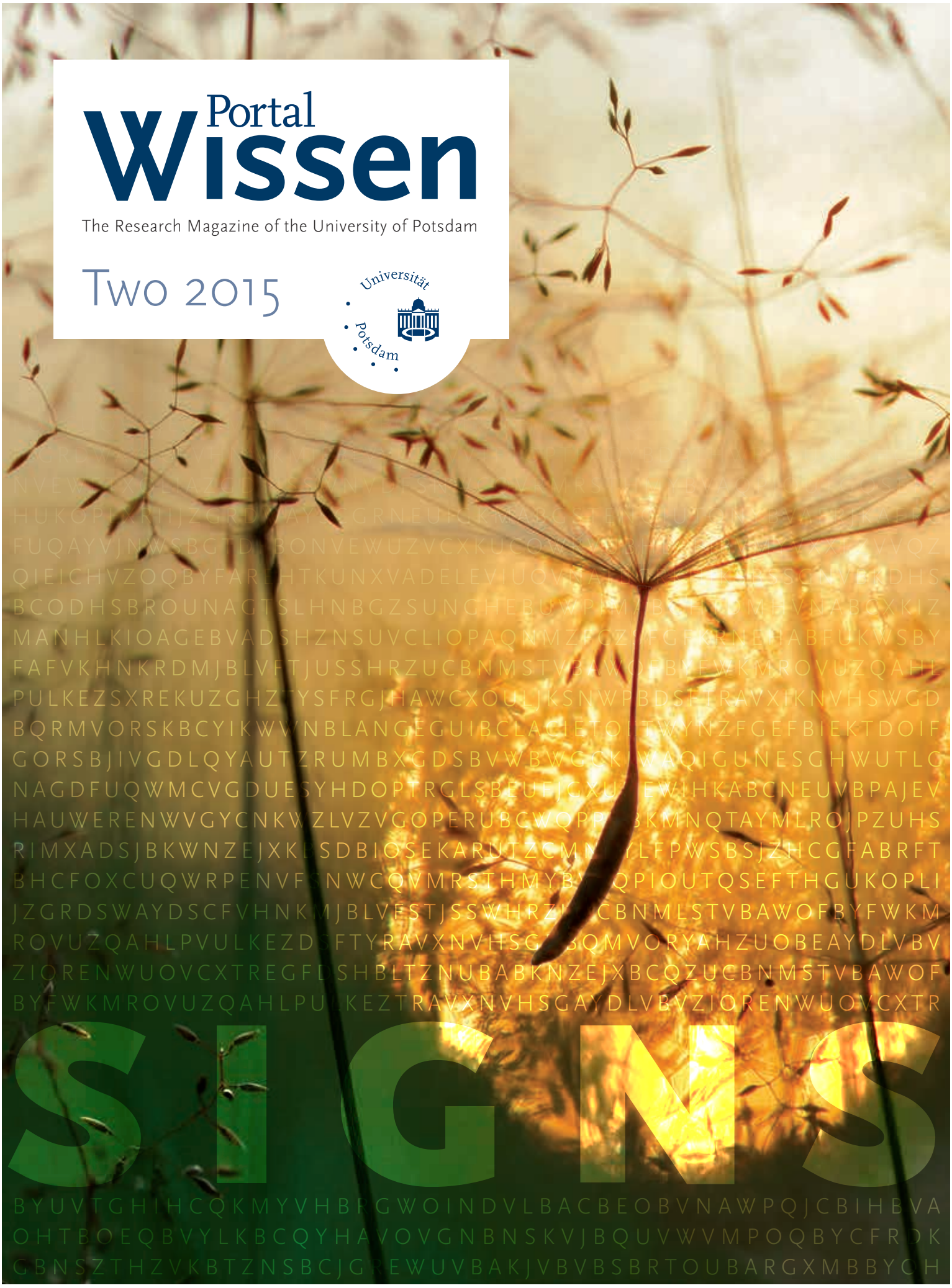
Portal Wissen

The Research Magazine of the University of Potsdam

Two 2015

Universität Potsdam



SIGNS

The Photographer of Signs

Sandra Bartocha took the cover photo and the pictures introducing the five themed sections of the magazine.

I love nature. It makes me really happy to be outside and feel the elements. As a nature photographer I have to keep an eye out for signs – for example weather signs that create the perfect conditions for shooting my photos. Has the night been cold and the morning windless enough to create the necessary fog in the forests in autumn? What do satellite pictures and the precipitation radar have to say? Will there be nice, fluffy clouds and a clear sunny evening that allow me to work with light in the landscape?

When I am out in nature, I pay attention to internal signs. Moments that make me pause, situations that fascinate me because they appeal to me aesthetically and emotionally. Why do I find a situation beautiful? Why does it appeal to me? What is the essential element I want to capture? This raises the question of the right technique and realization to perfectly capture this specific motif and mood.

The intended result of this process is not, however, to document but rather to interpret the experienced scene and thereby takes on a very personal dimension.

THE PHOTOGRAPHER

Sandra Bartocha is a nature photographer and a specialist author as well as a project seminar leader. She grew up in Mecklenburg-Western Pomerania and fell in love with the striking landscape of the Baltic Sea, the forests, and lakes of this unique German federal state. Bartocha studied Media Studies, English Language and Literature, and Educational Studies at the University of Potsdam. She is chief editor of the magazine »Forum Naturfotografie«. Between 2007 and 2013 she was vice president of the German Association of Wildlife Photographers (GDT). Sandra Bartocha has successfully participated in national and international competitions like »Wildlife Photographer of the Year« and »International Photography Awards«. She took part in the pan-European project »Wild Wonders Of Europe«. For four years, Bartocha has been working on a long-term multimedia project – »LYS« – about northern Europe.

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Our service for you. Scan further links directly with your smartphone or tablet and a free app for QR-Codes (e.g. ZBar, QR Code Scanner, QR Droid).

Photo: Bartocha, Sandra

Dear Readers,

Signs take a variety of forms. We use or encounter them every day in various areas. They represent perceptions and ideas: A letter represents a sound, a word or picture stands for an idea, a note for a sound, a chemical formula for a substance, a boundary stone for a territorial claim, a building for an ideology, a gesture for a cue or an assessment.

On the one hand, we open up the world to ourselves by using signs; we acquire it, ensconce ourselves in it, and we punctuate it to represent ourselves in it. On the other, this reference to the world and ourselves becomes visible in our sign systems. As manifestations of a certain way of interacting with nature, the environment, and fellow human beings, they provide information about the social order or ethnic distinctions of a certain society or epoch as well as about how it perceives the world and humanity.

As a man-made network of meanings, sign systems can be changed and, in doing so, change how we perceive the world and humanity. Linguistically, this may, for example, be done by using an evaluative prefix: human – inhuman, sense – nonsense, matter – anti-matter or by hierarchizing terms, as in upper class and lower class. The consequences of such labeling, therefore, may decide on the raison d'être of the signified within an aspect of reality and the nature of this existence.

Since ancient times we have reflected on signs, at first mainly in philosophy. Each era has created theories of signs as a means of approaching its essence. Nowadays semiotics is especially concerned with them. While linguistics focuses on linguistic signs, semiotics deals with all types of signs and the interaction of components and processes involved in their communication. Semiotics has developed models, methods, and concepts. Semiosis and semiosphere, for example, are concepts that illuminate the processing of signs, i.e. the construction of meaning and the interaction of different sign systems. A sign is not limited to a monolithic meaning but is culturally contingent and marked by the socio-economic conditions of the individual decoding it. Sociopolitical and sociocultural developments therefore affect the processing of signs.

Dealing with signs and sign systems, their circulation, and reciprocal play with shapes and interpretive possibilities is therefore an urgent and trailblazing task in light of sociocultural communication processes in our increasingly heterogeneous society to optimize communication and promote intercultural understanding as well as to recognize, use, and bolster social trends.

The articles in this magazine illustrate the many ways academia is involved in researching, interpreting, and explaining signs. Social scientists at the University of Potsdam are examining whether statistics about petitions made by GDR citizens can be interpreted retrospectively as a premonitory sign of the peaceful revolution of 1989. Colleagues at the Institute of Romance Studies are analyzing what Alexander von Humboldt's American travel diaries signalize, and young researchers in the Research Training Group on "Wicked Problems, Contested Administrations" are examining challenges that seem to raise question marks for administrations. A project promoting sustainable consumption hopes to prove that academia can contribute to setting an example. An initiative of historians supporting Brandenburg cities in disseminating the history of the Reformation shows that the gap between academia and signs and wonder is not unbridgeable.

I wish you an inspiring read!

PROF. DR. EVA KIMMINICH
PROFESSOR OF ROMANCE CULTURAL STUDIES

Photo: Kimminich, Prof. Dr. Eva

Omen

Vorzeichen

Signalize

Ausgezeichnet

Signs and Wonders

Zeichen und Wunder

Punctuation

Zeichensetzung

Question Marks

Fragezeichen

Imprint

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Photo: Bartocha, Sandra


OMEN

The True Richard III

What bones tell us about people, or how Professor Michael Hofreiter decodes the DNA of the English King

The skeleton of Richard III.

Photo: University of Leicester

No, Richard III did not have a hunchback; Lars Eidinger is exaggerating. When the actor prepares for his role as king of England at Berlin's Schaubühne and adds a hunch to his back, this is just theater. It is his way of suggesting the evil that has been ascribed to the English king for centuries. Whether Richard III actually was the unscrupulous monster that Shakespeare depicted in the darkest colors, Prof. Michael Hofreiter cannot say. But he does know that the hunchback is an exaggeration. "Richard III suffered from scoliosis, which caused a misalignment of his shoulders. That's all. And he was neither dark-haired nor dark-eyed, as often portrayed, but had blonde hair and blue eyes."

The Potsdam researcher can prove these details and many more. Together with a team of 15 specialists, he performed a scientific analysis of the king's skeleton – and a skeleton discloses not only age, eye color, and hair color, but also cardiovascular problems, earwax consistency, and lactose tolerance. The meticulously isolated and purified DNA, which is now being decoded step by step in the laboratories on the Golm campus of the University of Potsdam, speaks a clear language: it reveals the genotype of the supreme military leader of the English army, who lost his life at Bosworth Field in 1485. In their laboratories, the researchers ground small samples of the royal bones and teeth, dissolved them, and sifted out the genetic material. In the end, there was almost a hundred percent certainty that these were the remains of Richard III.

But how did samples of the royal remains, which surfaced in the Middle English town of Leicester in 2012, end up at the University of Potsdam? Professor Hofreiter, who is dressed casually in jeans, t-shirt, and organic slippers, worked in England for four years. He knows the full story of the late recovery of Richard III. However, the long line of small animal figurines on Hofreiter's desk indicates that many of his earlier projects must have been in a different field. He has researched extinct mammoths, cave bears, saber-toothed tigers, and wild horses; animal biodiversity is his true passion. "Fierce battles are raging in the field of human genetics, so I prefer to avoid them. Besides, sources of contamination with modern DNA are very high in number." But he made an exception for the English king. In the laboratory, strict care is taken to ensure sterility. The researchers standing between the centrifuges and freezers wear gloves, and the most sensitive areas can only be entered via a security door system. By the end of the year the Professor of General Zoology and Evolutionary Adaptive Genomics, who grew up in Bavaria, hopes to finish this project and return to his research on extinct animals.

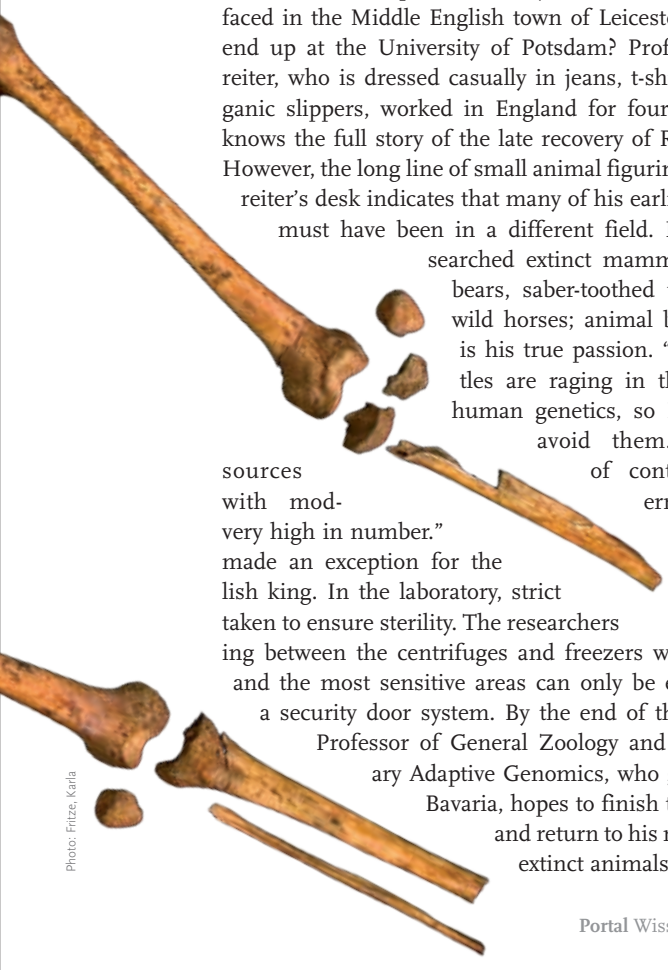

Photo: Fritze, Karla

For Hofreiter, the research project on Richard III began in 2012 with a phone call from geneticist Turi King of Leicester University. "Turi King always wanted to learn more about old DNA from me. She told me that the Richard III Society was searching for the remains of their revered king." Richard III was one of the few English kings whose skeleton was presumed lost. It was known that he had been laid to rest in the Franciscan monastery of Leicester – but Henry VIII had most monasteries razed, including this one. At least there were old maps of the former site. It turned out that the foundations of the monastery had been covered by a parking lot. So a small ditch was dug there on 25 August 2012 – and what a find they made! "It was stunning," Michael Hofreiter says. The excavated skeleton was almost complete. "Only the feet were missing." Scientists soon established that these were the remains of a man in his mid-30s; the wounds also fit with what we know about Richard III: The skeleton showed signs of eleven injuries, nine of which on the skull. All evidence pointed to Richard III.

> *"But genetics would have the final say."*

But genetics would have the final say. For that, living descendants of the king had to be found. The genealogists followed many clues, combed through church registers, marriage records, land registers, and old newspapers – and came up with two maternal and five paternal relatives, some of whom were unaware of their aristocratic background. They were scattered across the country, and one of them was tracked down as far as Australia.

Richard III himself had no living descendants. All his offspring, born in or out of wedlock, died childless. So the researchers followed the lineages of his sisters and great-great-grandfather. "There are two regions in the human genome that are passed on almost un-

THE RESEARCHER

Prof. Dr. Michael Hofreiter studied biology in Munich and earned his PhD at Leipzig University in 2002. Until 2010 he worked at the Max Planck Institute for Evolutionary Anthropology in Leipzig. He held a professorship in evolutionary biology and ecology at the University of York until 2013, when he was appointed Professor of General Zoology/Evolutionary Adaptive Genomics at the University of Potsdam.

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The tomb of Richard III was found under a parking lot.

changed from generation to generation: First, the mitochondrial DNA from the mitochondria, the energy sources of cells. These 'power stations' have their own genes, which make up about 16,000 of our three billion base pairs. They are maternally inherited, through the ovum," Hofreiter explains. Second, the Y-chromosomes. These sex chromosomes are passed down from father to son. Of the seven descendants found, the five on the paternal lineage turned out to be unrelated to Richard III. In other words, since Edward III – the common ancestor of Richard III and his five descendants and Richard III's great-great-grandfather – there must have been a "milkman's child" in at least one of the lineages, that is, a child from an extramarital affair. The two maternal descendants were "real". "It's less likely there is a 'milkman's child' in the maternal lineage," Hofreiter says, "unless a baby was switched at birth." The researchers were very lucky. They now have the technical capabilities to decode centuries-old DNA and opened the right window of opportunity at just the right time. "In a few decades, the lineage of Richard III will be extinct. The two maternal descendants have no children."

"There are two regions in the human genome that are passed on almost unchanged from generation to generation."

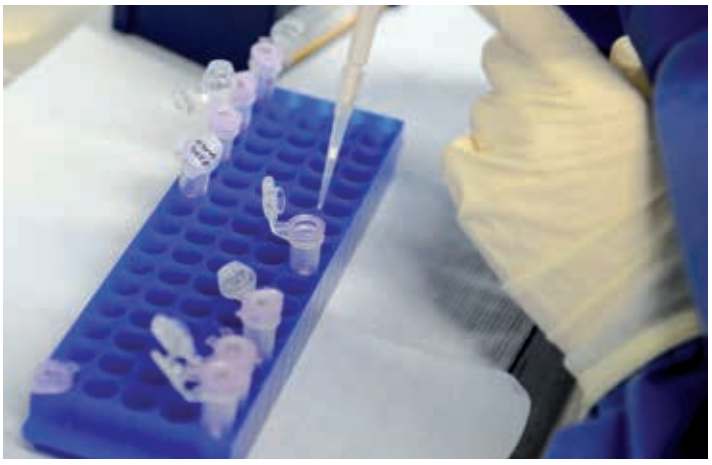
"We now have the technical capabilities to decode centuries-old DNA."

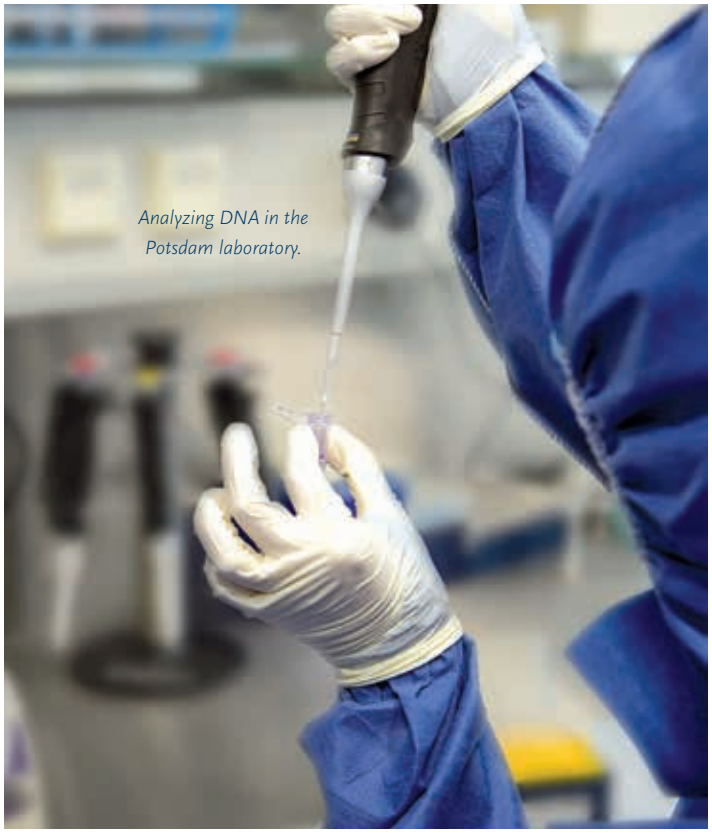
The two living descendants of Richard III from the maternal lineage: Wendy Dulig and Michael Ibsen.

Portrait of Richard III, 16th century.

Photos: University of Leicester (3); Wikimedia/gemeinfrei (bottom right)

The **genome,** or genetic material, of a living organism or virus is the entirety of material carriers of the heritable information of a cell or virus particle: chromosomes, deoxyribonucleic acid (DNA) or ribonucleic acid (RNA) in the case of RNA viruses, in which RNA (not DNA) is the carrier of information. In a more abstract sense, the genome represents the entirety of heritable information. Thanks to the rapid development of modern techniques, much progress has been achieved in genome analysis in recent years. It is estimated that about 20,000 researchers worldwide are involved in decoding the human genome alone.





Analyzing DNA in the Potsdam laboratory.

On 4 February 2013, a press conference was held in Leicester, in which the definitive positive identification of the Richard III's remains was announced. In December 2014 the genetic facts were published in a paper by 18 authors, led by Turi King and Michael Hofreiter. They would have liked to finish the entire project by the time the remains of Richard III were reburied as part of a one-week ceremony in Leicester in late March 2015. "But that was not possible. We are planning to have the genome completely analyzed by the end of the year – including any genetic defects," Michael Hofreiter explains. A total of €50,000 has been earmarked for the project. "The costs of such analyses are much lower these days than they used to be. The first genome sequence extracted from fossils, the Neandertal genome, had a budget of €5 million. And now, just five years later, the same can be done for €10,000. Since we want to considerably improve quality, we have budgeted €50,000 for Richard III to get a high-quality genome that offers all sorts of answers."

The bone dust has almost been used up. What was left was returned to Leicester, where it was buried with the remains of Richard III. Michael Hofreiter could not attend, for time reasons. He would also like to see the performance of Richard III at the Schaubühne – despite scientific inaccuracies. "But at the moment I have no time to go to the cinema or theater." And he missed the Wave Gothic Meeting in Leipzig in May this year. Does Michael Hofreiter feel drawn to mortality in his spare time, too? "No," he says cheerfully. He just enjoys the music and the great atmosphere of the city where he has been researching old DNA for over 10 years. In his early days, he worked in the laboratory; these days he spends most of his time in front of his computer writing manuscripts and applications for third-party funding.

"We are planning to have the genome completely analyzed by the end of the year – including any genetic defects."

HEIDI JÄGER

Photos: Fritze, Karla (3)

Thaw in the Permafrost

Will the Siberian tundra become a source of carbon emissions?

Photo: Schennen, Stephan

The permafrost soils of the Arctic are the cold stores of the North. What they shut in over thousands of years is kept safe: plant remains, animal bones, microorganisms. But it seems that climate change is slowing this cooling system. Air temperatures are rising, twice as much as the global average. In the thawing soil, microbes are starting to break down carbon, which enters the atmosphere in the form of the greenhouse gases methane and carbon dioxide, further contributing to the heating up of the climate. The Russian-German Project "CarboPerm" drills down on this subsurface problem. Potsdam geophysicists help to look into the ground.

As Stephan Schennen and Jens Tronicke trudge through rough terrain, their feet sink into the mud. Every few decimeters, geophysical profile lines run across the surface. The muddy ground of the Great Lyakhovsky Island far in the North, in the Siberian Arctic, gives the researchers a hard time. With a ground-penetrating radar, they send electromagnetic waves into the ground and register travel time and amplitude of the reflected signals to make hidden geological structures visible. When a storm rolls in, the Potsdam geophysicists interrupt their work, as they do not want to risk damaging the sensitive devices. Spare parts cannot be obtained here. If anything goes wrong, everything will have been in vain.

In the summer of 2014, PhD student Stephan Schennen made his second trip to the Great Lyakhovsky Island to collect data for the CarboPerm project. Electromagnetic and geoelectric methods allow him to "look" up to 25 meters into the ground in an area the size of a football field. And while boreholes show the composition of the soil or its sediments at one particular point, his geophysical methods can map larger underground structures, even in 3D.

The idea to include geophysicists from the University of Potsdam in the investigations was a result of the close collaboration between researchers from Potsdam's Alfred Wegener Institute/Helmholtz Centre for Polar and Ocean Research, who are in charge of the CarboPerm project, and the Institute of Soil Science of Hamburg University. For many years they have been researching Siberian permafrost landscapes with their Russian colleagues. Many drill cores were transported to laboratories, where they were analyzed layer by layer in order to reconstruct, for instance, the climate of past millennia. But they had no way of probing a larger area. "Our technologies permit us to explore and characterize the underground across a wide area," says Jens Tronicke, Professor of Applied Geophysics at the University of Potsdam. "Be it in archaeology, geology, or engineering – geophysical methods can be applied anywhere, and now on permafrost soil, too."

> *"Our technologies permit us to explore and characterize the underground across a wide area."*

Marked out measuring surface in a secondary valley, the outcrop shows the extremely ice-rich sediments.

Data acquisition with a ground-penetrating radar on a permafrost site in the summer.

Under the auspices of the CarboPerm project, geophysicists from Potsdam work hand in hand with polar, oceanic, and atmospheric scientists, with geologists, biologists, and soil scientists and geochemists. It is the first time that such a comprehensive methodical approach has been applied in a permafrost region, with researchers analyzing the same samples, data, and measurements from one particular place in the Siberian Arctic. Together they want to find out more about the organic carbon that has been stored there for thousands of years, about its formation, turnover, and release as a result of global warming.

"It is the first time that such a comprehensive methodical approach has been applied in a permafrost region."

And the problem may indeed reach dramatic proportions: The permafrost soil covers as much as a quarter of the landmass of the northern hemisphere and holds 1,700 gigatons of carbon, that is about 2.5 times the amount of carbon in the global vegetation.

If temperatures continue to rise, will these gigantic Arctic carbon reservoirs turn into sources of carbon emissions? This is the question plaguing the project's researchers. To find answers, they do not mind braving the harsh Arctic conditions.

The Great Lyakhovsky Island is nearly uninhabited. At camp at the mouth of a river, built by reindeer herders, the researches stay in wooden houses on skis, which can be moved in the winter on ice and snow. Even though the researchers arrive in the spring, temperatures can drop to -30°. For heating there is nothing more than a potbelly stove, Stephan Schennen explains. During his first visit in April 2014, it was still snowing. He had to interrupt his work many times to protect the sensitive measuring devices. "I had brought some spare parts, cables and

"If you know you have only three weeks and can't come back easily, every minute counts."

THE PROJECT

"CarboPerm" is a three-year project comprising multidisciplinary investigations into the formation, turnover, and release of organic carbon in Siberian permafrost. Project partners are the Alfred Wegener Institute of Polar and Ocean Research, the universities of Potsdam, Hamburg and Cologne, the German Research Centre for Geosciences in Potsdam, the Max Planck Institute in Hamburg and Jena as well as Russian institutes. Research focuses on the effects of climate-induced and environmentally related changes on the sensitive terrestrial Arctic ecosystems and the natural production of greenhouse gases in tundra landscapes. The German Federal Ministry of Education and Research (BMBF) is funding the project with €4.5 million.

www.carboperm.net

Photo: Schennen, Stephan

plugs, and large rechargeable batteries, which lasted quite a while. In the end, I was very lucky; everything went fine."

During the second measuring campaign last summer everything went according to plan, too. It does not get dark there at night, as the sun never sinks below the horizon, but that did not affect the sleep of the exhausted young geophysicist. As long as he was awake he was measuring. "If you know you have only three weeks and can't come back easily, every minute counts."

This spring Stephan Schennen went on his – for the moment – last trip to Siberia. This time he travelled to the Lena delta to take geophysical measurements on the islands of Samoylov and Kurungnakh. Back in his office, he displays 3D images of the surveyed underground on his laptop. An enormous amount of data has been collected and needs to be analyzed. He plans to finish his doctoral thesis by the autumn of 2016 when the CarboPerm project also ends. The project aims to more reliably forecast the development of permafrost soils and their contribution to the global carbon balance. At the International Permafrost Conference in Potsdam in 2016 the researchers will present their results.

ANTJE HORN-CONRAD

THE RESEARCHERS

Prof. Dr. Jens Tronicke studied geophysics in Münster. After being awarded his PhD in Tübingen, he researched at various universities in the US and at the ETH Zurich. Since 2005 he has worked as a Professor of Applied Geophysics at the University of Potsdam.

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Stephan Schennen studied geosciences with a focus on geophysics in Bremen and Potsdam. Since 2013 he has been a doctoral student in the CarboPerm project.

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Walking back to the base camp after a long day of measuring.

Photos: Fritze, Karla (top); Schennen, Stephan (3. center, bottom)

Photo: Bartocha Sandra


SIGNALIZE

Pages from Humboldt's American Diaries.

Il y a dans l'Orinoco un poisson Mapurito qui pue horriblement !

Palometa

des Abdominaux. Corps. large ovale, comprimé. Bouche petite. dentes acutissimi in utraque maxilla : yeux très grands. Ecailles très petites couleur de nacre de perle. une grande nageoire dorsale, 2 petites pectorales et 2 ventrales plus petites encore. Queue fourchue. Le corps forment au bas ventre des épines dirigées une scie, cette scie va jusqu'à $\frac{2}{5}$ de la queue. on commence une énorme nageoire anale. Orinoco. Guarico. Atabapo.
Long 3 po. largeur 5 y.

Barbanche

cod. loco. des Abdominaux sans écailles, à
applatie horizontale. Des rétes au lieu
forme de rubans de 1 li de large et 6
gulaire, comprimée par en haut, plat
dessus elle une crête de cuir jusqu'à
rales, 2 ventrales plus grandes et une
Loricaria. 2 barbes dans la machoire sup

Caparro

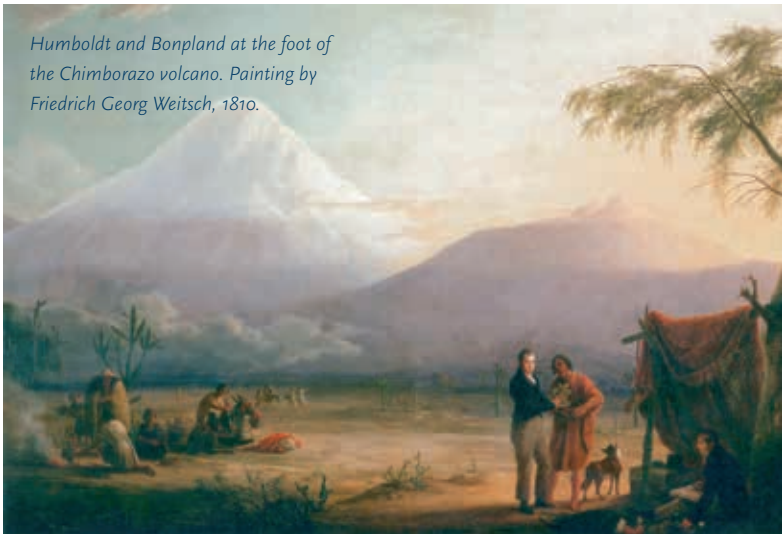
ed loco. à grandes écailles, argenté verdatre.
pinnes, l'anale très large, queue fourchue.
vant deux épines, tournées vers la tête.
oblonge, comprimé. au Cyprinus.

Photos: Staatsbibliothek zu Berlin – PK (3)

Leaving Behind Signs of Life

Humboldt's American Travel Diaries

Between 1799 and 1804, Alexander von Humboldt (1769–1859) and his companion botanist Aimé Bonpland undertook three major expeditions: They explored the Orinoco River and the Rio Negro, crossed the Andes Mountains and climbed the Chimborazo volcano, and trekked through Mexico to the United States, where they met President Thomas Jefferson. Humboldt recorded his observations in his "American Travel Diaries", which were acquired by the Prussian Cultural Heritage Foundation in the autumn of 2013. Since early 2014, a group of experts led by Prof. Dr. Ottmar Ette has been researching the diaries in the sub-project "Genealogy, Chronology and Epistemology". The objective is to look back on and reappraise the untapped quantity and breadth of Humboldt's observations. A second sub-project, "Preservation, Contextualization and Digitalization", at Berlin's State Library is dedicated to preserving and digitalizing Humboldt's scientific heritage.



Humboldt and Bonpland at the foot of the Chimborazo volcano. Painting by Friedrich Georg Weitsch, 1810.

Humboldt feared disappearing: vanishing off the face of the earth, drowning or being buried under masses of snow. Not only for his own sake, but also out of fear of his notes being lost for future generations. "Humboldt wanted to leave behind signs, which is why he wrote day and night during his American journey," Ottmar Ette explains. We are indeed lucky his travel notes were not lost given what is written in them. After all, while traveling on the Orinoco, Humboldt and Bonpland's pirogue – a small dugout canoe used by the indigenous population – capsized and Humboldt's notes went overboard as well. Humboldt risked his life to save them. "He would later blame the captain," Ette smiles. While walking across a snow slab during the expedition through the high Andes, Humboldt's biggest fear was that his notes would fall into the depths with him. "These anecdotes show the fragility of Humboldt's work and the precariousness of passing these notes on to us," Ette underlines. To make sure his "signs of life" would not be lost forever, Humboldt sent many letters to Europe during his journeys through America, so at least some of his comprehensive, transgressive thinking would be preserved.

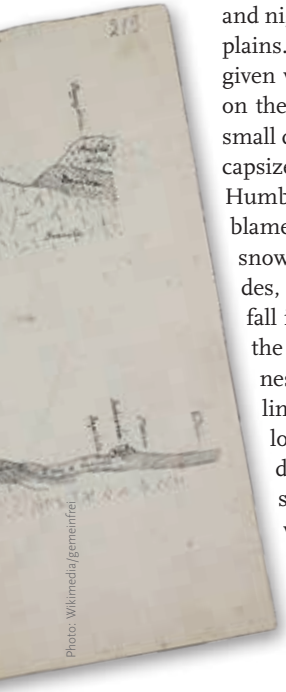


Photo: Wikimedia/gemeinfrei

Project coordinator Dr. Julian Drews describes Humboldt's scientific motivation as very modern: "He wanted to feed himself into a network of knowledge. Humboldt's knowledge was not monolithic; it was dynamic and flexible." That is why the Berlin researcher did not appreciate the Academy of Sciences planning to honor him with a bust during his lifetime. He objected – and won. "This is typical of Humboldt," Ette says with a smile. A bust did not fit with Humboldt's way of thinking. He was constantly correcting himself, as doctoral student Julia Bayerl reports: "Humboldt amended the marginal notes in his travel diaries even decades later." They were a life's work.

> *"Humboldt's knowledge was not monolithic; it was dynamic and flexible."*

This work consists of nine volumes Humboldt had bound in pigskin after his return. All in all, they comprise 4,000 pages written in ink and pencil in French, German, Spanish, Latin, and even the languages of the indigenous populations. He chose to describe mining in German, plants and animals in Latin, and events and remarks about the journey in French. "Humboldt practically wrote the whole time. The number of pages he produced is amazing," Ette remarks. "Paper was scarce. During the journey, they had to constantly replenish their paper stock," Julian Drews adds. Humboldt wrote

Dr. Julian Drews, Prof. Dr. Ottmar Ette, and Julia Bayerl.

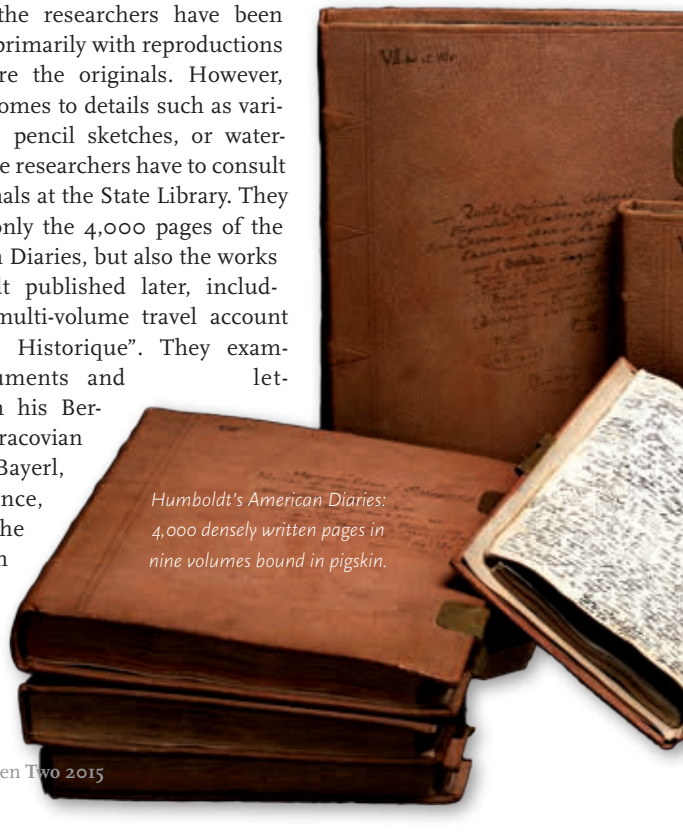
while on-board the pirogue on the Orinoco, very dangerous given the monkey cages and the sail behind him; he wrote in the jungle, plagued by mosquitos, by candlelight, oil lamp or the stars. At one point there are 150 blank pages, so the exhausting walk up the Chimborazo must have made writing impossible. His mental condition is reflected in his diaries, too: "You can tell his mood by the regularity of his handwriting," Ette points out.

As a natural scientist, Humboldt's fields of interest spanned from anatomy to zoology. He did not think only in narrow scientific disciplines; he wanted more: "Humboldt wanted to find out what binds the universe at its core," Ette explains. "He searched for signs of life on our planet." Humboldt was interested in the totality of life forms and the signs they create. So after his journey to America, he exchanged ideas on sign systems, vigesimal systems, and language with his brother Wilhelm. Last but not least, he wanted to record his own life in writing. "Humboldt knew that science is a neverending story, but the life of a human being is not," Ette states.

"Humboldt knew that science is a neverending story, but the life of a human being is not."

The American Diaries testify to Humboldt's goal to make the invisible visible. While traveling on the river he drew up maps, made drawings of the inside of a mountain, and sketched landscapes from a bird's-eye view. It may have been his way of silencing his fears of getting lost: providing an overview and looking for the macrocosm in the microcosm. "Humboldt also described previously unknown plant and animal species. Who knows if we would know them today without him," Julia Bayerl adds.

Three doctoral students and two postdocs are working on the sub-project at the Institute of Romance Philology in Potsdam. Since the Berlin State Library has completed the digitalization of Humboldt's Diaries, the researchers have been working primarily with reproductions – to spare the originals. However, when it comes to details such as various inks, pencil sketches, or watermarks, the researchers have to consult the originals at the State Library. They use not only the 4,000 pages of the American Diaries, but also the works Humboldt published later, including his multi-volume travel account "Relation Historique". They examine documents and letters from his Berlin and Cracovian estates. Bayerl, for instance, studies the American



Humboldt's American Diaries: 4,000 densely written pages in nine volumes bound in pigskin.

Photos: Fritze, Karla (2, top); Staatsbibliothek zu Berlin – PK, Carola Seifert

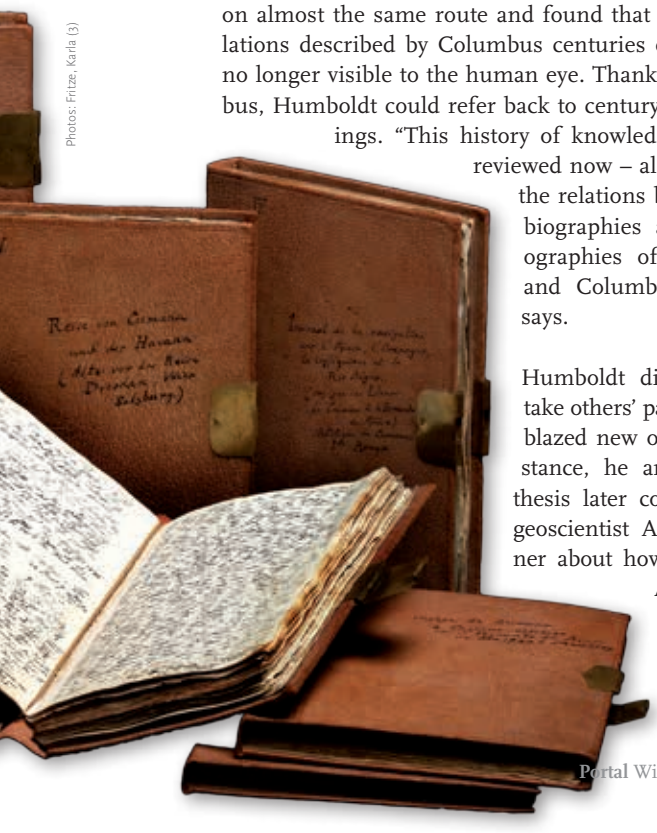
THE PROJECT

The joint research project **"Alexander von Humboldt's American Travel Diaries"** is funded by the BMBF and spans three years, 2014-2017. It combines two sub-projects: **"Genealogy, Chronology, Epistemology"** at the University of Potsdam under the supervision of Prof. Dr. Ottmar Ette and "Preservation, Contextualization and Digitalization" at the State Library of Berlin, Prussian Cultural Heritage Foundation. Both projects have been closely linked and funded by the BMBF, after the Prussian Cultural Heritage Foundation acquired the diaries in the autumn of 2013.

http://www.uni-potsdam.de/humboldtart/projekt/bmbfverbundprojekt.html

Diaries from a pictorial science research perspective, a very attractive and challenging venture as "Humboldt made more than 400 sketches in these diaries. Humboldt learned early in life from Daniel Chodowiecki how to do copperplate engraving and etching," the scientist explains. She focuses on the complex relations between pictorial and written images. Among other things, she compares the travel diaries with his later travel book "Voyage aux régions équinoxiales du Nouveau Continent" written between 1805 and 1838, which is partly based on the travel diaries. Of particular note is that not all sketches from the diaries where chosen to be published in the travel book and engraved in copper. "I can only assume at this point that Humboldt did not publish these sketches because he considered them not concise enough, or the high printing costs forced him to be selective." Bayerl mentions various kinds of images in the diaries: mathematical and astronomical visualizations, animal and plant illustrations, diagrams, in-depth studies of architecture and hieroglyphs, and maps and mountain profiles. She even takes a closer look at stains. Of course, they are not images in the traditional sense, but are very telling visually: an inkpot tumbled over or water of the Orinoco; Humboldt also used stains to mark passages in the text. On only one occasion did he draw a human being: a priest wearing a hat and some sort of high-heeled shoe. "Presumably this type of shoe was worn in the high Andes for better grip," Ette says.

Julian Drews researches the history of the "discovery" of America from an epistemological point of view. After all, Humboldt's journey to America is considered the "second discovery" of the continent. Humboldt walked in the footsteps of Christopher Columbus and in fact carried a copy of his biography. He crossed the Atlantic on almost the same route and found that the constellations described by Columbus centuries earlier were no longer visible to the human eye. Thanks to Columbus, Humboldt could refer back to century-old recordings. "This history of knowledge must be reviewed now – also based on the relations between the biographies and autobiographies of Humboldt and Columbus," Drews says.



Photos: Fritze, Karla (3)

Humboldt did not only take others' paths; he also blazed new ones. For instance, he anticipated a thesis later confirmed by geoscientist Alfred Wegener about how the South American and African coastlines fit together like a jigsaw puzzle. For Humboldt, this was a clear indication of the existence of a former supercontinent. We now know this supercontinent "Gondwana" drifted apart over millions of years. He was just as fascinated by the similarities between ancient Egyptian and early American cultures – including the development of pyramidal architectonic structures and theocratic societies. "For Humboldt everything was in motion and interconnected," Ette says. "He was the first proponent of globalization theory."

JANA SCHOLZ

THE RESEARCHERS

Prof. Dr. Ottmar Ette studied in Freiburg and Madrid; since 1995 he has held the chair of Romance Literature at the University of Potsdam. He is the manager of the research project on Alexander von Humboldt "American Travel Diaries: Genealogy, Chronology and Epistemology" (2014–2017), which is funded by the German Ministry of Education and Research (BMBF).

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Dr. Julian Drews studied Spanish philology, general and comparative literature and philosophy at the Universities of Potsdam and Granada. From 2008-2011 he was an associate member of the post-graduate program of the German Research Foundation (DFG) "Life forms and life knowledge" and earned his doctoral degree in 2013. Since January 2015 he has been a research assistant (post-doc) and coordinator in the BMBF joint research project.

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Julia Bayerl studied Romance literature and art history at the universities of Regensburg, Buenos Aires, and Santiago de Compostela. In February 2014 she joined the BMBF project as a research assistant and doctoral student. Her doctoral thesis focuses on "Iconotextual Studies of Alexander von Humboldt's American Travel Diaries".

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BRAIN scholar John Jansen is at home on high plateaux

The Australian geoscientist John Jansen researches the formation of the Scandinavian Mountains

Photos: Egerum, D.L.

John D. Jansen sampling bedrock in Jotunheimen, Norway.

"When people think of mountains most bring to mind steep, towering slopes with jagged peaks, as in some parts of the Alps", says John Jansen. "But many mountain ranges have significant areas that are flat-topped." The Australian geoscientist with European roots is currently at the Institute of Earth and Environmental Science to pursue an exciting geological question: What actually causes flattish surfaces, or plateaux, to form in high mountains? The answer could reveal not only a lot about the history of mountains and their evolution, but also challenge a theory that has prevailed for more than a century.

"The existence of high plateaux has traditionally been interpreted as evidence for tectonic uplift," says Jansen. "The flattish topography is usually thought to have formed long ago when that landscape was close to sea level followed by rapid tectonic uplift to its present-day high elevation." But more recently, geoscientists have proposed alternatives to tectonism for explaining some plateaux. Climate is the other major process that shapes Earth's surface, and at high-latitudes mountains have experienced a very long history of cold climate dating back more than 10 million years when Earth experienced accelerated cooling. "Cold climate processes, such as glacial erosion and frost action, might also have the capacity to develop flattish topography in situ without any involvement of tectonics." The goal is now to test this hypothesis and to do so, this Australian has left his sunny homeland for a research project that will take him and his team to remote parts of the Scandinavian Mountains. "Nature is already diabolically complicated, so it often helps to study slightly simpler systems where fewer things are going on all at once. This helps with targeting the fundamental processes that drive landscapes." Scandinavia presents a natural laboratory to examine the role of cold-climate processes, because the region has not been subject to large-scale tectonic uplift.

> *"Nature is already diabolically complicated, so it often helps to study slightly simpler systems where fewer things are going on all at once."*

The mountain felsenmeer plateaux make for a rather hostile workplace, but Jansen seems to thrive in such environments. He clearly relishes the combination of intellectual and physical labour that comes with a career in geoscience: "We walk up steep mountains with heavy gear, dig holes, walk back down with even heavier packs filled with stones and sand for the lab; it's insane but fun too," he laughs. "Best of all are probably the weeks spent in far-flung places with comrades who can reliably work hard and have fun while doing so. This produces good science."

THE RESEARCHER

John D. Jansen, Ph.D. studied geology at the Bendigo College. He received his doctoral degree at Macquarie University in Sydney in 2001. He worked at the University of Wollongong, the University of Glasgow, the University of New South Wales and the Stockholm University. Since December 2014 Jansen has been a Marie Skłodowska-Curie Fellow at the Institute of Earth and Environmental Science at the University of Potsdam.

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Photo: Egholm, D.L.

He is also grateful for his good fortune. "I've been very lucky to have spent the years since gaining a PhD working with some very clever folks in many wonderful landscapes. I especially like dry, stony places, but seem always to wind up in cold, wet spots," he jokes about Norway and Scotland, where he was based at the University of Glasgow for six years. The time in Glasgow signalled a major shift in Jansen's interests. Up until that time he was primarily a fluvial geomorphologist (a specialist in desert rivers) and had barely seen a glacial landscape let alone worked on one. "The Scottish Highlands opened up a new world of processes associated with ice." That work involved studying waterfalls and what they reveal about how rivers respond to glacio-isostatic rebound, which is the rapid uplift of Earth's crust following ice sheet decay. "We applied cosmogenic nuclides in a neat way that allowed us to measure the rates at which knickpoints (waterfalls) were migrating upstream and therefore deepening valleys." Cosmogenic nuclides by the way are formed in surface rocks due to bombardment by cosmic rays from exploding supernovae. Jansen describes that some of his work involves highly sophisticated technology and collaboration with geochemists and accelerator physicists. "Using cosmo is way out and especially funny as I can't even operate a telephone properly!"

The research in Scotland led naturally to Scandinavia. "Actually, it's glacio-isostatic rebound that first got me interested in Scandinavia. The Scottish Highlands, around Loch Linnhe, are rebounding today at about 2 mm per year, which is fast, but northern Sweden is rocketing up at 10 mm per year!" Such uplift rates are among the fastest anywhere on Earth, but yield just a few hundred metres of uplift in total—nothing like the kilometres of uplift experienced by mountain ranges such as the Himalayas or the Andes. As it turned out, the Swedish rivers lack the erosional power to down-cut and counteract this uplift and instead get carried up with the rebounding landscape. Jansen found that most of the erosion, in fact, occurs under the ice during deglaciation when huge volumes of meltwater and sediment combine to cut bedrock gorges in just a century or two. "This was a surprising finding and we published the results last year in *Nature Communications*."

> *"The Scottish Highlands opened up a new world of processes associated with ice."*

Another string to Jansen's research involves extreme events. In April he travelled to Nepal along with fellow Geohazards Group members Amelie Stolle and Wolfgang Schwanghart to help with their project examining cataclysmic floods. "It's not easy to imagine such a gigantic event, but roughly 5 cubic kilometres of gravel and sand were ejected from the Annapurna massif into the Pokhara valley—possibly involving a combination of earthquakes, landsliding, and the collapse of a temporary lake high up in the mountains," he explains. "Most amazingly, this all happened just 800 years ago, which is just yesterday in geologic terms." Such recent events are a reminder of the colossal upheavals that frequently characterise this part of our planet. Indeed, Jansen and his colleagues were fortunate to depart

The Gråskarvet Plateau, Norway.

Photo: Espen Dahl

Kathmandu just days before the massive earthquake struck on 25th April.

Extreme erosion and deposition during deglaciation is one of Jansen's major research themes. Along with Martin Margold at Stockholm University, he is documenting the size and timing of floods associated with the collapse of a huge ice-dammed lake in a remote part of Siberia. "There were several floods more than 200 m deep flowing down the Vitim-Lena river system to the Arctic Ocean just as the big ice sheets were breaking up at the end of the last two ice ages." Big influxes of freshwater into the Arctic Ocean have the potential to trigger major climate feedbacks in the northern hemisphere. Jansen makes the point here that "We know that climate drives rivers and glaciers via precipitation, but in the case of the Siberian superfloods, surface processes might have driven changes in Earth's climate system. It's complicated and endlessly fascinating."

The fieldwork in Russia also feeds Jansen's political interests. "I'm very interested in totalitarianism; its development and aftermath, perhaps," he suggests, "due to reading too much Orwell and Kundera as a teenager." Russia was not an easy place to work back in 2012, but in light of more recent events we've put further work on hold until change finally comes and who knows when that will be," he says grimly. Of course living in the former GDR offers another historical perspective, which clearly inspires Jansen too. "Living in amongst the last 80 years of German history means a lot to me. My father is Dutch but his father's family came from Germany."

"The plateaux topping high-latitude mountain ranges might have developed via cold-climate processes."

Before moving to Potsdam last December, Jansen had been working in Scandinavia for some years already. After Glasgow he moved on to a postdoc at Stockholm University and it was there that he became familiar with the long-standing theory that sees Norway's mountain plateaux as remnants of uplifted peneplains whose flatness was established close to sea level more than 100 million years ago. The flattish summit areas are termed the Paleic Surface, which literally means ancient, and Jansen agrees that "they probably do have very ancient roots, but I question whether such areas were ever close to sea level, and as for Mesozoic peneplains I think it's fair to say that the evidence is rather thin. Such ideas go back to the work of W.M. Davis more than a century ago, yet still carry undue influence especially in some far corners of the geoscience community."

In fact, Jansen questions the whole idea of describing erosional landscapes in terms of age. "It's a question that's more usefully framed in terms of erosion rates, not ages. When you think about it, nearly every part of a mountain landscape is eroding: some regions, like Taiwan, are eroding at more than five km per million years, whereas others like central Australia are eroding at less than one metre per million years." Jansen suggests that the impulse for ascribing an age to a given landscape surface is outmoded, and lacks real meaning for contemporary landscapes, except in rare cases. "Advances with cosmogenic nuclides and thermochronometry mean that erosion rates can be determined very precisely over a wide range of timescales. This has been a revolutionary step forward for the geosciences and we are applying these new approaches to understand the evolution of the Scandinavian Mountains."

John D. Jansen sampling bedrock with a rock cutting saw.

Photo: Egholm, D.L.

The Scandinavian plateaux are certainly eroding slowly, but even slow erosion has an effect over very long time spans. Over the last 2-3 million years glaciers have cut valleys and fjords more than 2 km deep in some places, but the felsenmeer plateaux extending between deep valleys have been subject to intense frost action over more than ten million years. "We know that freeze-thaw processes break up rock and transport it downslope via a diffusion-like process known as frost creep. We're calibrating mathematical models with field-based analyses and cosmogenic nuclide measurements to test the hypothesis that frost action can cause topographic smoothing over many millions of years. In other words, the plateaux topping high-latitude mountain ranges, such as in Norway and Greenland, might have developed via cold-climate processes and need not be linked to tectonics at all."

Thanks to a BRAIN-Marie Curie Fellowship, Jansen joined the group of Oliver Korup, Professor for Geohazards at the Institute of Earth and Environmental Science, last December. "Oliver has assembled a talented group of researchers. Here in Potsdam there's an expert in virtually every branch of the geosciences," he enthuses. In addition, Jansen will be working with colleagues in Denmark, Sweden and Australia. This international project demands a cosmopolitan lifestyle with a lot of movement, but "most importantly", he says, "I always try to travel with my old three-speed bike. It's heavy like a tractor and perfect for snowy winter days and for blowing off steam in the woods nearby."

MATTHIAS ZIMMERMANN

Photo: Bartocha, Sandra

Ancient Languages and the Benefits of Slowness

Classical Philologist Ursula Gärtner

Ursula Gärtner gets carried away when talking about Catullus' love poems – and her passion is contagious. She talks about how the Roman poet's use of the "narrating I" when talking about his feelings immediately spoke to his readers. Gärtner is Professor of Classical Philology at the Historical Institute of the University of Potsdam and listening to her evokes similar feelings as readers of Catullus' poems. Sitting in her office with a view of antique-like colonnades, the researcher tells us what moves her so much about her subject. "These wonderful texts are still so vivid today. They speak to us directly yet also have the charm of being distant." Gärtner is interested in how these ancient texts affect readers. She is especially drawn to the imagery: pictures can signify a lot – emotions, facts, or people.

When asked whether one should learn Spanish or Latin, Gärtner answers, "Our advantage is slowness." Learning ancient languages, unlike modern ones, is not about communicating as quickly as possible but rather understanding them and their functionality from within. She also emphasizes the traditional cultural and historical orientation of her subject, which provides access to Europe's roots. "Literary forms, such as fables, that had been shaped in ancient times were later transformed by Jean de La Fontaine and Gotthold Ephraim Lessing." European philosophy and historiography were also determined by ancient societies. Classical philology investigates not only fiction but also a variety of texts forms – for example, in philosophy, medicine, and historiography. "All texts handed down through history can be read as literature. There is no strict separation."

THE RESEARCHER

Prof. Dr. Ursula Gärtner has been Professor of Classical Philology at the University of Potsdam since 2002 after being an Assistant Professor at Leipzig University and Interim Professor in Potsdam und Mainz. She habilitated in 2000 about Virgil's impact on imperial Greek literature.

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Photos: Fritze, Karla (2)

Gärtner is particularly interested in the fables of Phaedrus. She believes he was a very well educated author from the upper class. That his texts address the upper crust of Roman society strongly contradicts previous research, which interpreted Phaedrus as a freedman expressing an adaptive morality in the form of fables. Gärtner believes, however, in poetological play in fables. "He is a poet very familiar with Greco-Roman poetry, continually alluding to the existing literary topoi." He altered, for example, the poetological metaphor adopted from the Hellenistic poet Callimachus, which says that you should not walk wide roads but small paths – i.e. produce new, fine poetry. Ironically Phaedrus contradicted this metaphor: "I have followed [Aesop] and have made the path a road." For Gärtner, a felicitous pun: "The irony reminds me of Monty Python," she says, laughing, "when the crowd in the movie Life of Brian shouts, 'Yes, we are all individuals' and one person interjects: 'I'm not.'"

"All texts handed down through history can be read as literature."

Gärtner is proficient not only in Latin and Ancient Greek but also Hebrew. She acquired the Hebraicum on her own initiative at school in a "Hebrew study group". "Over two years, three of us met at our religion teacher's house, where we had tea and cookies while preparing for the Hebraicum." Her father was a professor of classical philology in Heidelberg at the time, which is why Gärtner, born in Heidelberg, went to Freiburg after high school. "I could not study under my father," she says. In Freiburg, she initially studied classical philology and Protestant theology – not least because of her love of Hebrew in the Old Testament. After two semesters, however, she realized that she would not become a pastor. Her passion for ancient languages remained, and Gärtner finished her doctorate about similes in the work of Valerius Flaccus in only one year with a scholarship of the "Studienstiftung des deutschen Volkes".

Her first application after her habilitation in Leipzig was successful (and she was accepted): 13 years ago Gärtner came to Potsdam. She took over a young subject at the University of Potsdam. Classical Philology had only been established in 1995. "My two predecessors had laid the foundation, and we built on it," Gärtner remembers. "The Potsdam Latin Day is my baby," she says with a smile. When she established this event 10 years ago, only 70 people took part. Today, 500 participants attend the Latin Day lectures, which are specifically geared toward the interests of school children and teachers of Latin. "It shows that Latin is not an exotic subject but one that attracts tremendous interest," she says. The speakers are not only Latinists and Graecists. Many visitors come from related disciplines. The Latin Day was the starting point for the project "www.BrAnD2. Wille. Würde. Wissen. Zweites Brandenburger Antike-Denkwerk", funded by the Robert Bosch Stiftung from 2014-2017. Within the framework of this project, five schools enter into a dialog with the University. In March, six months after the Latin Day, the University of Potsdam hosts a schoolchild congress, in which children present projects on a given topic. Students of classical philology support them didactically. The theme of the last conference was the concept of "the will". One group, for example, did a role-play on the Forum Voluntatum. "Some of the schoolchildren really delved into the matter with a lot of courage and fantasy," says the philologist.

Front page of an edition of Phaedrus' fables published in Leiden in 1745.

"It shows that Latin is not an exotic subject but one that attracts tremendous interest."

Gärtner has helped develop a new research focus in the field: ancient imagery. The research field is highly topical, since it connects to both Visual Studies and Digital Humanities. "We investigate how certain elements in the literature evoke imagery in the mind of the reader," says Gärtner. The imagery of similes in the ancient epic has particularly interested her since her doctorate. At that time, she had the idea to create an anthology of the

Photo: Wikimedia/gemeinfrei

Passionate about classical languages: Prof. Ursula Gärtner.

similes from the ancient epic and a corresponding database. This project is now taking shape: Together with colleagues from Tufts University in the USA, Gärtner is working on a "Linked Open Dataset of Similes in Ancient Epic Poetry". It includes datasets on numerous search criteria: ones referring to abstract forms ('Tertium Comparationis') like "wrath", comparative images of "lions", or even people like "Achilles". It simultaneously creates a new instrument to retrieve, link, and represent such data. "Both here in Potsdam and at Tufts University we are trying to involve students in helping us locate the similes and enter them into the database," Gärtner says. An application for external funding has been submitted. "The project is not only interesting for classical philology but also for a variety of subjects."

Such projects show how fruitful classical philology research can be for a broad spectrum of disciplines in the humanities. The symposium "Text Kontext Kontextualisierung" organized by Gärtner in July 2015 was also dedicated to this rudimentary, yet explosive topic in the humanities. "When we speak of contexts, we usually mean that we have found a basis for a better understanding of an object under investigation." Experts of various disciplines presented their conception of "context". Again, Gärtner refers back to Phaedrus. He was the first Roman author to make the fable its own literary genre. Before him, fables had traditionally been used in a text to illustrate an argument. Phaedrus created the genre of the fable, which enticed readers to contextualize and interpret for themselves.

Although Gärtner, born in Heidelberg, feels comfortable at the University of Potsdam and was "very cordially" welcomed by her colleagues 13 years ago, she has other plans for afterwards. "My husband and I dream of retiring to Vienna." Until then, though, there is still time – the philologist still has a lot ahead of her at the University of Potsdam.

JANA SCHOLZ

Photos: Fritze, Karla (3)

Test setup.

Photo: Lee, Choonkyu

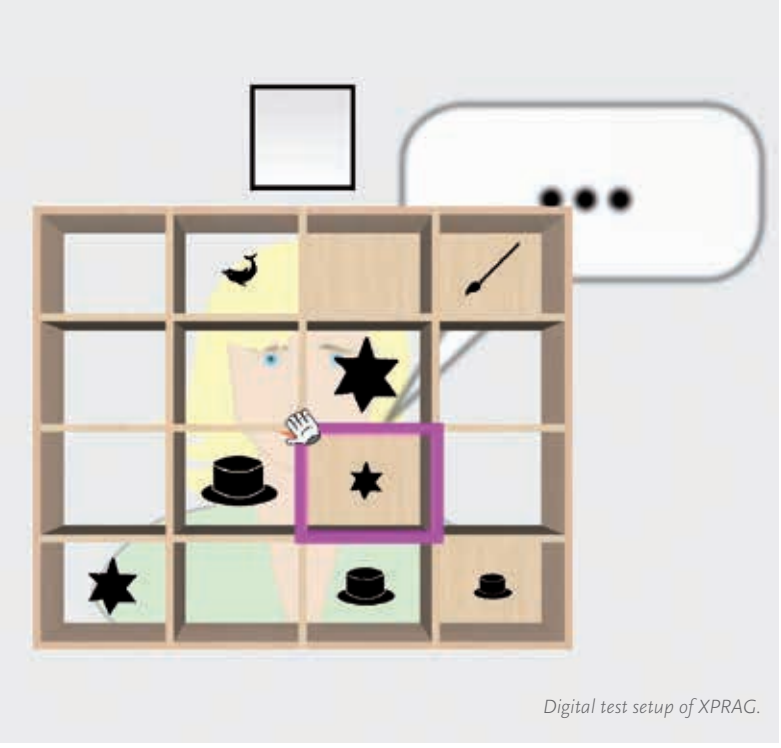
WITH **MY** LITTLE EYE…

Linguists research how information is processed in the brain when we change our perspective

"I might speak differently to you than I would speak to someone else," Isabell Wartenburger says. This is how the Professor of Patholinguistics/Neurocognition of Language summarizes one of her current research projects. Since she is aware that a journalist cannot make much of her professional jargon, she uses other terms and adjusts herself to her conversation partner – she changes her perspective. But what does that mean for her brain? How much brainpower is required to react to various communicative situations? A project at the University of Potsdam applies different methods to research such processes in children and adults. "Experimental Pragmatics" (XPRAG) comprises 16 projects scattered throughout Germany that focus on the use and meaning of language. This research association is being funded by the German Research Foundation (DFG).

In the Potsdam sub-project led by Prof. Dr. Barbara Höhle and Isabell Wartenburger, three postdocs are studying how the awareness of a conversational partner's knowledge influences his or her own understanding of language. Since October 2014, several tests have been done to establish how the new perspective is assumed. In a way, they are playing "I spy with my little eye..." with their study participants.

Maria Richter is one of these postdocs and explains the setup: "According to our experimental design, the experimental participant plays a communication computer game with an avatar, i.e. an artificial person, as a conversational partner. The participant and the avatar face each other virtually and look at a mostly empty shelf. Some of the shelves contain an object. The avatar asks the participant to move a certain object with a mouse click." The interesting thing is that some shelves are covered on one side so that the participant can see them, but the avatar cannot. This creates a conflict: While the avatar sees just two objects of a kind, the participant sees three. So if the avatar asks the participant, for instance, to move the little sheep to the top, the participant has to consider that the avatar does not have the same knowledge: The participant sees three sheep of various sizes, while the avatar can see only two. Since the smallest sheep in the eyes of the participant is not visible to the avatar, the participant has to suppress the impulse to choose this one and move the medium-sized sheep instead. This means the respondent has to take on the perspective of the avatar and click on the medium-sized sheep.



Digital test setup of XPRAG.

Photo: XPRAG

> *"Can one's egocentric view be shut out so easily, and if so, when exactly does this happen?"*

Can one's egocentric view be shut out so easily, and if so, when exactly does this happen? And how much brain activity is required to ignore the little sheep that cannot be seen by the avatar? For how long and when exactly does the little sheep play a role in the subject's brain? All this is made visible through an electroencephalograph (EEG), which registers the brainwaves throughout the processing time.

Maria Richter joined the XPRAG team in March 2015 and brings a lot of experience in recording and evaluating neuroscientific data by EEG. Together with associated postdoc Lu Zhang, she has researched what happens in the brain when we communicate with someone and this communication can succeed only by adopting the point of view, or perspective, of the other person. "Our work is based on the finding that a speaker provides only as much information as is required, from his or her point of view, to be understood – not more than necessary. Consequently, the

THE PROJECT

The priority program **"New Pragmatic Theories based on Experimental Evidence"** (SPP 1727) is funded by the German Research Foundation (DFG). Of its 16 projects, three are being done at the University of Potsdam:

- L2PronRes: Syntactic and discourse-level constraints in native and non-native pronoun resolution (Adj. Professor Dr. Claudia Felser, University of Potsdam)
- ExCl: Exhaustivity in Cleft Sentences (Prof. Dr. Victor Edgar Onea Gáspár, Göttingen University, and Prof. Dr. Malte Zimmermann, University of Potsdam)
- CoGCI: "Ich sehe was, was du nicht siehst" – Common ground and contrastive information in children's and adults' reference resolution (Prof. Dr. Barbara Höhle and Prof. Dr. Isabell Wartenburger, University of Potsdam)

www.xprag.de

speaker has to speculate about what the conversation partner already knows, i.e. their common ground. Besides, both the speaker and the listener may possess knowledge their counterpart is unaware of. It may result from a privileged position and is therefore referred to as privileged knowledge." If the speaker does not correct a knowledge conflict, communication may be hampered, Maria Richter underlines. "We try to simulate this communicative situation in a number of computer experiments and monitor the subjects' EEG," her colleague Lu Zhang adds.

The experiment of the Potsdam linguists is just one of many pieces of the "experimental pragmatics" puzzle. Once pieced together, they will help to understand how the brain processes language and how quickly we can take on another's perspective. "We have evaluated the reactions of between 20 and 25 adults," Isabell Wartenburger says.

Similar tests are being conducted with children to find out how and when children learn that their own perspective does not always fall in line with that of the speaker and how they integrate this knowledge into their linguistic communication. The test design for studying children differs in that they are not placed in front of a computer, but in front of a real shelf with stuffed animals. Their reactions help us to understand at what age children are able to change perspective and what mistakes they make. In an eye-tracking study, postdoc Choonkyu Lee records and analyzes the eye movements of four and five year olds. "We use a grid with many shelves. On the one side, some shelves are closed. Then a doll gives the children tasks like 'Grab the little sheep!' We record the children's eye movements to establish how quickly and precisely the right object is identified in a situation where the doll cannot see the smallest sheep, making the mid-sized sheep the correct one to grab," Choonkyu Lee explains. The evaluation will show whether and how quickly children of a certain age are able to take another's perspective.

"Especially when it comes to children, it is very interesting to figure out at what age they are able to abstract from their own perspective."

According to Isabell Wartenburger, the experiments do not have an immediate practical benefit, but are invaluable to pragmatics research and could be of great importance for the future development of therapeutic approaches or for the linguistic interaction between human beings and computers. "Especially when it comes to children, it is very interesting to figure out at what age they are able to abstract from their own perspective and understand that the knowledge, ideas, and feelings of others differ from theirs – and adjust to it," the psychologist underlines. Based on the EEG and the eye-tracking method, the Potsdam linguists want to establish a model for determining when and how fast we can change perspective and say "I spy with my little eye – and see what you see, too."

HEIDI JÄGER

THE RESEARCHERS

Prof. Dr. Barbara Höhle studied linguistics at the Technische Universität (Berlin) and earned her doctoral degree and habilitation at the Freie Universität Berlin. Since 2005 she has been Professor for Psycholinguistics/ Language Acquisition at the University of Potsdam.

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Prof. Dr. Isabell Wartenburger studied psychology in Bielefeld, earned her doctoral degree at the Charité Berlin and was an Endowed Junior Professor with tenure track at the University of Potsdam. Since 2013 she has been Professor of Patholinguistics/ Neurocognition of Language at the University of Potsdam.

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Maria Richter was a student of patholinguistics at the University of Potsdam and became a doctoral student at the Max Planck Institute for Human Cognitive and Brain Sciences in Leipzig in 2011. In March 2015 she joined the XPRAG team.

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Dr. Choonkyu Lee studied linguistics and psychology at the University of Southern California in Los Angeles (USA) as well as psychology at Rutgers University New Brunswick (USA) where he completed his PhD in 2012. He worked as a postdoc at the Utrecht Institute of Linguistics in Utrecht (Netherlands) before joining the XPRAG team as a postdoc in October 2014.

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Dr. Lu Zhang acquired an M.Sc. in Language Science and Technology at Saarland University. In 2009 she became a doctoral student at the University of Bielefeld. In 2013 she took up a postdoc position at the Berlin School of Mind and Brain, and in the summer of 2014 she joined the XPRAG team as an associated postdoc.

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Photos: privat (5)

At the Climate Frontline

Potsdam climate researcher Stefan Rahmstorf not only conducts excellent research but also engages in science communication

For the climate scientist it was a highlight of his career, although a somber one. His article on new findings about the impact of climate change on the Gulf Stream system was the cover story in the prestigious scientific journal Nature Climate Change in May 2015. The key message: The overturning circulation in the Atlantic Ocean has slowed down – even earlier than predicted. The heating system of Europe has flagged. The reason is probably global warming, among other things through the melting of the Greenland Ice Sheet. Lead author of the study is Stefan Rahmstorf, researcher at the Potsdam Institute for Climate Impact Research (PIK) and Professor of Physics of the Oceans at the University of Potsdam.

Proxy data – data gathered from ice cores, tree rings, corals, and ocean and lake sediments – made it possible to reconstruct the temperature data of the past 1000 years and provided new insights into the climate system. But beyond the scientific success, the father of two children is concerned about the results but also views them with some detachment. "I am not happy about it, of course, but after 20 years as a climate researcher I have got used to the findings about climate change being not necessarily uplifting."

At the **Potsdam Institute for Climate Impact Research (PIK)** on Potsdam's Telegrafenberg, researchers in the natural and social sciences from all over the world work closely together to study global climate change and its impact on ecological, economic, and social systems. They examine the Earth system's capacity for withstanding human interventions and devise strategies and options for a sustainable development of humankind and nature. The Institute is organized in four research domains: Earth System Analysis, Climate Impacts & Vulnerabilities, Sustainable Solutions, and Transdisciplinary Concepts & Methods. PIK is part of a global network of research and academic institutions dealing with global environmental changes. It plays an active role in the Intergovernmental Panel on Climate Change (IPCC) of the United Nations.

www.pik-potsdam.de

Photo: PIK

Nonetheless, he puts his heart and soul into climate research. The foundations for a life as a natural scientist were already laid during his childhood, Rahmstorf says. Between the ages of 6 and 12 he lived at the Dutch North Sea – his father had a job there. The days at the seaside left their mark. "My whole family spent a lot of time building sand castles and the like," the researcher tells us with a smile. "It inspired my enthusiasm for the ocean."

After school Rahmstorf first enrolled for physics and later specialized in physical oceanography. The path from a physicist and an oceanographer to a climate researcher was not long. "In the final analysis, climate is physics," Rahmstorf says, "and the ocean is one of the most important parts of the climate system." The huge water masses of the Earth are in constant material and energy exchange with the atmosphere. It is impossible to imagine the climate models the researcher is developing at PIK without these heat and CO_2 buffers.

Actually, he was drawn to this topic by the high social relevance. "My diploma thesis was still about the theory of relativity and cosmology, but I wanted to dedicate my work to a topic that is not only scientifically interesting but also of benefit to the people." After all, climate change is the biggest challenge for humankind in the 21st century.

He has a quiet office on the hill Telegrafenberg, a bit away from the bustling city center. Photos of cloud formations, ice lumps in the Arctic Ocean, beaches, and landscapes are on the walls. Taking photos, dancing salsa, kayaking,

and swimming are ways to balance out his academic working day, which he usually spends at his desk. Analyzing data, programming mathematical models, answering e-mails, drafting conference papers and academic publications – climate research mainly happens at the computer. Besides his work as a researcher Rahmstorf still finds the time to engage with the public. He is one of the initiators and author of two climate blogs – RealClimate and KlimaLounge. He writes columns for environmental magazines and articles for the daily press. He has also authored several books about climate change. In 2011 the children's book "Wolken, Wind & Wetter" was published – a book close to his heart and his favorite publication, he says. "As a child I was thrilled by popular natural science books. I would like to pass that on."

In his professional life Rahmstorf is not only dealing with data, analyses and models. Sometimes he must also deal with his fellow men, perhaps more than scientists in other fields. "There is a small but very vociferous sector of society who aggressively rejects the findings of climate research, sometimes using personal attacks and even physical threats," Rahmstorf explains. "You simply have to get a thick skin." By now he has become relaxed about it and puts these inconveniences into perspective with a historical example. "Compared to the problems Galileo Galilei had because he stood up for his research results, these things are negligible."

Nevertheless: Does it not sometimes drive him to despair when political and economic stakeholders and the public do not recognize the urgency of the topic, if one climate summit after another goes by without significant results and valuable time seeps away? "The so-called skeptics have succeeded – with great financial support – in delaying important climate protection measures. That does not affect me so much as a scientist but it will have serious consequences for humankind," Rahmstorf clarifies, who lives without a car and with solar panels on his roof. "We risk to slide into a world of massive conflicts if droughts and crop failures cause hunger crises and large-scale migration that will eclipse by far what we are experiencing now."

Rahmstorf is looking optimistically into the future though. "Surveys show that the majority of people consider climate change a serious problem, at least in Europe." The full implications and urgency, however, have not reached them yet. The problem is not for a lack of accessible facts but results from other reasons. Climate change slowly creeps up. There is not just one clear perpetrator, and the problem seems to be so big that many people feel helpless.

Solutions to climate problem are already available but hampered by economic and power interests, the researcher emphasizes. He sees the upcoming climate summit in Paris in December as a potential turning point. "There are many positive signs, for example that the USA and China came to an agreement. The International Energy Agency, the World Bank, and also the Pope have issued clear statements in favor of phasing out coal. The conditions for reaching a successful climate agreement are much better than in 2009, but there are only a few years left to change course and turn around the trend in global emissions."

HEIKE KAMPE

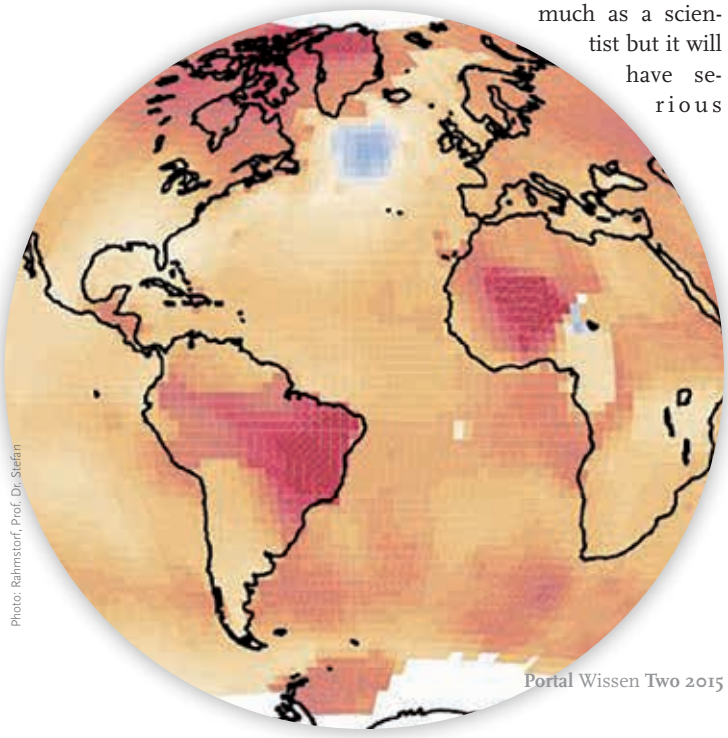


Photo: Rahmstorf, Prof. Dr. Stefan

Photo: Bartocha, Sandra

PUNCTUATION

A Camel instead of a Mouse

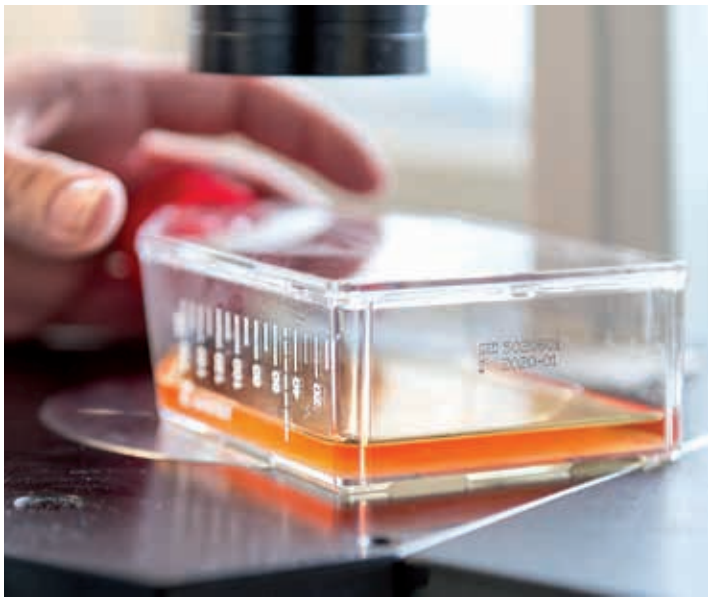
Biologists are developing a new system to produce antibodies

The body produces them in masses during an infectious disease. They are able to bind to specific surface structures of bacteria and viruses, dock themselves to them and mark the disease trigger for depletion. Antibodies are small wonder weapons that the body uses to protect itself. They also play an important role outside the body. Antibodies are routinely used in biomedical diagnostics and therapy. Producing them, however, is time-consuming and expensive. Potsdam biologists want to simplify the procedure.

Flat culture flasks, Petri dishes, and microplates filled with orange and red liquids are stacked in the culture cabinet of cell biology laboratories. Katja Hanack takes a vial from the incubator and places it under the microscope. Millions of tiny cells are swimming in the nutrient fluid, invisible to the human eye. Only at a 10-20x magnification do the small transparent spheres become visible. They produce the precious cargo the biologist is looking for: antibodies. The immune cells had to go

Photo: Fritze, Karla

Prof. Katja Hanack at the microscope.



through a complicated process before becoming small antibody factories in the laboratory culture.

Katja Hanack is Professor of Immunotechnology. She and her research group are developing a system that will enable the production of highly coveted antibodies in cell cultures, much faster and cheaper than this has been done so far. The demand for these small connecting particles is immense in medicine and industry.

"Antibodies are the most commonly used binding molecules," the scientist explains. "They are virtually everywhere in diagnostics and therapy." Pregnancy hormones, viruses, tumor proteins, and pharmaceuticals can be detected in the blood with the help of antibodies. Tests for diabetes and autoimmune diseases are also based on the binding ability of the molecules. Certain cancers and inflammatory reactions from rheumatism or Crohn's disease are treated with antibodies.

"The vast amount of antibodies has to be produced somehow," explains Hanack, who was the head of the InnoProfile Research Group "Antibody Technologies" at the University of Potsdam until recently and now holds an endowed professorship. "This means an immense expenditure of effort, which requires a lot of time and material." Antibodies have usually been prepared by injecting animals – usually mice – with an exogenous substance, a viral particle, a bacterium, or some other substances. Experts call these foreign substances "antigens". The animal's immune system recognizes the exogenous substances triggering an immune response that produces an antibody specific to the antigen. The animal's spleen is then removed and the antibody-producing cells in the spleen are isolated. "The spleen cell repertoire of a mouse produces millions of different antibodies," Hanack explains. Further immunological tests are needed to isolate the cell that produces the desired antibody. "The entire procedure usually takes six to eight months," explains the researcher.

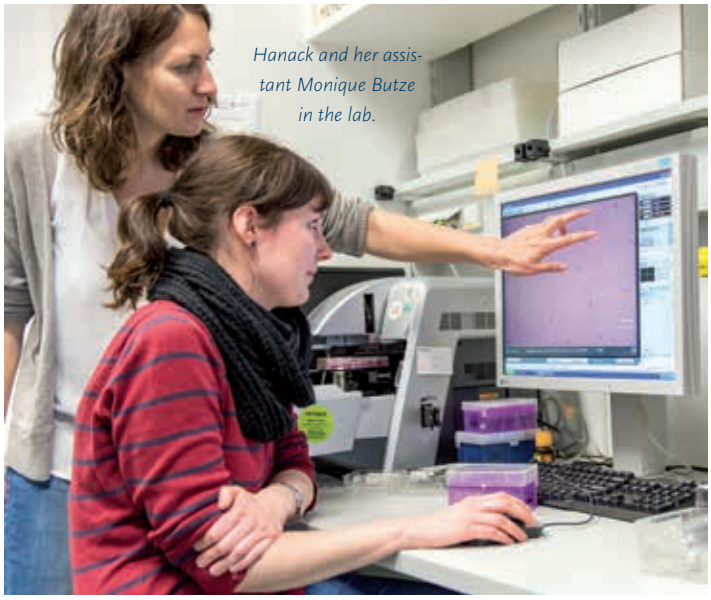
"The spleen cell repertoire of a mouse produces millions of different antibodies."

The young professor has set herself an ambitious goal: Producing antibodies in a single month rather than six to eight. And fewer mice will have to lose their lives. In a cell culture, she reconstructs what happens in the animal or human body during an immune response – from the antigens' initial contact with the immune cells to the production of specific antibodies. These are released by the cells into the medium, where they can be "harvested". The procedure would make removing the animal's spleen unnecessary. Immune cells from the blood then cultivated in the laboratory would suffice. In addition, human antibodies, which have had to be "humanized" from mouse antibodies in an elaborate process for them to be usable for therapeutic purposes, could be produced much more easily with human cell cultures.

"This looks good." Hanack is pleased with what she sees on the monitor of her assistant Monique Butze, who is examining llama immune cells isolated from their blood and cultivated in the lab. On the screen are blob-shaped cells with long extensions; these "dendritic cells" recognize foreign substances such as viruses and bacteria in the body, eat them, and dissolve them. This is the body's first step in its immune response and the starting point for establishing antibody production in a cell culture.

Dendritic cells are the "sentinels of the immune system". They present characteristic parts of previously absorbed and dissolved foreign matter on their own cell surface. This is the signal to other immune cells – T-lymphocytes: "Look, this is what the enemy looks like." Once T-lym-

Photos: Fritze, Karla (2)



Hanack and her assistant Monique Butze in the lab.

phocytes have registered the information, they function as a messenger, passing the information on to other immune cells – B-lymphocytes. They eventually produce specific antibodies that dock to the surface structures of the invaders and render them harmless. "That's our goal," explains Hanack.

An initial success for Hanack and her team has been that the dendritic llama cell, isolated from a llama blood sample and replicated in a cell culture, are now active and functional. Their next step is to add a specific antigen to a cell culture, i.e. the protein to which the antibody will later attach. When the dendritic cells present the structures of the antigens on their cell surface, they are also detected by the added T-lymphocytes. The Potsdam scientists are breaking new ground with their research on how llamas and camels produce camelid antibodies. While conventional antibodies are Y-shaped with two heavy and two light molecule chains and can only stably bind to an antigen with both arms, some camelid antibodies have only two heavy chains, which nevertheless bind to the antigen very stably. Such features simplify their handling and are ideal for industrial use.

"Camelid antibodies are extremely stable; they can be heated to 90 degrees Celsius and they are still fully functional after refolding," explains Hanack. Their enormous heat stability is probably a result of their adaptation to the high ambient temperatures at home. In addition, camelid heavy-chain-only antibodies are smaller and more soluble. You can penetrate the tissue much more deeply and thus bind antigens unreachable to conventional antibodies.

So far, however, there has been no method of cultivating camelid immune cells. What reagents can the cells tolerate? What nutrients do they need? What environmental conditions can they tolerate? Researchers have to answer these questions through elaborate test series. If successful, they will then have to develop "cell lines". Those cells that produce the desired antibodies will be selected but would, however, survive in the cell culture for only a few days, which is why the researchers fuse them with cancer cells. The resulting cells – "hybridomas" – continue producing antibodies but are simultaneously immortal since they take on cancer cells' ability to divide indefinitely. This process has already become a standard for antibodies derived from mice but has yet to be developed for camelid antibodies.

Hanack and her research team are currently working on two fronts – researching antibody-producing cell cultures and establishing camelid antibodies for application. "We want to develop a standard technology for camelid antibodies as has been done for mouse antibodies," clarifies Hanack. The researchers ultimately want to simplify procedures and novel binding molecules for medicine and industry.

Once a cell line has firmly established itself, it can produce virtually an unlimited number of antibodies. For the camelid antibody this is still some way off given the number of hurdles yet to be overcome. The researchers need a lot of patience when, for example, the one immune cell with the right antibody happens to not be among the thousand examined. Hanack keeps her "treasures" at icy temperatures: Selected cell lines are transferred into a "deep sleep" in large steel tanks at -200 degrees Celsius and can remain in this state for decades. Once the antibody is needed, the cells are thawed and ready for use.

"We want to develop a standard technology for camelid antibodies."

HEIKE KAMPE

THE RESEARCHER

Prof. Dr. Katja Hanack studied biology in Rostock and Berlin. She earned her doctorate at the University of Potsdam and was head of the junior research group "Antibody Technologies". Since 2015 she has been an endowed professor of immunotechnology. The endowed chair is co-financed by the Federal Ministry of Education and Research and eight regional biotech companies.

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Photos: Fritze, Karla (2)

Guest Commentary

DR. BOBAN ARSENIJEVIĆ
UNIVERSITY OF NIŠ, SERBIA

My views presented in this commentary are a synthesis of the information which motivated my decision to spend two years of research at the University of Potsdam and of the insights I gained during the first six months of work at this university. I aim to outline my benefits as a researcher from pursuing research at the Linguistics Department of the University of Potsdam, and at the same time to provide the readership with a glimpse of the university from the perspective of "the other".

There is a general consensus that the academic scene in Brandenburg is not sufficiently international, both in the sense that it has few international members, and in the sense that it is infrastructurally unprepared for them. This was the reason for launching the BRAIN project, which provided me with the opportunity to stay in Potsdam. However, a low degree of international involvement is definitely not a characteristic of the University of Potsdam's Department of Linguistics. The department involves a significant number of internationals and a vivid international collaboration.

The department is also very diverse, as it includes theoretical, experimental, and computational linguists, applies a broad spectrum of methodological approaches, and next to the obvious German and other European languages, it also studies lesser-described languages from Africa and South America.

To a large extent, the credits for this situation go to my host at the University of Potsdam, Prof. Gisbert Fanselow, who is one of those people with a strong sense of vision and mission, and at the same time with the energy and skills to realize them. His research group, which has warmly embraced me even though I am not officially its member, is characteristic for its methodological approach, with all the advantages of a non-mainstream approach, but at the same time sufficiently close to the main stream syntax to have intensive bidirectional interaction with it.

I also have the privilege to take part in the work of the research group in theoretical semantics, for which I am grateful to its leader Prof. Malte Zimmermann. This additionally increases the room for interaction and exchange, key factors in research and in my own motivation for the research stay.

However, it is my general impression that my lucky situation is not a rule in the German academia, in the sense that the organization along the axis of research is not by itself very supportive of interaction and collaboration within and among departments. In particular, this is due to the fact that individual chairs within the department are highly independent and without institutionalized coordination, and research groups are formed only within funded projects but not outside them. In this way, a department without an SFB or a similar project, or members of the department not included in it, remain without any horizontal links, and hence typically also without significant mutual interaction. A coordinating body at the level of departments and the possibility to form research groups even without project funding could significantly improve the scientific output, both in terms of quantity and quality.

Back to the advantages of the University of Potsdam in respect of interaction and exchange, I need to stress its vicinity to two other big universities and to research institutes in Berlin. It is well known that a geographic concentration of strong research centers is beneficial for their work, and the administrative organization of this area was generous to the local academia.

Finally, for me personally, Brandenburg provides a well measured mixture of the Eastern European warmth and subversivity, and the Western functionality and productivity. I believe that this is a property that the local community could benefit from not only in the academia, but also in other aspects of community life.

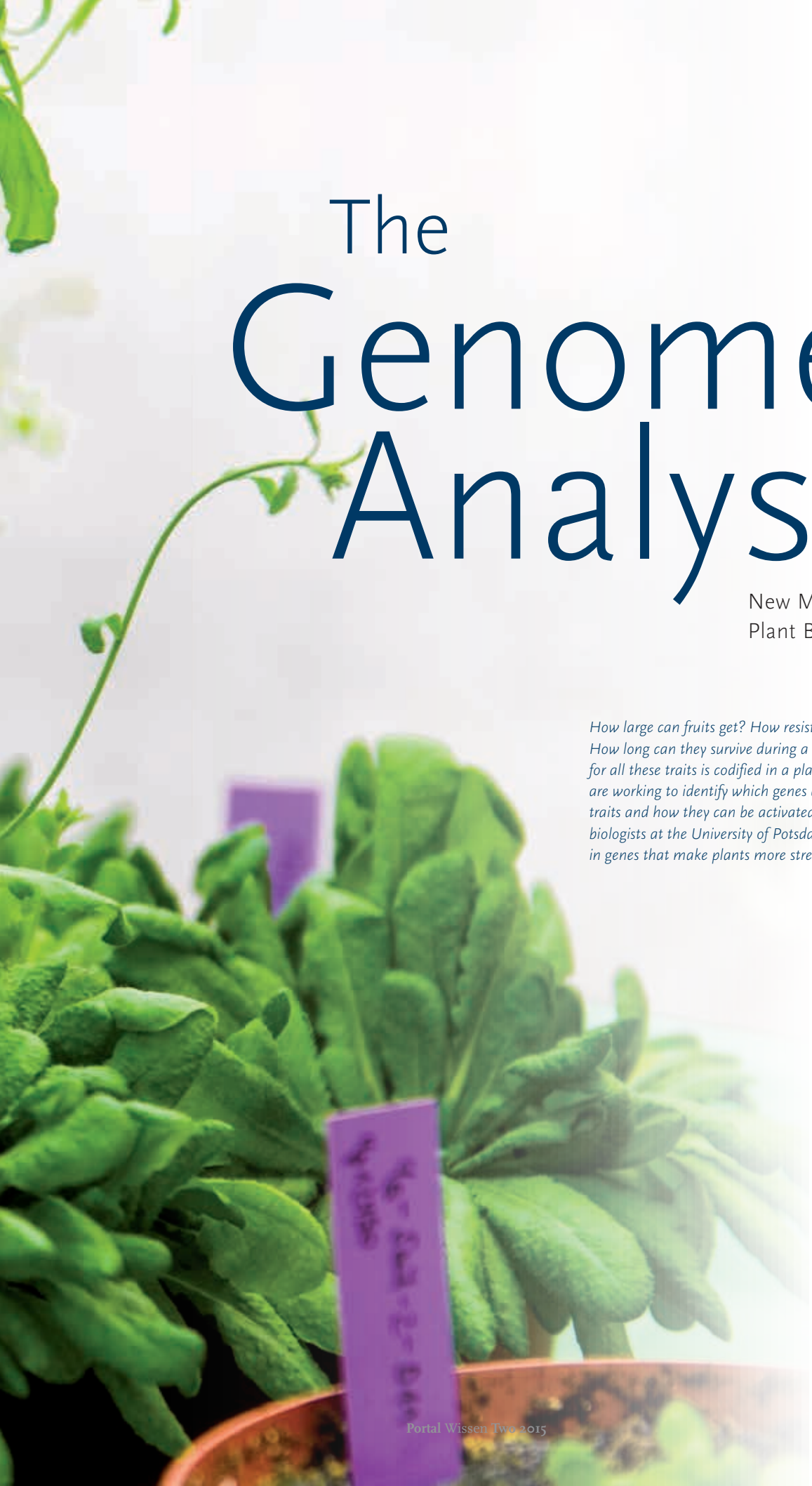
Finding an answer to the question:
What stimulates plant growth?

Photo: Hölzel, Thomas

The Genome Analysts

New Methods in Plant Breeding

How large can fruits get? How resistant are they to disease? How long can they survive during a drought? The information for all these traits is codified in a plant's genome. Researchers are working to identify which genes are responsible for which traits and how they can be activated or deactivated. Molecular biologists at the University of Potsdam are primarily interested in genes that make plants more stress-tolerant.



In the greenhouse.

Dr. Tsanko Gechev.

To a layperson it may sound as if the researchers at the chair Molecular Biology have brought a bit of biodynamic gardening to the lab. Molecular biologist Tsanko Gechev is holding a little plastic bottle labeled Super Fifty, which contains a brown powder. This highly concentrated Ascophyllum nodosum seaweed extract is harvested on the Irish coast and processed into a powder by the company BioAtlantis. The company claims the concentrate has many positive effects on plant growth: a higher crop yield, stronger root growth, and a higher soil bacteria count. The compound is a so-called biostimulator or plant strengthener.

In the climate chamber, Dr. Gechev shows us why Super Fifty is being used in molecular biological research. Pots and pallets with plants of all age groups are tightly packed on shelves at a constant 21°C. Some show the first green of the rosette; others already have seeds on long stems. Arabidopsis thaliana – the common thale cress – is the plant geneticists' "pet". Its complete genome was mapped in 2000, and the functions of many of its genes are already known. It is therefore relatively easy for the researchers to determine which gene activities are influenced by a biostimulator.

Gechev is the scientific manager of the "CropStrengthen" project, in which the common thale cress meets Super Fifty. CropStrengthen, funded by the EU and industrial partners, is part of the European Industrial Doctorate Network (EID). As a Horizon 2020 project of the Marie Skłodowska-Curie Actions, it also supports young researchers. Five doctoral candidates of 180 applicants were chosen to research in CropStrengthen over the next four years. "Our goal is to find out which genes are responsible for an enhanced stress resistance in Arabidopsis thaliana and to then carry these results over to crops," Gechev explains. For these examinations, the University of Potsdam is collaborating with two commercial partners – Ireland-based BioAtlantis Ltd. produces the biostimulants and Netherlands-based Enza Zaden breeds the crops.

"Our goal is to find out which genes are responsible for an enhanced stress resistance in Arabidopsis thaliana."

Ivan Ivanov from Bulgaria is the first doctoral candidate who is working on his thesis within the program. The young molecular biologist will be researching in Potsdam over the next 18 months and then another 18 months at Enza Zaden. The advantages of this are obvious for him. At the university he will benefit from the researchers' expertise and be able to study the latest biotechnological and biochemical methods as well as learn how to evaluate the mass of data with bioinformatics. At the commercial partner, he will learn about the relevance of his research in practical applications. "My employment chances after my doctoral studies are strong," he underlines.

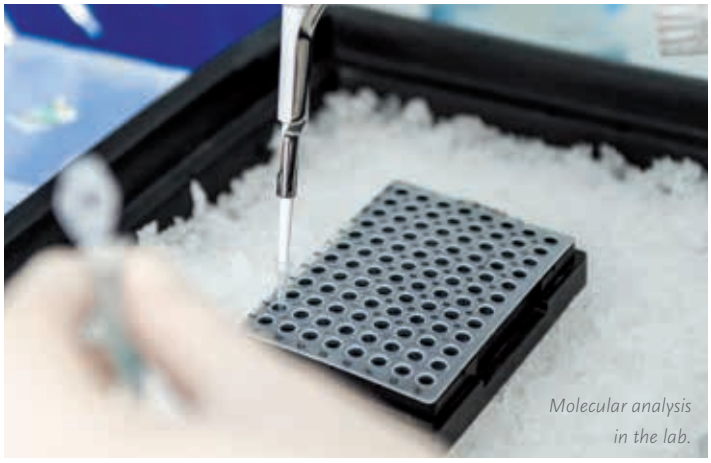
Bernd Müller-Röber, Professor of Molecular Biology at the University of Potsdam, pulls all the strings. "Plants cannot run away and have developed many mechanisms during evolution to cope with various environmental conditions," he explains. Dry or wet conditions, too little or too much light, insufficient nutrients or damage due to caterpillars – plants react to the various challenges they face at a location, even if it is not immediately visible. The adaptations are usually invisible and take place at the metabolic and genetic level in the plant. It seems

"The key question is what stimulates plant growth."

THE PROJECT

"CropStrengthen" is part of the European Industrial Doctorate Network and a Marie Skłodowska-Curie Action funded by the European Union. The stress tolerance of crops will be enhanced using new methods of plant breeding and by identifying the respective genes.
Participating: University of Potsdam, Department of Molecular Biology, BioAtlantis Ltd., Ireland, Enza Zaden Beheer B.V., Netherlands
Duration: 2015–2018

Photos: Hölzel, Thomas (2)



Molecular analysis in the lab.

that biostimulants like Super Fifty help the plants to genetically adjust to stressors. They can better tolerate dry and cold periods and also continue to grow even if they lack nutrients. "We have not yet understood why," Müller-Röber explains. "The key question is what stimulates plant growth."

The researchers will analyze what happens in the plants at the molecular and biochemical level when treated with plant strengtheners. As a first step, Arabidopsis thaliana will be cultivated with and without biostimulants under both stress and optimal growth conditions. The molecular biologists will then analyze the plant's genome. Do the resulting patterns of gene activity differ in the cultivated plants? Which genes are activated or deactivated? Which physiological processes does it influence? The researchers hope that this knowledge will later enable them to hybridize the genes for higher stress tolerance into vegetable crops like tomatoes and bell peppers through conventional breeding.

"Our aim is to develop diagnostic markers for breeding programs."

The highlight: Once the researchers have identified the relevant genes, they will be able to select those parents whose genome contains the desired sections. Their aim is to make successful breeding considerably more economical and faster because those hybrids with little promise at the genomic level can immediately be excluded. "Our aim is to develop diagnostic markers for breeding programs," Müller-Röber explains. If we succeed, breeders will be able to look for the respective markers in the genome of the sprout and determine if it is worth further cultivating or breeding this plant. "There is no need for fields to grow the plants until their traits become visible; all initial screenings can be done in the lab," Müller-Röber continues. This procedure is already being used when the genes for the desired traits are already known.

Such a gene is ATR7. The researchers have determined that it increases stress tolerance in the model plant Arabidopsis thaliana, although the physiological reasons for this are still unknown. This research aims to understand the functionality of ATR7 and to identify related genes in crops.

"We can save a lot of time, space, and money," Müller-Röber emphasizes, "but we must not assume that the molecular analysis in the lab is sufficient." The genome does not reveal everything. "The traits of a plant are ultimately the result of its interaction with the environment." Tests in the fields and in the greenhouse are still necessary. "We are ultimately broadening possibilities."

HEIKE KAMPE

THE RESEARCHERS

Prof. Dr. Bernd Müller-Röber studied biology and philosophy in Tübingen. Since 2000 he has been Professor of Molecular Biology at the University of Potsdam.

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Dr. Tsanko Gechev studied biology at the University of Plovdiv, Bulgaria. Since the beginning of 2015 he has been scientific manager of CropStrengthen.

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Photos: Hölzel, Thomas (4)

Photo: Bartocha, Sandra


QUESTION
MARKS

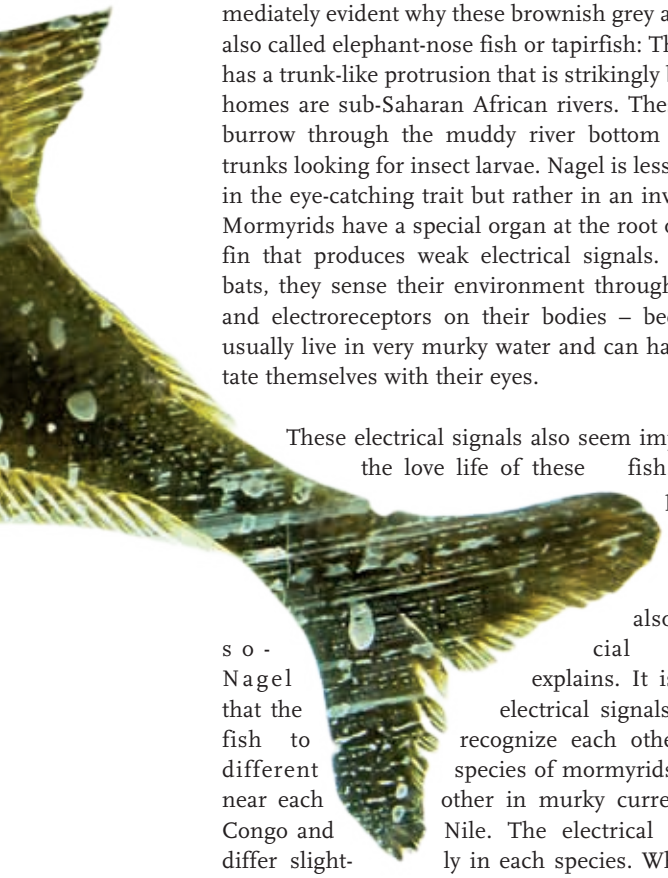
The Electric Code for a Partner

Mormyrids rely on electrical signals to choose partner

Photo: Fritze, Karla

How do new species develop? This question has plagued researchers for centuries and remains one of the most topical questions in evolutionary and biodiversity research. Potsdam biologists are looking for mechanisms in the behavior and genome of African mormyrids that divide one species into two. The weakly electric fish seems to have taken a special evolutionary path.

It is feeding time. Transparent mosquito larvae float and twitch in the big and small aquaria. The mormyrids in the basin usually stay in their hiding spots – brown plastic tubes. Every once in a while a fish scurries out. "They are nocturnal animals," explains the biologist Rebecca Nagel, who studies the mormyrids' behavior in the research group Evolutionary Biology. When it is light, they prefer to stay in hiding. It is immediately evident why these brownish grey animals are also called elephant-nose fish or tapirfish: Their mouth has a trunk-like protrusion that is strikingly bent. Their homes are sub-Saharan African rivers. These animals burrow through the muddy river bottom with their trunks looking for insect larvae. Nagel is less interested in the eye-catching trait but rather in an invisible one. Mormyrids have a special organ at the root of their tail fin that produces weak electrical signals. Similar to bats, they sense their environment through impulses and electroreceptors on their bodies – because they usually live in very murky water and can hardly orientate themselves with their eyes.



These electrical signals also seem important for the love life of these fish. "We hypothesize that the electrical impulses also have a social function," explains Nagel. It is assumed that the electrical signals allow the fish to recognize each other because different species of mormyrids often live near each other in murky currents of the Congo and Nile. The electrical discharges differ slightly in each species. What sounds like a diffuse crackling and noise to the human ear is possibly a signal to identify a conspecific (that is, a member of the same species) and potential mate. The intriguing thing is "that the closer the species are related, the more different the signals are." Previous examinations of the research group showed this, as Nagel explains, who is writing her doctoral thesis about mormyrids. "Closely related fish can better differentiate themselves from each other."

The biologist wants to observe the animals' behavior to find out if the male mormyrids select females of the same species based on their electrical identifying code. Mormyrids are especially interesting to evolutionary biologists because they are rich in species. Speciation may result from their ability to communicate through electrical signals. Biologists call the interrupted genetic flow between populations once belonging to the same species "reproductive isolation". Only those individuals will mate that belong to a specific group. Reproductive isolation is considered a crucial factor in the development of new species. Geographic barriers are usually the reason for isolation. Darwin's finches on the Galapagos Islands are perhaps the best-known example. The specific signals of mormyrids may have a similar barrier effect that once precipitated evolution.

THE PROJECT

GENART: Funktionelle GENomik biologischer ARTbildung

Participating: Museum für Naturkunde – Leibniz Institute for Evolution and Biodiversity Science at Humboldt University Berlin, University of Potsdam, Berlin Centre for Genomics in Biodiversity Research (BeGenDiv), Leibniz Institute for Zoo and Wildlife Research (IZW), Berlin Institute for Medical Systems Biology (BIMSB) of the Max Delbrück Center for Molecular Medicine

Duration: 2012–2015

Funded: Leibniz Association

http://www.naturkundemuseum-berlin.de/forschung/genart

The studies are part of the project "Funktionelle GENomik biologischer ARTbildung" (GENART), funded by the Leibniz Association. A network of molecular geneticists, neuroethologists, bioinformaticians, and evolutionary biologists is researching the genomes of three evolutionarily successful animal groups – mormyrids, locusts, and crickets – and is identifying the genes essential for speciation and their functions. Ralph Tiedemann, Professor of Evolutionary Biology and Systematic Zoology, heads the project in Potsdam. He works in close cooperation with Professor Frank Kirschbaum from Humboldt-Universität in Berlin.

> *"The closer the species are related, the more different the signals are."*

The aquarium for Nagel's tests is about two meters long. Gratings separate the basin into three areas. The male swims in the middle, the females on the right and left – a conspecific and a non-conspecific. Once the lights go off at 5pm, a camera begins recording the movements of the fish. For 12 hours it captures the male mormyrid's location. Does he prefer the side of the conspecific female?

Nagel evaluates the test the following morning. The video of the nocturnal activities shows a black fish silhouette against a light background. Broken lines on both sides of the aquarium glass delineate the various areas of the basin. If the fish crosses these lines, it is considered an approach to the female. The biologist

Photo: Fritze, Karla

Mormyrids in an experimental aquarium.

studies 20 mormyrid couples belonging to two different species in this way. Special software spares her from having to watch hours of video by analyzing the male's duration in various parts of the aquarium.

The researcher also carries out a second test to exclude that the male is reacting to other signals like chemical messenger substances or visual stimuli. During this test no females are in the two external basins but only electrodes that imitate typical female electrical signals. If Nagel demonstrates that the male spends more time near the conspecific signal during both tests, her hypothesis would be confirmed and this would explain how different species are able to develop in a habitat without geographical barriers. Nagel will next use artificially generated signals to examine if the animals also recognize slightly altered patterns as conspecific and how large the margin for alterations is.

"Gene duplications are regarded as the 'motor' of evolution."

The biologist will use genetic tests to ultimately find out how the electric organ of mormyrids developed and how exactly it functions, because this has not yet been clarified in detail. The researchers already know that this organ developed out of skeletal muscles. Nagel is now examining gene activities in the cells of the skeletal muscle and the electric organ at the fin tail of the fish. Her assumption is that the genes in the ion channels of the cell walls in these two cell types are differentially active – and are responsible for the signal generation. She expects to find higher gene activity in the electric organ, which would indicate the evolutionary origin of the typical signals. "These fish have a so-called fish-specific gene duplication," Nagel explains. Some gene groups exist twice in the genome of the fish. "We assume the electric organ developed in connection with this duplication." Mutations can occur at the doubly present genome sections without creating a selective disadvantage for the organ, because one gene remains intact to fulfill the original function. Gene duplications are regarded as the "motor" of evolution, because the duplicative genes can develop new functions. This mechanism in African mormyrids may have resulted in electrical communication among the animals and delimitation from other groups, which enabled them to develop so many species.

HEIKE KAMPE

THE RESEARCHER

Rebecca Nagel studied biology and molecular biology in Rochester (New York) and Mainz. Since 2014 she has been working on her doctoral thesis at the University of Potsdam.

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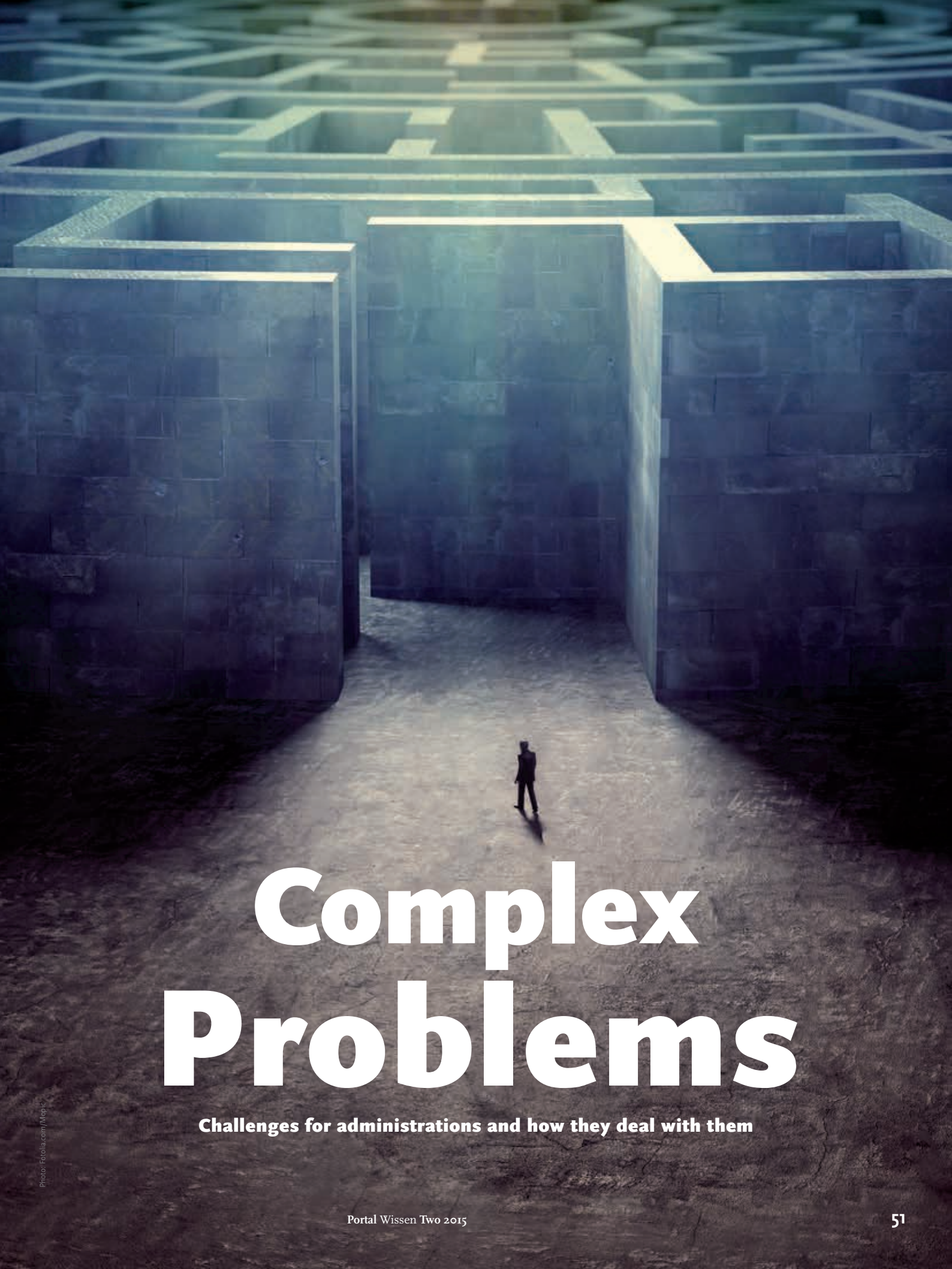
Photos: Fritze, Karla (2)



Complex Problems

Challenges for administrations and how they deal with them

Photo: Fotolia.com/Mopic

Basanta Thapa and Robert Gäde.

The new airport BER is a prestige project and one of the largest construction sites in Europe. However, it has turned out to be a "wicked problem" ever since the groundbreaking ceremony on 5 September 2006. Construction costs have skyrocketed from EUR 1.7 billion to around 5.3 billion. Local residents have filed lawsuits to prevent certain flight routes, and the parties concerned – the states of Berlin and Brandenburg and the federal government – are at loggerheads about the project. Worst of all, the airport, already being depicted as the hub of central Germany, remains unfinished. The opening, initially planned for 2007, has been postponed several times. Now 2018 is envisaged, though also this subject to change. So what went wrong? Such questions are researched by the research training group "Wicked Problems", which looks into how "public administrations" deal with complex challenges.

"Wicked problems are just what their name suggests," says Prof. Dr. Harald Fuhr, spokesman of the program. Because of their complexity, they are hard to grasp, let alone define. They are difficult to delimit in time and space and often involve or affect a larger number of stakeholders, and they are frequently closely related to other problems. "Analytically speaking, wicked problems can be characterized as a combination of simultaneously occurring levels of complexity, uncertainty, and ambiguity," Fuhr explains. And this mélange has far-reaching consequences for public administration and the way it tackles problems.

Twelve graduates in political, social, administrative, and economic sciences joined forces to research the issue and established the research training group – with support of the German Research Foundation (DFG) – at the Faculty of Economic and Social Sciences at the University of Potsdam in 2012. "We are less interested in wicked problems as such, but in the way they are dealt with," Fuhr says. After all, they are just the background against which the young researchers study how administrations function and develop.

"To some, administration is something dull, narrow-minded, and cumbersome," Harald Fuhr states. "But you have to realize that in industrialized nations every other Euro of the gross domestic product runs through the unknown corridors of public administration. And last but not least, political reforms are implemented by public administrations. Many people wish administrative processes would be less time consuming. We want to find out why this is often not the case, and what is done about it." As a professor of international politics, Fuhr knows a lot about administrations in various parts of the world and how they work. And due to global integration processes and complex challenges, they are undergoing radical transformation. Climate change, digitalization, migration, international crime, global financial flows – for quite some time, public administrations have faced global processes with worldwide consequences. In dealing with such issues, all factors need to be considered and all stakeholders have to be onboard. "Problems have varying degrees of complexity. Some may be solved by the administrations alone at, say, the local level," Fuhr maintains. "But at the national, EU, or global levels, there are so many stakeholders that a completely different approach and new strategies are needed."

"We are less interested in wicked problems as such, but in the way they are dealt with."

Such strategies are being tracked down by the program's members and on various levels, as the subtitle of the Research Training Group "Wicked Problems, Contested Administrations" suggests: "knowledge, coordination, strategy". Faced with previously unknown problems, administrations look for, among other things, new strategies or revise existing ones. In other cases, they strive for better coordination, both internally and with external players. Last but not least, administrations always depend on expanding the knowledge base of their actions.

In their research, the PhD students focus on one of these levels. Robert Gäde, for instance, looks at the transnational cooperation between tax authorities regulated by bilateral and multilateral treaties. "I am looking at how certain countries have translated these directives into national law," the young researcher says. Tax information is exchanged in three ways used in varying intensity and degrees of success: automatically, spontaneously and on request. For the automatic ex-

THE PROJECT

Research Training Group "Wicked Problems, Contested Administrations: Knowledge, Coordination, Strategy" (WIPCAD)

Spokesman: Prof. Harald Fuhr (International Politics)
Funded by: German Research Association (DFG)
Duration: 2012 – 2017

www.wipcad-potsdam.de

Photo: Fritze, Karla

change, larger data packets about foreign nationals are transferred to their home countries at regular intervals. For the spontaneous exchange, revenue officers of the source country, i.e. where the data is collected, spontaneously send potentially useful data to the home country of an individual or corporation, whereas in the third case they do so at the request of their colleagues in the country of residence only.

Robert Gäde works with data made available to him by the German and Dutch ministries of finance. The amount of data transferred automatically is extremely vast and thus probably difficult for the tax authorities to analyze. For his research, the spontaneously sent information and the proportion between requests and answers are more relevant. After all, they indicate the general willingness of the fiscal authorities of a country to cooperate. He also compares the number of cases with the general quality of an administration as rated in international indices. In addition, Gäde has held qualitative interviews with tax officers in selected countries, as the exchange of information is influenced by other factors, too: degree of autonomy of the fiscal authorities, having same language as the partner country, or economic interdependence, to mention but a few.

In evaluating the data, Robert Gäde is following up the assumption that low-tax countries systematically share less information than high-tax countries, which have a natural interest in tracking down money transferred to offshore havens for tax evasion. "Consequently, tax competition is shifting from the level of tax rates to that of the administration – which is well aware of it and acts accordingly," Gäde explains.

While Robert Gäde was one of the first PhD students to join the program in 2012, Basanta Thapa arrived with the third group in 2014. His project explores the prospective influence of big data analytics (BDA), a possible new source of knowledge, on administrations. Could the centralized collection and provision of data revolutionize existing knowledge regimes? He spent several months surveying his field theoretically to create the framework for his research. "Currently, there is an incredible hype around big data analytics," Thapa explains. "You notice that it is a black box with yet-to-be-understood opportunities. It is not clear what technical possibilities there are. Right now, there is a lot of talk, but little has been implemented so far." Still, it is plain to see that the "datafication of the world", that is, measuring the world with digitally connected sensors including smartphones and the "Internet of Things", has brought a new quality of perception. Initial applications include traffic management in big cities. The concept of "smart cities" builds on big data analytics as well. "As far as I can see, Germany is lagging far behind in this respect," Thapa says. "This is not least due to the fact that the issue has been discussed here mainly under the label 'Big Brother'." Based on his theoretical work, Thapa will have to examine individual aspects and the effects of big data analytics in administration. To this end, he will conduct field research in cities using or discussing BDA more intensely. So it may well be that one day his studies will take him to Singapore, London, or Boston.

"Currently, there is an incredible hype around big data analytics."

Basanta Thapa enjoys the research freedom of the program. "Nobody is telling you what to do; you have to outline and develop your project yourself." At the same time, the young researchers benefit from the contact with each other. Despite the comparatively broad theoretical framework, the program offers a lot of room for networking: a colloquium, meetings, summer schools, a lecture series, and smaller working groups bring all participants together at regular intervals and facilitate an intensive exchange at various levels. "A joint and compulsory course is the beating heart of the program,"

THE RESEARCHERS

Prof. Dr. Harald Fuhr studied political sciences, sociology, economics, economic and social history at Goethe University Frankfurt am Main and the Philipps-Universität Marburg/Lahn; PhD (1985) and habilitation (1993) in Constance. Since 1997 he has been Professor of International Politics at the University of Potsdam.

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Photos: Fritze, Karla (3)

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WICKED PROBLEMS

"Wicked Problems" stand out through a high degree of complexity, uncertainty and ambiguity. This is why they are a fundamental challenge for institutions of public administration – at local, national and international level. The term "wicked problems" has been used in English-speaking social sciences since the 1960s. For the Research Training Group "Wicked Problems, Contested Administrations: Knowledge, Coordination, Strategy" it has been translated into German.

Harald Fuhr agrees. "If nothing else, it is the message of the German Research Foundation to universities to develop structured doctoral programs from the funded research training groups." – Which is really needed, as the political scientist explains. After all, it is the declared objective of the program to provide the best conditions for young doctoral students to do excellent research – all while training them in step with actual practice. "Some of them will find jobs in research, others in practical fields," Fuhr remarks. "And a third group will oscillate between them as 'pracademics'. In the doctoral training they will acquire the skills to work at the intersections of research, management, and administration. And help find solutions for wicked problems."

"We want to identify new work patterns in administration and problem solving."

Entirely new solutions are needed. However, Fuhr underlines that the program is no think tank for wicked problems, nor is it aiming to solve them. "We are mainly interested in how administrations deal with such problems and how they choose to address them. Nevertheless, we want to identify new work patterns in administration and problem solving – and find out if they can be transferred and generalized."

It has become apparent thus far that in large, complex undertakings and projects control and administration are not enough – like in the construction of a major airport, for instance. "In such cases, all stakeholders must be onboard at an early point," Fuhr says. "Ideally before the first stake is driven. First and foremost, objections, problems, and 'no-nos' should be explored, as this approach brings higher input legitimation." And certain problems might not be encountered at all.

MATTHIAS ZIMMERMANN

Photo: Lima, Raphael

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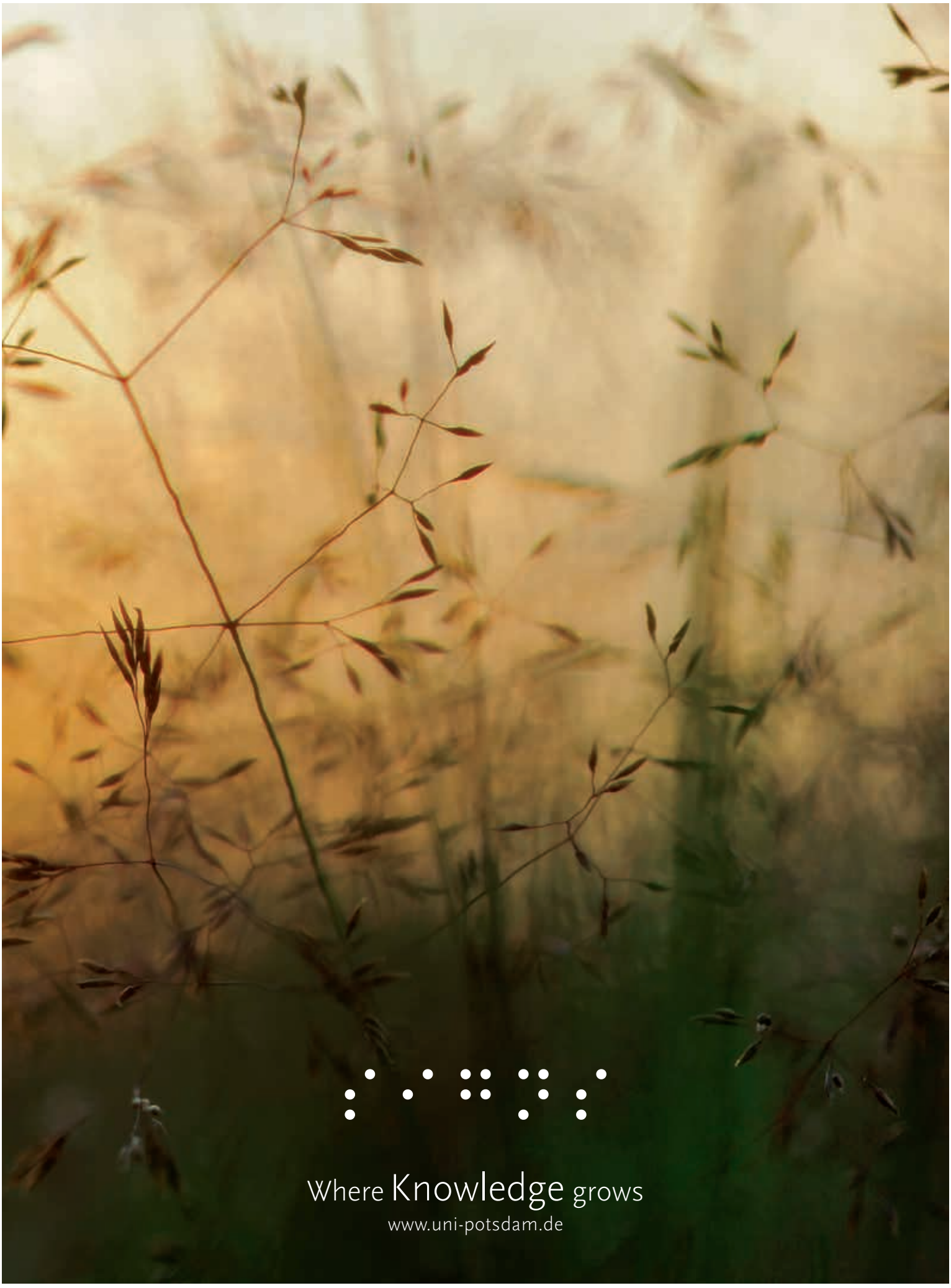
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