

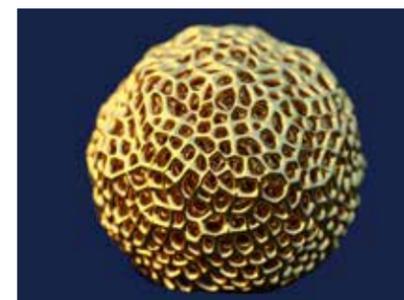


Future of Oceans: Cod, Herring and Sprat | Research Policy: The Europe We Want | Mobile Communication: Love at Your Fingertips | Neurophysiology: Fear and Fear Memory | Structural Engineering: How Much Longer? | Nanotechnology: Hats Off to Self-Organisation | Museum Cooperation: The Best of Both Worlds



Cover: picture alliance/blickwinkel

Networking: Scientists and researchers pool interdisciplinary resources and approaches to foster sustainable fishing, thereby contributing to the dialogue on effective fisheries management.



Commentary

Peter Strohschneider

The Europe We Want

2

Basing research on pluralism and freedom, not economic reductionism

News

Onward, Upward and Out?

4

Wide Horizon

4

Building Polish-German Bridges

5

Transatlantic Dialogue

5

Humanities and Social Sciences

Anna-Maria Walter

Love at Your Fingertips

6

How mobile phones are changing gender segregation in Pakistan

Life Sciences

Hans-Christian Pape

Fear and Fear Memory

12

Shedding light on the underlying cellular principles and molecular mechanisms

Portrait

Rembert Unterstell

A Public Intellectual

16

An encounter with Jena-based sociologist Hartmut Rosa

Life Sciences

Martin F. Quaas

Cod, Herring and Sprat

18

Combining biology, economics and law to contribute to sustainable fisheries

Engineering Sciences

Mark Alexander Ahrens and David Sanio

How Much Longer?

22

Engineers use mathematical models to predict the longevity of bridges

Natural Sciences

Andreas Herz, Dong Wang and Peter Schaaf

Hats Off to Self-Organisation and Self-Assembly!

26

Looking to nature for help in fabricating metallic nanofilms

In Focus

Hans-Dieter Bienert

The Best of Both Worlds

30

The Pergamon Museum in New York: Exhibition and symposium at the Met

Peter Strohschneider

The Europe We Want

Research policy and research funding must not be allowed to lapse into the thought patterns that are currently gaining ground throughout the continent. Research and innovation for a Europe fully equipped for the challenges of tomorrow should be based not on economic reductionism but solely on pluralism and freedom.

The present situation in Europe gives cause for concern. Wherever we look, there is a narrow, economic and reductionist concept of Europe that seems to be gaining currency and is threatening to become the most important guiding principle in politics, industry and society.

The detrimental effects that such a reductionist concept has on the process of European integration can be seen on all sides: Europe is struggling to define its responsibility in and a joint response to the refugee crisis; the European debt crisis continues to impact the continent; concerns regarding the legitimacy of the European Union remain in focus; and public debate is being affected by national populisms and new forms of xenophobia which, through misleading and misguided notions, seek to fill the vacuum of rich cultural meanings that a purely economic version of Europe leaves behind. Even before the shocking outcome of the Brexit referendum, the idea of a widely legitimised, pluralistic, integrative European Union was in jeopardy. Today, it is even more so.

And what about research and its funding? One might think that this is a different issue altogether. In fact, this is another context in which we must ask ourselves what kind of Europe we want.

Do we want a Europe that bases its research funding on the concept of economic reductionism and therefore limits its researchers to finding “real solutions” to “real problems”, to use the recent words

of Carlos Moedas, the European Commissioner for Research, Science and Innovation? Do we want a Europe that pits impact-oriented research against curiosity-driven research, instead of viewing both as essential and interrelated components of our research and innovation systems? And do we want a Europe that so drastically underestimates the diverse and enormous social, economic and cultural functions that research and science serve?

It's up to us, everyone with an interest in research and the future well-being of the continent, to shape the Europe we want to see. We should continue to be guided by the principles that have given Europe its capacity for innovation in recent decades: the pluralism of research horizons, methods, topics and approaches; the balance between programme-oriented and curiosity-driven research which is essential for that pluralism; and the freedom of researchers to choose research topics without direct economic, political, social or ideological stipulations.

These principles are not, as Commissioner Moedas put it, “traditionalist constraints” to fostering scientific innovation, economic growth and European prosperity. On the contrary, they are the basis for the very success of this mission.

It is therefore fundamentally important that research and the funding of research are spared this kind of narrow economic approach. Real innovation can be found not only in the solution of known problems, but also in delving into the unknown. What would we know about climate change if it weren't for curiosity-driven research? In science and scholarship, it is also about coming up with ideas and approaches that we did not expect or anticipate.

This article is adapted from a speech given by the DFG President on “Societal Challenges and Innovative Capacity: Future Perspectives on European Research and Innovation Funding” at Science Europe's ERA High-Level Workshop on 3 May 2016 in Oslo.



Illustration: DFG / Gorczany

in innovation-intensive sectors. But how do we foster this climate of innovation? One-third of public research expenditure in Germany goes to programme-oriented and applied research, while two-thirds fund university-based, curiosity-driven research. Thus, one of the main reasons why research and innovation have a far-reaching societal and economic impact is that in an important part of our science and research system, expectations of future societal impact and applicability are not criteria for funding decisions.

From this we can conclude two things with regard to European research and innovation funding: first, impact considerations should not be generalised beyond programme-oriented and applied research. And second, we should do everything we can to maintain a climate of intellectual opportunity and the freedom to try out ideas which at first glance seem less than convincing. The history of science is replete with examples of important findings that only gradually found acceptance.

The basis for this climate of opportunity is European diversity and versatility: the pluralism of funding systems and funding instruments that we have on a national, bilateral and European level and their interrelationships. This structural pluralism must be protected and strengthened throughout Europe.

To achieve this, we need balanced and pluralistic decision-making systems at every level – national, bilateral and European. We not only need funding systems that base their decisions on social, economic or political applicability and future impact, but also those that make decisions based on the sole criterion of scientific quality. We also need a healthy balance between national and bilateral research funding and European funding instruments.

It is these balances and interconnections that create the climate of opportunity that researchers need to flourish. This is the Europe we should be working for.

Professor Dr. Peter Strohschneider
is the President of the DFG.

It follows that, in terms of building more innovative capacity in Europe, we should not inflate the concept of impact. The ways in which research projects develop, what knowledge they generate and what benefits they produce cannot generally be planned in advance. When impact is discussed in relation to research funding, it usually refers to (uncertain) expectations of future impact. These are, of course, both important and legitimate – and where research seeks to find direct solutions to clearly defined societal problems, such expectations can play an important role. But to make anticipated impact the single most important criterion for research funding would massively impinge upon the capabilities and the far-ranging societal functionality of modern science.

Germany's experiences may be a good illustration: the country is performing well economically, exports and tax revenues are rising, and a significant number of Germany's mid-sized companies are global leaders

Onward, Upward and Out?

Symposium sheds light on transatlantic experiences

The DFG Symposium “Onward, Upward, and Out?” at the end of May looked at a familiar yet (ever) new topic – recruiting early career researchers to the scientific community. During the discussions, 90 researchers and representatives of science policy, research management and science communication from both sides of the Atlantic reviewed past experiences and looked ahead to the future. The transatlantic symposium at the Wissenschaftszentrum Bonn, convened by Professor Russell Berman of Stanford University, Professor Dr. Julika Griem and Dr. Johannes Völz of the University of Frankfurt and DFG President Professor Dr. Peter Strohschneider, explored the situation in the humanities and social sciences in Germany and North America. The symposium adopted a comparative perspective, with the objective of obtaining concrete outcomes from the discussions. The deficit analysis was that whereas in Germany the stage between completing

schneider, explored the situation in the humanities and social sciences in Germany and North America. The symposium adopted a comparative perspective, with the objective of obtaining concrete outcomes from the discussions. The deficit analysis was that whereas in Germany the stage between completing



Illustration: DFG/Lichterscheidt

a doctorate and receiving the offer of a professorship – in other words, the postdoctoral stage – proves especially difficult, in the US it is post-graduate programmes at graduate schools in particular that have come under pressure. Approaches to a solution included the shared desire for an improved culture of supervision in the humanities and social sciences, and for earlier and honest information about career prospects in academia and beyond. The view was that a career outside academia should no longer be regarded as a “failure” and a professorship should no longer be regarded as the only “gold standard”. Against this background, alternative career paths in academia and in other sectors were also discussed.

www.dfg.de/dfg_magazin/internationales/160530_transatlantisches_symposium/index.html



Illustration: DKN

Wide Horizon

International workshop on foresight strategies

Discussions with a wide horizon: Following on from the conference “How Can Science Contribute to Sustainable Global Development?” held at the UN headquarters in New York in 2015, organised by the DFG and the United Nations University, a four-day workshop was held at Villa Vigoni in Italy in mid-April. The DFG-funded event was organised by the German Committee Future Earth in partnership with the Future Earth platform and the Sustainable Development Solutions Network. 40 leading researchers in the natural and social sciences as well as key decision-makers from all over the world took part in the workshop, debating problems and challenges in the implementation of the Sustainable Development Goals.

www.dfg.de/dfg_magazin/internationales/160418_dkn_future_earth/index.html

Building Polish-German Bridges

Copernicus Award 2016: the DFG and FNP present award to cell researchers from Warsaw and Göttingen

At the beginning of June, the Copernicus Award 2016 for services to German-Polish cooperation in science and research, presented by the DFG and the Foundation for Polish Science (FNP), was awarded to Professor Dr. Agnieszka Chacińska from the International Institute of Molecular and Cell Biology and Professor Dr. Peter Rehling from the University of Göttingen. The award, worth €200,000, was presented by the presidents of the DFG and the FNP, Professor Dr. Peter Strohschneider and Professor Dr. Maciej Żylicz, in Warsaw.

It recognised the “pioneering” work carried out by the pair in the field of molecular cell biology,

which has been reflected in numerous collaborations and joint publications over the past 15 years.

Agnieszka Chacińska (left) has led the Laboratory of Mitochondrial Biogenesis at the International Institute of Molecular and Cell Biology in Warsaw since 2009. In her work, which has already been recognised with multiple awards, she studies the dynamic processes surrounding the formation of organelles and the biogenesis of mitochondria.

Peter Rehling, who has been a Professor and Director in the Department of Cellular Biochemistry at the University of Göttingen since 2007, investigates with great suc-

cess how proteins pass through the membrane of mitochondria, specifically how multiprotein complexes on and in the membrane control these processes and how proteins which have entered the cell transform into multiprotein complexes.



Illustration: IMCB, Warsaw

Illustration: private

The two cell biologists are the sixth pair to receive the Copernicus Award from the DFG and the FNP. The prize has been awarded every two years since 2006.

www.dfg.de/en/service/press/press_releases/2016/press_release_no_13/index.html



Illustration: DFG

Transatlantic dialogue: In mid-April, DFG President Peter Strohschneider travelled to Washington D.C. to take part in the Science and Technology Policy Forum, which was organised by the American Association for the Advancement of Science (AAAS). The focus of the conference, which was attended by high-profile participants, was

on global relationships within science and international science policy. The speakers included Barack Obama’s science advisor John Holdren, Secretary of Energy Ernest Moniz and Argentina’s Minister of Science Lino Barañao. During the session on “International Issues in Science and Technology Policy”, the contributors on the podium

included the DFG President, his counterpart from the Max Planck Society, Martin Stratmann, and Cherry Murray, Director of the Office of Science at the Department of Energy. They discussed the role and status of basic research. Particular emphasis was placed on the recurring conflict between societal and political expectations of practical applicability and the requirements of knowledge-driven research without prescribed results.

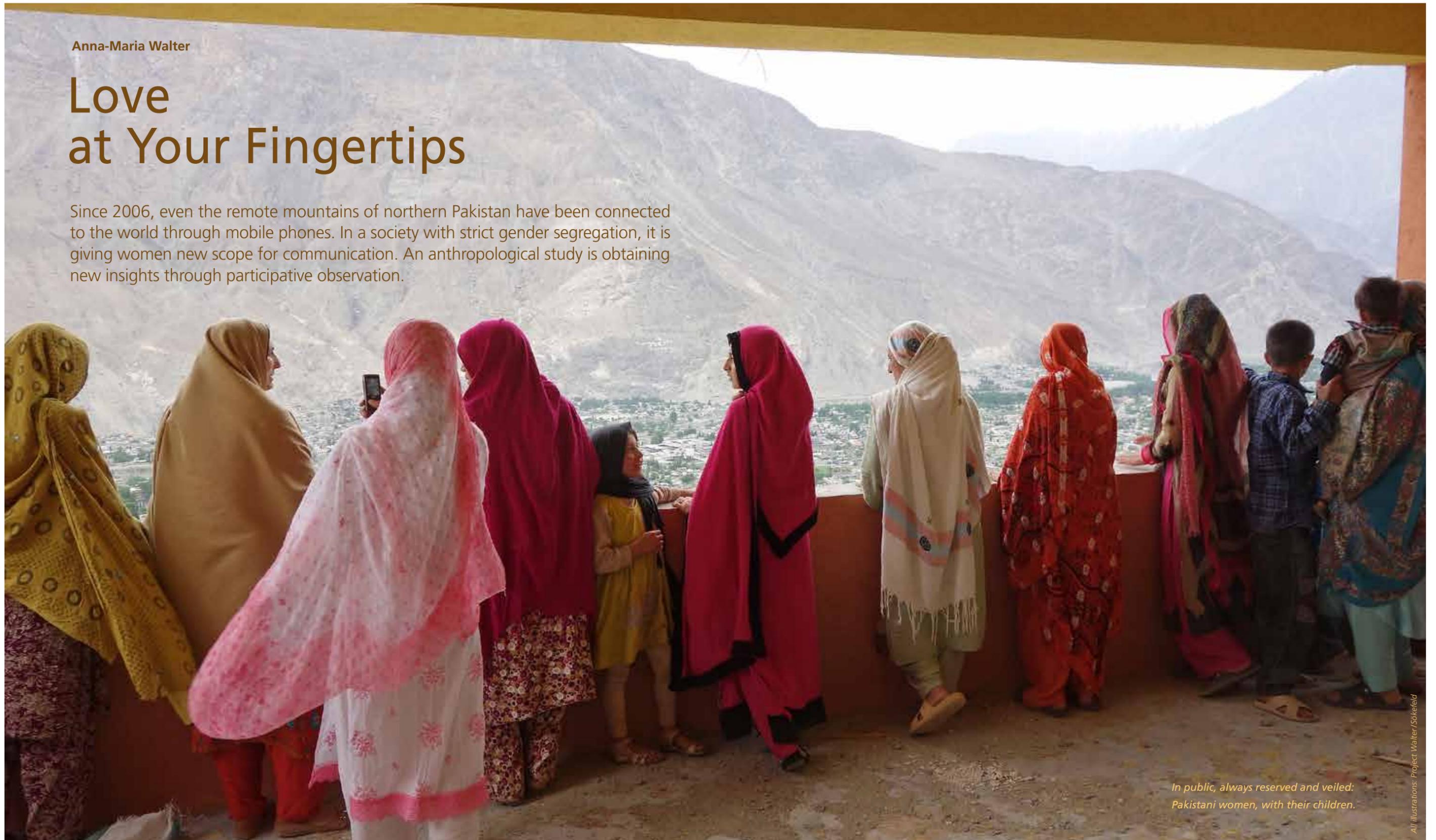
Afterwards the DFG President visited the University of Maryland, Baltimore County (UMBC), which has an excellent reputation for educational participation and educational careers for under-represented groups. President Freeman Hrabowski (left in photo) and other representatives of UMBC explained the university’s profile and funding experiences to Strohschneider.

www.dfg.de/en/dfg_profile/head_office/dfg_abroad/north_america/reports/2016/160421_praesidentenreise_bericht/index.html

Anna-Maria Walter

Love at Your Fingertips

Since 2006, even the remote mountains of northern Pakistan have been connected to the world through mobile phones. In a society with strict gender segregation, it is giving women new scope for communication. An anthropological study is obtaining new insights through participative observation.



*In public, always reserved and veiled:
Pakistani women, with their children.*

Beep, beep!” Something on the thin mattress next to me lights up and vibrates. For what seems like the hundredth time in the last two hours, Rubina has a text message. The young woman immediately dives for the phone from her younger cousin’s bed. The message causes a smile to spread over her pretty face. “I swear I miss you, darling!” she translates for me. She crawls closer to me and pulls the blanket over our heads to share more details. There may be few secrets between women, but Rubina doesn’t want to share the more delicate conversations with all her sisters. “I embrace you from behind and touch you with my hand.”

It soon gets hot and suffocating under the warm, synthetic blankets and we emerge again. I’m gratified to have the young woman’s trust, and even more pleased about her happiness in love. All day she has been exchanging text messages with her new husband. It’s almost like a real-time conversation but in writing, in a combination of the local language Shina, the national language Urdu and a few words of English. Ali is studying in “down-country” Pakistan while Rubina still lives in her parents’ house in Gilgit, up in the mountains; they need a way to bridge the distance. What could be better than a private phone?

In a society like Pakistan, where interaction between the sexes is very regulated, such intimate messages might at first seem surprising. In the town of Gilgit in northern Pakistan, in the Karakoram mountains, only a few women, very reserved and heavily veiled, appear in public.



In everyday life in Pakistan there is strict gender segregation. As shown in this picture, men keep to themselves while women can only look in through a window. Below: Women’s sphere of influence is in the domain of home and family. The mobile phone, which is also used as a digital camera, is becoming increasingly common in private.



Right: Family breakfast after the wedding, a traditional Gilgiti ritual.

In the private atmosphere of the home, things are different. All members of the family depend equally on one another and take an active part in family life. To understand life from the perspective of the local women and experience their everyday existence for myself, I spent a good 14 months living with different families. I experienced cold water, power cuts, few personal belongings, physical hard work and a lack of privacy, but also sincere hospitality, the warmth of an extended family and exuberant gatherings of women.

My field research is part of a DFG project to study the social impacts of mobile communication in Gilgit, a region in the far north-west of former Kashmir. This mountainous region only began to be connected to the mobile phone network in 2006. In this highly gender-segregated society, women’s sphere of activity is largely restricted to their own relatives and neighbourhoods. The project is specifically concerned with the question of whether and how women use the potentially larger radius of action and communication offered by the new technology. Calling relatives, staying in touch with grown-up children, listening to the radio, sharing music, taking photos or videos and accessing the Internet – these are just a few of the things that a mobile phone allows you to do. But in everyday social interaction, the technology is mainly associated with the (re)negotiation of gender relations.



Which brings us back to Rubina. She and Ali fell in love as teenagers and kept in touch sporadically through letters, phone calls on the landline, and later by mobile phone. The fact that they are cousins helped a lot. After much patience they managed to contrive their *nikah*, the Islamic wedding. Most marriages take place within the extended family; in a region of such linguistic, religious and ethnic diversity, there is considerable distrust of all strangers. Because Ali does not yet have a job, the two must wait a bit longer for their *shadi*, the social consummation of the marriage. Older women, in particular, envy the young people of today in this age of flirting and dating; until a few years ago it was still the practice for a couple to avoid all contact until the bride moved in with the husband’s family.

Ideas about gender relations are constantly changing and subject to

social negotiation. Inspired by Indian soap operas, Bollywood films, Pakistani celebrity talk shows and Western education, many young women nowadays yearn for romantic love. Rubina has already turned down several marriage offers. Because premarital feelings are considered shameful for girls, she could not tell her parents openly and it took some time for her father to realise that her heart belonged to a certain cousin. Rubina would never admit the platonic relationship in front of her mother, so ashamed is she of her own initiative.

An arranged marriage is not a “forced marriage”. Most of my Pakistani friends consent freely and confidently to a suggested suitor and trust in the experience and good intentions of their parents. Nusrat, who has just turned 23, does not seem very interested when her mother asks her what she thinks about a promising can-



Mobile phones are carried everywhere, allowing people to stay in touch even in remote mountain regions: here a young woman uses a stop on a long journey on foot to check her messages.

didate. At the *nikah* ceremony she does not even dare to look at the good-looking young man beside her. He is at least as shy as she is, as he presents her with the gift of a new Chinese smartphone. Only during the next few weeks do the couple start to get closer through the mobile phone. They send each other photos, spend hours talking on the phone and so form an emotional connection.

Because this is usually the first – and only – intensive contact with the opposite sex, many young people do fall in love. In autobiographical accounts, women later recount narratives of their love marriages, although on closer examination, the affection did not start to grow until after the wedding. So they are happy to integrate the imported ideas about romantic love into the established system of arranged marriage.

These “mobile phone romances” are not so much about making contact with strange men as about extending a woman’s own range of action within socially accepted confines. The new technology is the most important tool for this, making individual communication easier. But in the district of Gilgit the private domain of the mobile phone should not be overestimated. Within the household, to some extent everyone hears everything, so there is always a certain degree of social control. Young people do not usually seek



Trusting conversation is an essential part of participative observation by the field researcher.

to overstep boundaries or break with social norms. Values of modesty are deeply embedded and the individual restrains himself or herself in favour of the collective of the extended family. However, young people try the established boundaries within certain limits.

A good example of these sites of contestation is the case of my “little sister” Batool. She has just turned 17 and is studying hard at school to become a doctor. Some time ago her family received a *rishta*, a marriage proposal, for her from a related family. After lengthy deliberation she signalled to her parents that she agreed to an arrangement with the young man, but the engagement has not yet been officially announced. Nevertheless, the two marriage candidates have established contact with one another.

In the evenings the family members often sit together around the warm oven. The girls study for

school or college, the older women busy themselves with housework or look after the children, and I write my field notes. Batool looks up, checks to see that the adults are occupied, and grabs one of the mobile phones lying around. She sends her almost-fiancé a quick text message – “It’s me” – to let him know who is contacting him from the unknown number. The two exchange a few messages, which she immediately deletes again. Although this behaviour has effectively been noticed by family members, as more messages are sure to arrive from Mehmud during the course of the day, Batool maintains the impression that “nothing happened”. She does not yet have her own phone. Without a good reason, like studying outside the home or getting married, her father sees no need for it. Because her mother is illiterate, the children can send text messages freely.

The risk of loss of control prompts a certain distrust of the new technology among elders. In a poem in Shina, a teacher from the nearby Bagrot valley personifies the mobile phone as the “devil’s little brother”, which encourages young people to think “stupid” thoughts: “With the new fashion in their hands, they don’t study their school lessons, [...] dial wrong numbers.” The fact that many men try their luck by dialling unknown mobile numbers represents an irritating problem for young women. Occasionally, with the help of a few friends, they will defend themselves against interlopers by teasing callers with feigned affection.

Mobile communication is thus being adapted to the everyday life and traditional ways of Gilgit-Baltistan, creatively appropriated by our protagonists Rubina, Nusrat and Batool to push boundaries but not overstep them. The statement I heard most in my interviews with women was: “It all depends on the person; any technology can be put to good or bad use.”



Anna-Maria Walter, M.A.

is a doctoral student and research assistant in the Department of Social and Cultural Anthropology working with Prof. Dr. Martin Sökefeld at LMU Munich.

Contact: Institut für Ethnologie, Oettingenstraße 67, 80538 München, Germany

www.en.ethnologie.uni-muenchen.de/staff/professors/sokefeld/mobil-phones/index.html



Hans-Christian Pape



Fear and Fear Memory

It's a worrying fact that one in five people will experience an anxiety disorder at some point in their lives. This makes it all the more important to understand the cellular basis and molecular mechanisms of these emotions. Neurophysiology research is providing some illuminating answers.

The first time was terrible. I remember it clearly – the man in the white coat, the buzzing sound of the drill, the stabbing pain in my mouth. Ever since then, not just the thought of the dentist but even the waiting room and the smell of the practice have brought me out in a cold sweat.” Everyone has had experiences like this – they are an example of how an object or a context and the way we evaluate it influence our emotional responses.

But what exactly is fear – or anxiety? In everyday language the words “fear” and “anxiety” are often used interchangeably, but in fact they are two different entities: anxiety is a general feeling of apprehension caused by diffuse influences which are perceived as potentially threatening. Fear, on the other hand, is triggered by specific stimuli, objects or situations. It results in a fear or alarm response with physiologically observable effects such as raised blood pressure, faster breathing, increased sweat production or flight behaviour.

From a biological point of view, these responses are important components of human behaviour: they protect us from things that are unpleasant or harmful. The phylogenetic origin of these responses and their positive selection throughout evolutionary history are easily explained: individuals who respond with fear in a dangerous environment survive better. In German a scaredy-cat is called an Angsthase (scared bunny), with negative connotations, but in Chinese mythology the rabbit is a symbol of longevity. Put simply, “The brave die first!”

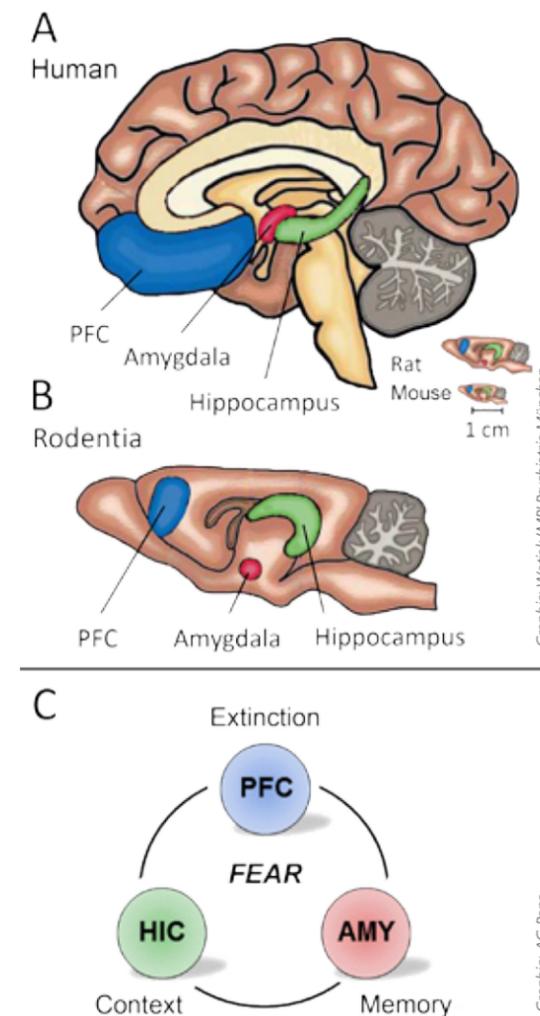
In conceptual terms, the evolutionary preservation of these responses in mammals, including humans, proved to be an advantage

because it made cross-species approaches and interpretations easier and therefore revealed the principles on which this emotion is based. However, there are significant individual differences determined by a complex interplay of genetic predisposition, autobiographical factors and neurobiological processes. Extreme experiences can result in excessive responses up to and including anxiety disorders. Indeed, the number of people who suffer from anxiety is a cause for concern: the probability that an individual will experience an anxiety disorder at some point during their life is around 20 percent, meaning that one in five of us is affected.

Can we follow the pathways of fear in the brain? As a basic rule, fear responses affect specific brain circuits. There is also a high degree of homology between the brain regions in humans and other mammals, particularly rodents, which have been extensively studied. Given the phylogenetic preservation of these responses, this is not surprising. In neurobiological terms we have to distinguish between regions of the brain that mediate reflex-like fear responses and those which allow the higher-level control of these reflexes. The latter, in particular, are of particular interest as mediators of learning-

dependent modifications or therapeutic “targets”.

Today we know that our fear responses are regulated by a triad of brain regions. The first is the amygdala, which plays an important role in the emotional components of the memory of an unpleasant event, known as fear memory. The second is the hippocampus in the temporal lobe of the brain, which provides information about the context of an event. The example of the visit to the dentist and the subsequent fear response experienced in the waiting room vividly illustrates the interplay of context and fear memory. Finally there is the prefrontal cortex, which



functions as a kind of higher-level instance. It evaluates the event and can also mediate relearning, which actively suppresses the initial fear memory.

Neurobiologists call this process “extinction”. When anxiety becomes abnormally high, exposure therapy seeks to exploit these processes. The patient is repeatedly exposed to the fear-causing stimuli and memories in order to achieve re-evaluation. One problem is the relatively high relapse rate, which is mainly due to the fact that the fear memory is not “deleted”, only “overwritten”. This means that the initial fear response can re-occur later on.

So how do the different regions of the brain work together in functional terms? The three areas do not operate as self-contained units. This

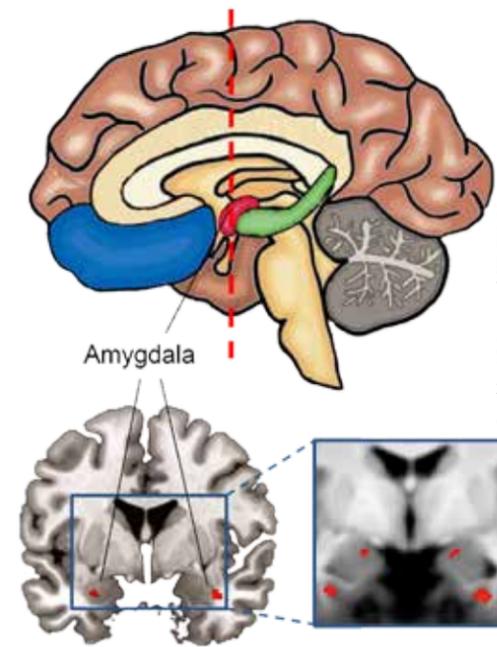
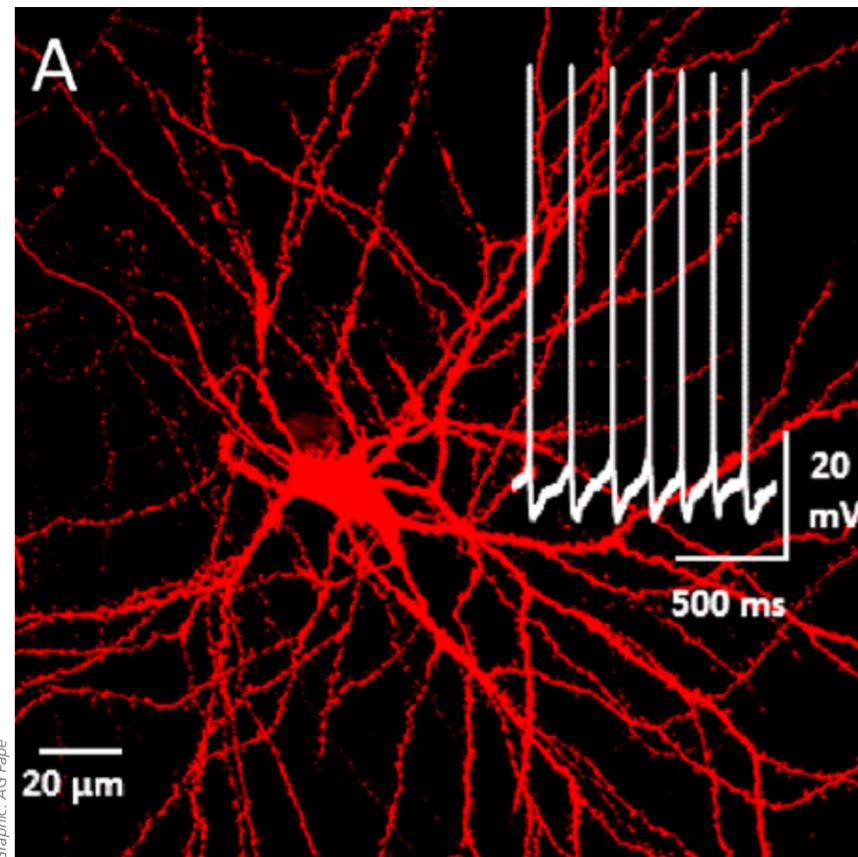
means that out of the populations of widely distributed neurons, distinct subpopulations must be activated and functionally connected in a behaviour-dependent manner. In the laboratory we trained fear memory in mice, used fine-tipped microelectrodes to simultaneously record the electrical activity of individual neurons in the relevant brain regions, and discovered important principles of neuronal connectivity. All neurons in the amygdala and hippocampus have the ability to generate rapid electrical signals (termed action potentials) – the basis of information processing in the nervous system. In a fear-relevant situation the pattern of neuronal activity changes in a characteristic way, as specific subpopulations fire their signals synchronously. Out of the multitude of spatially remote

neurons a relevant network is selected, functionally coupled and stabilised to form a circuit of the fear memory. It is generally assumed that this is how something learned is transferred to long-term forms of memory: neurons are functionally linked and their connections (synapses) are stabilised.

In order for this to happen, their activity must be synchronised. Memory formation requires a signal to be sent repeatedly even after the fear-relevant stimulus has subsided. These repetitions are like a “replay” of the stimulus situation, which occur particularly during sleep. So sleep promotes memory formation – in mice as in humans. In fear extinction, the neurons of the prefrontal cortex are functionally linked according to similar principles of synchronisation. In this way the neurons form spatially distributed functional networks, termed ensembles. The composition of an ensemble varies depending on its function, and the integration of the individual members depends on the rhythmic timing of their electrical activity. The neuronal fear matrix thus consists of synchronised activity patterns of spatially distributed neurons in the brain. The three regions represent necessary but not sufficient junctions between the networks.

How can fear memory or fear extinction be regulated from the per-

The neurophysiological correlates of fear memory and fear extinction provide researchers with lots of information – for example on the characteristics of a neuron in the mouse amygdala. The intracellular dye makes the neuronal structures visible and electrophysiological techniques reveal the profile of rapid electrical signals.



When aversive stimuli reach the human brain the amygdala is activated. Magnetic resonance images (section shown in the diagram above) with activation pattern at maximum resolution (right).

spective of basic research? Both the brain's own transmitters and “exogenous” substances from outside the brain that suppress the fear matrix in the amygdala or stimulate the extinction system of the prefrontal cortex have a potentially anxiety-inhibiting (anxiolytic) effect. Recently we have succeeded in identifying the function of a “new” transmitter system in the brain. Here specialised neurons release a transmitter (neuropeptide S or NPS), which has a short-term anxiolytic effect and in the long term promotes the extinction of fear memory. Neurobiologically, this profile of NPS action can be explained by its site and mechanism of action: it acts on synapses of neurons in the amygdala which mediate the influence of the prefrontal cortex. Only recently did we discover that exposure to stress activates this transmitter system. In general terms, stress makes us more sensitive to emotions, increases sensitivity to anxiety and impairs fear extinction. But stress exposure also causes more NPS to be released in the amygdala, reducing the effects of stress.

Stress is one of the critical influencing factors in anxiety disorders. This prompts the question as to whether NPS could be useful in

prevention or treatment. Since there are findings which reveal that NPS also affects processes outside the fear matrix, it would be wise to be cautious. However, studies carried out by our Collaborative Research Centre (CRC-TRR58) also indicate that this transmitter system plays a critical role in fear and anxiety in humans. They show that genetically determined variants of NPS receptors in the brain are a risk factor which is associated with oversensitivity to stress, increased activation of the fear matrix and fear interpretation (the “catastrophe response”) in both healthy subjects and patients with a panic disorder.

How do these findings contribute to our understanding of genetic predisposition to anxiety disorders? Obviously, it would be naive to assume that changing a single genetic factor or a handful of genes can explain the causes of an anxiety disorder. Rather, the development of anxiety problems is associated with a combination of genetic and environmental factors. Promising candidates are genes of the signalling pathways and transmitter systems of the neuronal fear matrix. The receptor for NPS is one of these candidates. Many of these variables and the accumulation of their effects manifest healthy or abnormal behaviour.

To summarise, in recent decades we have successfully characterised some key principles of the fear matrix in the brain. In spite of these successes, it should be noted

that our current understanding is mostly based on reductionist models. They reduce the concept of “fear” to the conscious experience when confronted with a threat. What are still less well understood are the processes that determine the different types of fear (to spiders, public speaking, death and so on) and ultimately the subjective feeling of “anxiety”. These involve interactions of various functional circuits in the brain and other systems of the human organism. They cannot be understood as an integrated system, but as a collection of multiple subsystems with interactions in changing combinations, depending for example on the individual situation and the particular strategy pursued. Understanding these combinations – characterising not just the principle, but the variability and individuality – will be one of the future challenges in brain research.

The CRC/Transregio CRC-TRR 58 is investigating these interfaces, bringing together researchers from Münster, Hamburg and Würzburg to further decode the mechanisms of “Fear, Anxiety and Anxiety Disorders”.



Prof. Dr. Hans-Christian Pape

is the Director of the Institute of Physiology I at the University of Münster and spokesperson for CRC-TRR 58.

Contact: Institut für Physiologie, Robert-Koch-Straße 27a, 48149 Münster, Germany

<http://sfbtrr58.uni-muenster.de>



Rembert Unterstell

A Public Intellectual

His ideas about social acceleration have made Hartmut Rosa a sought-after expert in the media – but the Jena-based sociologist does not want to be an “agony uncle”

We live in an expertocracy where politicians seek expert advice and journalists are constantly on the look-out for experts to express views and take part in debates. When it comes to buzzwords like “time stress”, “turbo-capitalism” or “breathless society”, no one in Germany is more in demand than Jena-based sociologist and social theorist Hartmut Rosa. Vividly, engagingly and to the point, he has the ability to explain his ideas and put them in the wider context of social change while interpreting phenomena such as fast food, speed dating and multitasking. A media expert, then?

Rosa is certainly media-savvy; on his desk is a studio-quality mobile microphone system for recordings and live interviews (photo right). But the sociologist, who speaks and presents so well, is also aware of the negative aspects of his media presence – like when journalists categorise him as an “acceleration guru” or seek out his views on “time without time”. “I’m not an agony uncle,” he says, obviously enervated. “That’s neither my job nor my position as a sociologist.”

Appointed Professor of General and Theoretical Sociology at the University of Jena in 2005, Rosa has built an international reputation as

a social researcher, interpreter of our times and acceleration theorist. In his habilitation thesis, “Acceleration – The Change in Temporal Structures in Modernity”, which has now been translated into six languages, he formulated a core thesis: since the late 18th century, modernity has not been driven by money, greed, power or egoism, but by acceleration; and time acts behind people’s backs, affecting all social and cultural spheres. He presents the history of modernity as a history of acceleration.

For sociologists, Rosa’s contribution is that he has brought a common buzzword in contemporary and cultural criticism systematically to an overall perspective and integrated the acceleration thesis into a critical theory of modernity for the first time. In his research, Rosa operates on the assumption that there are three dimensions of acceleration. Firstly there is technological acceleration – a locomotive is faster than a horse-drawn carriage, an e-mail is faster than a letter. Secondly there is social acceleration: life partners come and go, flexible job-hopping is the order of the day. Thirdly, he analyses a rampant acceleration in the pace

The modern human – working and living breathlessly and at a run. Hartmut Rosa analyses and interprets the age of acceleration.

of life, associated with the feeling of being left behind and of inadequacy.

The overall picture that Rosa paints is a bleak one: the ratio of social acceleration to deceleration, motion to steadiness, he argues, has gone beyond a tipping point – an irreversible process with extreme consequences, from the collapse of ecosystems and uncontrollable pandemics to contemporary diseases like burnout, depression and heart attacks.

How did he end up in this field of research? Rosa was born in 1965 in a rural area of the High Black Forest. His private and family life is still centred around Grafenhausen, a small community to the south of the Schluchsee (“I’m involved in the local tennis club and in setting up a museum on our experience of time, and I play the village organ once a month.”).

When he went to the nearby University of Freiburg in 1986 to study political science, philosophy and German literature, he was, as he explains today, deeply unsettled by the urban pace of life. Time spent studying at the London School of Economics and, later, Harvard University brought him into contact with urban worlds and “constitutions of time”. He obtained his doctorate in 1997 at the Humboldt University of Berlin under the supervision of Axel Honneth with his dissertation “Identity and Cultural Practice”, a study of the political philosophy of Canadian Charles Taylor.

Only then did he turn his attention to questions relating to the sociology of time, taking his research topic to New York, “the fastest city in the world”, where in 2001/2002 he worked as a Feodor Lynen fellow and visiting professor at New School

University. After a stint in Mannheim he moved to Jena, where he completed the habilitation process and was later appointed professor. In 2013 he also became the director of the Max Weber Center in Erfurt.

In addition, Rosa is the spokesperson for the DFG-funded Research Training Group “Landnahme, Acceleration, Activation. Dynamics and (de-)stabilisation of modern growth societies”. The linking jumping-off point is the hypothesis that modern societies need growth, innovation compression and acceleration, a “dynamic stabilisation”, in order to sustain the system on which they are based. The logic of competition and increase immanent to the system has consequences for individuals, primarily in the form of alienation experiences. But what, asks Rosa, characterises a non-alienated life? Rosa devoted years to the study of this question, including a number of smaller projects, and published a book in autumn 2015 based on an idea that he describes as the opposite of the much-cited “alienation”: resonance.

He theorises that people strive, in fact yearn, for “resonant relationships with the world”. For Rosa, achieving resonance means the ability to be touched and moved inside by people or things, vibrating together and to a certain extent interactively – for example in encounters with other people, in the experience of music, literature and art, in the experience of nature, and also in religion. The more we are capable of securing spaces and axes of resonance, the better our chances for a good life – the door is opened to a new social-philosophical viewpoint.

We should perhaps note that Rosa, his master keys of “acceleration” and “resonance” in hand, runs



Illustration: Unterstell

the risk, like great theorists before him, of making all modern phenomena fit the Procrustean bed of his structure of thought. But it is equally obvious that the original analyst fulfils to an even greater degree the role that was in vogue and admired before the expertocracy of today, not just in France (Roland Barthes) or in the US (for instance in the person of Susan Sontag): that of a public intellectual. Recently turned 50, Hartmut Rosa will continue to have things to say in academia, in public and in the media. With a lively touch, clear-sighted interpretations and his own unique approach.

Dr. Rembert Unterstell is Publishing Executive Editor of *german research*.



Illustration: Coloures-pic/fotolia

Martin F. Quaas



Illustration: Maïke Nicolai / GEOMAR

Cod, Herring and Sprat

Joining forces, not fragmentation: a wide range of research areas can contribute to sustainable fisheries, from marine biology to economics and law. The Cluster of Excellence “The Future Ocean” is seeking to establish a dialogue.

It's not a new insight, but an important one: overfishing of the oceans remains a global problem. For many fish stocks, so-called fishing mortality now exceeds natural

mortality. In other words, humans consume more fish than predatory fish, seals and other hungry aquatic species. This impacts on the ocean as a habitat and indirectly on

populations of plankton, jellyfish and seabirds. A closer examination reveals that the interrelationships at work are complex and it is a huge challenge to accurately

describe and quantify all the effects of overfishing. Another important insight is that it's not just biological processes which play a role: economic and social processes are equally important. In addition to supplying food, fishing also provides jobs in coastal areas and to some extent social identity.

The Research Unit “Sustainable Fisheries”, part of the Kiel-based Cluster of Excellence “The Future Ocean”, has been studying this topic since 2007. Given Kiel's lo-

cation, the group's work is mainly focussed on the Baltic Sea. It is not only the sea that the researchers in Kiel know best, but also a spatial system of manageable scope and a habitat for a manageable number of fish species. In economic terms, there are mainly three important species: cod, herring and sprat. On the German Baltic Sea coast there are less than 2,000 fishing vessels, three quarters of which are small boats used for artisanal coastal fishing. What might ecologically, so-

cially and economically sustainable fishing on this coast look like? One might assume that ecological and economic considerations would be in conflict. Yet the research reveals that sustainable fishing does not have to be economically disadvantageous. Although the transition to biologically sustainable use results in a short-term drop in earnings, in the long term fishing companies can actually increase their profits. The reason for the growing profits is higher “resource rent”, which arises because fish are naturally a valuable commodity. Unlike other consumer products, fish do not have to be manufactured, simply caught. The difference between the market value of a fish and the costs involved in catching it is referred to by resource economists as “resource rent”.

If stocks recover thanks to sustainable practices, catching fish requires less effort. Costs therefore fall and the resource rent increases. In political terms, however, there is a downside: the fact that fishing then requires less equipment and fewer workers may endanger the social side of sustainability.

The matter becomes even more complicated when we consider the coexistence of species. For example, if cod stocks in the Baltic Sea significantly increase, this is to the detriment of herring and sprat, because these are the preferred food of cod. This results in a trade-off: either fisheries must severely limit the sprat catch or they must limit the cod stock so that profitable sprat fishing is still possible. Thus, sustainable resource management always demands compromises.

Marine biology contributes valuable knowledge, including in-

formation about the natural variability of fish stocks. This depends to a large extent on the amount of salt water that flows into the Baltic from the North Sea. Recently it has also been suggested that major declines in the cod stock may be due to parasites. This area of research in “The Future Ocean” is therefore a comprehensive examination of phenomena which have previously only been studied from one single perspective or another. While fisheries policy has traditionally aimed at balancing economic and ecological interests, “The Future Ocean” follows the approach put forward by the United Nations, the Ecosystem Approach to Fisheries Management, which takes a balanced account of social, economic and ecological

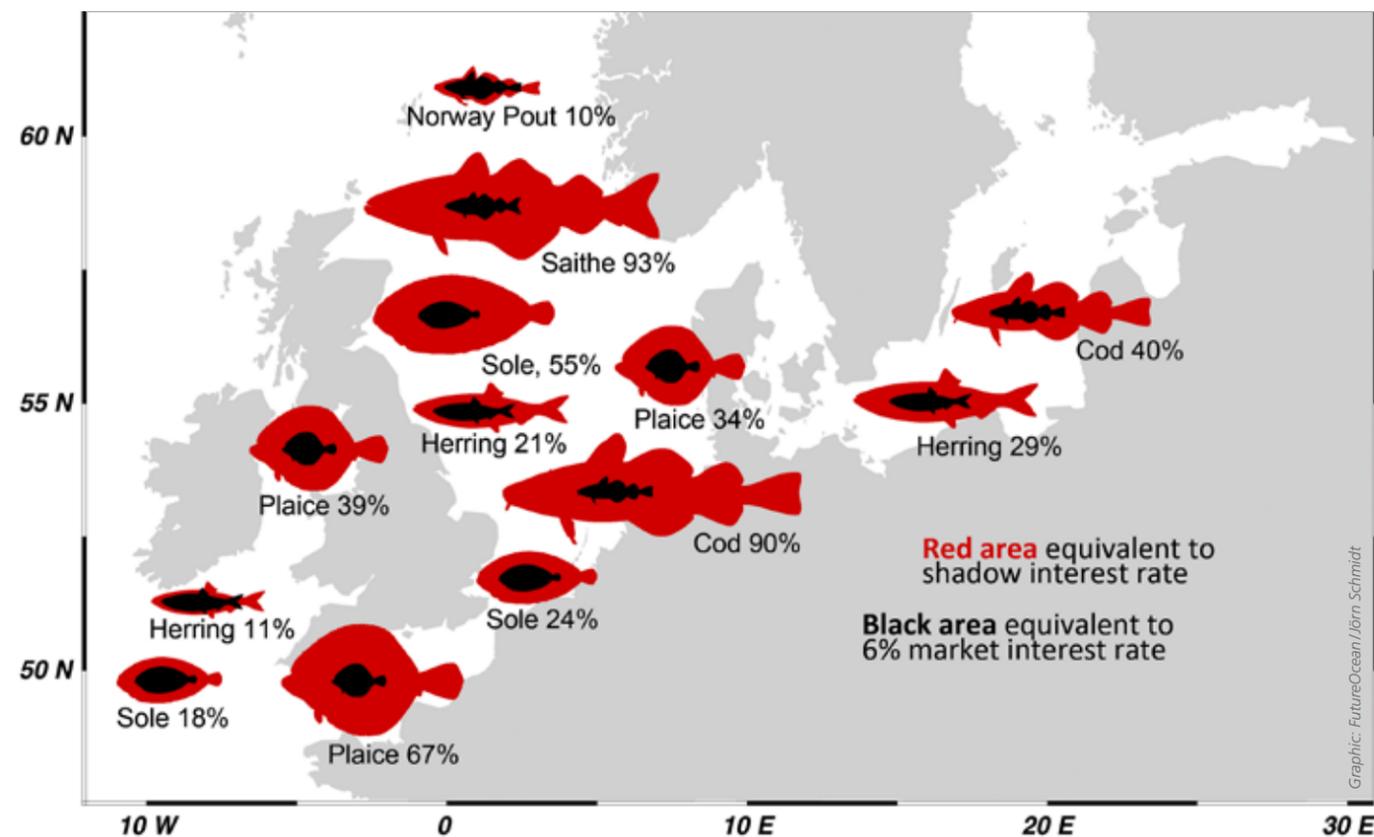
factors in the interests of sustainable resource management.

Efforts to model such processes – and thereby identify the associated uncertainty factors – have made progress, and not just in the Baltic Sea. In an interdisciplinary project, researchers in resource economics and in fish and evolutionary biology at Kiel University, GEOMAR Helmholtz Centre for Ocean Research Kiel and the University of Helsinki in Finland have computed how fishing and aquaculture will develop for popular edible fish such as sea bass, salmon, cod and tuna. These four species are among the most important in markets and on menus in North America and Europe. While salmon and sea bass are mostly farmed, cod and tuna are predominantly wild-caught.

The study focussed on the question of how wild fish stocks will develop between now and the middle of the century, taking both biological and economic factors into account. Further factors considered were technical progress in fisheries, the growing global demand for fish and the rise in supply from aquaculture (fish farming). The interaction between these factors was computed in a variety of scenarios.

A realistic prognosis of the development of economically important wild fish stocks requires the consideration of both economic and biological driving forces. Nonetheless, at the end of the study researchers were surprised to find that economic devel-

Representation of the so-called shadow interest rates for 13 fish species. The higher the percentage, the more overfished a given species is and the more worthwhile an investment would be for both fishermen and fish stocks.



Left: A catch of sprat. Right: Discussions in situ – for example with Björn Fischer (left in photo) from the fishing vessel SK 14 – are an important part of the interdisciplinary research.

opment has a much greater impact on fish stocks than they expected. In summary, although the growth of aquaculture production can take the pressure off wild fish stocks, this positive effect will probably be overwhelmed by greater demand and technical progress in the fishing industry. Under current conditions, aquaculture production would have to increase annually by a percentage in double digits to protect stocks – a well-nigh utopian figure from a research perspective.

There is also the problem that farmed fish are often fed on wild-caught fish. Even at very optimistic rates, with greater use of alternative feed, the pressure of fishing

on feed fish stocks would increase enormously – and probably result in their collapse. The sustainable use of wild fish stocks can only be achieved through much more effective fisheries management. To prevent the collapse of fish stocks, the researchers conclude that the only solution is institutional change which significantly improves the effectiveness of fisheries management for wild fish species.

It is at this point, if not before, that law comes into play. Legal researchers are also part of the Future Ocean team. Through a variety of projects, the Walther Schücking Institute for International Law at Kiel University is examining the core problem of whether the oceans should be simply available to all (including in terms of exploitation of the resources they contain) or whether they should be more strictly pro-

tected as a common heritage of humanity. Associated with this is the critical re-examination of the definitive UN Convention on the Law of the Sea. After all, achieving something worthwhile demands the right legal instruments – even on the high seas.



Professor Dr. Martin F. Quaas researches and teaches in the Department of Economics at Kiel University and is the head of the Research Unit “Sustainable Fisheries” in the Cluster of Excellence “The Future Ocean”.

Contact: Institut für Volkswirtschaftslehre, Umwelt-Ressourcen und Ökologische Ökonomik, Christian-Albrechts-Universität zu Kiel, Olshausenstraße 40, 24098 Kiel, Germany

www.futureocean.org



Mark Alexander Ahrens and David Sanio

How Much Longer?

Unrelenting traffic, corrosion and weathering all take their toll on the prestressed steel used in bridge construction. Structural engineers use mathematical models to predict the progress of fatigue and therefore the useful life of these structures more accurately. The reliability of forecasts depends on the quality of the data and the accuracy of the methods used.

We encounter predictions and forecasts every day, for example when we watch the evening news. What will the weather be like tomorrow? How will the DAX react to current events? How will the Middle East conflict develop? Other forecasts are more personal: Will my next performance evaluation result in that long-awaited promotion? When will I build my own house or start a family? Seen in a global context, they are often trivial: Will my commuter train be on time today? Will my team win the championship next season?

But interestingly, all forecasts have one thing in common: they are based on models that simplify reality, using them to look into the future with the assumption that reality will not change significantly or suddenly compared with previous events and experiences. While weather forecasts today are some of the most “reliable” predictions (accuracies of around 90 percent are achieved for the following day), long-term forecasts are usually much more unreliable and more complex.

The same is true in structural engineering. One of the biggest chal-

lenges currently facing structural engineers is assessing and predicting the condition of the physical infrastructure, particularly bridges. In Germany, this includes bridges that form part of federal main roads, those that are the responsibility of local authorities, and those in the national rail network. But regardless of location, the key questions are the same: What kind of condition is the bridge in? How long can it continue to be used safely in view of constantly growing traffic loads and the effects of ageing? What strengthening measures will be needed and when?



Left: Flyover of prestressed concrete in the Heerdter Dreieck in Düsseldorf shortly before it was dismantled. Below: A glimpse inside – exposed tendons with strain gauges; a tendon was cut through to simulate failure.

In Germany in 2010 there were around 39,000 bridges on main roads managed by the federal government; the number for the whole country is estimated to be around three times higher. A substantial 70 percent of these are prestressed concrete bridges and a further 17 percent are made of non-prestressed steel-reinforced concrete.

In simplified terms, prestressed concrete can be seen as a technological refinement of the reinforced concrete technology that became widespread during the post-war economic boom. Prestressed concrete behaves rather like a stack of books held out horizontally in front of you, which will not fall as long as it is sufficiently compressed from the sides. In a prestressed concrete bridge this compressive force is supplied by the high-strength steel tendons. These are put in place during construction, extended with coupling joints if necessary, tensioned prior to commissioning and anchored against the bridge. The concrete, which by itself can withstand large compressive forces but only low tensile forces, is pre-compressed.

This new technology, as it was then, was used to bridge ever greater

distances with slender, aesthetically pleasing, economically built structures. But they were not immune to the forces of time. The load-bearing structure is altered by use and by external influences such as weathering and corrosion. Fatigue caused by traffic load and heavy vehicles also results in internal damage.

The principle is easy to understand: when you bend a piece of wire, nothing appears to happen. But if you keep bending the wire back and forth, it will eventually break. This phenomenon is known as “fatigue”. Whether a material

breaks also depends on the size of the load it is subjected to. In some cases, reducing the load by half allows the load to be applied hundreds of times more before breakage occurs. Of course, prestressed steel must not break at all as it provides the tension required to give the bridge its function. To prevent this from happening, engineers use computational models that allow them to calculate stresses in prestressed steel and predict the progress of fatigue.

What makes this particularly difficult is the fact that, unlike mass-produced cars or electrical appliances, bridges are usually one-off designs. Only in a few cases are the superficial similarities great enough for two bridges to be described as sister structures. But even here there are differences, for example in the dimensions, the quality of the materials used or the individual load history. So in engineering, as in other disciplines, it is necessary and standard practice to simplify complex real systems. This





Illustration: David Sanio



Illustration: David Sanio

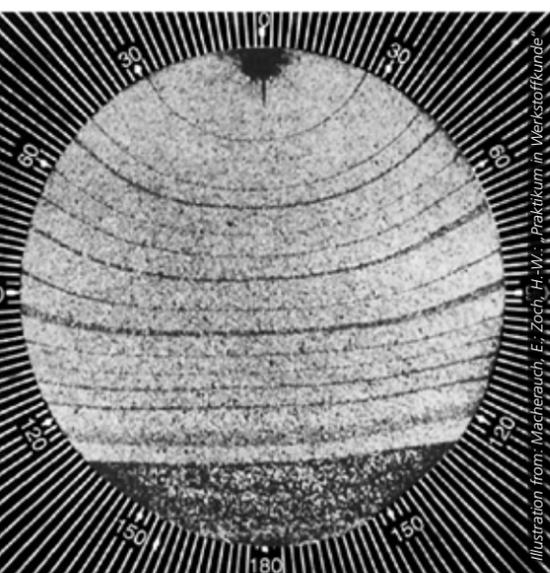


Illustration from: Wacherauch, E., Zoch, H.-W.: „Praktikum in Werkstoffkunde“

Samples are essential to assess the structural condition of a bridge. Top: Taking a core sample. Centre: The extracted core, which will be analysed in the laboratory. Below: Fracture surface of a tendon after a fatigue test.

is usually done with the help of computational models that depict reality in a simplified manner.

The necessary simplifications require a quality and accuracy assessment that is best carried out on real structures. The city of Düsseldorf, the research group's project partner, made a reference structure available for this purpose – a prestressed concrete bridge in the area known as the Heerdt Dreieck.

To calculate a fatigue lifetime – the length of time for which the structure will reliably withstand changing load – engineers normally use a large number of input variables, some of which are uncertain. These must usually be defined in advance using estimates, standards or other methods, and initially have an undetermined influence on the result. The aim of the project is to define these values as accurately as possible, insert them into the calculations and thus improve accuracy as much as possible. In the process the engineers determine the parameters on which the forecast primarily depends and whether and how decisive parameters can be identified more precisely.

First a finite element model of the structure is generated, which calculates the stress on individual components – in this case, primarily the tendons – from external loads (such as the weight of the bridge and traffic). This model depicts the structure geometry (width between supports, section heights and wall thicknesses) and material characteristics on a computer.

Concrete, reinforcing steel and prestressed steel are assigned specific characteristics such as strength, rigidity and fatigue strength, in accordance with technical regulations. These characteristics can be measured more accurately using specimens in the laboratory to replace originally conservative estimates with more exact measured values. Destructive testing is carried out on specimens to provide real characteristic data for the material. As part of the project, cores were taken from the bridge and samples were taken of the prestressed steel during the dismantling.

These samples can be used to measure special parameters known as fatigue resistance under the repeated application and relief of a load. Fatigue breakage occurs under high load after just a few repetitions, but when the load is lower, breakage only occurs after many thousands or even millions of load cycles. This situation is represented by Wöhler curves (S-N curves), named after the German railway engineer August Wöhler (1819–1914). These curves were derived experimentally in the laboratory for the prestressed steel of the bridge. The almost 8 million variable loads acting on the tendons ranged from 7 tonnes to 40 tonnes.

Test loads were used to test the model further. A vehicle with a known weight was placed in defined positions and the deformation of the bridge – a matter of millimetres – was measured with a precise levelling instrument. The measured and calculated deformations can be compared and the model can be calibrated.

Like human skin, prestressed bridges lose their elasticity over time. Engineers also have methods of calculation for this variable. To accurately measure the losses over time, the team cut through one of

Right: Measurement equipment is fitted on the prestressed concrete bridge. Immense volumes of data must be handled to predict the fatigue and likely lifetime of the structure. Below: Attaching strain gauges to the exposed tendons.

the tendons and observed the nearby strain gauge to see how great the loss actually is. This information is also fed into the calculation.

Another factor that significantly affects lifetime is external loads. These mainly result from vehicles passing over the bridge, but also from the effects of temperature and temperature fluctuations. For the calculation, “virtual” standard vehicles are made to cross the bridge at a defined frequency, producing a load which is then relieved. There are two key factors that are made more accurate by measurement: the number of vehicles and the weight or axle load of each vehicle. The number is generated from a detailed evaluation of current and historical traffic counts in the area around the bridge. The axle

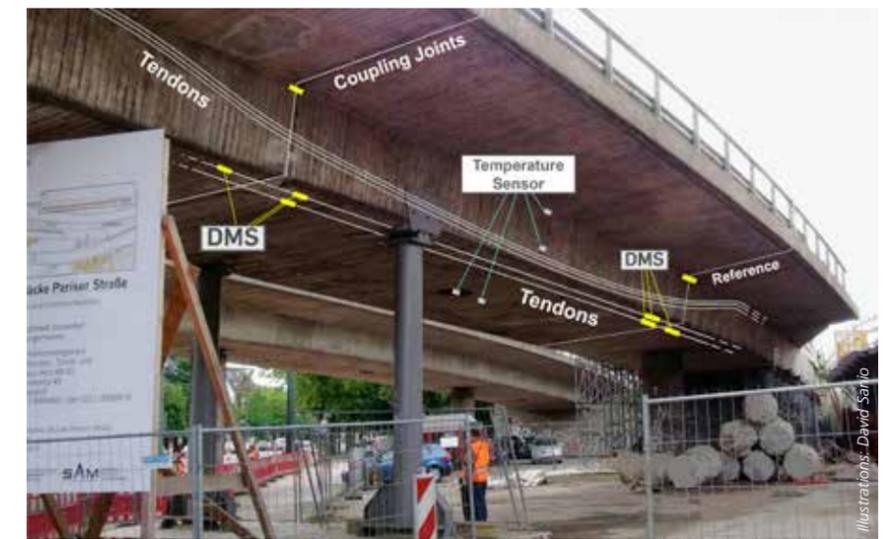


Illustration: David Sanio

loads are calculated in a relatively complex process from strain measurements of the prestressed steel.

To do this a large-scale observation programme is initiated, with the stresses in the steel being measured over several weeks using strain gauges with everyday traffic. The strain gauges are attached directly to the previously exposed steel. The resulting pattern, produced from around two billion measurement data, is analysed and evaluated using special counting processes that reduce the mass of information to the essentials. The load produced by fluctuating external temperatures is also measured at various points in the concrete and fed into the calculations.

Using all this data, it is then possible to predict the lifetime of the bridge. The measurable loads on the tendons are recalculated and extrapolated until numerical failure occurs. Generally, many different parameters come into play. On the reference structure the engineers were able to demonstrate that the numerical lifetime forecast can be considerably extended using “best possible” data gathering. To manage bridges economically and with mini-

mal impact on resources, it is important to apply local material data accurately, allowing for changes over time, and to use the actual weight of heavy lorries instead of traffic models drawn from regulations and standards. Perhaps the most astonishing, and certainly the most notable, fact is that a single lorry causes nearly the same amount of fatigue as 100,000 cars.



Dr.-Ing. Mark Alexander Ahrens and Dipl.-Ing. David Sanio

are research assistants for the Chair of Concrete Structures, held by Prof. Dr.-Ing. habil. Peter Mark, at the University of Bochum.

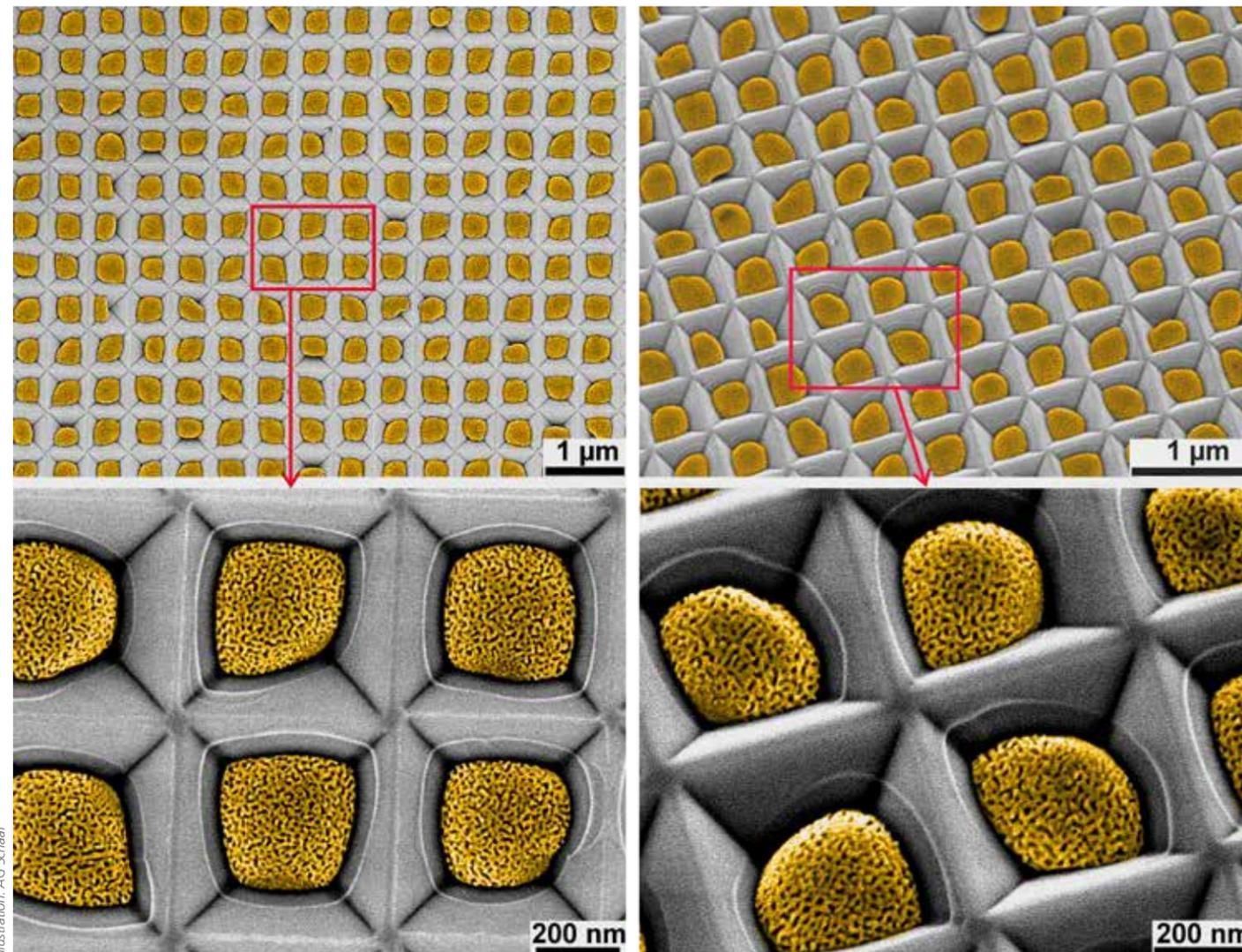
Contact: Ruhr-Universität Bochum, Lehrstuhl für Massivbau, 44780 Bochum, Germany

The project is supported by the city of Düsseldorf's Department of Traffic Management as cooperation partner, which provided the structure and traffic count data and carried out levelling.

www.massivbau.rub.de/german/aktuelles/news/dfg_hochstrasse.html



Andreas Herz, Dong Wang and Peter Schaaf



Hats Off to Self-Organisation and Self-Assembly!

Metallic films of nanometer thickness are used for electronic applications in which they must be stable and not decompose into nanoparticles. On the other hand, nano-sized metallic spheres of uniform size in a defined arrangement are very interesting for new applications in optics, sensor technology and medicine. Researchers are looking to nature for help in fabricating such complicated nanomaterials. The magic word is “dewetting”, a process that could enable their easy fabrication.

Left: Nanoporous gold nanoparticles arranged on a predefined and prestructured silicon dioxide/silicon substrate.

They cannot be seen, but metallic nanoparticles, such as tiny gold spheres with a diameter of just a few millionths of a millimetre, have interesting properties that are different from those of normal metals. This allows them to support new applications in the area of medicine, energy generation and computer technology. In the long term, they might be able to help to find pathogens or destroy cancer cells. There are also suggestions that they could be used in optics and sensor technology. How can these promising nano-spheres be produced in the same size and in a defined, regular arrangement? This is essential for many conceivable options and as such, a serious question and a major challenge for technology-oriented researchers in micro- and nanotechnology.

Much depends on nanoparticles. Ultra-thin fixed layers, just a few nanometers thick, can accelerate technological progress – for example in the transistors and resistors in electronic circuits used in smartphones, televisions or components for PCs. This is all done with thin films. Modern coating methods allow ultra-thin layers to be created and used as components in microsystem technology. So far, so (apparently) easy!

However, there are also undeniable difficulties. From the physical point of view, thin films have a crucial disadvantage. As they are so thin, their surface is large in relation to their volume. However, materials try to make their surface smaller. Anyone who has ever looked out of their window at the rain knows



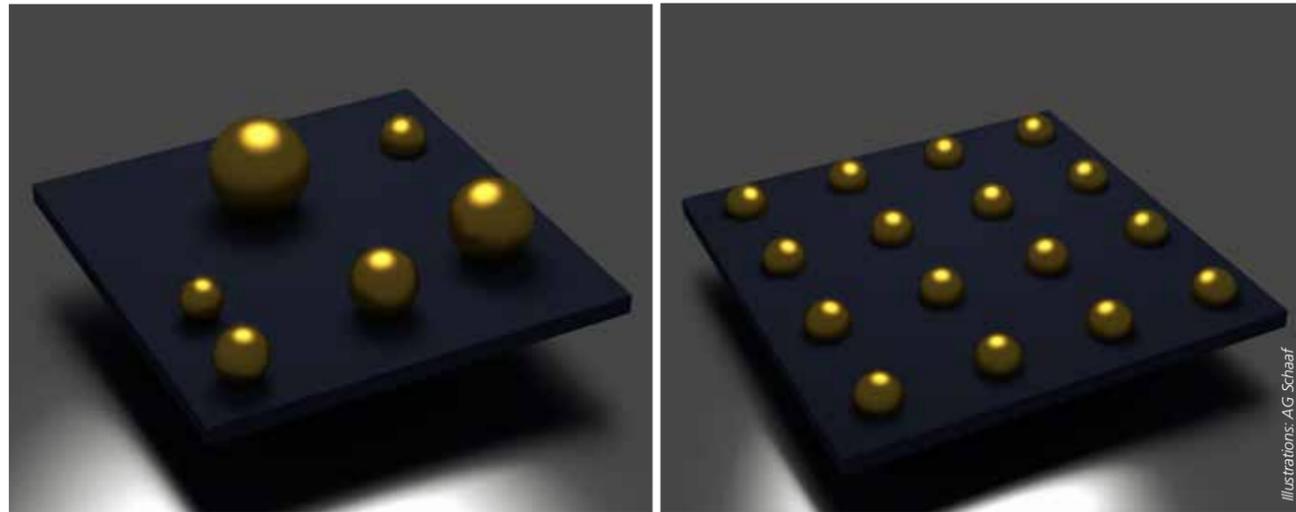
Researchers must work with nanotechnology under clean room conditions because most dust particles are larger than nanostructures and would interfere. Two researchers working on the “PVD coating plant” in the clean room at the Institute of Micro- and Nanotechnologies at the TU Ilmenau.

what that means: water droplets form on the windowpane. In a car on the other hand, a film of water on the screen is preferable as it is transparent, but it is not easy to see through droplets. A thin layer behaves in a similar way. For energy-related reasons, it does not want to remain a layer, but tries to agglomerate, that is, to form droplets. Particles eventually form as the outcome of this “self-organising process”.

A sufficiently high temperature is required to trigger the diffusion process which is a material transport; unlike water, this can happen in a solid state, so without a liquid. This process is known as solid state “dewetting”, as the formerly unbroken layer no longer wets the whole substrate. In a component designed to function perfectly as a thin film, this is an annoying and unwelcome side-effect.

However, this effect can also be used deliberately: it is not complicated to produce functional particles in submicrometre range by exposing a thin metallic layer to heat. These metallic nanoparticles have the potential to be used in many different ways – as catalytically active particles used to break down pollutants in environmental technology, for example, or to trace pathogens or in IT storage media. The remarkable thing is that in nanoparticle form, the properties of the original gold change; gold nanoparticles have a quite different appearance.

These two perspectives form the starting point of a DFG-funded research project at the TU Ilmenau where researchers investigating materials for electrotechnology are working on the dewetting of thin metallic films. The Institute of Micro- and Nanotechnologies



Left: Tiny nano-sized gold spheres made by dewetting a 20 nm thick gold layer on a smooth substrate. The resulting gold spheres are different sizes and randomly arranged. Right: It is possible to create a different kind of structure on a prestructured silicon dioxide substrate. The tiny gold spheres are all the same size and arranged perfectly regularly (schematic views).

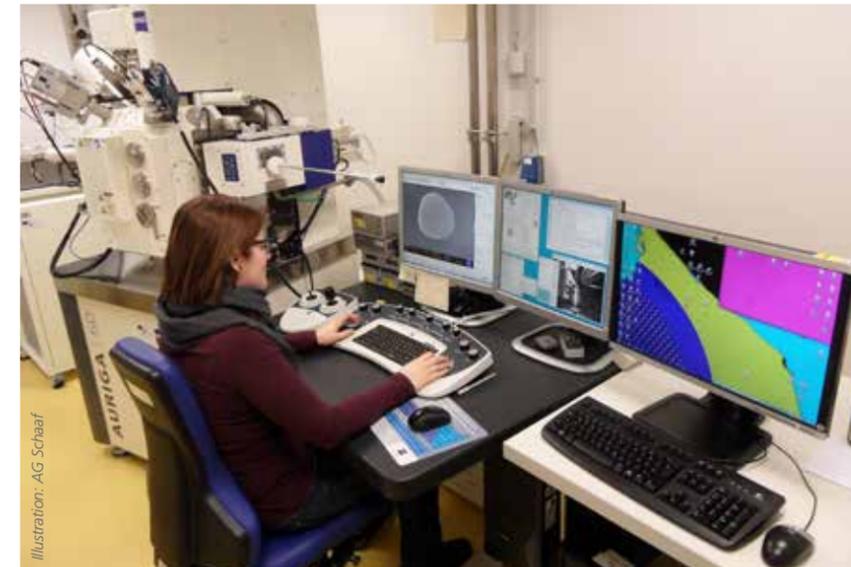
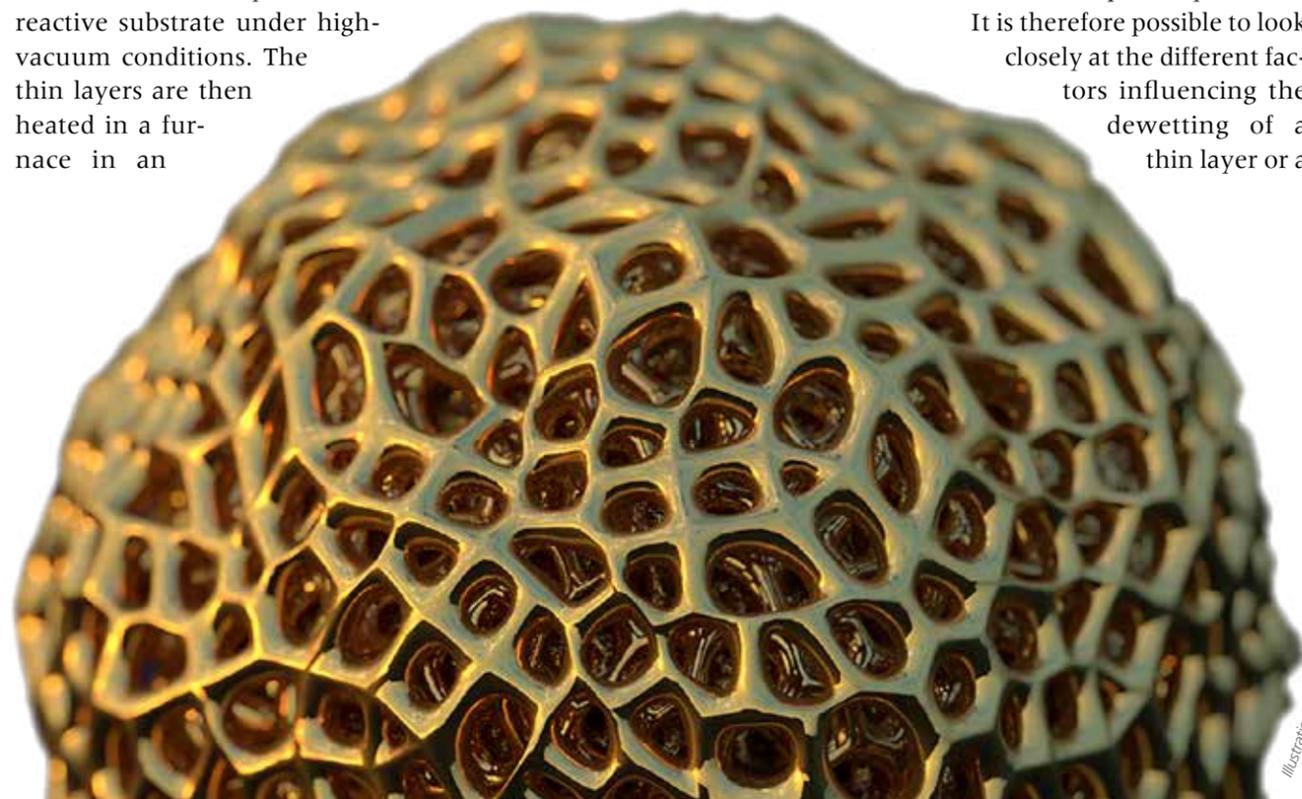
(MacroNano®) at the TU Ilmenau offers the option of producing thin films with the most advanced coating methods such as electron beam deposition or sputtering for thin film deposition. Different metals such as gold or nickel can thus be deposited with precision on an inert, i.e. chemically stable, non-reactive substrate under high-vacuum conditions. The thin layers are then heated in a furnace in an

atmosphere of protective gas to prevent oxidation.

The specimens then undergo materials analysis. A scanning electron microscope (SEM) is an essential part of a materials scientist's toolkit. Primarily it is used to image structures down to the nano

range. It reveals how the layers change after the application of heat. Sometimes however it is necessary to change the "view" of the structures being examined. A focussed beam of gallium ions can be used to accurately prepare a nanostructure. X-ray examination is used as well as electron microscope analysis.

It is therefore possible to look closely at the different factors influencing the dewetting of a thin layer or a



Nanoparticles can be examined and prepared with a scanning electron microscope with an integrated ion beam column ("dual beam FIB"). Project technician Diana Rossberg works on some specimens.

ganisation offers wide ranging options for innovative research. This is learned from the nature, meaning that the natural principles governing self-organising processes are exploited. The goal of future basic research is to understand and gain control over nature. Only when the fundamental mechanisms have been understood will it be possible to move forward on the way to application. There is a lot of promising potential.

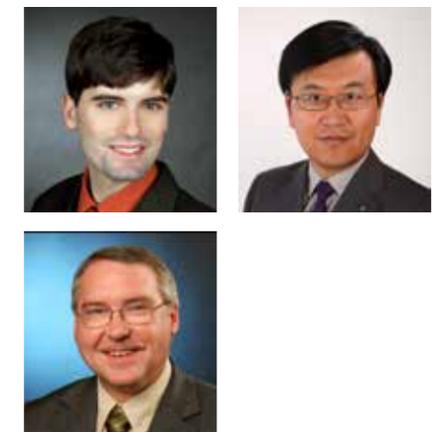
layer system. These parameters can be revealed firstly for the thin layer itself; for example, the thickness of the layer essentially determines the size of the particle that forms. What effect do different sizes of particle or layer thickness have? Why vary them? Secondly, the substrate is also a factor. The composition of the substrate can have a crucial influence on the process and the result. It is possible to define its geometry with special structuring processes (such as nanoimprint lithography and reactive ion etching), which imposes a precisely defined spatial arrangement on the random character of self-organisation. All of the nanoparticles are identical and have a well-defined order. The geometry of the substrate and the thickness of the layer must be coordinated so that the particles arrange themselves in the required way and are rigidly distributed by size.

A thin layer consisting of a combination of different materials, such as a double layer of gold and nickel, gives rise to the question of how this system will react: will they mix or

not? This means that the combination of materials yields more opportunities to create or vary properties. As well as the size and arrangement, the composition of nanoparticles in an alloy can be precisely determined, allowing properties to be defined and even new materials to be produced.

Another trick is to create an alloy from soluble (miscible) elements, i.e. gold and silver. They are easy to mix into an alloy. Using an acid to dissolve silver is particularly successful, while gold does not react. This method also allows nanoporous or sponge-like nanoparticles to be created, which have even more interesting properties than normal gold nanoparticles. Firstly, a huge surface area makes this nanomaterial extremely interesting for catalytic and medical applications. Secondly, the electrical, electronic and optical properties change. Research is currently being carried out into optical applications.

Overall, the studies show that where nanoparticles are concerned, the phenomenon of self-or-



Dipl.-Phys. Andreas Herz is a doctoral researcher working on the DFG project at the Technical University in Ilmenau.

Dr.-Ing. habil. Dong Wang is a faculty member at the TU in Ilmenau and works on the project.

Prof. Dr. Ing. Peter Schaaf is the project leader and holds a chair at the University.

Contact: TU Ilmenau, Institut für Mikro- und Nanotechnologien MacroNano®, Institut für Werkstofftechnik, Gustav-Kirchhoff-Str. 5, 98693 Ilmenau, Germany

www.tu-ilmenau.de/en/wt-wet



Hans-Dieter Bienert

The Best of Both Worlds

In an enthusiastically received exhibition, the Metropolitan Museum of Art together with the National Museums in Berlin and other leading research museums presented the treasures of the Hellenistic world in New York. The DFG was also involved as the funding body of numerous excavation projects and co-organiser of an accompanying symposium.

Even the *New York Times* was impressed: “Truly epic” was the comment from the venerable and often stringent newspaper on the exhibition “Pergamon and the Hellenistic Kingdoms of the Ancient World”, which was shown at the Metropolitan Museum of Art in New York from the end of April until mid-July. Through almost 300 exhibits, it presented the epoch between the death of Alexander the

Great in 323 BC and the gradual spread of Roman domination in the eastern Mediterranean over the following two centuries.

About a third of the carefully selected and beautifully presented exhibits – marble sculptures, bronzes, terracotta, gold jewellery, mosaics, vessels made of glass and precious metals – were on loan from the antiquities collection of the National Museums in Berlin,

one of the most important collections relating to Pergamon and Hellenism. German archaeologists were among the first to start excavating and scientifically studying these sites nearly 140 years ago. Researchers from Germany are still playing an important role today through numerous research projects, especially researchers from the German Archaeological Institute (DAI). A lot of this scien-



Illustration: DFG/Altevogt

tific field research has been funded by the DFG.

So it was only logical for the DFG, in partnership with the Metropolitan Museum, to organise a two-day colloquium at the end of April to accompany the exhibition. Together with Met Director Dr. Thomas Campbell, DFG Secretary General Dorothee Dzwonnek welcomed over 300 attendees and guests to the event, which attracted both high-profile participants and well over 1,500 audience members on both days of the symposium.

In her introduction, Dzwonnek underlined the importance of scientific cooperation between world-leading museums such as the Met and the National Museums in Berlin. She noted that recent conflicts in the Middle East and the systematic destruction of irrecoverable cultural artefacts in Palmyra and other places made it necessary to strengthen international research cooperation in archaeology, as in other fields, in order to protect and preserve our shared cultural heritage. Museums have an important role to play here as both places of research and guardians, custodians and showcases, and therefore presenters of this research to interested members of the public.

After the symposium, the President of the Prussian Cultural Heritage Foundation, Leibniz Prize recipient Professor Dr. Hermann Parzinger, delivered a Leibniz Lecture on the Scythians, Greece's northeastern neighbours. Still actively involved in research in spite of his considerable workload in cultural policy and administration, Parzinger presented the treasures of an intact, richly furnished Scythian grave – also pointing out that modern archaeological research has

Left: “Il spinario” and numerous other exhibits at the New York exhibition showed the extent of mutual influence between classical Hellenistic art and that of other cultures. Right: Words of welcome to the accompanying symposium from Met Director Thomas Campbell and DFG Secretary General Dorothee Dzwonnek. Below: Leibniz Lecture with Hermann Parzinger.

opened up whole new possibilities of interpretation by exploiting a wide range of analytical methods from the natural sciences.

Prior to this, during a reception given by the DFG at the German House, home not only to the Mission of Germany to the UN but also to the DFG's New York office, Parzinger and Dzwonnek had called for closer international cooperation between major research museums. Universal museums in particular, they said, are called upon – and have the capability – to enter into such cooperations, not only for the “safekeeping” of human cultural heritage but also for its study and public presentation. There is also a need for close partnership with the countries of origin of many objects in the sense of participative cultural heritage – a view shared by Daniel Weiss, the President of the Metropolitan Museum.

Dzwonnek and Parzinger together with a small scientific delegation discovered just how stimulating open and interdisciplinary exchange across subject boundaries is to research during a visit to the Institute for the Study of the Ancient World (ISAW), around the corner from the Metropolitan Museum, founded in 2006. The team working here includes early career researchers from Germany who have one- or two-



year fellowships. Both the funding recipients and ISAW Director Professor Roger Bagnall praised this example and recommended that it be emulated in classical and ancient studies and the humanities as a whole.

Dr. Hans-Dieter Bienert

is the Head of Division of Humanities and Social Sciences 1: Humanities and Cultural Studies at the DFG Head Office.

www.metmuseum.org/exhibitions/listings/2016/pergamon

The Deutsche Forschungsgemeinschaft

The Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) is the central self-governing organisation responsible for promoting research in Germany. According to its statutes, the DFG serves all branches of science and the humanities. The DFG supports and coordinates research projects in all scientific disciplines, in particular in the areas of basic and applied research. Particular attention is paid to promoting young researchers. Researchers who work at a university or research institution in Germany are eligible to apply for DFG funding. Proposals will be peer reviewed. The final assessment will be carried out by review boards, the members of which are elected by researchers in Germany in their individual subject areas every four years.

The DFG distinguishes between the following programmes for research funding: In the *Individual Grants Programme*, any researcher can apply for financial assistance for an individual research project. *Priority Programmes* allow researchers from various research institutions and laboratories to cooperate within the framework of a set topic or project for a defined period of time, each working at his/her respective research institution. A *Research Unit* is a longer-term collaboration between several researchers who generally work together on a research topic at a single location. In *Central Research Facilities* there is a particular concentration of personnel and equipment that is required to provide scientific and technical services.

Collaborative Research Centres are long-term university research centres in which scientists and academics pursue ambitious joint interdisciplinary research undertakings. They are generally established for a period of twelve years. In addition to the classic Collaborative Research Centres, which are concentrated at one location and open to all subject areas, the DFG also offers several programme variations. *CRC/Transregios* allow various locations to cooperate on one topical focus. *Cultural Studies Research Centres* are designed to support the transition in the humanities to an integrated cultural studies paradigm. *Transfer Units* serve to transfer the findings of basic research produced by Collaborative Research Centres into the realm of practical application by promoting cooperation between research institutes and users.

DFG Research Centres are an important strategic funding instrument. They concentrate scientific research competence in particularly innovative fields and create temporary, internationally visible research priorities at research universities.

Research Training Groups are university training programmes established for a specific time period to support young researchers by actively involving them in research work. This focusses on a coherent, topically defined, research and study programme. Research Training Groups are designed to promote the early independence of doctoral students and intensify international exchange. They are open to international participants. In *International Research Training Groups*, a jointly structured doctoral programme is offered by German and foreign universities. Other funding opportunities for qualified young researchers are offered by the *Heisenberg Programme* and the *Emmy Noether Programme*. In so called *Reinhard Koselleck Projects*, the DFG supports especially innovative research undertakings by outstanding scientists and academics.

The *Excellence Initiative* aims to promote top-level research and improve the quality of German universities and research institutions in the long term. Funding is provided for graduate schools, clusters of excellence and institutional strategies.

The DFG also funds and initiates measures to promote scientific libraries, equips computer centres with computing hardware, provides instrumentation for research purposes and conducts peer reviews on proposals for scientific instrumentation. On an international level, the DFG has assumed the role of Scientific Representative to international organisations, coordinates and funds the German contribution towards large-scale international research programmes, and supports international scientific relations.

Another important role of the DFG is to provide policy advice to parliaments and public authorities on scientific issues. A large number of expert commissions and committees provide the scientific background for the passing of new legislation, primarily in the areas of environmental protection and health care.

The legal status of the DFG is that of an association under private law. Its member organisations include research universities, major non-university research institutions, such as the Max Planck Society, the Fraunhofer Society and the Leibniz Association, the Academies of Sciences and Humanities and a number of scientific associations. In order to meet its responsibilities, the DFG receives funding from the German federal government and the federal states, as well as an annual contribution from the Donors' Association for the Promotion of Sciences and Humanities in Germany.



Illustration: Unterstell

In the courtyard of the DFG Head Office in Bonn, the *Salonorchester der Wissenschaftsorganisationen* is a familiar and well-loved sight. In the summer months, the ensemble made up of colleagues from the surrounding offices gives open-air recitals during the lunch break. At the end of June, the orchestra gave a demonstration of its skill with some lively and delightful rhythms in the park of Villa Hammerschmidt, the official residence of the Federal President in Bonn. To mark Bonn's 20th anniversary as the headquarters of several UN organisations, the city held an open day in the former government district with the motto "Introducing International Bonn". The Salonorchester provided a musical contribution from the world of science and the humanities.

Impressum

german research is published by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation); Publisher: WILEY-VCH Verlag GmbH & Co. KGaA, P.O. Box 10 11 61, 69541 Weinheim, Germany; For the annual subscription rate please refer to the Wiley Online Library: <http://olabout.wiley.com/WileyCDA/Section/id-404508.html> Address of editorial staff: DFG, Press and Public Relations, Kennedyallee 40, 53175 Bonn, Germany; postmaster@dfg.de; www.dfg.de

Editor-in-chief: Marco Finetti (responsible for content)
Publishing Executive Editor: Dr. Rembert Unterstell
Copy Editors: Stephanie Henseler, Inken Kiupel
Translation: oneword GmbH, Böblingen

Printed by: Bonner Universitäts-Buchdruckerei (BUB);
Printed on Inapa Oxygen silk, coated, 100% recycled, FSC certified paper with a semi-matt surface.

ISSN 0172-1518