD in 2005 at the University of Lancaster, England. In 2006 he moved to the Technical University of Darmstadt to work on his habilitation thesis, where he led the Emmy Noether research group “Embedded Sensing Systems” starting in 2010. In 2013 he received the Google Glass Award for his work. He has served since 2014 as professor of embedded systems at the University of Freiburg. His research focuses on wearable sensors, activity recognition, and machine learning.

Photo: Thomas Kunz

Diverse Alliance

Jürgen Rüländ is studying the example of Southeast Asia to determine how international politics can become more democratic

by Yvonne Troll



Countless islands, separated by vast stretches of ocean – when one looks at Southeast Asia on a map, what one sees is a fragmented landscape. This image is also symbolic of the lack of uniformity that characterizes, and in some respects divides, the countries in the region. While the per capita income of Singapore is relatively high, Cambodia and Laos are two of the poorest countries in the world. Young democracies like Indonesia and the Philippines stand alongside the socialist one-party system of Vietnam, the absolute monarchy in Brunei, and the authoritarian government of Myanmar. And while Indonesia

has more Muslims than any other country in the world, the Philippines are predominantly Christian and Thailand mostly Buddhist.

But there is an organization that unites almost all of the countries in the region: the Association of Southeast Asian Nations (ASEAN), a so-called regional organization. It is the subject of Jürgen Rüländ's research. The Freiburg political science professor has been studying developments in Southeast Asia for more than 30 years. He is interested primarily in how the people of the member countries are allowed to participate in



Different realities: the business district of Singapore, a city state with great economic power, and a traditional settlement in Laos, one of the poorest countries in the world

Photos: Oksana Perkins, Pascal RATEAU (both Fotolia)

the decisions of ASEAN. These decisions are often difficult to understand yet have an increasing impact on the lives of all citizens, says Rüländ. "If one of the greatest goals of the 18th and 19th centuries was to democratize nation states, we will need to devote considerable thought in the future to the question of how international politics can be made more democratic."

“The pressure from below is there and it’s real.”

Rüländ conducts his research from a comparative perspective: The European Union (EU) has also been accused of failing to involve the citizens of its member countries in decisions. In ASEAN, however, this tendency is much more pronounced, the political scientist says. The main points of criticism raised not only by Western observers are thus that the organization is elitist and dominated by the individual nation states. The decisions are

made by a small circle of high-ranking political functionaries, while members of the national parliaments and actors from civil society hardly have any say at all. The cooperation is informal and non-binding, and this makes it largely inefficient. Decisions also require the consensus of all member states. Unlike in the EU, the countries do not transfer any sovereignty rights to the institution. In fact, the principle of non-intervention in internal affairs is held in high regard by the ASEAN members. "The countries were, with the exception of Thailand, subjected to the colonial rule of foreign powers up until fairly recently. It would be unthinkable for them to again relinquish core areas of their authority," explains Rüländ.

The Keyword Is Empowerment

ASEAN has enjoyed a certain degree of success despite these limitations. It was founded in 1967 and has been developing steadily ever since into a solid partnership – albeit with a limited



scope, as Rüländ says. The association aims to create a common market by the end of 2015. “Although this will have a direct impact on the people, for instance with regard to the job situation or the development of competition for small and family-owned businesses, they have practically no say in the matter.”

“The parliament is essentially a facade.”

But the pressure from the populace is rising, and the keyword is empowerment. The people are beginning to articulate their interests and demand their say in political processes. The number of non-governmental organizations (NGOs) and interest groups is on the rise in Southeast Asia. But their work is difficult, says Rüländ. Meetings between ASEAN functionaries and representatives from NGOs last no longer than 30 minutes and consist of a statement read by a third party. Moreover, the NGOs aren’t allowed to elect their own representatives. “The pressure from below is there and it’s real, but the extent of its success is questionable at the moment.”

Rüländ visits the region regularly and seeks direct contact with the actors from societal groups.

Field research is a key component of his complex mix of methods. ASEAN representatives are also important dialogue partners for him, for instance officials from the foreign ministries of the member states or the departments that serve as interfaces between the organization and the people of the individual countries. Since ASEAN’s high functionaries speak a language that is driven by interests and designed to project a certain image, however, it is essential to consult additional sources that present alternative points of view. In addition to the interviews with experts, Rüländ analyzes various written sources, such as websites, blogs, newspapers, official documents, and specialist literature. In this way, he compares data and facts and puts them into perspective.

Rüländ contradicts the common view among researchers that regional organizations around the world are growing more similar to the EU. With regard to terminology, ASEAN has many institutions modeled on Europe. In 2007, for instance, the organization passed a charter in which all of the member states pledged to uphold democracy, the rule of law, and human rights. In the same year, the regional parliament, which had been founded at the end of the 1970s, was subject to a formal reform. By renaming it, the authorities hoped make it appear more democratic – as a reaction to the growing international

criticism to the effect that ASEAN cultivated an elitist political style that ignored the interests of the people.

Global Standards, Local Interpretation

However, it is more important to look behind the terminology, says Rüländ. It is necessary to examine which norms are actually being implemented. “The parliament has neither legislative nor supervisory functions. It possesses only advisory powers. In addition, the positions the members represent are very similar to those of their governments.” Instead of adopting European norms one-to-one, ASEAN adapts them to fit their own interests. In order to preserve harmony and unity, the organization hardly discusses contentious issues like the human rights situation in Myanmar at all. An ASEAN statement on the protection of human rights passed in 2012 is internationally controversial, because it provides loopholes as soon as national interests become involved. “The parliament is essentially a facade,” sums up Rüländ. He regards an organization based on the European model as unrealistic, not



The European Union as a model? The question of whether ASEAN is growing more similar to the EU is one of the topics of Jürgen Rüländ's research.

Photo: European Parliament

least due to the differences between the countries. “This leads to a situation in which it is necessary to remain on the level of the lowest common denominator.”

The topic is embedded in the research focus “Dynamic Alignments and Dealignment in Global Southeast Asia” at the Freiburg Institute for Advanced Studies (FRIAS) and in the project “Grounding Area Studies in Social Practice,” funded by the German Federal Ministry of Education and Research. Besides Rüländ, the project also includes the ethnologists Prof. Dr. Judith Schlehe and Prof. Dr. Stefan Seitz, the economist Prof. Dr. Günther Schulze, and the historian Prof. Dr. Sabine Dabringhaus, who are thus also strengthening research on Southeast Asia at the University of Freiburg. Rüländ's work does not just benefit science; it also has current practical relevance in political consulting. Together with colleagues, he takes part in meetings with think tanks and sits on committees that help to shape German policy on Southeast Asia. In addition, he and his team make sure to stay informed about current developments in the region. “After all, we don't want to just sit in an ivory tower and conduct research for a small group of experts.”

www.southeastasianstudies.uni-freiburg.de



Prof. Dr. Jürgen Rüländ studied political science, history, and German studies at the University of Freiburg. He earned his PhD in 1981 and his habilitation qualification in 1989, both in Freiburg. Following stints in Passau and Rostock, he returned to the Breisgau, accepting a position at the Department of Political Science. From 2001 to 2007 he served as director of the Arnold Bergstraesser Institute in Freiburg. In addition, he has taught and researched for more than seven years at several Southeast Asian universities. His research interests include cooperation and institutions in international relations, globalization, and regionalization; international politics in the Asian-Pacific region; democratization; and political, socioeconomic, and cultural change in Southeast Asia.

Photo: Hanspeter Trefzer

Further Reading

Nguitragool, P./Rüländ, J. (2015): ASEAN as an actor in international fora. Reality, potential and constraints. Cambridge (= Integration through law: The role of law and the rule of law in ASEAN Integration 7).

Rüländ, J. (2014): The limits of democratizing interest representation: ASEAN's regional corporatism and normative challenges.

In: European Journal of International Relations 20/1, pp. 237–261.


Rüländ, J. (2014): Constructing regionalism domestically: Local actors and foreign policymaking in newly democratized Indonesia. In: Foreign Policy Analysis 10/2, pp. 181–201.



A Penchant for Extremes

Sonja-Verena Albers is studying the molecular surface structure of unicellular organisms that live in unusual habitats

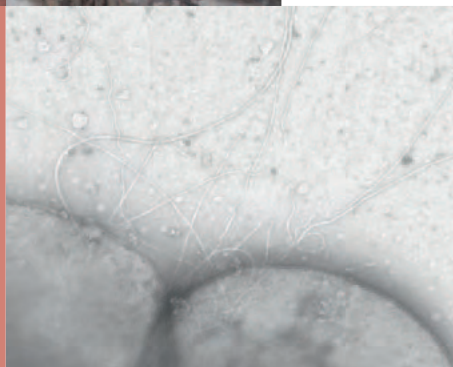
by Eva Opitz



*The sulfur- and acid-loving archaeon *Sulfolobus acidocaldarius* lives in hot springs at Yellowstone National Park at temperatures between 70 to 90 degrees Celsius. Photo: private*

Some like it hot, and others even hotter. Some organisms, like the heat-loving archaea, feel right at home at temperatures between 80 and 120 degrees Celsius. The unicellular organisms measure a mere one micrometer on average, have no cell nucleus, and inhabit extreme living spaces like salt lakes, high-pressure deep sea vents, or highly acidic habitats. "They used to be known as archaeobacteria," says Prof. Dr. Sonja-Verena Albers, professor of microbiology at the University of Freiburg since September 2014. "Scientists long believed that archaea can only exist under severe conditions like these." Albers heads one of five research groups distributed over the entire world that have set themselves the goal of elucidating the surface structure of these unusual organisms with the help of molecular tools.

General interest in archaea grew when it turned out that they do not live only in extreme habitats but may also be found in the intestines and on the skin of humans, yet never cause diseases there. "It is difficult to explain why many bacteria ended up becoming pathogenic but not a single archaeon," says the scientist. When it became clear that a particular substance in human blood increases the risk for heart disease, researchers made a surprising discovery: archaea are the only organisms that grow on this blood component and are therefore capable of reducing its concentration. Scientists are also discussing what role archaea play in diets. "They increase visibly in numbers when people start a fasting cure," says Albers. Methanogenic archaea are also the only organisms that produce methane in mammalian intestines through metabolism. The gas is then released into the environment when we breathe, where it is a known climate factor.



„A whip made of protein filaments that works similarly to a propeller: Archaea move with the help of filament-like structures.

Source: Sonja-Verena Albers

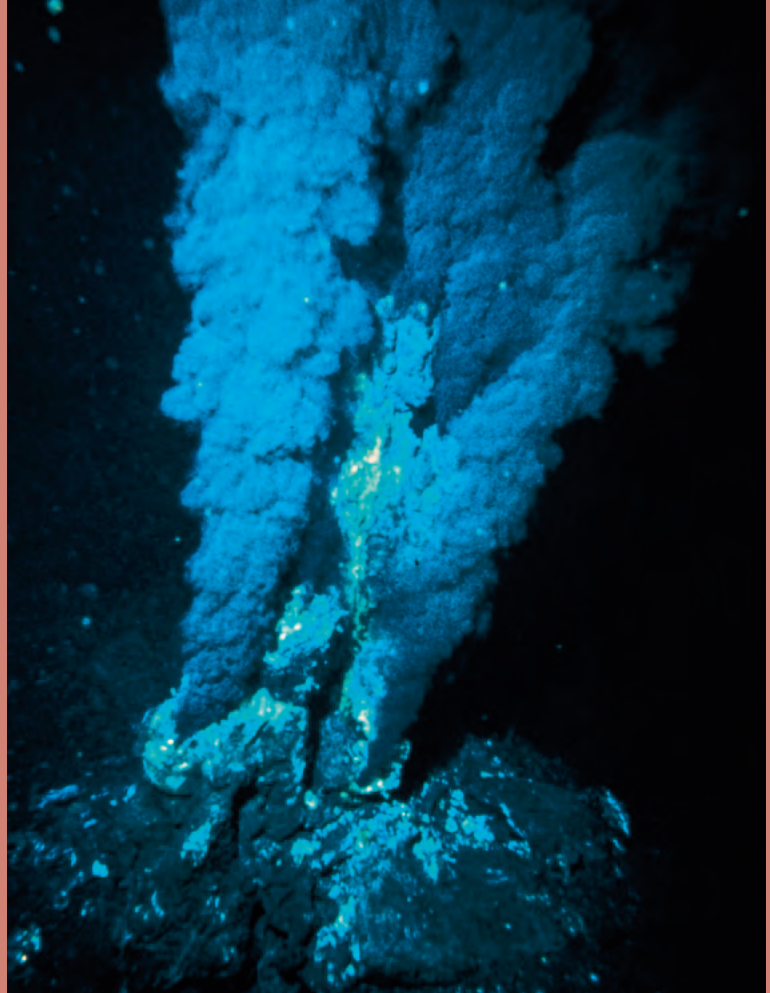
In a Domain of Their Own

In the 1960s and 1970s, researchers dispelled the erroneous belief that these unicellular organisms with a penchant for extremes belong to the domain of the bacteria. Scientists classify all living things into domains, also known as empires. According to the latest classification, archaea form their own domain – as do bacteria and eukaryotes. The last two contain unicellular organisms with nuclei like yeast cells, as well as plants, fungi, and animals. “On the outside, archaea are hardly distinguishable from bacteria,” says Albers. But there are clear differences in their molecular DNA machinery, which helps them translate genetic information into proteins. In archaea this process does not proceed in the same way as in bacteria, but rather more like in eukaryotes. “Moreover, their metabolism works in a completely different way, and important components of the cell wall indicate that these organisms have a unique status,” the microbiologist stresses. In 1977, the American microbiologist Carl Woese demonstrated that the ribosomal ribonucleic acid (rRNA) of archaea is clearly different from that of bacteria. Ribosomes are cell organelles in which protein biosynthesis occurs with the help of ribonucleic acid (RNA).

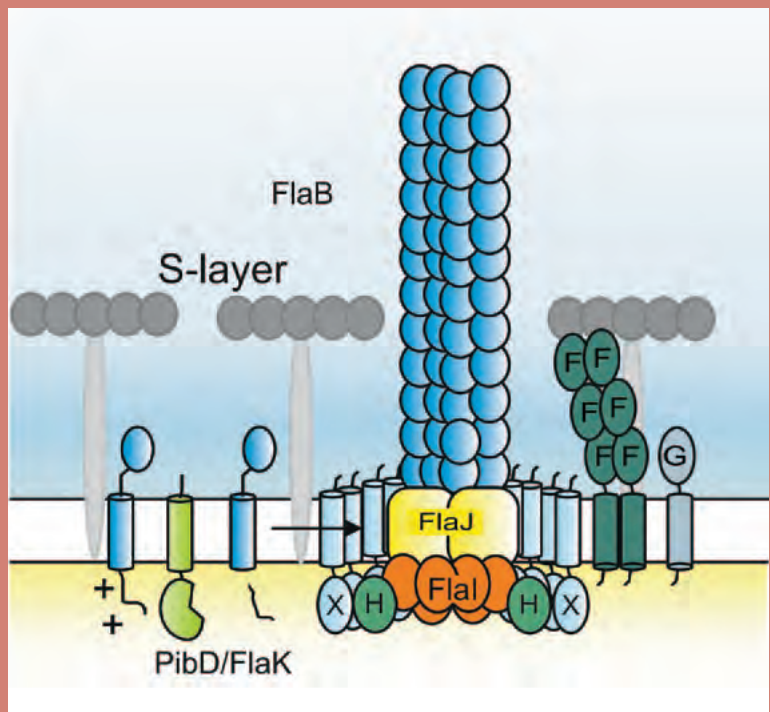
Albers has been studying *Sulfolobus acidocaldarius* in the lab since 1997. She has even brought this sulfur- and acid-loving archaeon back with her to Freiburg from trips to hot springs

„Von außen sind die Archaeen nur schwer von Bakterien zu unterscheiden“

at Yellowstone National Park in the USA. Thanks to this archaeon's preference for hot environments, its proteins are resistant to heat. “We can thus work at room temperature and do without the usual refrigeration,” explains the scientist, who discovered her interest in archaea while writing her degree thesis at the Max Planck Institute of Biochemistry in Martinsried. Her latest findings have led to another unique feature being attributed to the archaea – the way they move. “It had already long been known that archaea can



Hot sulfur vents in the deep sea, so-called black smokers, are home to certain archaea. Photo: P. Rona/NOAA



The archaeon is surrounded by a protein layer, called the S-layer. It gives the cell a solid shell. The archaeum penetrates the S-layer, and its filament is outside of the cell. The archaeum's motor, which powers the filament, is located in the cell membrane and consists of the proteins FlaJ, FlaI, FlaH, and FlaX. The filament protein itself is called FlaB. FlaF and probably also FlaG serve to anchor the archaeum to the cell wall.

Source: Sonja-Verena Albers

move in a way similar to bacteria with the help of filament-like structures.” These structures are whips made of protein filaments and work similarly to a propeller: A “motor” on the end anchored to the cell wall starts them rotating, enabling a swimming motion. It wasn’t until the 1980s that studies demonstrated that the movement apparatus of the archaea has an entirely different structure than that of bacteria. However, these studies assumed that the structure was a so-called flagellum like those of bacteria.

From Flagellum to Archaellum

The first indications that the structure allowing the archaea to move is different came from the field of genomics. While a bacterium’s flagellum needs up to 50 proteins to start the motor enabling it to reach its goal, *Sulfolobus* needs only seven proteins. Albers and her colleague Ken Jarrell from Queen’s University in Ontario, Canada, collected a large amount of data showing that an archaeon’s flagellum is fundamentally different from the complex structure of bacteria. The two decided to rule out potential confusion as to the name of the structures and published an article calling the archaeon’s flagellum an “archaellum” in 2012. Two years later, the name was added to standard microbiology textbooks. “We thus made it clear to students that these are two clearly distinguishable structures,” explains Albers, “flagellum for bacteria and archaellum for archaea.” The corresponding structure in eukaryotes is called a cilium. “All three are domain-specific and evolved independently of one another.”

Another task of the fundamental research Albers is engaged in concerns determining the functions the various proteins in the unicellular archaellum are responsible for. What is certain is that several proteins remain inside the cell, while the motor protein in the cell wall helps them to coordinate the contact with the outside world by way of the thin, cord-like filament proteins outside of the cell. “This tiny, minimalistic motor structure is just as efficient and fast as the more complicated structure of the flagella,” says the microbiologist – she can imagine that what she describes as a “nanomachine” could also provide inspiration for nanobiotechnology. There is already a candidate for the motor protein, which does not destroy the membrane of the cell wall despite its propeller-like rotation and holds the

archaellum in place. “We also still need the precise structure of the other subunits, and we do not yet know how the movement looks in detail.” This will involve genetically modifying individual elements, whose absence provides indications concerning their function.

What *Sulfolobus* – in contrast to the halophilic (salt-loving) archaea – does not have due to its small size is the ability to react to an external stimulus and change its direction by initiating a so-called signal transduction cascade. “Bacteria can identify and head straight for substances that interest them – like a computer that ensures that the stimulus reaches the motor,” the researcher explains. Despite the fact that they have entirely different motors, halophilic archaea and bacteria use the same mechanism to link their movement structure to an external stimulus. “The archaea have adopted the system of bacteria and adapted it to their own motor.” In the end, when the researchers have explained the interplay between all of the elements, they plan to create a three-dimensional image of the entire archaellum.

www.ag-albers.uni-freiburg.de



Prof. Dr. Sonja-Verena Albers was appointed to a chair in microbiology at the Institute of Biology II of the University of Freiburg in 2014. After studying biology in Würzburg, she wrote her degree thesis at the Max Planck Institute of Biochemistry in Martinsried. She earned her PhD at the Rijksuniversiteit Groningen, Netherlands, and received a grant from the Dutch science organization NWO to establish her own research group. In 2008 she was appointed Max Planck research group leader at the Max Planck Institute for Terrestrial Microbiology, and in 2011 she completed her habilitation at the University of Marburg. In 2012 Albers received a starting grant from the European Research Council to continue her research on the archaellum. Photo: private

Further Reading

Shahapure, R./Driessen, R.P./Haurat, M.F./Albers, S.-V./Dame, R.T. (2014): The archaellum: A rotating type IV pilus. In: *Molecular Microbiology* 91/4, pp. 716–723.

Reindl, S./Ghosh, A./Williams, G.J./Lassak, K./Neiner, T./Henche, A.L./Albers, S.-V./Tainer, J.A. (2013): Insights into Fla1 functions in archaeal motor assembly and motility from structures, conformations, and genetics. In: *Molecular Cell* 49/6, pp. 1069–1082.

Jarrell, K.F./Albers, S.-V. (2012): The archaellum: An old structure with a new name. In: *Trends in Microbiology* 20/7, pp. 307–312.

Letting Patients Have Their Say

The website www.krankheitserfahrungen.de provides valuable information for people with illnesses and their families

by Anita Ruffer

Mr. M. was suffering from chronic pain. He had scrupulously followed the orders his doctor had given him, taking his blood pressure three times a day and writing down the results. And what did his doctor's colleague do when he came in for his next checkup? "He glanced at the paper it briefly, crumpled it up, and threw it back to me." The patient accompanies his account with a contemptuous laugh and a throw-away gesture, thus indicating that he found the doctor's behavior insulting. It is not known whether this is how the scene really played out and whether the doctor intended to insult the patient – and that's not the point anyway. What Mr. M. recalls in this form is his subjective perception of the situation, and for him it was a negative experience. The way in which patients construct and present their stories can provide

profound insight into what it's like to live with a difficult illness.

For Prof. Dr. Gabriele Lucius-Hoene from the Department of Rehabilitation Psychology and Psychotherapy at the University of Freiburg's Institute of Psychology, authentic narratives like these provide "outstanding scientific source material." And that's not all: by sharing their experiences with illness, patients help others suffering from the same condition and their families to get used to their new life situation. "Journeys without a map" is how medical sociologist Arthur Frank from the University of Calgary, Canada, refers to the plight of patients suffering from a severe illness, which takes away all of the certainties they had taken for granted up to that point. People who have already been living with an illness for a



With their narratives, patients can support fellow sufferers and their families and help them make decisions. Photo: Britt Schilling

long time can offer others with the same illness practical and emotional support, help them make decisions, and give them useful tips – such as on how diagnostic procedures run, what helped them, and what daily life with the illness is like.

Portraying a Range of Experiences

The Internet is full of blogs, chat rooms, and forums on particular diseases. “But it’s difficult to determine how balanced and relevant the information is,” says Lucius-Hoene. Under her coordination, the Universities of Freiburg and Göttingen launched the website www.krankheits-erfahrungen.de in 2011, and they now also receive support from a working group at the Charité teaching hospital in Berlin. It is the first site in Germany to offer patient stories for specific ill-

nesses compiled with scientific methods. It currently includes modules for seven illnesses and will soon be expanded to nine. The stories are not meant to be statistically representative but to portray as wide a range of experiences as possible: including experiences with doctors, payers, and therapies as well as the interviewee’s own experiences coping with the illness.

“Every contribution is valid.”

Lucius-Hoene and her team conducted up to 50 extensive interviews for each of the illnesses featured on the site, such as chronic pain or type 2 diabetes. They then transcribed them, published them as video, audio, and text files, and organized them by topic with the help of computer pro-

Name: Lisa Nym Datum: 15.10.'14 Nr: 75 **SCHMERZ-TAGEBUCH**

Stimmung:

Morgens: ☹️ 😐 😊
 Mittags: ☹️ 😐 😊
 Abends: ☹️ 😐 😊

Schlaf:

😊 😐 ☹️
 Dauer: 4 1/2 Std.

Sonstiges:

Magenschmerzen,
Migräne, Rücken


Schmerzen:

Morgens:
 Mittags:
 Nachmittags:
 Abends:
 Nachts:

Medikamente:

Morgens:
 Mittags:
 Nachmittags:
 Abends:
 Nachts:

Schmerzregion:



☹️ 1 ☹️ 2 ☹️ 3 ☹️ 4 ☹️ 5

How do people describe pain, and what images do they find for it? Some patients keep a pain journal to document the course of their illness.

Illustration: Svenja Kirsch

grams to provide users with various means of finding the information they need. Since the material is authentic, it is also used for training in medical professions. "The interviewers do not say what they think about the narratives," stresses Lucius-Hoene. "Every contribution is valid." The well-being of the patients was always given precedence over what was good for the website as a whole during the interviews, also with regard to the decision over what could be published. Evaluation studies show that some of the patients experienced the empathetic interviews practically as a kind of therapy.

Expert on One's Own Illness

The team took its inspiration for the concept of the website from www.healthtalkonline.org, on which a group named DIPEX (Database of Individual Patients' Experiences) from the University of Oxford, England, has collected personal stories on more than 90 different illnesses or health questions since 2001. Trained by the English experts, working groups in twelve more countries have launched similar sites and joined the umbrella organization DIPEX International. But just copying the original was not an option: the mentalities and healthcare systems in the various countries are too different.

Whereas medical research usually works with standardized questionnaires and statistical approaches like the counting and analysis of data, krankheitserfahrungen.de provides a unique collection of qualitative data from the perspective of the patients themselves. In compiling the personal accounts of patients, narrative coping research is asserting its place alongside evidence-based medicine. "From an epistemological perspective, that's a paradigm shift," says Lucius-Hoene.

Ultimately, her goal is to give the patients a much higher standing than they have previously enjoyed in the healthcare system as experts on their own illnesses. What needs to happen before doctors finally take the oft-cited need for patient-centeredness seriously? How can they and their patients make participative decisions concerning therapies? It can at least be said that the website received support from the funding priority "Translational Research on Patient-Centered Approaches to Chronic Disease Care," which was established by the German pension insurance fund, the statutory and private health insurance companies, and several federal ministries. The project coordinator believes that it will still be a long time before doctors start taking into account the stories before making decisions on treatment. However, initial research projects

“From an epistemological perspective, that’s a paradigm shift.”

provide indications of what patients need in order to learn how to live with a severe illness.

Imitating the Doctor’s Voice

At any rate, the chronic pain patient Mr. M. certainly did not experience the doctor’s disdainful behavior as supportive. “Doctors should be trained to be conscious of the role they play for their patients in helping them to cope with their illness.” That is the conclusion Lucius-Hoene and a team of colleagues reached in a study on scenes in which patients imitate the voices of their doctors. The team meticulously analyzed 394 such scenes from interviews with 26 type 2 diabetes patients and 30 chronic pain patients – in the knowledge that the way the narrators represent their doctors corresponds to their own emotions and strategic goals at the moment of narration.

“Have you always been so fat?” says a diabetes patient, impersonating her doctor. Like many fellow sufferers, she has to deal with doctors who admonish her in humiliating fashion to change her lifestyle – which, as diabetics know, is actually not a bad idea. But what they want is to feel respected and treated as a person. A pain patient quotes his doctor as having said “Why don’t you go to a psychiatrist?” – thus demonstrating how much people like him have to struggle to gain acceptance for their suffering among those in their personal environment, including their doctors. They feel all too often like they are being labeled as lunatics who only need to put in enough effort and follow their doctor’s orders to get rid of their pain, at least that’s how they describe it in their narratives.

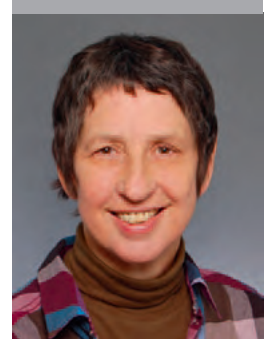
Images for Describing Pain

How should one speak about a disease in the first place? Should one simply not talk about it at all? Leon Murthy wrote a bachelor’s thesis under Lucius-Hoene in which he analyzed how people describe pain and what images they find for it. People with a more rational disposition, for instance, rate their pain in the morning, afternoon, and night on a scale from one to ten. Another

patient speaks of a “glowing iron ball” that “rolls down her spine.” Another module on the website is devoted to epilepsy, an illness that, like chronic pain, is regarded as socially problematic. In a dissertation also supervised by Lucius-Hoene, Martina Breuning established that pain and epilepsy patients both develop their own strategies for how, when, and to whom they reveal their illness.

In any case, talking can help when patients find themselves confronted with the diagnosis of a life-threatening disease like colon cancer – described in one of the more recent modules. The patients use completely different linguistic strategies to grapple with the prospect that their death might be near. That is the conclusion drawn from an analysis of 43 interviews in the dissertation of Dr. Sandra Adami, a research assistant and former doctoral candidate of Lucius-Hoene. While some people tell stories of “other people’s death,” others already know what song they want to be played at their own funeral.

www.krankheitserfahrungen.de



Prof. Dr. Gabriele Lucius-Hoene is a licensed physician and a trained psychologist, neuropsychologist, and psychological psychotherapist. She earned her habilitation qualification in psychology at the University of Freiburg with a thesis on identity constitution and coping in the autobiographical narratives of soldiers with war injuries to the brain and their spouses. She served as a project head at the collaborative research center “Identities and Alterities” from 1997 to 2000. She has coordinated the project DIPEX (Database of Individual Patients’ Experiences) Germany since 2008. She was a fellow at the Freiburg Institute for Advanced Studies (FRIAS) in 2011/12.

Photo: private

Further Reading

Ziebland, S./Lavie-Ajayi, M./Lucius-Hoene, G. (2015): The role of the internet for people with chronic pain: Examples from the DIPEX international project. In: British Journal of Pain 9/1, pp. 62–64.

Lucius-Hoene, G./Groth, S./Becker, A.-K./Dvorak, F./Breuning, M./Himmel, W. (2013): Wie erleben Patienten die Veröffentlichung ihrer Krankheitserfahrungen im Internet? In: Die Rehabilitation 52/3, pp. 196–201.

Lucius-Hoene, G./Thiele, U./Breuning, M./Haug, S. (2012): Doctors’ voices in patients’ narratives: coping with emotions in storytelling. In: Chronic Illness 8/3, pp. 163–175.



Surveillance and Its Consequences

Why public perception should play an important role in the development of new technologies

by Thomas Goebel

What feelings, thoughts, and actions does surveillance elicit in people? What effects does a camera on a public building have, for example? Does it make people feel safe or controlled, are they concerned about what might happen with their images, and does it perhaps even lead them to change their behavior?

These are the kinds of questions the philosopher Dr. Elisa Orrù addresses in her work – at a European level. She is a research assistant and habilitation candidate at the University of Freiburg's Husserl Archive. She also studied practical philosophical aspects of surveillance technologies as a part of the interdisciplinary European Union-funded research project SURVEILLE. The University of Freiburg's part of the project is being conducted at the Centre for Security and Society. The initial question is "How do European citizens

perceive surveillance – and how can this perception be taken into account in developing new technologies?"

However, the question contains a problem from a philosophical-ethical perspective, says Orrù: "One doesn't want surveillance technologies to be seen in a negative light, but one can't deceive the people either." Hence, the goal in developing new technologies cannot be to manipulate them such that people don't even realize anymore whether and how they are being observed. On the contrary, the goal must be a method that takes the perceptions of those concerned seriously and is compatible with the European values of democracy and the rule of law.

To this end, Orrù began by studying what negative effects surveillance can have. She analyzed

interviews in which citizens answered questions on relevant topics and compiled a list of the side effects of surveillance. “First of all, there is the violation of the private sphere,” she says – whether through body searches, the searching or surveillance of private spaces, or control over personal data such as in the recording of telephone conversations or e-mail messages. Second, there is the fear that personal data and information are not sufficiently protected or can be misused.

“When we think we are under observation, we do not behave as we otherwise would.”

In addition, it is possible to make out a “surveillance paradox,” says Orrù: “Surveillance technologies are introduced to give people a feeling of security – but they can also achieve the opposite.” When a space is placed under video surveillance, for example, it can give people the impression that it is especially dangerous there, and when intelligence agencies conduct large-scale operations, the fear of personal data being misused can be greater than the hope for more security.

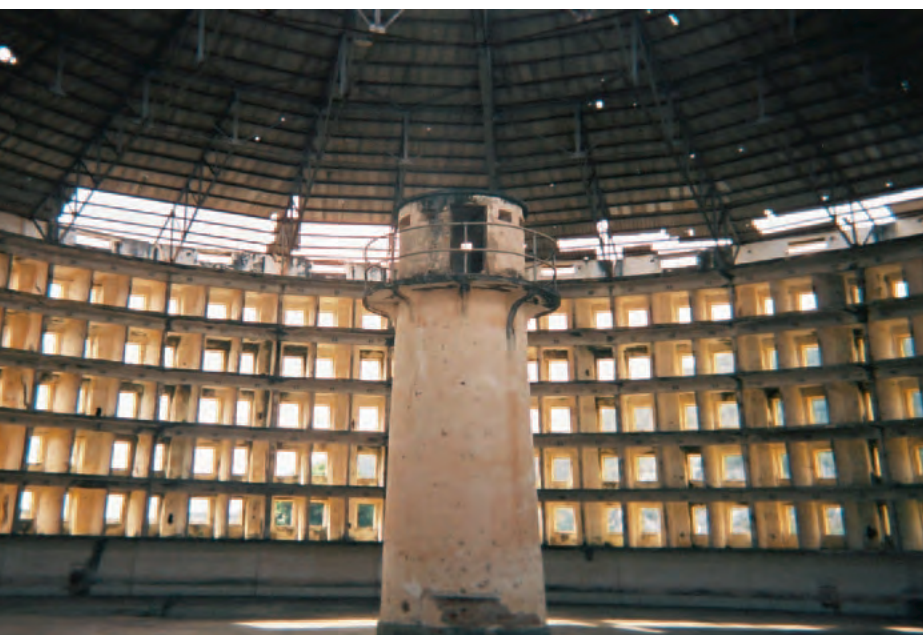
The effect of surveillance is not limited to the individual either, says Orrù, but also has an indirect impact on society through so-called chilling effects, sometimes also referred to as deterrent effects. “When we think we are under observation, we do not behave as we otherwise would.” Even just the feeling of being under surveillance can lead to unquestioning obedience or self-censorship, whether this is a conscious reaction or not. “That can have negative consequences for rights like freedom of assembly,” says Orrù – because in case of doubt, the citizens will prefer to back off.

Future surveillance technologies should take into account potential problems like these by design, says Orrù, not afterwards. Here she refers to a concept developed by Ann Cavoukian, the former Information and Privacy Commissioner of the Canadian province of Ontario, that is currently the subject of much debate in the EU, namely that of “privacy by design.” However, Orrù would recommend replacing the term privacy: “If there is surveillance, there can never be complete privacy. The term can thus lead to misunderstandings.” Besides, it cannot encompass all of the side effects it entails, she adds.

Three New Principles

Orrù recommends replacing the concept of privacy with three other concepts. The first principle should be to limit the extent of intrusions and violations as much as possible: “minimum harm by design”; second, it should be visible from the outset which measures are being introduced with what purpose, how they work, and how efficient they are: “transparency by design”; and third, it should remain clear at all times who is doing what with which data and who is responsible for it: “accountability by design.” This could be documented technically, for example on log files. In the SURVEILLE project report, Orrù advises the EU to apply these three principles to all future research and development in the area of security technologies.

Orrù also deals with the effects of surveillance in her habilitation project, which is being supervised by the Freiburg philosophy professor and director of the Husserl Archive Prof. Dr. Hans-Helmuth Gander. Her working title for the thesis is *Surveillance and Power: A Philosophical Analysis Based on Three Surveillance Initiatives*



Big brother is watching you: The panopticon principle enables a single guard to watch every prisoner. They do not know when they are being watched – and are always under pressure to be on their best behavior. Photo: Friman/Wikimedia Commons

in the European Union. The concept of privacy is also a focus of her analysis in this project: "My thesis is that we should not give up the concept but extend it to include citizens' perceptions."

Classical definitions of privacy are primarily about excluding others or controlling access to the private space. That is too static and too narrow for Orrù. She prefers the definition of the cultural



Photo: stockphoto-graf/Fotolia

and media studies scholar Helen Nissenbaum, who understands privacy as "contextual integrity": "Every communication situation involves legal norms, but even more important are social norms that are often not explicitly stated," explains Orrù. "According to this understanding, there is privacy when we can be sure that these norms are being respected." In other words, we must be certain that doctors won't publish the results of diagnoses with our name on the Internet and that friends won't pass on secrets that we have entrusted to them.

Means of Power

In politics, this concept can help us to grasp violations of privacy that would otherwise be concealed, says Orrù – and it leads us to the question of who makes and has control over which rules. "Surveillance is always also a means of power." She aims to study three European surveillance initiatives: the EURODAC database, which contains the fingerprints of asylum-seekers, the "Schengen Information System" (SIS II), which was introduced to compensate for the discontinuation of border controls, and the plans for data retention laws. "In the realm of freedom, security, and law, the distribution of powers between the national states and the EU is still unstable," she says. The political decision-making

processes in this context have not yet been completed, and it is therefore easy to observe how power is distributed.

The historian and social philosopher Michel Foucault has also studied the interplay between surveillance and power. He invokes the idea of the panopticon, a type of prison building with a watchtower in the center allowing all of the inmates to be watched at all times. "They know that they can always be watched," says Orrù. That alone is a form of discipline – regardless of whether they are actually being watched or not. Totalitarian states in the Eastern bloc influenced the behavior of their citizens in a similar way, leading them to always expect that the authorities were keeping a file on them, even when this was not actually the case.

This brings Elisa Orrù back to the starting point of her considerations. She stresses again the importance of taking into account the perceptions of the people who are, or at least think they are, being kept under surveillance. In the case of a public building in which cameras were placed for a time, for example, it only came out under the pressure of protests that they were fake. "If all we are doing is making sure that no private data is violated, we will come to the conclusion that there is no problem here because nothing was collected and kept on file," says Orrù, "but we should indeed have a problem with it."

www.surveille.eu

Dr. Elisa Orrù

studied philosophy at the University of Milan, Italy. In 2008 she earned her PhD from the University of Pisa, Italy, with a dissertation on legitimation issues in international criminal law. She has conducted research in Princeton, USA, at the Max Planck Institute for Comparative Public Law and International Law in Heidelberg, and several times at the Max Planck Institute for Foreign and International Criminal Law in Freiburg. Since 2013 Elisa Orrù has been writing her habilitation thesis at the University of Freiburg's Faculty of Humanities. She is a research assistant at the Centre for Security and Society and at the Husserl Archive.

Photo: Thomas Goebel

Further Reading

Foucault, M. (1977): *Discipline and punish: The birth of the prison*. New York.

Orrù, E. (2013): Report on methodology and criteria for incorporating perception issues in the design phase of new surveillance systems. SURVEILLE Deliverable 3.6, published online at <http://surveille.eui.eu/research/publications>.

Nissenbaum, H. F. (2009): *Privacy in context: Technology, policy, and the integrity of social life*. Stanford.

Masthead

uni'wissen, the research magazine of the University of Freiburg, is published twice a year.

Publisher

Albert-Ludwigs-Universität Freiburg,
Rector Prof. Dr. h.c. Hans-Jochen Schiewer

Responsible for Content

Rudolf-Werner Dreier,
Director of the Office of Public Relations

Expert Advisory Board

Prof. Dr. Jürgen Bausch, Forest Science
Prof. Dr. Ralf von den Hoff, Archaeology
Prof. Dr. Gunther Neuhaus, Vice President for Research, Biology
Prof. Dr. Sabine Rospert, Medicine
Prof. Dr. Margit Zacharias, Vice President for Innovation and
Technology Transfer, Microsystems Engineering

Editorial Staff

Nicolas Scherger (Head Editor)
Rimma Gerenstein, Yvonne Troll

Address of Editorial Staff

Presse- und Öffentlichkeitsarbeit
Albert-Ludwigs-Universität
Fahnenbergplatz, 79085 Freiburg
Phone: +49 (0)761 203-4301
Fax: +49 (0)761 203-4278
E-Mail: uniwissen@pr.uni-freiburg.de

Print Run

9,000 copies

English Translation

Dr. David Heyde

Design, Layout

Kathrin Jachmann

Cover Photo

Thomas Kunz

Advertisements

Gregor Kroschel
Phone: +49 (0)761 203-4986
gregor.kroschel@zv.uni-freiburg.de

Printing and Production

Hofmann Druck, Emmendingen

Distribution

Office of Public Relations

Yearly Subscription Price

6 euros
uni'wissen is available free of charge
for members of the university.

ISSN 2194-8054

© Albert-Ludwigs-Universität Freiburg. All rights reserved.
Reproduction, also of excerpts, only with permission from
the editors. Articles indicating the author's name do not necessarily
reflect the opinions of the publisher or the editors.
The editors reserve the right to edit or abridge articles sent
in by external contributors.

uni'wissen is available online at
www.wissen.uni-freiburg.de



Presse- und Öffentlichkeitsarbeit
Albert-Ludwigs-Universität
Fahnenbergplatz, 79098 Freiburg
Telefon 0761/203-4301
Fax 0761/203-4278
E-Mail uniwissen@pr.uni-freiburg.de
www.wissen.uni-freiburg.de