



Cover: Screenshot Bjoern Richerzhagen

The virtual gaming world meets actuality: the alternate reality game "Ingress" pits two factions against each other, here in the real environment of Berlin.



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Both Global and National

The Annual Meeting of the Global Research Council in Tokyo, intensive consultations with partners in Argentina, Brazil and Russia, scientific policy advice at the United Nations in New York – the DFG’s job is to support the best knowledge-driven research whether at home or in the international aspects of its work.

How should we take things forward with the Excellence Initiative? How can we improve the working conditions and career prospects of young researchers? And what does the future hold for the research system in Germany as a whole? These and related questions are posed from a national perspective, and it is questions like these that are typically addressed in statements on research and funding policy by the German Research Foundation and its President – for example in this magazine. If this edition has a noticeable international focus, it is not because there is nothing more to say about the German research system (or only the same thing in response to the same questions). Rather, the thematic focus derives from the substance of the matter at hand and the current situation.

The substance is the special importance that the international dimensions of research and research funding have always had in the DFG’s activities. And the situation is a plethora of events in recent weeks and months (due in part to the unpredictabilities of planning and scheduling international travel and appointments), during which this importance was very much in evidence, and which are therefore covered elsewhere in this edition of german research.

Reason enough, then, to take a look at the DFG’s work in the international arena – and for a little self-assessment first, which is perhaps best formulated as a question, if one that cannot be comprehensively answered here: What is it that makes the DFG explore the globe? And what are its concerns at international level?

Globally and nationally, the DFG’s international activities are based on what you might call a dual function and a dual aspiration for its actions. Firstly, on the international stage it also operates as the biggest funding organisation for free, curiosity-driven research and the self-governing or-

ganisation of the research community in Germany, and it does this concretely wherever there is a need for international cooperation. Secondly, the DFG works on an international level because it strives to strengthen the principles and the funding of free basic research, whose advocate it is, all over the world – on all continents and in many countries, however different they may be socially, politically or in terms of their research systems.

Neither of these aims could be achieved without the help of our partners, and both depend on intensive global collaboration. Together with over 80 partner organisations, we work to create shared scope and funding opportunities for research: at bilateral, pan-European and global level. Shared principles, values and standards are particularly important, for instance in relation to the quality, openness and fairness of scholarly review and selection processes, good scientific practice, or respect for intellectual property.

These are the standards upheld by the two major international associations of research organisations, of which the DFG – if you will permit me to say it – is a particularly active member: Science Europe and the Global Research Council (GRC). The GRC, in particular, has set itself the goal of developing a common understanding and consistent global standards in research funding, not only to promote better cooperation between established organisations but also as a guide for emerging or reorientating research systems.

The extent to which efforts like these have flourished could be seen at what was already the fourth Annual Meeting of the GRC in Tokyo at the end of May. The outcome of the meeting was something that could hardly have been anticipated when the supranational association was founded in 2012: a clear acknowledgement of free basic research as an indispensable



Illustration: DFG / Damian Gorczyński

foundation for social and economic prosperity. This must be seen against the background of the increasing global tendency, in politics and society, to view research primarily in utilitarian terms. In a growing number of research systems, research is being funded in thematically demarcated programmes focused on short-term, direct applications.

There are many member organisations of the GRC which find themselves confronted with prescribed priorities of this type. This makes the Tokyo resolution all the more noteworthy. It describes curiosity-driven research as being not in opposition to economic and social relevancies and objectives, but in functional support of them. This reveals an astonishing global consensus on the most important functions of research.

However, when something more concrete is needed, when researchers want to collaborate across national borders within this framework of shared values, then it ultimately and very pragmatically comes down to funding. That is why the DFG enters into bilateral agreements with funding organisations worldwide, be it in relation to joint calls or processes for synchronous review, selection and funding when proposals are submitted jointly to the DFG and a foreign partner organisation.

The most recent examples are the intensive consultations and resulting agreements with partners in Argentina and Brazil in June, and also in Russia, where we not only maintained but expanded our bilateral relations in politically very difficult times. Here as there, the direction is defined by terms like “topical flexibility” and “curiosity-driven”, and on every visit and in every meeting – notably, on the initiative of the people we were meeting with – the focus was on the special role of independent research funding.

Finally, scientific policy advice and agenda-setting are a third activity that the DFG pursues both globally and nationally. It only appears to take place on another level, because when the question is what contribution can be made by science and research to the implementation of the UN Sustainable Development Goals, as was the case at a recent conference organised by the DFG and the United Nations University (UNU) at the United Nations in New York, then the importance of basic research and its funding and therefore the best possible conditions and development opportunities for this research are brought back on to the agenda.

So the DFG uses many approaches as it seeks to perform its role as effectively as possible at international level – funding the best curiosity-driven research in close cooperation with partners abroad and with a continual self-critical eye to ensure the quality of our work.

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



Policy Advice on the East River ...

How can research contribute to the implementation of the UN's upcoming global sustainable development goals? This was the question debated at a DFG / United Nations University conference in New York.

Global sustainable development and the potential contribution of research were the key issues at an international conference held at the end of April, organised by the DFG and the United Nations University (UNU) with the support of the Permanent Representative of the Federal Republic of Germany to the United Nations (UN) in New York. The meeting at UN headquarters brought together more than 60 researchers from a range of disciplines, decision-makers from UN committees and representatives of

political and civil society groups. During the conference, entitled "Measuring Sustainable Development", the main topic of debate was the question of how scientific research can contribute to the development of indicators and measuring instruments for global sustainable development goals.

In his introductory address, Deputy UN Secretary General Jan Eliasson noted that such instruments could support more effective implementation and evaluation of sustainable global development.

"The source of wisdom is knowing the facts", Eliasson said. Science and research could play a crucial role in this respect, he added, because the realisation of the Sustainable Development Goals (SDGs) expected to be passed by the UN in autumn 2015 can only be assessed with meaningful indicators.

In his introduction to the conference, DFG President Professor Dr. Peter Strohschneider recalled the report of the Brundtland Commission, published in 1987, and thus just how long the sustainability debate

Before the final event in the UN main building (right to left): DFG President Peter Strohschneider and Secretary General Dorothee Dzwonnek with Jörg Hacker (Leopoldina), Amina Mohammed and Robert C. Orr (both UN), Guilherme de Aguiar Patriota (Brazilian Permanent Representative to UN) and Jakob Rhyner (UNU).

has been ongoing, a debate which has lost nothing of its urgency in the present day. However, the necessary progress can only be achieved if scientific research in its various dimensions – from knowledge-driven basic research to applied research – is also utilised in political decision-making processes. The conference, said Strohschneider, provided an excellent platform for this.

The discussions that followed, in four panels, were also concerned with potential conflicts of aims in the implementation of individual sustainable development goals. Professor Jakob Rhyner, UNU Vice Rector in Europe, identified two possible conflicts: in the setting of priorities and in the balance between short-term and long-term development objectives. He noted that the successful implementation of the SDGs will depend on a sensitive but determined approach to such conflicts.

The final event of the conference, to which guests were invited jointly by the Permanent Representatives of Brazil and Germany to the United Nations, took place in the UN main building. The 150 participants included researchers, UN experts and representatives of the countries involved in the current negotiations on the post-2015 agenda. They discussed the key findings of the four panels, which were also commented on by senior UN staff.

DFG Secretary General Dorothee Dzwonnek described the outcomes of the conference as an "example of science-driven policy advice", remarking upon the way in which relevant expertise and a wealth of different perspectives had been a key feature of the meeting. "Our aim was to introduce scientific research into the process in order to create an open forum for discussion between researchers, users and decision-makers. Over the last two days you have all discussed a variety of approaches and concepts, with a high level of commitment but always with a strong awareness of practicability and possible implementation."

In her address during the concluding event, Amina Mohammed, Special Adviser to the UN Secretary General on Post-2015 Development Planning, referred to the favourable timing: "2015 is the global year of action. It gives us what is perhaps a unique opportunity to chart a path of sustainable global development towards the future that we want and need. One can sense a broad consensus, which is very encouraging." Professor Dr. Jörg Hacker, President of the German National Academy of Sciences Leopoldina and a member of UN Secretary General Ban Ki-moon's Scientific Advisory Board, expressed confidence in his closing remarks: "The participation of members of the UN Secretary General's Scientific Advisory Board was assuredly very helpful in strengthening the link between science and the political process."

Detailed information and key documents relating to the conference are available at: www.dfg.de/en/dfg_profile/head_office/dfg_abroad/north_america/reports/2015/150421_dfg_unu_conference_dossier/index.jsp

... and soon on the Rhine?

The German House on the UN Plaza was the venue for the panels and the UN main building the venue for the closing event: the best possible settings for the DFG/UNU conference "Measuring Sustainable Development". But in future, conferences like these could be held in Bonn, where the World Con-



ference Center Bonn (WCCB) was opened at the start of June. DFG Secretary General Dorothee Dzwonnek believes that the new facility creates promising prospects for the city as a science hub and conference location as well as for cooperation between science and international politics. "The WCCB has the potential to play a very positive and, we hope, inspiring role, especially for the many scientific and UN institutions which form part of the cityscape and profile of Bonn," said Dzwonnek, who participated in the opening of the conference centre by UN Secretary General Ban Ki-moon (see photo above) as an "ambassador" for the city. She added that the WCCB could also be a potential venue for large DFG events such as the Annual Meeting, which is held at regular intervals in Bonn.

Researching in Freedom

Annual Meeting of Global Research Council in Tokyo reinforces importance of knowledge-driven research to our shared future

The 4th Annual Meeting of the Global Research Council (GRC) took place from 26–28 May 2015 in Tokyo. The meeting, which this year was organised by the Japan Society for the Promotion of Science (JSPS) and the South African National Research Foundation (NRF), was attended by senior representatives of more than 70 research funding and research organisations from all over the globe, including a notable number from sub-Saharan Africa. The DFG was represented by its President, Professor Peter Strohschneider (6th from right in the group photo).

In his welcome address, the Prime Minister of Japan, Shinzo Abe, stressed one of the key concerns of the GRC: on the basis of a shared understanding of research and its most important task, to construct uniform standards that support new and developing research and funding organisations to develop their structures and processes, and thus improve the basis for international cooperation.

In joint declarations the participants acknowledged the value and function of free, knowledge-driven research as an essential foundation for social and economic prosperity, and underlined the political responsibility to expand the necessary potential and take concrete measures. This consensus had been prepared in advance at GRC regional confer-

ences around the world and the conference brought it to a unanimous global commitment.

At a symposium preceding the GRC meeting, Professor Strohschneider called for basic research free from specified aims and topics. In his address the DFG President also outlined a number of issues which he considers central, paradigmatic problems and then described the resulting potential for international cooperation.

Alongside the GRC Annual Meeting, the Governing Board also met and agreed on a number of key procedural changes for the future of the GRC and deliberated on the next Annual Meeting. This will take place in New Delhi in May 2016 and address the issues of equal opportunity in research and transdisciplinarity. **gru**

www.globalresearchcouncil.org/meetings/2015-annual-meeting



Illustration: GRC/Koichi Mizoguchi

DFG Secretary General Dorothee Dzwonnek had three reasons for making the trip to Latin America at the end of May, where she visited various places and organisations in Brazil and Argentina. In addition to holding talks on research policy, Dzwonnek saw a change of leadership at the DFG's Latin America office in São Paulo and inaugurated the first International Research Training Group (IRTG) with Argentinian partners.

During meetings with two Brazilian federal research funding organisations, CAPES and CNPq, at the German embassy in Brasília – in which CONFAP, the umbrella organisation of federal state funding organisations, also took part – the focus was on deepening German-Brazilian cooperation. A dialogue with FAPESP, the research funding organisation for the federal state of São Paulo, paved the way to more intensive cooperation in the coordinated programmes. For example, a common process is to be developed for the review of IRTGs, Collaborative Research Centres and Research Units.

Active in Latin America

Consultations by Secretary General Dzwonnek in Brazil and Argentina / Staff change at DFG's São Paulo office



Illustration: DFG Office Latin America

At a reception held at the residence of the German Consul General in São Paulo, the research community bid farewell to Dr. Dietrich Halm, head of the DFG's Latin America office, and welcomed his successor Dr. Kathrin Winkler. Dietrich Halm established the office at the beginning of 2011 and made an important contribution to coop-

eration between the DFG and Latin American funding organisations. Dzwonnek said: "Through your strong concepts, vision and good management, you have earned the office an excellent reputation."

Kathrin Winkler spent six years in the Chemistry and Process Engineering group, which has given her an in-depth knowledge of DFG

funding programmes. She has already acquired relevant experience in Brazil and Argentina. "Ms. Winkler knows the dos and don'ts in the challenging world of international research funding," said Dzwonnek.

The first German-Argentinian IRTG, "Surface Processes, Tectonics and Georesources: The Andean Foreland Basin of Argentina" was inaugurated by CONICET President Professor Roberto Salvarezza and Dorothee Dzwonnek in Buenos Aires. The Argentinian spokesperson Professor Monica López (Buenos Aires) and the German spokesperson Professor Manfred Strecker (Potsdam) both gave an introduction to geoscience research (our photo shows the team at DFG Office Latin America during the visit of the Secretary General (centre) to São Paulo).

"I returned with some very positive images and impressions," said the DFG Secretary General. "The cooperations that have been established offer considerable potential on both sides that deserves to be further developed." **fbe**

Building Bridges between West and East

German-Russian research cooperation: RFBR and DFG celebrate 20 years of partnership / Ceremony to mark anniversary in Moscow and programme of visits in St. Petersburg

At the beginning of June, the DFG and the Russian Foundation for Basic Research (RFBR) held a ceremony to mark their 20-year partnership. To celebrate this milestone, DFG President Professor Peter Strohschneider travelled to Russia to take part in a panel discussion with the President of the Council of RFBR, Professor Vladislav Panchenko. The

key topic of the evening was the role of the two funding organisations in the development of German-Russian cooperation in research. The 200 guests included senior ministry and government representatives from both countries and the heads of Russian and German partner organisations of the DFG, as well as many researchers who have received DFG

and RFBR funding over the last two decades.

On the day before, the DFG delegation visited the Russian Academy of Sciences (RAN) and met with President Vladimir Fortov, who signed the first cooperation agreement with the DFG 20 years ago in his function as Chair of the RFBR. The anniversary also marked the



Illustration: IIPAM RANEPa

beginning of a new partnership, as the DFG and the Russian Science Foundation (RSF), which was founded last year, agreed to foster institutional cooperation.

The DFG delegation's trip to Russia concluded with a visit to research institutions in the "northern capital" of St. Petersburg, where the first German-Russian Collaborative Re-

search Centre to be funded jointly by the DFG and RFBR (TRR 160) has been based since the start of the year. At the meeting in the rector's office of the State University and in the Faculty of Mathematics and Mechanics, spokesperson Professor Manfred Bayer (Technical University of Dortmund) presented the topic of the Collaborative Research

Lively panel discussion during the anniversary celebrations. Left to right: Vladislav Panchenko (RFBR), moderator Tatyana Ilarionova (IIPAM RANEPa) and Peter Strohschneider (DFG).

Centre "Coherent Manipulation of Interacting Spin Excitations in Customised Semiconductors" and the participating laboratories. **JA**

Change of Perspective through Migration

Two-day conference in Bonn / Discussions on Germany as a destination for migrants and religion as a factor in integration / Senior political figures present at opening

In early May 2015 the DFG organised a symposium in partnership with the University of Bonn, Forum Internationale Wissenschaft, the Orient-Institut Istanbul and the Institute for Advanced Study in the Humanities to discuss the academic consideration of German-Turkish migration processes. The theme of the two-day conference, attended by researchers and political decision-makers from both countries, was "Change of Perspective Through Migration?" and was the second event of its kind. The conference participants and representatives of

both countries were welcomed by Professor Michael Hoch, rector of the host university, and DFG President Peter Strohschneider, who expressed his pleasure at the presence of senior political representatives from both countries, including Aydan Özoguz, the German government's Commissioner for Migration, Refugees and Integration and State Secretary at the Chancellery, Hüseyin Avni Karshoglu, ambassador of the Republic of Turkey in Berlin, and Dr. Georg Schütte, State Secretary at the Federal Ministry of Education and Research.

The symposium took place against the background of social debate on migration and Germany's role as a destination country for migrants. When the recruitment agreement for workers from Turkey was signed in Bad Godesberg in 1961, both countries envisaged a "rotational" employment policy, whereby temporary immigration would be balanced out by return migration. Second- and third-generation immigrants of former guest workers are now living in Germany.

www.dfg.de/service/presse/pressemitteilungen/2015/pressemitteilung_nr_19/index.html

The International Approach

Evaluation of International Research Training Groups: DFG Infobrief makes results accessible

International Research Training Groups (IRTGs) are DFG-funded bilateral doctoral research programmes based at German and foreign research institutions. In an IRTG, researchers collaborate closely for a long period. The groups offer a common research and qualification programme and shared supervision of doctoral researchers. Between the introduction of this type of programme in 1997 and mid-2014, the DFG awarded funds to 109 IRTGs.

The DFG has carried out an in-depth evaluation study to assess what impact the international approach was having on the funding of doctoral researchers, established researchers and higher education institutions. Researchers and doctoral candidates express a high level of interest in bilateral and multilateral collaboration and have a lot of inter-

national experience under their belts. Research visits of several months to foreign partners are of both academic and personal value to doctoral researchers, enabling them to form their first research cooperations, including joint publications, but evidently do not prolong the time taken to obtain a doctorate. For universities, especially small and medium-sized institutions, IRTGs provide a good opportunity to increase their international visibility.

A steering committee set up by the DFG has drawn up recommendations for the future development of the programme on the basis of this study. One point that did emerge is that when deciding on IRTG proposals, more attention should be given to the complementarity of the participating institutions. A guideline on this is available on the DFG website.



The evaluation study and the statement of the evaluation steering committee are also available online. The results of the evaluation are summarised in the Infobrief "Drivers of Internationalisation: Results from the Evaluation of International Research Training Groups", which is available in German and English. **rdt**

www.dfg.de/en/infobrief

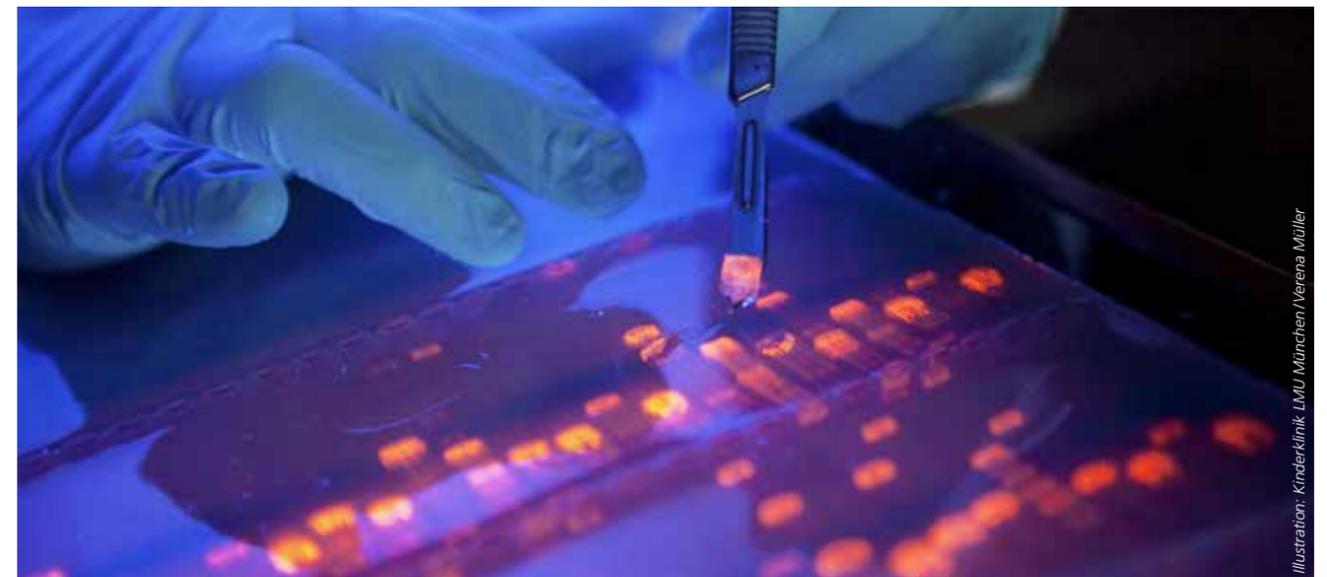


Illustration: Kinderklinik LMU München/Vereina Müller

Ralf von den Hoff

Magical Presence

Revered and crowned, but also vilified, remade and destroyed: in Ancient Greece, portrait statues of rulers and intellectuals were an important part of cultural, social and political communication. A German-French team of classical archaeologists, ancient historians and epigraphers is taking a closer look at the complex ways in which these images were used.



Tracking a metamorphosis: Portrait bust of a king in several stages of reworking (Berlin, from Pergamon, 2nd century BC) – left to right: First with a royal diadem and small pinhole (graphic reconstruction); then areas are added for a new hairstyle (pinholes are modern); finally a second state with new hairstyle.



Illustration: von den Hoff

A few decades after the death of Alexander the Great in 323 BC, the council of the Greek city of Erythrae made a decision that would have significant consequences. Some years previously, a citizen named Philites had killed a man whose ambition was to become tyrant of Erythrae, and in so doing saved democracy. In recognition of his actions, the citizens honoured Philites with a statue showing him as a tyrannicide with a sword in his hand. During another attempt at revolution, the statue's sword was destroyed – an act symbolic of the disarming of the citizenry. The citizens interpreted the gesture as being directed against them.

When this revolution, too, failed, the people of Erythrae decided to restore the statue of Philites complete with its weapon. The citizens decided that from now on the statue would be regularly cleaned and crowned with a wreath on the first day of each month and on all feast days. Wreaths were used to crown not only successful athletes but also citizens in recognition of services to the city. In Erythrae the bronze statue of Philites was cared for and honoured as though it were alive. It provided a constant, vivid reminder of the fact that everyone was called upon to defend democracy.

The story of the Philites statue is not unique in the ancient world. The cities and sacred places of Greece have been filled with numerous honorary statues since the fourth century BC. As well as giving prestige to the portrayed individual, they were also a means of political

Striking and impressive: The crowned head of the bronze portrait statue of an athlete (Izmir, museum, 1st century BC).

communication. The way they were treated was therefore significant: they were crowned or honoured on certain days, but also deliberately destroyed, repaired, reworked or replaced. Honorary statues functioned as role models, like that of Philites. In Athens, for example, it was forbidden to place any other images beside the statues of the famous tyrannicides of the early fifth century; no one in the democratic citizenry was to attain their status.

The message of certain statues could also change during their lifetimes. In around 280 BC the orator Demosthenes was honoured with a statue in Athens, showing him in a restrained attitude with folded hands, programmatically next to a representation of the goddess of peace. Demosthenes' biographer Plutarch later recounted how a soldier placed the money he had saved in the statue's hands and found it again months later, untouched. This was taken as proof of the incorruptibility of Demosthenes – although the pose was originally intended differently. In 44 BC the Athenians erected honorary statues of Cassius and Brutus, the assassins of Julius Caesar, beside the tyrannicide statues, in violation of their ancient law. In so doing they brought what were then already more than 400-year-old statues into contemporary political debate.

Evidently, portrait statues not only had a magical presence, as witnessed for example by the fact that statues were destroyed when someone wanted to erase the memory of the portrayed individual (known as *damnatio memoriae*); rather, they were actively integrated in citizens' everyday lives; their exemplary effect was reinforced or modified until their destruction or "death". In this

Top: Ancient witnesses on the Greek island of Delos – marble bases with traces of the erection and removal of bronze portrait statues at the entrance to Apollo's temple (3rd – 2nd century BC). Below: French students drawing statue bases on Delos.

way, they were given a kind of biography. So far, little research has been done into the dynamic lives of portrait statues from their erection until their eventual destruction. Yet this life bears witness to changing political positions, historical transformations and the new ideas of those in whose lives the images were present and were used.

The communicative role of statues in life environment and life practice is the subject of the research project EIKON. Since 2013, classical archaeologists, ancient historians and epigraphers from France and Germany have been studying evidence relating to the lives of Greek portrait statues from the fifth to the first century BC. The project is being led by classical archaeologist François Queyrel from the *École Pratique des Hautes Études* in Paris and Ralf von den Hoff from the University of Freiburg, who have been researching ancient portraiture for many years.

In individual paradigmatic studies, for example on the crowning of statues and their maintenance, repair and re-erection at sacred sites such as Olympia and Delphi and in cities such as Delos, important associated phenomena are analysed with the intention of producing a handbook on the "life" of Greek portrait statues. It will reveal the dynamic processes through which statues were integrated in the cultural, social and political practice of



Illustration: Krumeich



Illustration: Herbin



Illustration: von den Hoff

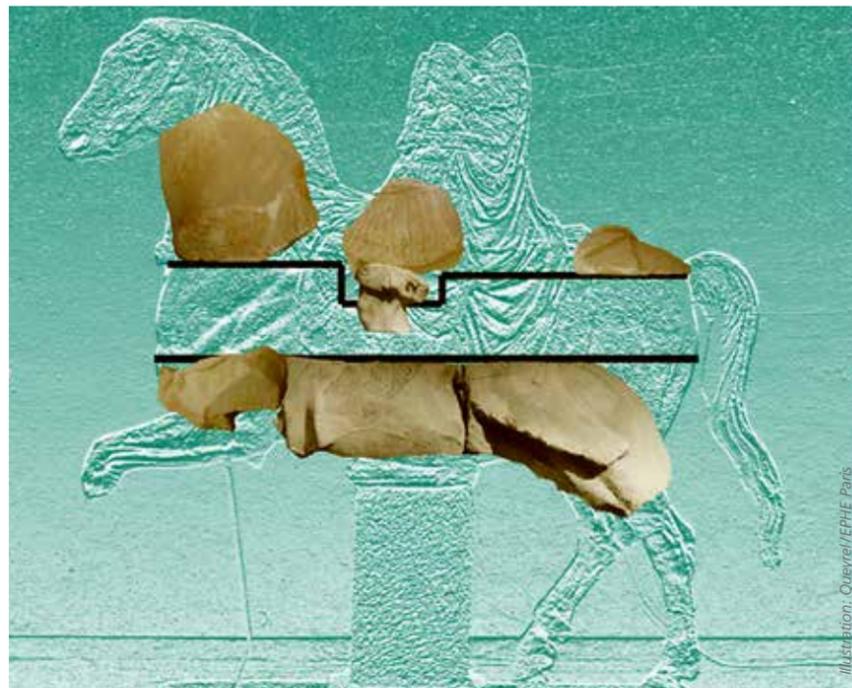


Illustration: Queyrel/EPHE Paris

Ancient Greece and can therefore also be understood as important medial factors in this practice.

The remains and records of portrait statues from the ancient world that still exist today – be they inscriptions or literary texts, marble or bronze fragments – are by their very nature scarce, often much degraded, and decontextualized. So one of the project's main aims is to find clues as to how the images were used and reworked. Many details about the life of ancient statues can be deduced from their physical remains. The statues need to be reconstructed. Inscriptions which were often added to the base contain names that have been chiselled out or overwritten, indicating a re-dedication of the statue. This was a common practice which reveals how slight was the importance of individual characteristics, for example in the physiognomy of the face. Some bases were used for lots of different statues in turn.

What portraits were destroyed in the process? How long did the statues remain standing? Portrait busts and statues were reworked to give them new attributes, but sometimes unimportant remains of old material were left alone. How did this happen? Some marble busts possess features such as dowel holes or channel-like recesses with which to position a wreath – as with the case in Erythrae – or permanently

Top: Marble portrait bust with experimentally marked pinholes for reconstruction of the original fitting of a wreath (Berlin, from Pergamon, 2nd century BC). Below: Reconstruction of an equestrian statue from surviving fragments (Delos, 1st century BC).



Illustration: von den Hoff

EIKON at work: Studying portraits of Alexander the Great in the Archaeological Collection of the University of Freiburg (J. Griesbach, F. Herbin, R. Krumeich).

attach the leaves of such wreaths. In what historical situations and how often can we find evidence of this, and can we reconstruct the particular effect of such crowned images?

Research on statues from ancient Pergamon in the Antikensammlung Berlin (Collection of Classical Antiquities of the Berlin State Museums), including the marble bust of a king of Pergamon, has begun to provide answers. By studying the find history, researchers have now linked it with the city's large gymnasium, the main place of education for young citizens, which was built in the early second century BC. The head be-

longed to a statue in military garb which stood in the largest room next to other ruler portraits. Wearing a diadem as a symbol of kingship, it originally possessed a shorter hairstyle. In a second phase the surface of the hair was smoothed over to attach a new hairstyle with fuller hair in small pieces of marble. This gave the statue a hairstyle similar to depictions of deities, presumably at a point after the individual's death. What is important, however, is that the king was given a new image that better satisfied the needs of the observer.

Much later, probably in the third century AD, more than 400 years after it was first erected, the statue was destroyed and the fragments were used as building material. This means that for over 400 years it served as a reminder of the glorious

royal period of Pergamon in the second century BC, even when Roman emperors had been ruling there for a long time. In a royal image such as this, the people of Pergamon saw and updated their own history: portraits could have a long life.



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www.eikon-anrdfg.eu



Rembert Unterstell



Left: Raging war: A knight in armour attacks unarmed townsfolk. An etching by Hans Ulrich Franck from 1643.

harvests, the financial situation of entire ruling houses was ruined, trade and commerce struggled to survive – and cultural life was all but non-existent. The inferno that had overturned whole ways of life was seen as the end time and a divine punishment.

Like the First World War, widely remembered 2014 as the great catastrophe of the 20th century, the Thirty Years War was the great catastrophe of the modern era. But what do historians really know about everyday realities and experiences far from the high-level politics and its theatres, between the Defenestrations of Prague, the battles of Wallenstein and the Peace of Münster? In truth, not much! Historians concerned with the early modern era point out that their understanding of the period depends on meaningful sources and testimonies. While the political and military action can be reconstructed from official records and chronicles, we have few sources to shed light on everyday situations and experiences. This is what makes personal testimonies so important.

Christian II, Prince of Anhalt-Bernburg (1599–1656), a moderately reformed Reichsfürst, educated, well read and well travelled but also somewhat marginal as a territorial lord, left a unique diary. There is no other document like it in Europe, as Professor Ronald G. Asch, a historian and specialist in comparative aristocratic research, emphasises. For no less than 35 years, from 1621 until 1656, this minor nobleman kept a detailed

personal record of his life, his estate and his times. The huge manuscript has the Thirty Years War as its backdrop and is considered by experts to be a singular source due to its variety, plentiful content, subtle rhetoric of Bildung and unusual subjective expressivity. Asch believes that nowhere in Europe is there another personal testimony “that comes close either quantitatively or qualitatively to the diary of Christian II, Prince of Anhalt-Bernburg”.

With such expert respect, what might we expect the prince to have entrusted to his diary? In prosaic terms he noted everything that entered his field of view. He gives an account of his daily routine, with visits, prayers and mealtimes, describes business transactions and official duties, records news from family and the court, notes nature observations, sketches impressions of his travels, and makes reference to his reading and correspondence. He records everyday life, including courtly amusements such as cross-bow shooting, archery and games in the ballroom, and reflects on visits and return visits as well as illnesses and deaths. Last but not least, he writes about religious disputes, and, exceptionally, records his own dreams – even trying his hand at dream interpretation. Like a window on the past, the diary reveals a rich and colourful world: one man’s life, world experience, and soul-searching. Although topoi of Bildung can be found in the diary, in general the entries are highly individual. According to Asch, we

Christian II, Prince of Anhalt-Bernburg: an 18th-century oil portrait from an older original.

should understand Christian as “an actor and observer in extensive networks characterised by both Protestantism and cultural concerns, and not primarily as a hard-pressed territorial lord and minor imperial state”.

A cooperation project has brought together the Chair of Modern History at the University of Freiburg and Herzog August Bibliothek in Wolfenbüttel, a library and research centre for the medieval and early modern periods, bringing technical and editorial expertise together around the same table. The aim of the project, led by Professor Ronald G. Asch, Freiburg, and Professor Helwig Schmidt-Glintzer, Wolfenbüttel, is to create an annotated digital edition of the diaries of Christian II, Prince of Anhalt-Bernburg. Work got underway in autumn 2013 with long-term funding from the DFG. A “long-term project” is the name given to research projects in the humanities and social sciences for which “the DFG considers longer-term funding to be justified in view of their central scholarly importance, their



A Window on the Past

For more than 35 years, Christian II, Prince of Anhalt-Bernburg kept a diary which paints a vivid picture of everyday life far from the great battlefields of the Thirty Years War. Now this extraordinary personal testimony is being digitally published as part of a long-term project to provide a new research instrument and a laboratory for the digital humanities.

It’s a vast source: 23 folio volumes with 17400 manuscript pages, bequeathed to the state archive of Saxony-Anhalt in Dessau and now being edited electronically. It bears witness to a tumultuous time, when the Thirty Years War

was raging across Europe like an infernal storm, seemingly without prospect of an end. When the Peace of Westphalia was signed in 1648, the territories had been laid waste. The conflict had left whole areas of the Holy Roman Empire of the

German Nation depopulated, with families wiped out and towns and villages plundered and sacked by undisciplined soldiers who passed through and demanded to be accommodated. Farmers were impoverished, partly as a result of bad



Illustration: HAB Wolfenbüttel/Editionsprojekt

Left: “Christian, the Younger, Prince of Anhalt” was a perennial and skilful diarist who was interested in the world beyond his small principality.

out on the screen how Christian, in his diary entries, switches blithely between German, French, Italian and Latin, challenging the editor's acuteness. “We need transcription conventions for each language, which we didn't anticipate,” he explains.

Dr. Arndt Schreiber, a member of the project team in Freiburg, is addressing another key editorial problem. The “annotation depth” must be tested and defined in order to ensure consistent historical-critical annotation right from the start, balancing “what is desirable in terms of scholarship with what is possible in the allowed time”.

The end result should be a modern online edition that satisfies all scholarly requirements. On the first sample pages, the high-resolution colour scans of the original manu-

script appear on the right and the transcription on the left on a webpage. Then there are translations of the multilingual source and critical tools including content-based introductions. Indexes and search screens for places, persons and full text will make it easier to search within the text, as will tabular summaries, a glossary and various maps.

Although it's an enticing goal, the question remains: how much return will the researchers get for their immense input? The editors point to the incredible value of the source, stressing that this edition will help to fill a gap in German 17th-century sources. Above all, they anticipate interdisciplinary value and benefits for political and military history as well as social and gender history. The diary may also provide answers to questions relating to royal research, ageing research, the history of emotions and dreams and even linguistic, literary and cultural history. Everyone involved is convinced of the “genuine value-added” of an electronic

thorough preparation and planning and their professional leadership”.

The majority of the work involved in preparing the edition, which is expected to take a maximum of 12 years, will be completed by two positions in Freiburg and Wolfenbüttel. In a three-year pilot phase ending in October 2016, 1500 pages covering the period 1635–1637 will be transcribed and electronically coded with the help of high-resolution page scans. The goal is to produce an XML-coded text (Extensible Markup Language) which will serve as the basis for the subsequent online presentation of the diary.

The primary aim during the pilot phase is to “define edition guidelines and confirm them in ongoing editorial work”, says Antoine Odier, doctoral researcher and a member of the project team in Wolfenbüttel. As we look over his shoulder at Herzog August Bibliothek, he points

Detailed on-screen transcription: project team member Antoine Odier at his workstation at Herzog August Bibliothek Wolfenbüttel.

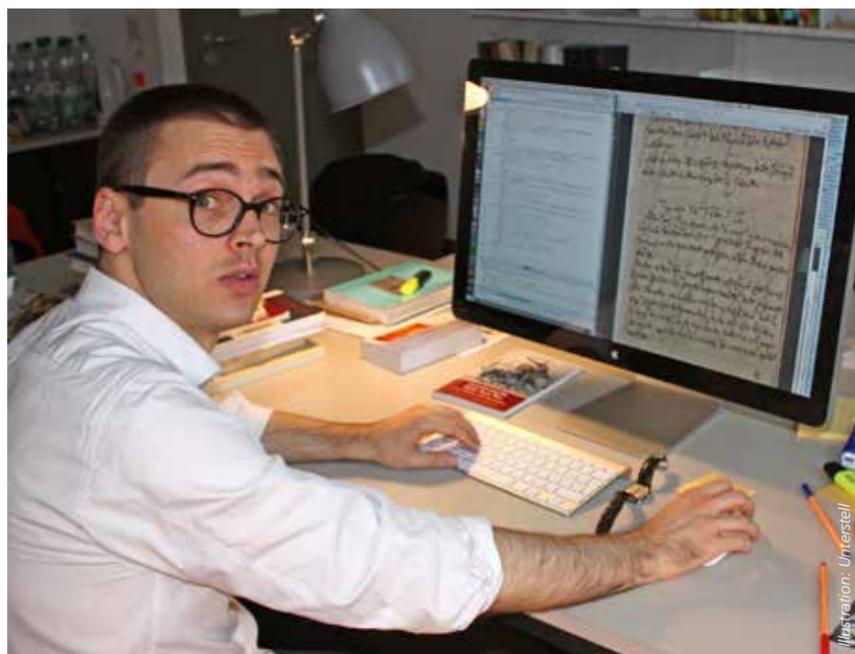
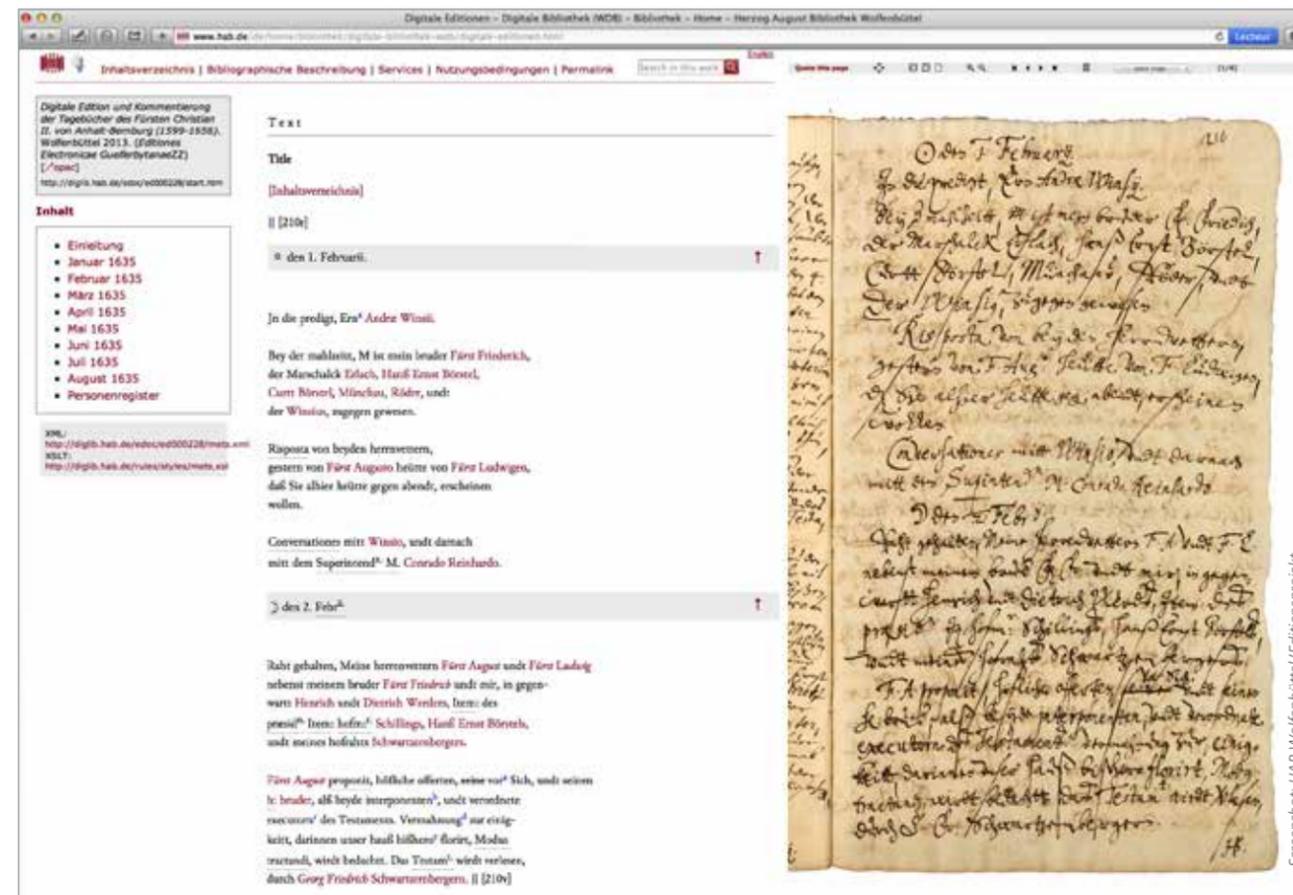


Illustration: Unterstell



Screenshot: HAB Wolfenbüttel/Editionsprojekt

Sample page of the diary edition: a colour scan of Christian II's original manuscript (right) opposite the transcription. At the bottom are links to translations, factual explanations and full personal names.

edition as the “medium of choice” (Helwig Schmidt-Glintzer).

As to the question of why Christian II continued to write so prolifically during a time of war, the answer remains unclear. As a Landesfürst, he obviously saw it as his responsibility to write to his sons to teach them and preserve his memory. In his diary, his concern for the worldly and spiritual wellbeing of his subjects is constantly in evidence. On 15 December 1637, he wrote: “It is reported how not only the people often fell upon dead carrion to eat it, but that a woman said she had had no bread for her children in 5 days, she could not push the youngest away from her when it bawled for nourishment, but she pushed the eldest away when they cried for bread. She also made plain

that she had to do them a harm, for she could not look upon their distress any longer.” Such hardship also challenges the reformed believer. His tendency towards a religious self-ascertainment may provide a second, overarching motive for writing his diary.

Christian rarely pens joyful entries, but there are a few. On 16 June 1636, for example, after a visit to Weimar, he enthuses: “At the evening meal and afterwards, we grew merry beyond all measure. We danced, and drank ad hilaritatem usque [to the point of hilarity], also rejoiced in the Lord with fine music. O Dieu redonne moy la liesse perdue!” [O God, restore to me the lost rejoicing!]. It must have been a rare experience of happiness in the war-torn 17th century with all its conflicts.

This period is remote from modern experience because life in those times was so different and people had different ways of thinking, seeing the world, and understanding their place in it. To bring people and events out of the remoteness of the past, the historian must examine meaningful sources. Historical personal testimonies can help us get closer to people in the past and their lives. The digital edition of this diary will therefore make an essential contribution to the digital humanities as both a new research instrument and a research laboratory for the Thirty Years War.

Dr. Rembert Unterstell

is Publishing Executive Editor of *german research*.

Project results will be published successively in the Wolfenbüttel Digital Library: <http://diglib.hab.de/?link=043>

Jörg Wrachtrup

Goodbye Carats, Hello Quanta

The properties that make diamonds so spectacular as precious gems also give them incredible applications in quantum technology. A Research Unit is investigating the basic characteristics of diamond in quantum physics and opening up new avenues in semiconductor technology, quantum information processing and medicine.

When most people look at a diamond, they admire the numerous optical reflections on the facets of the polished stone. Recently, however, quantum physicists, material scientists and chemists have become curious

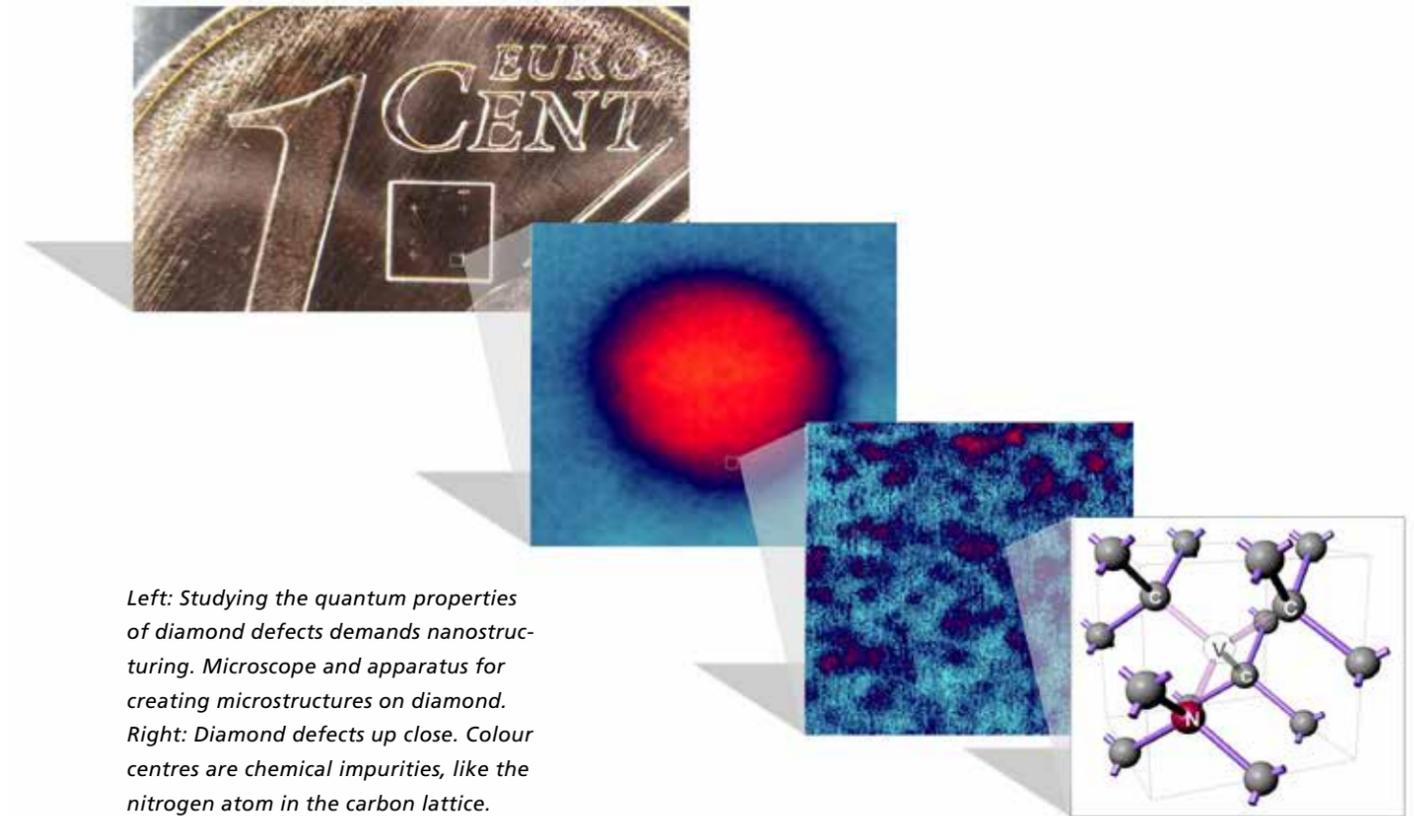
about the quantum nature of this material and in particular the defects within diamonds. The Research Unit “Diamond Materials for Quantum Applications”, made up of teams in Stuttgart, Freiburg, Ulm, Mainz, Leipzig, Munich, Ber-

lin, Saarbrücken and Würzburg, is exploring the extraordinary properties of diamond and seeking to exploit them in quantum science.

Pure diamond is made of carbon. The low mass of carbon atoms and their strong chemical bond in a



Illustration: Lehrstuhl Wrachtrup



Left: Studying the quantum properties of diamond defects demands nanostructuring. Microscope and apparatus for creating microstructures on diamond. Right: Diamond defects up close. Colour centres are chemical impurities, like the nitrogen atom in the carbon lattice.

Graphic: Lehrstuhl Wrachtrup

crystal lattice make diamond crystals one of the hardest materials known and also make the material optically transparent. Another remarkable property, a high index of refraction, causes light to be reflected from the surface. The result is the familiar sparkle that gives the gemstone its brilliant fire in the hands of a skilled cutter. A pure diamond appears absolutely colourless; a relatively small amount of impurities lends it colour and usually makes it especially valuable. The colour of the diamond depends on the chemical characteristics of the atom that has become incorporated in the lattice. Around 50 different types of atom can be introduced into a diamond lattice, giving a whole palette of coloured diamonds.

For the work of the Research Unit it is especially important to be able to manufacture artificial diamonds of high purity using different processes. In one method that has proved especially effective for technical and scientific purposes, the diamond is precipitated from the gas phase – to be precise a mixture of hydrogen and methane. This technique can be used to manufacture diamonds of almost any shape and size. For quantum physics research, this means it is possible to make diamonds of any given purity and introduce the desired impurity atoms. This is an essential requirement for the many uses of diamonds in quantum physics. The research team in Freiburg is working to produce exceptionally pure diamonds, which

are then made available to the other teams in the unit.

One of the main challenges of working with diamonds in quantum technology is the controlled placement of the impurity atoms. This process, known as “doping”, demands an accuracy to within 10 nanometres. Researchers in Mainz and Leipzig have achieved considerable expertise in this area. Using various methods, they are now able to place individual defect atoms in the crystal lattice of the diamonds delivered from Freiburg with an accuracy of just a few nanometres.

The team in Mainz first catches the impurity atoms in an ion trap in order to implant them in the diamond. In Leipzig, scientists are



The colour centres in a diamond crystal make the diamond glow red under green laser light.

using metal films with tiny holes to position impurity atoms precisely in the diamond. Both technologies are of great interest in semiconductor technology. Doping, the insertion of the impurity atoms, also plays a decisive role in the function of electronic components such as transistors. As components get ever smaller, their functionality increasingly depends on the precise placement of the foreign atoms.

The defects introduced to a diamond must be carefully embedded in control structures to allow the results of the quantum manipulation to be evaluated. In Berlin, Munich and Saarbrücken, researchers are therefore developing special structures that alter the optical properties of diamond in order to effectively manipulate the defects.

In a classic semiconductor chip, individual electronic elements are manipulated in a complex integrated circuit using control electrodes, and the intention is to do the same with individual defects in diamond. In diamond technology this is still difficult owing to the extremely small dimensions required in the control structures. Diamond is also an exotic material in semiconductor technology, with a range of physical principles still awaiting investigation in terms of nanostructure engineering. With this goal in mind, the group in Munich is seeking to create transistor structures and semiconductor nanostructures on diamond surfaces, and then supply these to the teams in Ulm, Stuttgart, Berlin

and Saarbrücken to pursue their own avenues of research.

The main reason that diamond is so attractive in quantum research is that it can be studied by means of relatively simple experiments. Most quantum experiments require precautions such as low temperatures or ultra-high vacuums. Because of its hardness and chemical composition, the diamond lattice protects the defects inside it very effectively against environmental influences, allowing the atomic impurities to be observed reliably for long periods of time without major experimental precautions. If the diamond only contains a few colour centres, a fluorescence microscope is sufficient to view the individual impurity atoms in the diamond lattice.

Another factor that is important to research and technology applications is the fact that specific quantum states can be achieved on the defects. Researchers can control the material by manipulating the magnetic moment of the electrons in the defects. Magnetic moment, or to be more precise the spin of the electron or nuclei, is either parallel or antiparallel to an external magnetic field. If the direction of the field changes, the spin follows suit.

This mechanism has a possible application in quantum information processing. Researchers are attempting to exploit quantum mechanical effects in order to process information extremely effectively. The Research Unit is using the electrons and nuclei of defect centres as quantum bits, the value of which is determined by the orientation of the spin: a parallel orientation to the magnetic field



Above: Doctoral researchers Thomas Häberle and Thomas Öckinghaus working with a diamond magnetometer. Right: Laser spectroscopy is an essential tool in any laboratory where researchers work with diamond defects.

represents 1 and an antiparallel orientation represents 0. To exploit the full potential of quantum information processing, quantum bits must exist in a state that can be both 1 and 0. This coherent superposition is one of the effects used in quantum information processing, for example to develop highly effective search algorithms. This effect is labile, and can be converted very quickly into the other state, whether parallel or antiparallel to the magnetic field, by lattice vibrations. But the exceptional hardness of diamond means that there are few lattice vibrations that could influence these superposition states. The research teams in Ulm and Stuttgart are exploiting this special quality of diamonds to try and utilise the defects for quantum information processing.

One field of diamond quantum technology that is attracting a lot of attention is sensor applications. The team in Stuttgart

discovered some time ago that diamond defects are extremely sensitive sensors for magnetic fields on the nanoscale. Interestingly, these sensors achieve their sensitivity under normal environmental conditions, giving them possible applications in the life sciences. Other members of the Research Unit have since demonstrated that diamond defects are also sensitive sensors for temperature and electrical fields.

To use the defects for these purposes, they are packaged in very small diamond crystallites measuring just a few nanometres across. The members of the research team in Würzburg are world-leading experts in the production and chemical modification of nanodiamonds. These nanodiamonds are made by grinding up large diamonds doped with colour centres in Freiburg. Particles of suitable size are selected from the ground material and then chemically modified. Nanodiamonds are now much in

demand worldwide because they have so many uses – for example as sensors for cellular or medical examinations. By carrying out basic research in both physics and materials science, the Research Unit is delivering results that are of direct interest both in quantum physics and in a range of practical applications.



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www.pi3.uni-stuttgart.de/



Bjoern Richerzhagen, Boris Koldehofe and Ralf Steinmetz

Immense Dynamism

When the virtual gaming world meets the real world in an “augmented reality”, communication networks quickly become overloaded. But what presents the biggest challenge to the Internet of the future also offers researchers possible ways of solving it.

They move through our cities in the early hours of the morning, meeting in small groups at seemingly random locations. Silently they stare at their smartphones until, as if in response to a secret signal, their hands suddenly start to move, typing. What’s going on? the outsider wonders. The inaugurated talk about “hacking”, the “enlightened” and “portals”. It’s like a scene from a bizarre film: real and

virtual at the same time, and it only comes to life through the display of a smartphone.

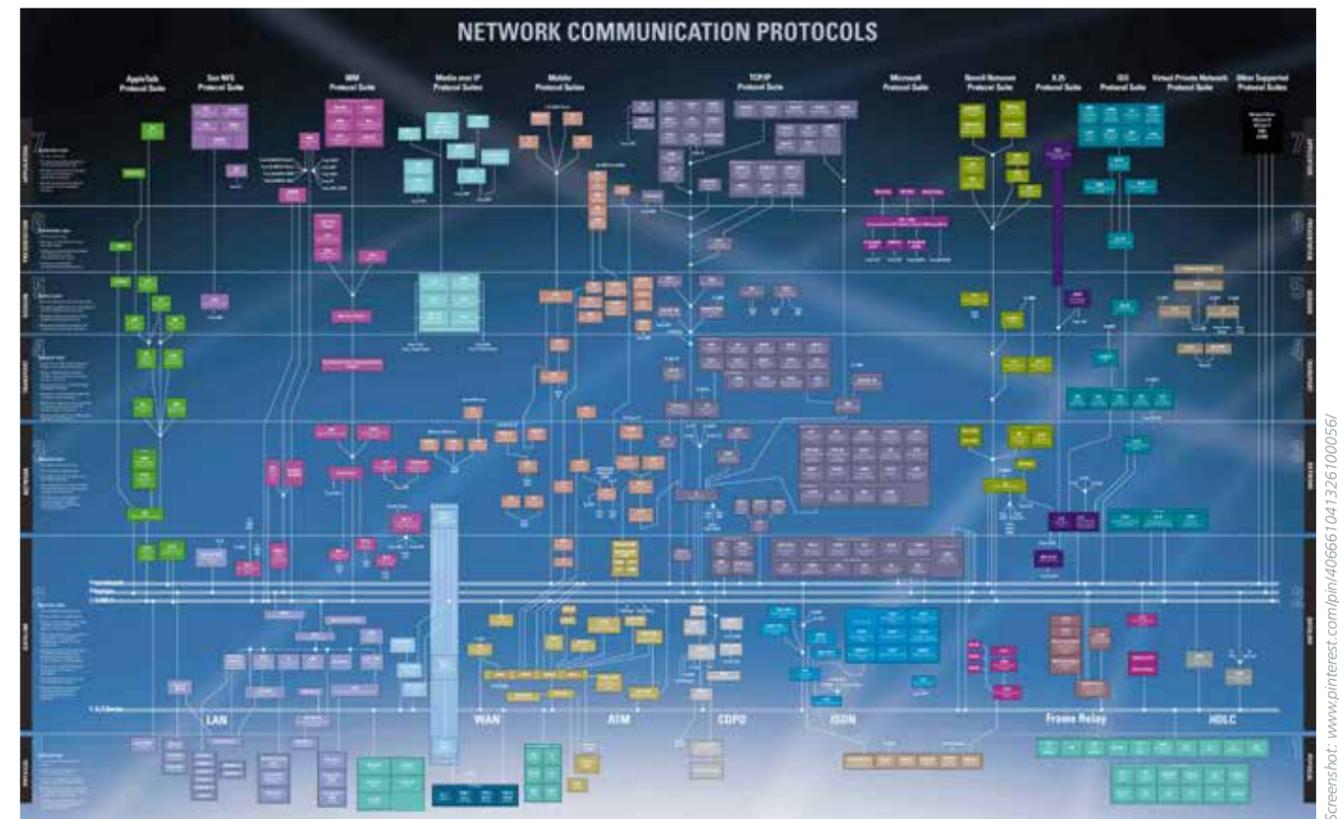
We’re talking about gamers who arrange to meet in squares and on streets, with smartphones and tablets, to play online games. The alternate reality game “Ingress” is causing a buzz among online gaming fans all over the globe. The interactive mobile game was launched by Google in 2012, and

it proved a hit with many gamers. The idea is simple: players belong to one of two factions and attempt to conquer areas for their faction by interacting with particular locations in the game, known as portals. The game is made exciting and unpredictable by the integration of augmented reality elements.

The virtual game world is directly linked to reality. In Ingress, real-world locations or buildings



Screenshot: Bjoern Richerzhagen



Screenshot: www.pinterest.com/pin/406661041326100056/

become portals that players aim to conquer. Players of both factions hold virtual battles at landmarks such as the Brandenburg Gate or the Eiffel Tower. A rendezvous is arranged with fellow gamers at strategically important locations, increasing the chances of conquering entire “regions” for one of the factions. The faction that successfully occupies the most regions wins the day. Ingress is an example of a new generation of mobile applications that relies on seamless local communication between mobile end devices. People inter-

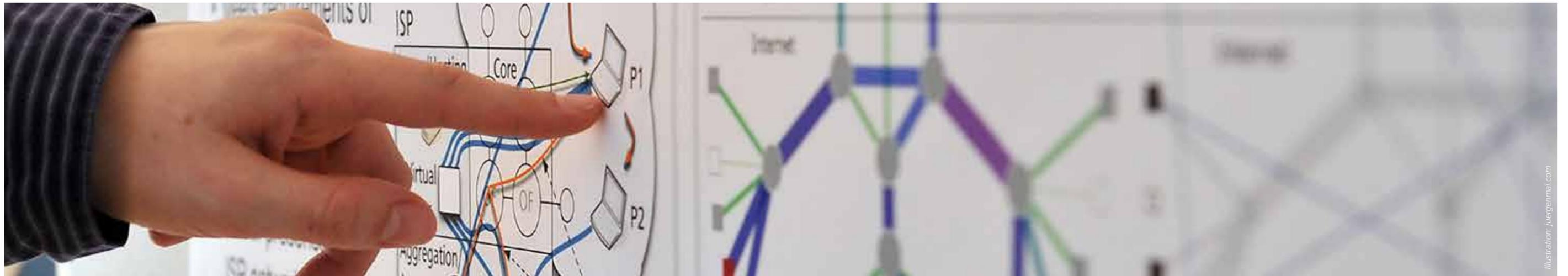
Left: Screenshot of the alternate reality game “Ingress”, which pits two factions against one another. Above: The variety of communication protocols used on the Internet is colourfully illustrated.

act with others in the environment and with the environment itself. The particular challenge for technical communication in applications such as this lies in their immense dynamism. When a large number of gamers gathers “spontaneously” at a location or when global campaigns (known in Ingress jargon as “anomalies”) take place, both the cellular infrastructure and the service provider’s infrastructure have to deal with a very high load. Events in the game then have to be distributed to a much larger number of devices, because the action affects a correspondingly high number of players.

But a large proportion of the communicated information is only important in the player’s immediate vicinity, so there is actually no need to route it via servers and mo-

bile phone cells. Players send their data to the service provider’s data centre through the mobile phone operator’s infrastructure and the service provider’s response comes back via the same lengthy path. This centralised communication principle generates unnecessary latency for providers and users. The quality and stability of data transfer is also more vulnerable in centralised networks, for example because gamers are walking around carrying their smartphones and the signal strength and transmission speed can vary from one place to another.

High dynamism in communication systems is the main focus of the DFG Collaborative Research Centre “Multi-Mechanism Adaptation for the Future Internet” (MAKI). Given the growing number and importance of mobile devices, the



relevance is obvious. Expressed in terms of information science, in order to cope with highly varying requirements and environmental conditions, communication systems themselves need to become much more dynamic. The participating researchers believe that the networking infrastructures that have developed over the last few decades will hinder a complete redesign of the Internet. In this respect the Collaborative Research Centre's approach differs from previous research approaches, which have been based on the assumption of a complete redesign of the "Internet of the future".

The MAKI team is working on the assumption that, in order to respond to the requirements of current and future applications, existing mechanisms need to be suitably replaced while a communication system is running. By switching from one mechanism to another, a process known as a "transition", the communication system can react to new requirements. In Ingress, for example, a transition might mean that players communicate directly ad hoc via Bluetooth or Wi-Fi. As a result, resource usage is reduced and the

burden on the supporting infrastructure is diminished.

Let's look at an example. In the project "Information-Centric View", the effects of the locality of information and interest are being investigated using the example of publish/subscribe systems. Publish/subscribe is a powerful communication paradigm that supports the efficient sharing of information. Providers and consumers are decoupled, i.e. they do not need to know the origin or the consumers of an item of information. Information

is mostly distributed by means of a broker infrastructure. In mobile and interactive applications like Ingress, however, entirely new potential for optimisation emerges when transitions make it possible to switch to an alternative communication mechanism, e.g. direct communication between participants.

Here is how it works in the case of Ingress. Gamers come together from different parts of the city by exchanging data through a conventional mobile phone connection. But as soon as they have gathered

or are physically in "transmission range", a smooth transition is made from the mobile network to Bluetooth or WLAN for local data communication. This not only takes the load off the central infrastructure, but also improves the quality of transmission.

Technologies such as Bluetooth and ad hoc Wi-Fi have different advantages and drawbacks in terms of energy consumption, range and data throughput. The method of transition developed in MAKI is designed to switch between these technologies according to application and environment. In order to use the active method of transmission, the publish/subscribe protocol must react to the change.

The goal of MAKI is to establish communication system adaptation and transition as basic principles of the future Internet. This links in to the vision of making the Internet of the future capable of reacting flexibly to changes and automatically selecting the most effective transmission method in a given situation. But first the theoretical and methodical basics need to be studied and developed. There are intriguing questions to be answered, particularly in the co-

ordination and planning of transitions: How local can and must transition planning be? What dependencies exist between different mechanisms? To what extent can the status of currently operating mechanisms be used to make the transition softer? To help answer these questions the researchers use the MAKI demonstrator, which shows the effects of transitions using several applications. In addition to the augmented reality game described above, live video streaming to mobile devices is also used. Applications vary significantly: in a video streaming scenario, data rates are much higher and information is distributed from a central source to all devices, whereas in an augmented reality game the information is generated by individual participants.

The researchers are convinced that the dynamism of the network represents both the main challenge and the solution for the Internet of the future: the communication systems of the future must be as dynamic as the applications that use them. This is the only way to ensure that a reliable Internet becomes reality in the long term. As the Internet and digital worlds permeate every aspect of our lives, this

reliability will not become a luxury, but indispensable to everyday life. No one can afford to use networks that are fault-prone, overloaded or too slow – and in the networked world of tomorrow, this will be more true than ever.



Bjoern Richerzhagen

is a researcher in the Collaborative Research Centre "Multi-Mechanism Adaptation for the Future Internet".

Dr. Boris Koldehofe

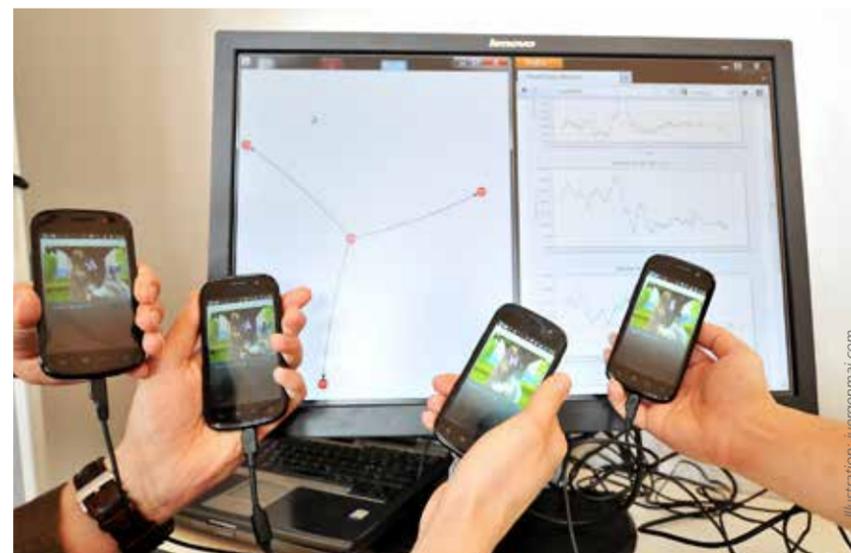
is the director and

Prof. Dr.-Ing. Ralf Steinmetz

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www.maki.tu-darmstadt.de/sfb_maki/ueber_maki/index.en.jsp



Alexandra-Maria Klein



“Please Pollinate!”

Wild bees find it hard to survive in intensively managed agricultural landscapes, and when the number of pollinating insects diminishes, it isn't just crop yields that are affected. As ecologists have demonstrated in Californian almond plantations, the type of pollination can even affect the quality of the fruits.

Numbers tell a story. During the almond blossom season in California, farmers need around 1.3 honey bee colonies. They invest an average of \$175 per colony – and for good reason. Californian almond farmers are compelled

to use honey bees for pollination because the intensively managed agricultural land, with its huge monocultures, does not provide a habitat for most wild bees and bumblebees. And without insect pollination, an almond tree would

produce no more than a few handfuls of almonds each year.

There are a few organic almond plantations where flies and wild bees perform some pollination services. Only when an almond plantation is located adjacent to

a natural habitat like chaparral (a shrubland ecosystem dominated by evergreen oaks) do various wild bees, bumblebees, butterflies and even hummingbirds visit the almond flowers. Optimum pollination is one of the most important factors in high almond yields. In the short term pollination is even more important than fertilising the trees and adequate irrigation, which has become an essential everyday part of Californian agriculture.

One of the reasons that many wild bees and other pollinating in-

sects ensure effective pollination services is that they visit flowers which are avoided by honey bees. In the cool spring, honey bees leave the shady flowers alone while other bees and flies visit and pollinate them.

Wild bees and honey bees also “interact”, for example when wild bees happen to fly to flowers where honey bees are collecting nectar and pollen. The disturbed honey bee flies to another almond tree. For successful pollination the pollen of one almond variety must be transferred to the stigma of another variety.

To make the job of harvesting easier, different varieties are planted in alternating rows, like an apple plantation in Germany. If a honey

bee only collects pollen from the thousands of flowers of one tree, i.e. one variety, or one row of the same variety because the trees within a row are closer to each other than to the next row, this form of pollination is worthless to the farmer.

Wild bees not only encourage honey bees to switch more often between varieties but also alternate between different varieties themselves, making them very efficient pollinators. Hoverflies and houseflies are also pollinating insects which contribute to the successful pollination of almond blossoms. Researchers at the University of Freiburg are studying the pollination process in partnership with researchers at the University of California (Berkeley and Davis) by firstly keeping insects away from



blossoms using gauze bags and then giving selected pollinator species access to the flowers.

The carpel, the part of a flower that develops into the fruit, is then removed and taken from the field to the laboratory in a microtube. In the laboratory the growth of the pollen tube of each individual flower can be studied under a fluorescence microscope. Pollination is deemed to be successful if at least one pollen tube has grown down

through the whole of the stigma to reach the ovary.

An almond farmer whose plantation is visited by wild insects from a natural habitat has higher yields than a farmer whose plantation has no wild bees – perhaps due to unfavourable weather conditions. In Californian almond plantations, honey bees will not fly if the wind speed is greater than 3 metres per second. However, some other bees will still fly in these conditions and

flies and moths will occasionally visit the almond blossom in strong winds. A commonly seen, dazzling blue-green sand bee even flies at wind speeds of over 10 metres per second.

When one species disappears from a species-rich ecosystem, its functional role is taken over by other species. In monotonous ecosystems and landscapes like the huge monocultures of California, there is no biodiversity; without honey bees, the harvest would fail.

In the field and in the lab: almond flowers are pollinated by hand using a brush (top). The growth of the pollen tube, essential to successful fruit formation, can be studied in detail with a fluorescence microscope (bottom).



During the almond flowering period, the honey bee is a vital pollinator. Almonds blossom during a period of frequent rain showers which saturate the soil. Most wild bees live in the ground and need a long time before the temperature allows them to become active and start looking around for flowers. Honey bees, on the other hand, remain in their manmade wooden hives during the rain. The hives remain dry on the inside, allowing the bees to fly as soon as the sun comes out again. During rainy weeks when the almond trees are blooming, honey bees are sometimes the only pollinators – even in plantations adjacent to natural habitats that provide a home for a diversity of wild bees.

The type of pollination could also influence the quality of the almonds. Almond trees which self-pollinate because they are not being pollinated by bees produce only a few, very large almonds. These self-pollinated almonds have a different mineral content and contain a lot of vitamin E, but little oleic and linoleic acid. Almond trees which are fully pollinated with fertile pollen produce a huge quantity of almonds which are often small



The carpel of a pollinated almond flower is delivered to the lab for study.

and contain less vitamin E, but high levels of oleic and linoleic acid.

Interestingly, the different mineral contents can only be explained by the type of pollination and not by the size of the almonds. Studies on other crop plants also show that bee pollination and self-pollination result in different storage lives. Consequently, the importance of pollinating bees and other insects in crop production is greater, but also scientifically much more complex, than previously thought.

So the question we have to ask is: How can we support these helpful wild insects in agricultural landscapes? Viewed throughout the year, biodiversity of wild insects requires natural resources such as food (nectar- and pollen-rich habitat islands), nesting sites (undisturbed exposed soil and dead wood) and suitable nesting materials (such as leaves, stalks, water and resin).

These resources are not sufficiently plentiful in industrialised farmland.

Bee diversity also requires the protection and renaturation of semi-natural habitats, more flower-rich landscapes and the cautious use of plant protection agents. The establishment of wild flowering strips and hedges and the use of diverse flowering set-aside land, cover crops, crop rotation and ecologically-oriented agriculture not only promote biodiversity but also the health of the honey bee.

A major challenge for farmers is to provide a habitat for useful creatures without encouraging pests – and therefore support a balance between conservation and food production. This is a very complex task that demands more knowledge than we currently have. For example, we know little about which insect species pollinate which plants, particularly crop plant varieties. We

also understand little about the resources that different bee species need for reproduction and which plant species in flowering mixtures offer a low potential for becoming undesirable “weeds” or attracting pest species on productive land.



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[www.nature.uni-freiburg.de/research/Globale evaluation](http://www.nature.uni-freiburg.de/research/Globale%20evaluation)



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.

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In 2015, the German government's Science Year for the City of the Future, there are major issues to be debated, and like every year the DFG has its own contributions to make. At the end of May, at the opening event of the ZWANZIG30 (2030) series, four experts discussed the opportunities and problems of urban development in megacities in an era of globalisation and urbanisation in front of an audience which filled the Bundeskunsthalle in Bonn. Under the moderation of Ranga Yogeshwar, the participants were (left to right): Peter Herrle (Professor em. of International Urban Development), Susanne Heeg (Professor of Geographical Urban Research), Christoph Ingenhoven (Architect) and Achim Hütten (Mayor of the "Edible City" of Andernach). A preliminary summary: "We need to renegotiate the future of the city, or the result will be social unrest that we can no longer cope with," said Herrle. Architect Christoph Ingenhoven conceded that structural measures alone are not sufficient to manage the social dynamics of a metropolis. Additional perspectives are needed. The next two talks in the ZWANZIG30 series, organised by the DFG and the Deutsches Museum Bonn, will be "Money or Life – To Whom Does the City Belong?" (1 October 2015) and "City 4.0 – A Future Without Waste and Congestion?" (26 November 2015). www.dfg.de/zwanzig30

