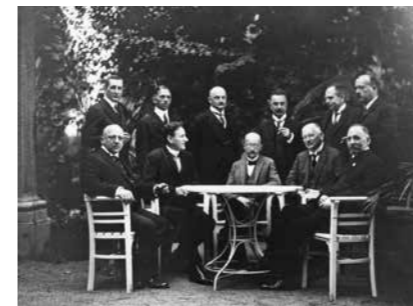




Cover: Shutterstock

Plastic waste contaminates land and water worldwide, here a polluted bay in the Philippines. Microplastics – a pressing environmental issue and research topic.



Microplastics in the Environment: Cycle of Contamination | Career Advancement: Opening Up More Future Avenues | Health Economics: The Dilemma of Digitalisation | Excavations: “Operation Betty” | Energy Transition: A Dialogue of Systems | History of the DFG: Reappraisal in Stages | Food Preferences: Influenced by Breast Milk

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Marlis Hochbruck

Opening Up More Future Avenues

What is needed to provide the next generation of researchers with the most effective support possible? As Vice President of the DFG, Marlis Hochbruck has been closely involved with early career researchers in recent years. As she leaves office, she also takes stock on a personal level.

In the midst of the ongoing coronavirus pandemic, it may surprise you at first glance, dear readers, to find a subject such as early career researchers and how best to support them in this *german research* editorial. On closer consideration, however, this is no coincidence: questions and answers concerning support in early career phases are among the most important agenda items in research funding – and this applies at the international level as well.

In providing support for early career researchers, the aim is always to open up more future avenues, be they personal, project-related or career-related. It is no coincidence that supporting early career researchers is one of the commitments that are set down in the DFG statutes. I firmly believe that supporting researchers as they seek to pursue an academic career must be central to science and the humanities and to the organisations who provide funding.

Reflecting on my time as DFG Vice President, I would like to share why early career researchers are important to the DFG as well as to me personally – and what we at the DFG have tried to initiate in new or different ways in recent years. Research funding faces a twofold challenge: on the one hand, to promote careers in all disciplines in a way that is best suited to the individuals concerned and on the other, to develop beneficial interdisciplinary and systemic career structures.

The starting point of all of our considerations and activities in recent years has of course been that the overall conditions for career paths and the opportunities for talent development in research are subject to an ongoing process of change. For this reason, the DFG has to monitor whether and how well its funding programmes are working by looking at the entire career ladder and funding chain – from doctorate to postdoc and on to the first appointment.

The insistent question to ask is: what funding programmes need to be adapted or revised? With this in mind, a working group appointed by the DFG Executive Committee in 2012 set itself the task of examining the current situation and identifying funding needs and requirements. With regard to the doctoral phase, it became apparent that two elements had proved highly effective: the funding of positions introduced in 2009 under the Research Training Groups Programme and the start-up funding, also introduced in 2009 in the coordinated programmes, to improve the transition from the doctoral to the postdoctoral phase.

So far, so good. At the same time, the DFG saw the need to advance the efforts being made under its programmes and to increase their flexibility. For the early postdoc phase, the research fellowship abroad was therefore supplemented with a more accessible equivalent in Germany. This has evolved into the Walter Benjamin Programme, which was launched in 2018. Moreover, the Heisenberg Programme succeeded in simplifying the complex dovetailing of DFG regulations with university structural requirements in the case of the Heisenberg Professorship, also enhancing flexibility.

Looking back, various stimuli came together. The modification of the Emmy Noether Programme in 2017, for example, was based on an internal DFG study on the progression and success factors of early career phases and on the Early Career Researcher Pact with its introduction of tenure-track professorships. What is more, the formal hurdle for applying to the excellence programme – at least one year of research experience abroad – was ended as a way of facilitating work-life balance. Nonetheless, international experience, networking, high-ranking publications and visibility remain essential prerequisites in promoting excellence. In order to give grantees more planning security, the funding period was increased from five to six years.

The Emmy Noether Programme also includes one especially essential element: the annual meetings in Potsdam. Like the Heisenberg networking meetings, these allow us to get to know funding recipients in person, often giving us the opportunity of direct contact with their academic world and their enthusiasm. The value of such personal encounters in terms of the insights we are able to gain can hardly be overestimated. Through the official programme, as well as in informal discussions, grantees share what they have found to be positive and beneficial as well as where problems have occurred or new requirements have arisen.

The annual selection meetings for the Heinz Maier-Leibnitz Prize were especially pleasurable, too. As is well known, the DFG has awarded this prestigious German funding prize to outstanding postdoctoral researchers since 1977. An empirical study carried out in 2017 confirmed that this prize is a ticket to an academic career. The prize money, currently still €20,000, is to be significantly increased in recognition of accomplishments and as an incentive. I personally very much hope this will happen in the foreseeable future.

Another adaptation has already been successfully implemented: the individual funding period for doctoral researchers in Research Training Groups will be extended as of spring 2022. The “Promoting Doctoral Studies” conference in autumn 2019, along with other study findings, showed that doctorates under DFG coordinated programmes take an average of 51 months to complete. In view of this, doctoral researchers will in future be able to receive doctoral funding for up to 48 months.

To return to the postdoctoral phase: all in all, the DFG funding portfolio pursues the goal of adapting to individual and disciplinary needs in a streamlined, flexible manner. The aim is not just to provide tailor-made funding opportunities but also to ensure “barrier-free” structures. Not least in view of this, we sought to produce a compilation of the principles of effective career development, which we published in spring 2021. These principles complement the “Guidelines for Safeguarding Good Research Practice”, which have now become established as a standard, along with the expectation



Illustration: DFG/Auserhofer

that university administrations, academic research communities, reviewers and funding recipients adopt these as their benchmark.

Looking back over the last few years, the funding of excellent researchers in early phases of their career has always been a priority for me and one to which I have dedicated myself with great pleasure. I am indebted to all those involved inside and outside the DFG for their constructive cooperation within shifting team constellations. Topics relating to early career researchers were also crucial during my time on the Senate, the Joint Committee and the Executive Committee. I strongly believe that the DFG will continue to offer and develop programmes and funding lines for doctoral and postdoctoral researchers in a proactive and constructive manner and according to their needs. The great importance and attention attached to basic research and its funding these days involves great responsibility for all those concerned, and the early career researchers of today and tomorrow should be given a special role in all deliberations.

M. Hochbruck

Professor Dr. Marlis Hochbruck

was Vice President of the DFG from 2014 until the 2021 Annual Meeting.

Rembert Unterstell



The Dilemma of Digitalisation

The German healthcare system – past and future: economist Jonas Schreyögg on structural problems that have become apparent, better access to healthcare data for evidence-based research and the expectations associated with electronic health records. In conversation with a member of the DFG's Commission for Pandemic Research.

german research: Professor Schreyögg, we are conducting this interview at the end of June, and for the first time in a long while the infection figures are falling, while at the same time more and more people are now getting vaccinated. Many are already breathing a sigh of relief. Are we now back to normal?

Schreyögg: As the pandemic subsides, there are positive effects that combine: the warmer season, the effect of widespread testing and then the impact of the vaccination campaign as the number of those vaccinated increases rapidly. At the same time, the Delta variant is

on the rise. It might also be that herd immunity will be difficult to achieve and we'll keep seeing small outbreaks. Nevertheless, I believe we can look positively into the future in the medium term: we are seeing a revival of the economy and society at large, too.

Our healthcare system is considered by other countries to be one of the best and most expensive in the world. Has it shown itself to be crisis-proof in the pandemic?

To some extent. We were lucky in Germany, especially at the beginning of the pandemic. If it had hit us as early and unprepared as Lombardy, which has one of the best healthcare systems in Europe, the situation would have been completely different. We have also been lucky because we have a much smaller staffing ratio than other countries, e.g. hospital personnel per ICU bed. This is half the ICU staffing ratio that countries like Italy or France have. So when we say our healthcare system has proven robust, we should add that the lockdown was imposed early on and the pandemic was slowed down at an early stage – that's why the kind of precarious situation we saw in Lombardy never arose in the first place.

The lockdown measures were politically justified based on the risk of overloading the healthcare system, latterly based on the availability of intensive care beds. With a maximum of 5,700 coronavirus patients in a total of 34,000 ICU beds, critics are now saying this was a case of political instrumentalisation. Do you agree?

I find this whole debate too indiscriminate. Not all ICU beds are the same. Many so-called intensive care beds are not strictly suitable for the provision of care to critically ill coronavirus patients. Treatment of these patients was mainly concentrated in university hospitals and maximum care hospitals (i.e. hospitals which usually have at least 500 beds); the figures

are now also available for this. Some of these facilities certainly reached their limits. With a view to treatment capacity, we would need to know what the specific staffing was for each patient, but these figures are still not known. I believe it is vital for us to find this out, based on each individual hospital. The limiting factor is not number of beds or ventilators: it's the number of staff available. This is where the whole discussion about beds simply doesn't go far enough.

Leaving aside the dramatic crisis in long-term nursing care, what structural problems has the pandemic particularly highlighted?

The disaster in Lombardy taught us that only the most severe coronavirus cases should be treated as in-patients. It is certainly true that the pandemic showed us that emergency care in Germany is a systemic problem. The Advisory Council on Developments in the Healthcare Sector, of which I am a member, presented an expert report on emergency care prior to the pandemic that recommends reforms. We have the problem in Germany that patients go into emergency departments very quickly. If we hadn't changed course at the beginning of the pandemic, we would have run into a big problem. In this respect, it was a groundbreaking decision on the

Professor Dr. Jonas Schreyögg ...

... holds the Chair of Healthcare Management at the University of Hamburg and is Scientific Director of the Hamburg Center for Health Economics (HCHE). Born in 1976, Schreyögg is an economist and holds a PhD from the TU Berlin. As a postdoc he worked at Stanford University. After obtaining his postdoctoral lecturing qualification, he was initially Professor of Business Administration, in particular

Health Services Management, at LMU Munich in 2009/2010 before being appointed to Hamburg in 2010. Among other things, he has been a member of the German Advisory Council on Developments in the Healthcare Sector since 2015; in 2019 he was appointed to the DFG's interdisciplinary Commission for Pandemic Research.



Economics and Health Science

Health economics is an interdisciplinary subject that looks at healthcare structures, combining approaches and perspectives from health science, economics and business administration. As a sub-discipline of health economics, "management in the

healthcare sector" addresses aspects such as healthcare provision in hospitals, doctors' surgeries and other institutions by examining issues such as organisational and personnel management as well as financial and quality management.

part of the Robert Koch Institute to ask patients to go into self-isolation at home in the case of mild progressions, to have this managed centrally via the Associations of Statutory Health Insurance Physicians or via the phone number 116 117 – and only to admit people to hospital in severe cases.

Crisis management on the part of the public health authorities – I'm thinking of contact tracing – has been the subject of scathing criticism ...

In Germany, we don't have a well-developed public health planning system as in the UK or some Asian countries. Here the public health service being in charge for public health planning was cut back by savings before the pandemic – to some extent it had already ceased to function properly. There needs to be a rethink here, fundamen-

tally and far beyond the pandemic. The role of the public health service has to be redefined and networked public health planning must be assigned a much more central role.

What do you mean when you talk about the "digitalisation dilemma of the German healthcare system"?

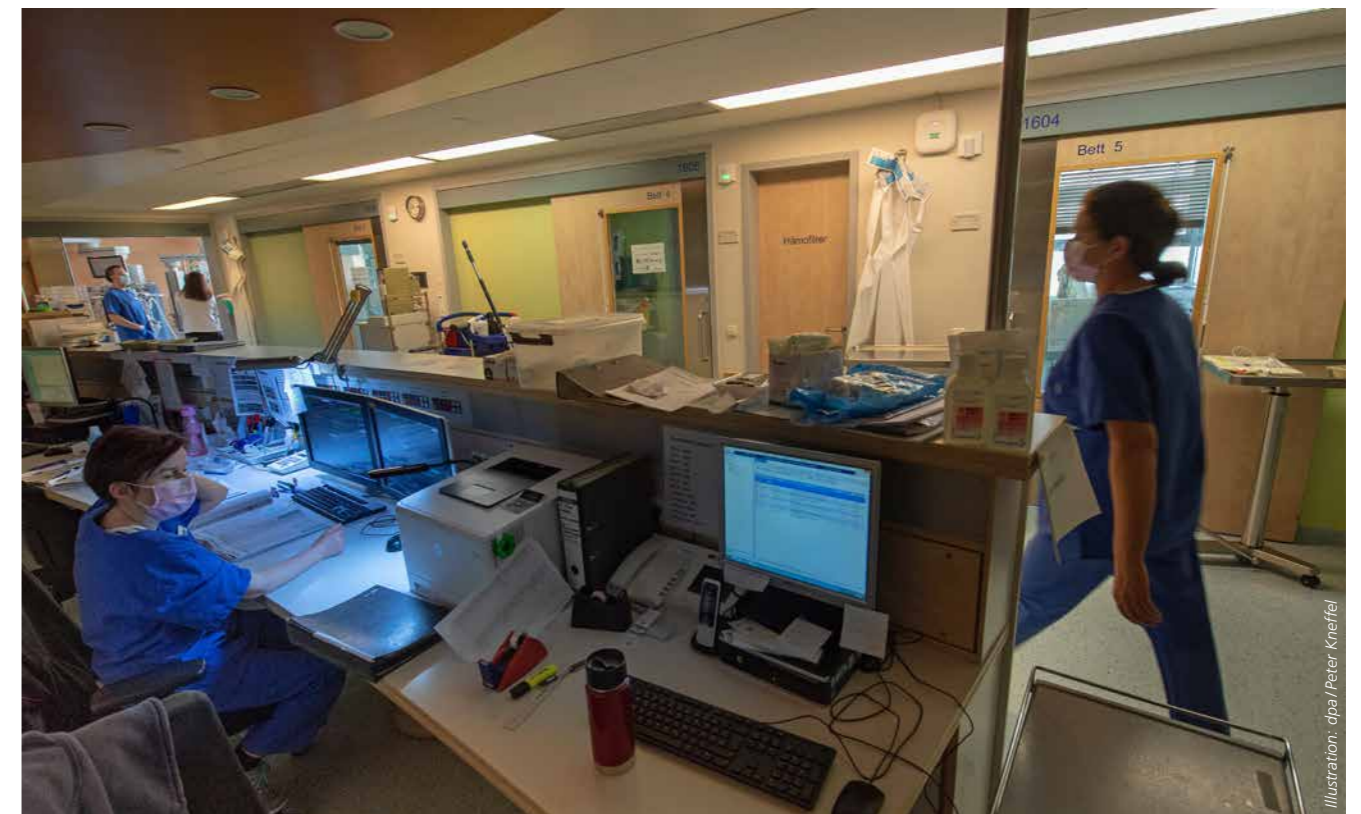
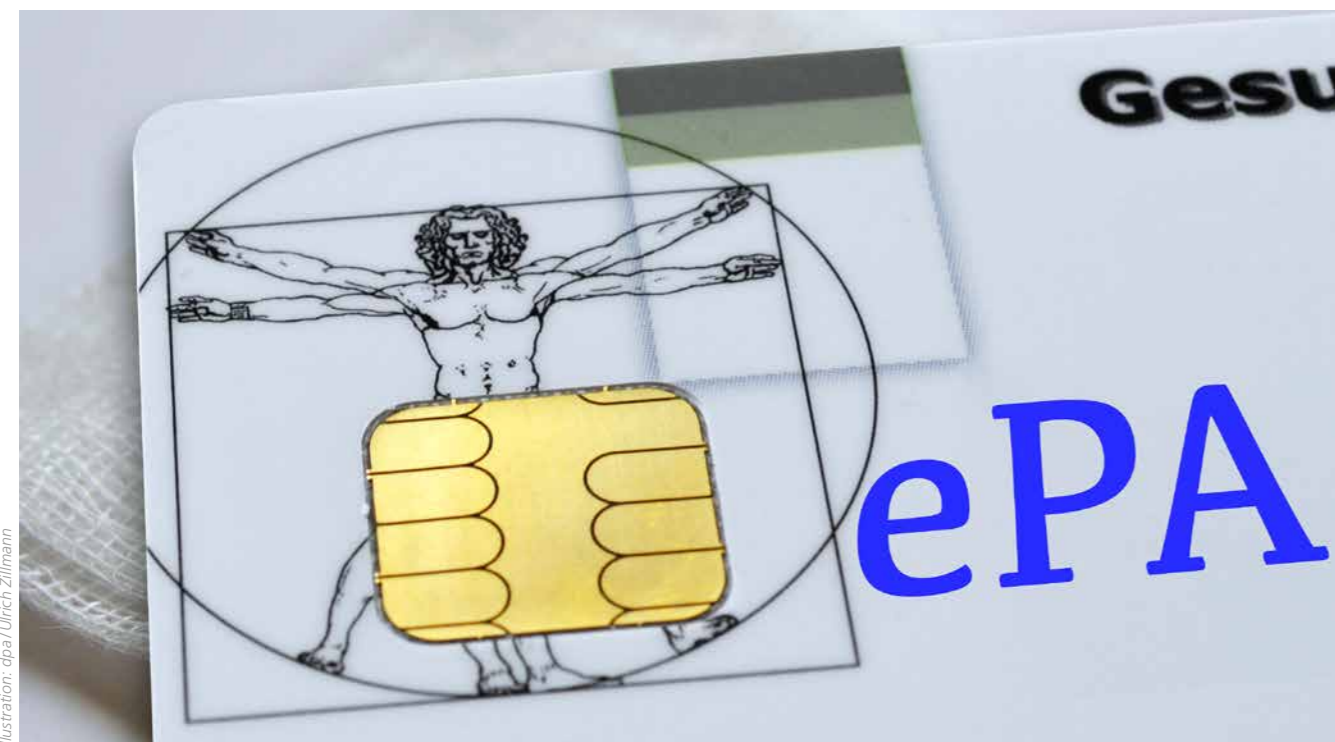
Even after 15 months, it is well known that the reporting chains from the public health authorities to the Robert Koch Institute don't function smoothly; they're still not fully digitised. Unfortunately, there are still a lot of data standards that have not yet been defined in the healthcare sector. Above all, access to empirical data to pursue research is worse than in other countries. In Germany, there is no central body that might be capable of combining data sets and

making them available in combined form, as would be necessary. This has implications: in Italy, studies were published relatively early on that combined infection data, clinical data and claims data from health insurance or regional health authorities; the same was true in England and the USA. We are lagging behind internationally in digitisation and data access for research purposes.

Large data gaps have emerged during the pandemic. As a health economist, which data sources would you mention here in particular?

There's a general need for better access to existing health data. A substantial part of my work is to manage these complicated forms of access to healthcare data. This is by no means insignificant! In international contexts, data from

Is the electronic health record of tomorrow an innovation driver from which data-based basic research could benefit, too? Scepticism and rejection have so far predominated among the population in Germany.



In many hospitals, the treatment of seriously ill coronavirus patients took doctors and nursing staff to their physical and emotional limits. As far as bed capacity allowed, patients were treated in isolated intensive care units.

electronic patient records have long been important – for example in the UK and the Scandinavian countries as well as Taiwan, Canada and the USA. In terms of health economics and health services research in Germany, how we move forward in the next few years will be crucial.

Doesn't the use of cancer registry data or case-related billing data etc. require special data protection?

That's what many people think. But the General Data Protection Regulation in fact allows privileged use of data in medical contexts. The problem in Germany derives more from how these provisions are legally interpreted – and how their interpretation differs from one federal state to the next.

Which healthcare system in Europe could we learn a lot from?

(laughs) There are a few I could name, but of course the Nordic countries are unique. The data sets and their interlinking are excellent – and these countries are subject to the General Data Protection Regulation, too. In connection with EU projects, we are seeing that in some countries where you might not expect it – Hungary and Slovenia in particular, for example – there is better access to research-related data than here in Germany.

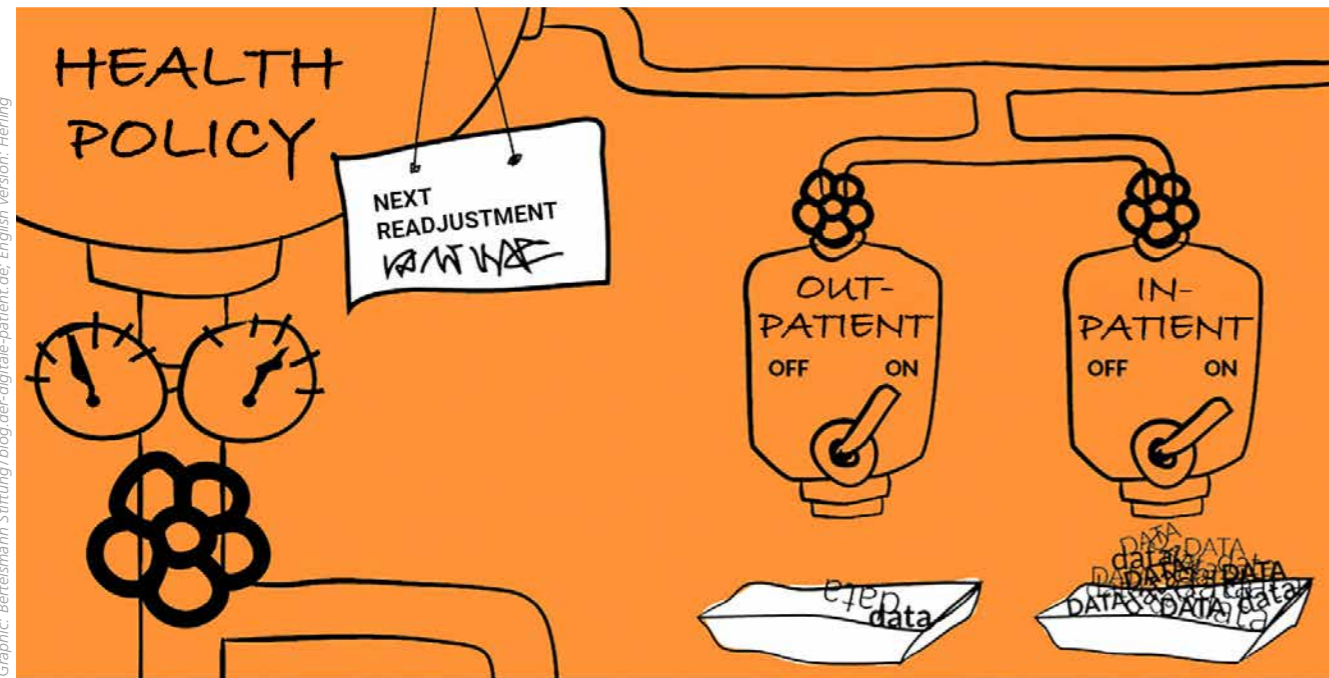
What is the main challenge facing the German healthcare system?

If we don't manage to become internationally compatible with regard to data sources and data

access, German researchers will increasingly resort to using foreign data. We need to get this message across again and again in the coming years: there is enormous value and benefit for Germany as a research hub to be derived from expanding this access and also improving it in terms of the way it is administered.

Would I be right in thinking that you have high expectations of electronic health records?

Yes, indeed. However, there are still a number of areas that need fixing. First of all, as many citizens as possible have to be persuaded to actually want to use such records. The experience of other European countries in dealing with patient records suggests that



There have been many attempts to reform the German healthcare system on a small scale. According to experts, however, it has not yet been possible to achieve a comprehensive structural reform in areas such as the system of hospital finance and in-patient services.

an opt-out procedure ought to be used (i.e. an electronic health record is created if no explicit objection is made – at the moment, the opt-in procedure applies). This is quite practicable, but so far it is not supported by a majority among the German population or in the Bundestag.

As a health policy advisor and as a member of the Commission for Pandemic Research, you advocate making empirical data from the healthcare system usable for research as well. Have the prospects for this improved since the Digital Healthcare Act came into effect in December 2019?

This was of course a very important step, but it is only an initial move towards achieving truly widespread use and the full range of benefits. First of all, it is important to gain the trust of citizens in Germany, since so many are sceptical of digitalisation. We saw this in

the DFG-funded ECOS survey, too, which is being conducted in seven European countries and focuses on the acceptance of measures during the pandemic. One striking result is that there are major differences in acceptance: scepticism is greater in Germany with regard to digitalisation and vaccine readiness is lower here than in many other countries.

Have your personal expectations been fulfilled in participating in the interdisciplinary commission on pandemic research?

Ever since I've been involved in research, I have adopted an interdisciplinary approach. This is not only enjoyable for me personally: in my opinion it is also the way to make progress scientifically. I find the collaboration in the plenary and sub-working groups across disciplinary boundaries to be vital and stimulating, not least because

it combines the differing research perspectives and questions. This can be a source of inspiration for one's own research work, too.

After the pandemic might well be before the pandemic. What can we learn from this as you see it?

The pandemic has shown us many things, both negative and positive. You might say the pandemic has been something of a lengthy seminar that has enabled us to critically examine a whole range of areas. Of course, this also applies to the political domain – and in my specialist area it concerns the organisation of the healthcare system. The next step will be to collate all the findings and draw conclusions – not just breathe a sigh of relief and go back to where we were before.

Interview: Dr. Rembert Unterstell,
Publishing Executive Editor of german research.

DFG Funding and Corona: An Initial Assessment

€140 million awarded for emergency support and pandemic research

The DFG has provided funding of approximately €140 million for research projects in direct response to the coronavirus pandemic. Of this amount, about €93 million has been allocated as additional support for ongoing DFG projects across all disciplines that have been affected by the pandemic and the restrictions on public life. A total of approximately €45 million has gone towards funding more than 150 new projects dedicated to research into COVID-19 as well as other epidemics and pandemics.

These were the figures announced by DFG President Professor Dr. Katja Becker in early July in conjunction with the annual meeting of the largest research funding organisation and central self-governing body for science and the humanities in Germany. "For well over a year now, the pandemic and lockdown have had a considerable impact on the work of many funded projects and the researchers involved in them. For this reason, mitigating these immediate consequences and enabling continuation and successful completion of the research has been our goal from the outset."

As Becker explained, funds of approximately €52 million have been approved for more than 4,000 projects under general research funding alone. Further supplementary grants went to the Collaborative Research Centres, totalling about €32 million, and to the Re-

search Training Groups with a figure of just under €9 million. These funds originate from the max. €175 million support package that was approved by the DFG's Joint Committee in the summer of 2020 and expanded in March of this year,



for which researchers and projects impacted by the pandemic are especially grateful.

For the time being, the coronavirus pandemic has had no negative impact on proposals for new projects or the continuation of projects already receiving funding, as a recent DFG analysis indicates. From the beginning of March 2020 to the end of February 2021, for example, the number of proposals for individual grants funding increased by approximately 1,800 to almost 16,700. The increase in the number of proposals from fe-

We will keep you posted about the impact the coronavirus pandemic has on the DFG's work and about all measures taken to date and in the future on our website www.dfg.de and via Twitter: [@dfg_public](https://twitter.com/dfg_public).

male researchers was particularly marked: they submitted 18 percent more proposals than in the same period last year, while 11 percent more proposals were received from male researchers. Similar developments were also noted by

French and Swiss partner organisations and the European Research Council (ERC). "Fortunately, these initial figures belie fears – sometimes discussed in the public arena – that female researchers in particular are currently discouraged from pursuing research as a result of increased care commitments. We now have to take

a look at these and other developments from a long-term perspective and on a differentiated basis," said the DFG President.

Becker gave a very positive assessment of the interdisciplinary call for proposals published in June 2020 as well as the seven calls for proposals under the new Focus Funding instrument, which supports research into the coronavirus and other epidemics and pandemics. "The level of interest in our calls has been tremendous, with a total of almost 700 proposals for either deliberately broad-based or very focused research." As a result, 151 new research projects are now receiving funding – 51 under the interdisciplinary call and 100 to date under the Focus Funding instrument.

www.dfg.de/en/service/press/press_releases/2021/press_release_no_33

Impulses for the Upcoming Legislative Period

DFG paper “Strengthen Knowledge-Driven Research, Benefit from Knowledge Reservoirs” lays out central fields of action and recommendations for setting the political course.



Illustration: Shutterstock

A view of the plenary chamber of the German Bundestag in Berlin: Now more than ever farsighted policymaking in research is needed.

In an impulse paper for the 20th legislative period of the German Bundestag, the DFG has set out what it considers to be the most important areas of action and recommendations to ensure that the sciences and humanities can continue to play a key role in addressing major challenges in the future. Now also to be found on the DFG’s website and addressed to policymakers in view of the upcoming federal election campaign, “Strengthen Knowledge-Driven Research, Benefit from Knowledge Reservoirs” is the title of the paper published by Germany’s largest research funding organisation and central self-governing body for science and research.

“Political and societal challenges such as the coronavirus pandemic illustrate that in some cases, scientific solutions can be required with enormous urgency. The capacity to develop acutely needed scientific solutions depends crucially on early research funding that is not initially dedicated to a specific purpose,” the paper states in its introduction. “More than ever, forward-looking research policy is needed that allows space for research-driven decisions and supports flexible action.” In terms of the strategic political decisions this will require in the upcoming legislative period, the paper provides 13 impulses covering several major fields of action.

From the DFG’s point of view, it will continue to be of central importance to strengthen knowledge-driven research in Germany in the coming years by providing appropriate funding and support. This also requires long-term investment in research – despite new debt and falling tax revenues in the wake of the coronavirus pandemic – as well as a clear political commitment to continuous budget increases and financial planning security for research organisations in connection with the Pact for Research and Innovation (PFI). Knowledge-driven research should continue to be funded and promoted across its entire thematic breadth. At universities, im-

provement of financial framework conditions in the upcoming second funding period of the Excellence Strategy should ensure even greater global competitiveness, in particular in terms of fair participation and funding opportunities for new proposals as well as in terms of the programme allowance for indirect project costs.

Several of the DFG’s impulses focus on far-reaching processes of change in the sciences and humanities and their infrastructures, in particular the digital turn. The latter is to be further advanced and utilised in the coming years, for example through the development and expansion of “digital expertise” in all subjects and disciplines and the development and strengthening of attractive digital job profiles and career paths. The field of research data continues to grow in importance, too: here the aim is to ensure long-term sustainability of research data management. To this end, the DFG considers it essential to provide long-term funding for the recently established National Research Data Infrastructure (NFDI) so as to transform



its current project status into a stable and long-lasting infrastructure.

The publication system is also to be made science-friendly by further expanding open access and the relevant financing structures, as well as ensuring reliable and practicable copyright legislation. From the DFG’s point of view, the national safeguarding of basic infrastructures for academic publications and not least the regulation of increasing global data tracking in academic

research are also of increasing importance in this context. Finally, major research instrumentation and instrumentation-related research infrastructures are to be financed in line with demand, based on an increase in funding and the inclusion of operating costs in research funding.

In addition to setting the course for the financial, structural, technical and legal framework conditions for knowledge-driven research and research funding in Germany, one of the DFG’s key political tasks in the coming legislative period will be to secure and strengthen the basis for research cooperation internationally. Important elements include the development of a coherent interministerial strategy for science diplomacy, strengthening of the European Research Area (ERA) and European research partners for Germany.

www.dfg.de/en/service/press/press_releases/2021/press_release_no_13

The paper, available in German only, can be downloaded at www.dfg.de/download/pdfpresse/20210505_pm_impulspapier_legislaturperiode.pdf

On 2 July, the Joint Science Conference (GWK) approved funding for ten further consortia in the context of the National Research Data Infrastructure Programme (NFDI). The GWK decision marks the end of the second funding round, in which 16 initiatives were submitted. As in the first funding round, the GWK followed the recommendation of the NFDI Expert Committee appointed by the DFG. A total of 19

The NFDI is Growing

DFG welcomes GWK decision to fund ten new consortia

consortia from all four broad scientific disciplines are now being funded.

In setting up the NFDI, the DFG is responsible for the selection, review and evaluation of NFDI consortium proposals, while the GWK is responsible for financial decisions. To be eligible

for funding, proposals must receive a positive recommendation by the NFDI Expert Committee, which is composed of academic researchers and experts from scientific infrastructure institutions.

“It is great to see the NFDI grow based on a research-driven process,” said DFG President Professor Dr. Katja Becker following the decision.

www.dfg.de/en/service/press/press_releases/2021/press_release_no_25

Christian Laforsch, Andreas Greiner and Martin Löder

Cycle of Contamination

From the deep sea to the atmosphere, from the tropics to the polar regions, microplastics are everywhere. Yet important mechanisms and processes relating to their formation and biological processing are still not understood. Researchers in a range of disciplines are seeking to change this and thus help to reduce the impact on ecosystems and humans.

Environmental pollution caused by plastic waste – here in a bay near the Philippine capital Manila, where a man searches for reusable material.

Plastics are an integral part of everyday life in the modern world. Their versatile properties have made countless technologies and medical innovations possible. Plastic products are light yet sturdy, corrosion-resistant, and have outstanding insulating properties. Thanks to these advantageous traits, combined with comparatively low production costs, plastics are now found in a wide array of products. Global production

of plastics increased from 1.7 million tons in the 1950s to 359 million tons in 2018. A rapid rise in production rates is also forecast in the coming years, with production potentially doubling in the next 20 years.

Yet the very characteristics that bring advantages in every-day life and technology also bring problems. In Europe, single-use products for the packaging industry account for almost 40 percent of plastic pro-

duction. As a result, the amount of plastic waste has also increased rapidly in recent years. In 2016, the proportion of plastics that entered the recycling process in Europe was just 31 percent. The rest of the continent's plastic waste still goes to landfills or is reutilised in some other way, for example by thermal recovery through incineration.

Yet as the result of thoughtless or improper disposal, a significant amount of plastic waste enters the environment – and it may be assumed that in newly industrialised countries especially, the proportion of reutilised or recycled plastic is much lower than in Europe and the amount that is not properly disposed of is all the larger.

The main reason why plastics cause such problems in the environment is that they are persistent and durable. Because they degrade very slowly, it is believed that many plastics will remain in the environment for hundreds of years. However, over time, due to chemical, physical and biological factors, they become brittle and break down into ever smaller fragments. Fragments less than 5 millimetres in size are known as microplastics; if they come from larger plastic parts, they are referred to as secondary microplastics.

Microplastics that have been industrially produced at this size, on the other hand, are known as primary microplastics. These are used in products like cosmetics, as hot-melt adhesive powder or as alternative sandblasting material. Large quantities of microplastics can also enter the environment through wastewater, plastics used in agriculture, or through the air as the result of abrasion of various plastic products, for example in the construction or clothing industry. It is now gen-

The CRC "Microplastics" aims to move from general models to a differentiated system-based understanding, as illustrated by this poster.



Processed plastic, for example from plastic bottles, gradually decomposes in the environment to form tiny microplastic particles; these enter organisms through water, soil and air and therefore end up in the food chain.

erally established that microplastics can be found in all habitats around the world, from the deep sea to the atmosphere and from the tropics to the polar regions, sometimes in large quantities. Not only the oceans, but also all the world's freshwater bodies and terrestrial ecosystems, such as farmland, are affected.

In the environment, the tiny size of microplastics means there is a high risk that the particles will be consumed by organisms. Once consumed, microplastics may cause harm to the organism. Possible effects include physical damage to the digestive tract, toxic effects of ad-

ditives – the chemicals that largely determine the properties of the plastic – and environmental pollutants which are adsorbed and may therefore be consumed in larger quantities. The latter points are the subject of heated debate among scientists.

There is also a debate concerning certain health hazards associated with microplastics. Firstly, there is the "translocation" of microplastic particles from the digestive tract to the tissues, which has been observed in various organisms, and the associated risks such as inflammatory reactions. In addition, no one has yet investigated the effects of microplastic particles and fibres that en-

ter the body through the respiratory tract. Secondly, it has been shown that microplastic particles can negatively affect the gut microbiome, which plays an important role for the immune system and the absorption of nutrients. Thirdly, there is the so-called vector or transport function of microplastics, since their durability means that pathogens, for example, can be transported over long distances.

The pervasive contamination of the environment by microplastics and the associated risks to ecosystems and ultimately to human health has recently been a topic of great public and scientific interest. But contrary

to the way things might appear at first glance, it is in fact a highly complex topic. For one thing, not all microplastics are alike. "Microplastics" is an umbrella term for particles of many different types of plastic, with different sizes, shapes, surface types and functionality as well as a wide range of chemical, physical and mechanical properties.

These different types are also present in the environment at different stages of degradation over time, and during this time the properties of the material can alter. This in turn can potentially lead to both changed environmental behaviour and complex biological effects.

Until recently, the young research field of microplastics has mostly been limited to developing suitable methods for detecting microplastics, quantitatively estimating environmental contamination and identifying "entry pathways". Researchers are also studying ecotoxicological effects, but often use brand-new plastics. So far, we have lacked a basic understanding of the physical, chemical and biological processes to which microplastics are subjected in the environment. Yet it is this understanding which provides the foundation for assessing the real risks that these materials pose.

The scientific study of the complex topic of microplastics demands an interdisciplinary approach that bridges traditional boundaries between subjects, because we can only understand the potential effects on organisms and therefore the environmental relevance of microplastics by taking into account their properties, their different processes of degradation and their behaviour in and between the environmental "compartments" of water, soil and air.

These complex research questions are the focus of the Collaborative Research Centre "Microplastics – Understanding the mechanisms and

A turtle takes a bite at a floating plastic bag. More and more plastic is being found in the stomachs of marine animals, who not uncommonly choke or are strangled to death by plastic waste.



Illustration: Shutterstock



Illustration: AG Laforsch

Examining microplastic particles – analysis involves a lot of laboratory work.

processes of biological effects, transport and formation: From model to complex systems as a basis for new solutions", established in January 2019. 31 researchers with complementary expertise in physics, chemistry, biology and geosciences, as well as process engineering and materials science, are working side by side.

It is anticipated that their findings, generated through a collabora-

tive approach, will lay the foundation for evaluating the environmental risks of microplastics. This in turn should lead to the development of new, eco-friendly plastics on the basis of sustainable polymer chemistry. These plastics should biodegrade faster and contribute to reducing and ultimately avoiding microplastics. The overarching vision, in the longer term, is to be able to modify

plastics in such a way that their new properties no longer have harmful effects on organisms and the environment. In the process, the research group hopes to make a significant contribution to answering fundamental questions relating to microplastics in our environment – and thus address an urgent ecological and societal challenge with the aid of science.



Professor Dr. Christian Laforsch,
Chair of Animal Ecology at the University of Bayreuth, is the spokesperson for the CRC "Microplastics".



Dr. Martin Löder
is leader of the research group.



Professor Dr. Andreas Greiner,
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Thomas Hamacher, Vedran Perić and Philipp Kuhn

A Dialogue of Systems

Energy transformation laboratory: An experimental platform was designed to explore and combine the use of electricity, heat and transport as realistically as possible.

Electricity was one of the key inventions of the 19th century. Electric energy supply for homes, factories and cities has profoundly transformed business and private life. Right from the start, there has also been a battlefield of different ideas for energy (supply) systems. Today this refers in particular to the energy revolution and the transi-

tion from fossil to sustainable energy sources.

Science must provide methods and tools that allow for these debates to take place rationally and based on evidence. The Center for Combined Smart Energy Systems (CoSES) at the Research Center for Energy and Information at the Technical University of Munich rep-

resents an attempt to support the future development of energy distribution networks through experimentation. The overarching objective is to turn the battle of systems into a dialogue of systems. It is essential for this purpose to set up an experimentation platform, as simulations alone are not sufficient to date, despite the progress achieved.

A high-voltage transformer that connects the experimental network of the smart grid laboratory to the public electricity network.

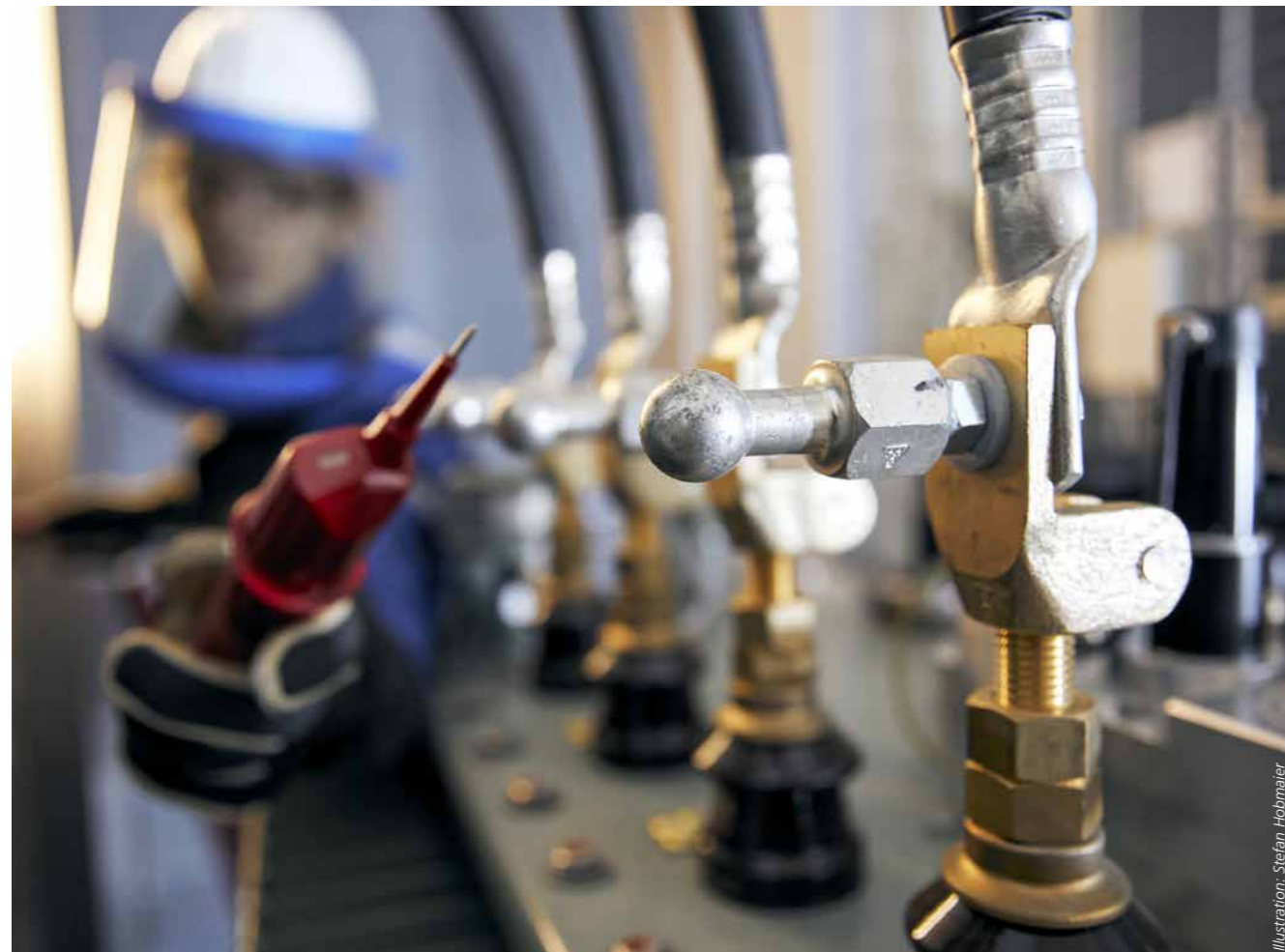
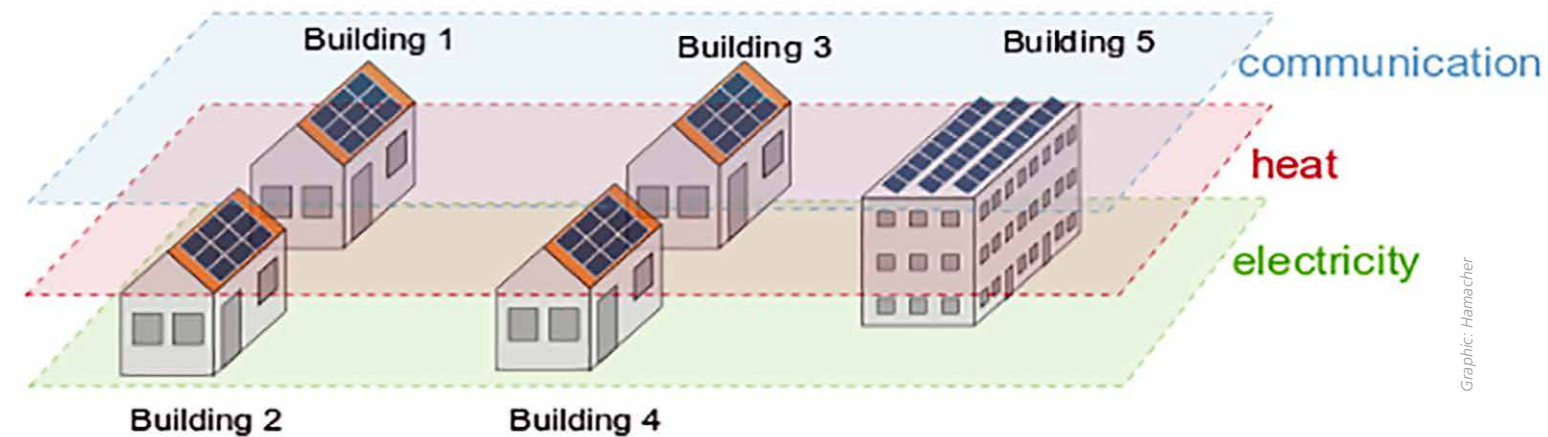


Illustration: Stefan Hobmaier



Graphic: Hamacher

Five buildings and three levels – the basic structure of the Center for Combined Smart Energy Systems (CoSES).

The laboratory is dedicated to investigating new forms of distribution networks with regard to their economic and technical feasibility. The CoSES is a smart microgrid laboratory for validating simulation and optimisation tools that have potential of being used in planning and optimisation of real-world systems. The interaction of simulations, validating the simulations in the laboratory and subsequent field tests, gives rise to an opportunity for producing scientific evidence that helps in addressing crucial questions related to the energy revolution. In a perfect world, field tests would not just show what is technically possible, but in the context of experimentation clauses, new regulations would already be applied in a few places.

This are also theoretical challenges related to central issues of the energy revolution. Various aspects must be taken into account, starting with the climate targets. To be able to achieve the stipulated goals, the energy industry must be transformed. According to the Federal Ministry for Economic Affairs and Energy, renewable energy accounted for 13.8 percent of German

primary energy in 2018. The plan is to increase this share to 100 percent within the next 30 years. The status quo varies greatly between different sectors, with the electricity sector far ahead of heat and transport. Particular attention must therefore be given to energy sources for space and process heating.

Further challenges include fair cost and profitability allocation among producers and consumers. One option is the liberalisation of energy markets. However, this has not been fully realised to date. Flexible demand can be encouraged through price incentives, for example. Location dependent energy cost has meanwhile become an important factor for the industrial sector. Another great challenge is reliability. Reliable high-quality electricity supply is a crucial factor for many industries.

An interconnection of heat, electricity and transport is key here. The transformation process must reach all sectors that will jointly improve the use of renewable energy. Much can be said in favour of “sector coupling” as renewable energies usually produce electricity, which ef-

fectively becomes a primary energy source. Electricity is the most convenient but also the most expensive energy carrier. High charges apply in addition, yet not for all consumers. Furthermore, there are two constraints that do not exist in fossil or nuclear electricity generation: Firstly, the place of production depends strongly on location factors, such as good wind sites in Northern Germany. The other aspect is the time of production, as the amount of available supply depends on the position of the sun and the weather.

It is due to these two conditions that a new energy system paradigm is required. Production and consumption sites can be connected with power lines. This is why there were calls for a European super network for a while. Unfortunately, little remains of this idea nowadays. Another alternative is to convert the electricity into a chemical energy carrier such as hydrogen that will be transported instead. However, this system is less efficient.

To a certain extent, the issue of electricity being produced and used in different places at a later time, can be compensated through balancing

effects of large electricity networks. Further options include electricity storage devices, such as batteries. Sector coupling now allows for the following solution attempt: electricity is used across all sectors and the other sectors offer “storage options”.

Take hot water production as an example: about 120 terawatt hours of energy are required for producing hot water in Germany. A base load of 13.6 gigawatts of electric power would be used to meet this demand with electric boilers. However, hot water can be easily stored for a limited time. If it is sunny during the day, electricity from a photovoltaic (PV) system can be used to fill the heat stores. The hot water is then used in the evening or the next morning. A PV capacity of around 50 GW is installed in Germany, producing around 48 terawatt hours of

electric energy. This means that at least 120 gigawatts of PV capacity would need to be installed to produce enough energy for all hot water consumption.

Owing to the fact that the electricity is also needed by other sectors, it is necessary to install far more photovoltaic capacity to meet the demand. However, production is often in excess of demand. The electricity is then used to heat up water. This concept is more cost-efficient than batteries, for example. Heat storage units and the thermal inertia of buildings can be used to make the production of space heat more flexible. Another option is to focus on wind energy here, as it produces more electricity in the winter months, which is also the heating season. A further option could be flexible charging of electric cars.

In the heat and transport sectors, the share of renewable energies will undoubtedly increase in the future. Sector coupling is therefore an approach to allow for optimised integration of renewable energies and for increasing the share of renewable energies across all sectors. What will a system that allows full sector coupling look like? One answer to this question is the idea of the CoSES laboratory. CoSES interconnects the electricity, heat and transport sectors. While a laboratory is an abstraction of reality, heat generation is represented very realistically at the CoSES laboratory. This had been a central aspiration when planning the laboratory. Various heating technologies, heat storage units and heat grids are installed at the laboratory for research purposes. The interaction of these

Researchers are working on different levels – a view of individual experiment stations.



Illustration: Stefan Hobmaier



Cogeneration unit for power-heat coupling: an integral part of energy systems.

technologies with the electricity sector is among the key research topics.

Another area the CoSES laboratory is dedicated to is digitisation. In this context, the researchers focus on real-time monitoring and energy forecasts as a prerequisite for flexible use. Conventional forecasting techniques and those using AI are among the key research areas. The quality of a forecast depends on whether predictions of user behaviour are available. Digitisation plays a major role in this context. The scale of the considered system is also relevant. After all, the behaviour of many people is easier to predict than that of a single person. Things will also depend on whether the systems are able to communicate with each other. Different communication technologies are illustrated and compared in the laboratory.

Energy distribution networks traditionally do not feature any measuring and communication

infrastructure, but this is gradually changing now. For example, there are control signals distributed among customers for turning their heat pumps off and on. Sound judgement is necessary when it comes to investing into new control and communication infrastructure. It is yet to be determined, how much communication is really necessary, and whether a few simple control signals such as a binary control signal, might suffice.

The laboratory has a three level design: the first level monitors distribution and consumption, including charging of electric cars, and decentralised generation of electric energy. The second level represents the heat system with an additional emulation of a local heat network. Communication is illustrated on the third level. Communication and system control take place on various time scales ranging from milliseconds through to several minutes or even hours. Future control sys-

tems must be able to cover all of these time ranges.

Politically, the course has been set for the energy revolution. Other crucial requirements include profitability, reliability and feasibility. These aspects must be considered holistically, and decisions regarding regulations must be adjusted continuously. Funding from the DFG and the Free State of Bavaria has allowed for a laboratory to be built that can contribute to breaking down many of these issues into “simple” scientific questions. This is an engineering as well as a theoretical challenge. Once this task has been solved, it will take us an important step closer to a sustainable energy system.



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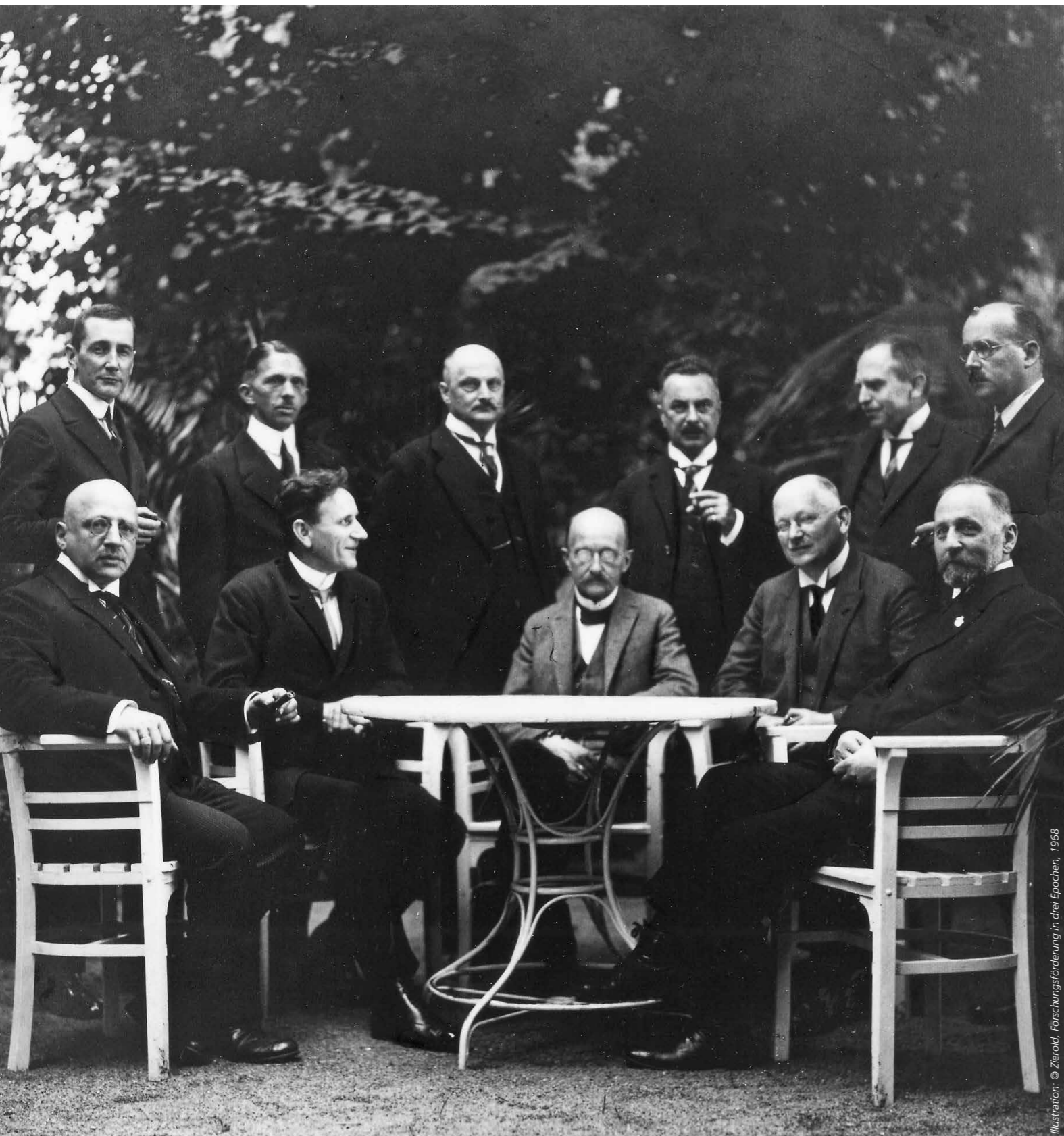
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Marco Finetti

Reappraisal in Stages

For a long time, the DFG was one of those organisations that avoided facing up to its history. Originally initiated by the pioneering Herbert/vom Bruch research group, a comprehensive critical study by historian Patrick Wagner has now been published that spans the period from 1920 to 1973.

When it came to examining its past, the DFG – formerly the “Notgemeinschaft der Deutschen Wissenschaft”, did not present a different image – let alone a better one – than other academic organisations and institutions in Germany over the decades, be it the Max Planck Society, formerly the Kaiser Wilhelm Society, or indeed higher education institutions in general. There was no reappraisal of the organisation’s role during the National Socialist era until the 1990s – more an act of persistent refusal than of shameful concealment.

It took until the DFG’s 75th anniversary before the first study on the funding organisation in the Weimar Republic and the Third Reich was produced in 1995 at the initiative of the then President Wolfgang Frühwald. The study presented by Frankfurt historian Notker Hammerstein did tap into source material, but it still left many questions unanswered in its assessment of involvement in the Nazi terror regime in particular.

This was a disappointment not least to the DFG itself, and in 2001 Frühwald’s successor Ernst-Ludwig Winnacker set up an independent research group to look into the history of the DFG from 1920 to 1970.

Left: the “Notgemeinschaft” Committee of 1924 with Fritz Haber (front left) and Max Planck (centre).

This group, led by historians Ulrich Herbert, Freiburg, and Rüdiger vom Bruch, Berlin, worked until 2008 – with €5.5 million of funding but barring any influence on the findings on the part of the DFG: to date it has produced some 20 individual studies and anthologies that either originated directly in the group or were started by its members.

This work focused on the development of individual research areas and subjects – research into language, genetics and cancer, for example – as reflected in DFG funding, while at the same time tracing organisational developments such as the “Funding Strategies of the DFG 1949–1968”.

Other initiatives promoting self-critical examination of the past also started in the research group or among those connected with it, closely supported by the DFG’s Executive Committee and Head Office, such as the exhibition entitled “Generalplan Ost” (Master Plan Eastern Europe) – a monstrous undertaking involving the resettlement and essentially the extermination of large parts of the population of Poland and Russia. This was shown at universities and memorial sites in Germany from 2006 onwards and also in Poland in 2012. Likewise in 2006, Winnacker and the historian Fritz Stern, who emigrated to the USA before the Nazis came to power, inaugurated

a memorial at the DFG Head Office in Bonn that displays two facsimile documents on two plain panels: a letter dated 1944 in which the anthropologist Ottmar von Verschuer – who still frequently received funding from the DFG through to the 1950s – expresses his enthusiasm for his new collaborator Josef Mengele and the latter’s investigations in Auschwitz, and a letter from world-famous historian Fritz Stern, who accuses the DFG and the academic community

Friedrich Schmidt-Ott, the first president of the “Notgemeinschaft” from 1920 to 1934 (photo ca. 1917).



of being complicit in the atrocities of the Third Reich, while also regarding the organisation as having “a second chance of a new beginning in a new Europe”.

At the end of 2020, and in connection with the 100th anniversary of the founding of the “Notgemeinschaft der Deutschen Wissenschaft”, the DFG then launched the information portal GEPRIS Historisch. Tens of thousands of approved and rejected funding applications from the years 1920 to 1945 can be accessed in this online catalogue, providing a clear picture of research projects, academic disciplines and the practice of research funding – a treasure trove not only for historical research.

Another result of this research is a study that spans five decades and three political systems. This is also closely linked to the Herbert/vom

Bruch research group, in which its author, contemporary historian Patrick Wagner, worked as a research assistant from 2003 onwards before becoming Professor of Contemporary History at the University of Halle-Wittenberg in 2006.

Not conceived of as a final volume of the research group yet synthesising much of the group’s work, Wagner’s study takes a comprehensive and critical look at the development of the DFG and of science-led research funding in Germany in the first half of its 100-year existence, extending to more than 500 pages and with the evocative title “Notgemeinschaften der Wissenschaft”: starting with the founding of the DFG’s predecessor organisation in 1920, it covers the Weimar Republic and the period of National Socialism, following through to the re-founding of the organisation after the Second World War and going on

into the early 1970s of the Federal Republic.

At the same time – based on a particularly insightful structure – the study sheds light on the roots of the DFG’s role in research funding and the system of academia, in which it continues to be a defining force, as well as examining the relationship between the academic and political domains in Germany during this period. It is precisely these current functions that the DFG performs for “the academic field” in Germany that Wagner actually places at the beginning, describing the three main aspects:

Firstly, he says, the DFG mediates between academia and politics by acquiring government funding and distributing this among the academic community; secondly, he sees the DFG as establishing rules that claim validity for the entire academic community and communicating these “qua authority, though also by applying gentle pressure through the resources it makes available” – here Wagner takes the issues of research misconduct and equality of opportunity as recent examples; thirdly, he says that it also transfers “symbolic capital” to its funding recipients, which he sees as being potentially translated into status gains and gratifications. According to Wagner, all these functions were performed by its predecessor organisation from its founding in 1920, and they were retained and continued to be asserted under three political systems.

Against this backdrop, Wagner examines the development of the DFG as an institution and its constitutional character, as well as its relationship with political actors, regimes and those who have received funding from it, including



The then DFG President Ernst-Ludwig Winnacker at the dedication of the memorial at the DFG Head Office in September 2006.

the latter’s own attitudes. For the period of the Weimar Republic and the “Notgemeinschaft der Deutschen Wissenschaft”, he identifies a “well-meaning autocracy” under its founding president Friedrich Schmitt-Ott – a man who was firmly rooted in royal Prussian tradition – along with a close-knit network of contacts between academics, ministry officials, bankers and industrialists and an increasingly politically motivated attitude among funded clientele, who initially believed themselves they were facing a situation of “emergency” and “danger” as Germany shifted “away from democracy”. During the Third Reich, the Führerprinzip likewise prevailed in the DFG, based on an alliance of National Socialist functionaries and junior researchers with nationalist professors who had become established prior to 1933, as well as a far-reaching “self-mobilisation” of the funding organisation and those funded, which Wagner sees as having ultimately resulted in “research in support of genocide and expulsion”.

According to Wagner, in the Federal Republic, too, the DFG initially

continued to function for a long time as a “reserve of privileged scholars” – a community primarily made up of a socially conservative elite that once again saw its academic pursuit and lifestyle as being under threat. It was not until the beginning of the 1970s that a democratic self-image “arising from a sense of conviction” began to take hold – driven by a generational change and a gradual process by which German academia opened up internationally, the main focus here being a reform of the DFG committees, epitomised in terms such as “reviewer democracy” (DFG President Julius Speer, 1968) and “scholars’ republic” (Speer’s successor Heinz Maier-Leibnitz, 1974). Wagner’s study does not continue beyond this point.

For the DFG, this study is another important contribution to a self-critical examination of its own past, not least as an affirmation of its actions in the present day, as President Katja Becker emphasises: “More than ever, we are now seeing just how much science and science-driven funding are at the service of

society and are able to contribute to tackling key challenges. Yet the inhuman research conducted in the 1930s and 1940s were seen in the same way, as was its funding. As such, Patrick Wagner’s study is a vivid illustration of how such self-made claims must not be allowed to degenerate into empty formulas. Research and research funding can only be humane if they demonstrate integrity themselves – and if we as individuals and as an organisation constantly work to maintain our integrity.”

Marco Finetti

is editor-in-chief of *german research*.



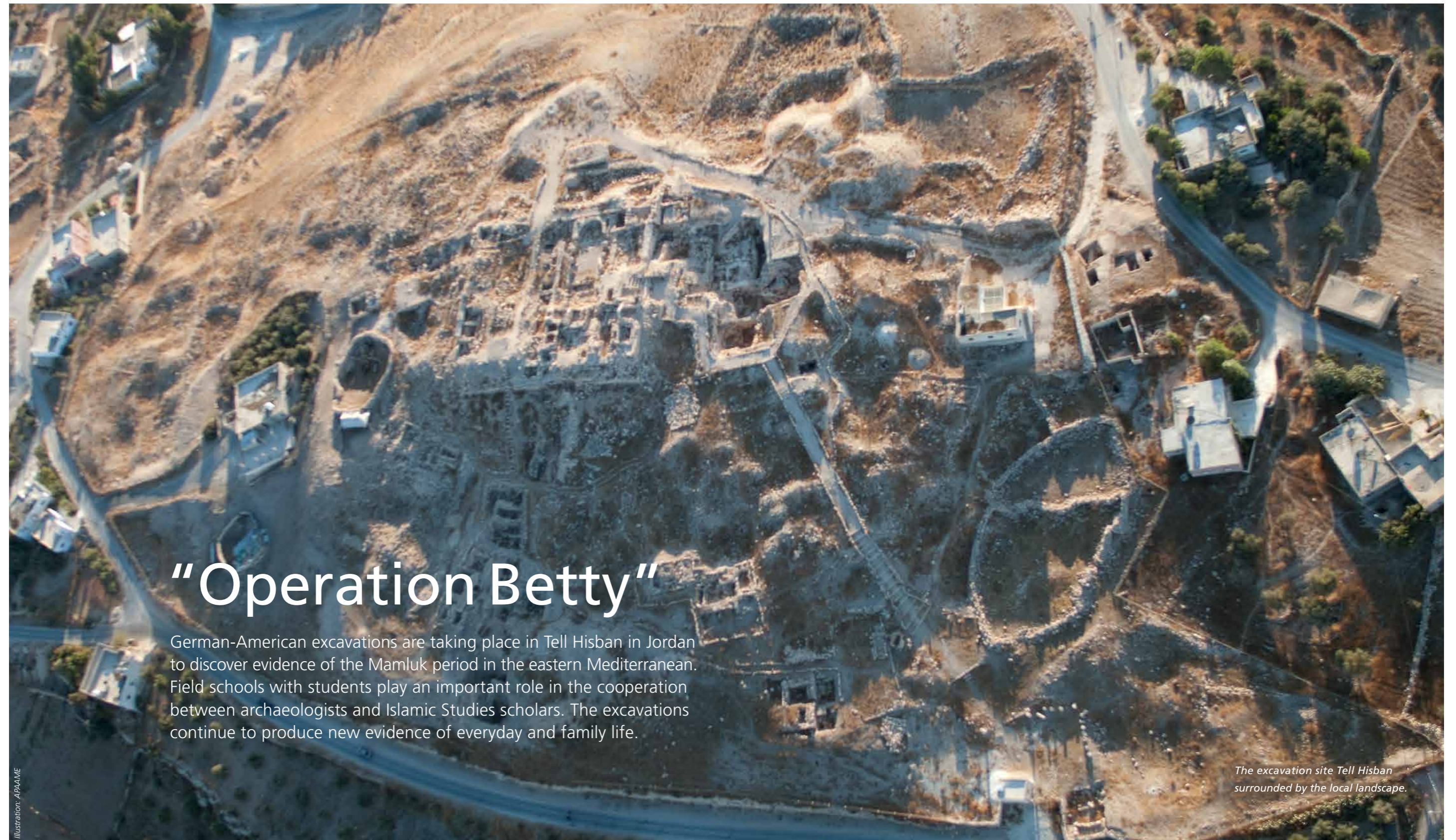
Patrick Wagner: *Notgemeinschaften der Wissenschaft*. Die Deutsche Forschungsgemeinschaft (DFG) in drei politischen Systemen, 1920 bis 1973 (studies on the history of the DFG, edited by Rüdiger vom Bruch (†), Ulrich Herbert and Patrick Wagner, vol. 12), Franz Steiner Verlag, Stuttgart 2021, 505 pages, €68.

www.steiner-verlag.de/Notgemeinschaften-der-Wissenschaft/9783515128575



Illustration: © Heinemann et al. (2005): *Wissenschaft-Planung – Verrückung – Verrückung*. Der Generälen Ost der Nationalsozialisten. Catalogue of the DFG exhibition, p. 12

Bethany J. Walker



“Operation Betty”

German-American excavations are taking place in Tell Hisban in Jordan to discover evidence of the Mamluk period in the eastern Mediterranean. Field schools with students play an important role in the cooperation between archaeologists and Islamic Studies scholars. The excavations continue to produce new evidence of everyday and family life.

The excavation site Tell Hisban surrounded by the local landscape.

An unexpected discovery occurred on the final day of excavation in 2018. The students were completely exhausted after three intense weeks of working in the blazing heat of Jordan's summer sun, when they found a broken cannon ball in the doorway of a medieval farmhouse. Then they found another one. In addition to these, they found layers of ash, attesting to destruction and a military conflict. Who had attacked the farmhouse in former times? Answering these and other questions would have to wait two years, until the next excavation season.

Tell Hisban is a multi-period archaeological site in the highlands of the Madaba Plains, about 20 kilometres south of the Jordanian capital of Amman. It is located at an altitude of more than 800 metres above sea level. On clear days, one can see as far as the Dead Sea, Jericho and the old town of Jerusalem from its summit. At dawn, it is even possible to see a glimpse of the rising sun reflected by the gold-plated roof of the Dome of the Rock to the west.



An "elephant's ear" cooking pot from the Mamluk era is gradually revealed.

The site comprises the tell with a medieval fortress, which sits on the ruins of a Byzantine church, whose structures contain the ruins of a Roman temple. The fortress towers over the ample remnants of an old village that was occupied, deserted and re-occupied a number of times since the Roman period. On the whole, there is evidence of settlement history stretching from the

Iron Age through to the early 20th century. It is thanks to this long history of occupation (and the many years of work on site) that Tell Hisban has become a significant reference project for archaeology in Jordan over the years.

In retrospect, it has been a training ground for three generations of archaeologists from Jordan and around the world. The excellently

preserved remnants from the 14th century CE make Tell Hisban the most important rural site of the Mamluk period in the eastern Mediterranean.

Led by a US team from the Andrews University in Michigan, excavations were launched in 1968. While the initial approach had been to investigate the biblical site of Heshbon mentioned many times in the Old Testament, the focus shifted in 1998 to an exploration of the overwhelming amount of Medieval Islamic remains that dominate the peak of the tell and cover its base. When the author moved from her native US to Germany in 2013, leadership of the excavations was transferred to the University of Bonn.

Excavations have been taking place in the form of field schools from the start. Scientific excavation is combined with the opportunity for students at all stages of their education to gather practical on-site experience. This important training opportunity has been organised by the Annemarie Schimmel Kolleg in Bonn since 2013.



The "pantry" of a farmhouse was also excavated and reconstructed. The arrow points towards the edge of an impression left by a storage jug.

The Annemarie Schimmel Kolleg is an institute for advanced studies that Professor Dr. Stephan Conermann established at the University of Bonn in 2011. The Mamluk Sultanate that was ruled by slave soldiers in Cairo is at the heart of the research and placement activities. The Sultanate extended across Egypt, Syria and the Hejaz (a

landscape in western Saudi Arabia) and it existed from 1250 until the Ottoman conquest of Egypt in 1517.

The Annemarie Schimmel Kolleg is dedicated to the objective of integrating issues of material culture into the Mamluk studies canon. In order to introduce historians whose work is based on written evidence to methods involving material cul-

Past and present – the excavation site Tell Hisban in the highlands of the Madaba Plain in Jordan is located at an altitude of more than 800 metres above sea level.



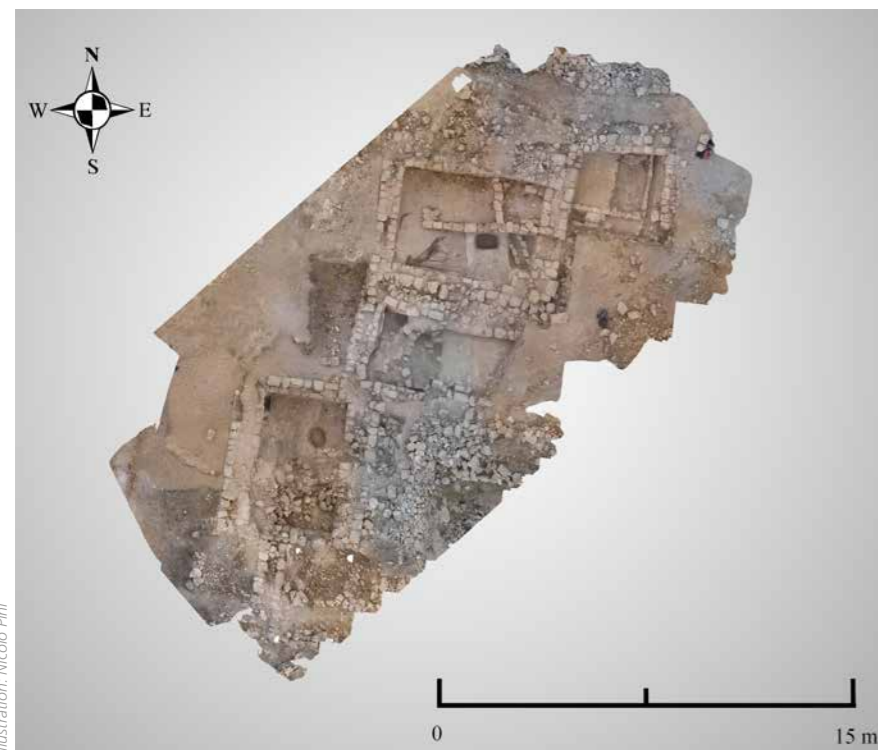
ture for their research work regarding the Mamluk society, the Kolleg has organised and funded three Mamluk Archaeology Field Schools in Jordan for its fellows. Professors, postdocs, doctoral candidates, master and bachelor students from the fields of Islamic studies and archaeology took part in these.

Tell Hisban: In the 14th century, the fortress of Hisban served as a garrison on the frontier of the Mamluk Sultanate, although just a few soldiers were stationed here. The fortress featured a well-equipped storage room that is fully preserved and that was filled with fragments of crossbow bolts and chain armour, as well as wooden shelves containing all the cooking and tableware a small garrison would need. In the village at the foot of the mound, there was a mosque, a madrasah (a religious school), a court of jus-

tice and a market square. Farmers, merchants and administrators used to live door to door in the village. The area was controlled by the Beni Mahdi, a tribe that provided important political and military support for the Sultan of Cairo.

It is impossible to estimate the exact number of residents of the village, as the site extends below the area of the modern village and its precise dimensions are therefore unknown. The residents of medieval Hisban lived in single-room stone buildings with vaulted ceilings and plastered floors and walls. The buildings were grouped around a shared courtyard and a family cistern, and some houses had sanitary installations. These units were self-sufficient and the clans used to make a living combining agriculture with animal husbandry, and to a lesser extent with local craft production.

An outline of the group of farmhouses in Field O.



The vaulted constructions were more than just simple houses. After remnants of barrel vaulting and walls that had collapsed in an earthquake had been moved aside, rooms that had been hidden for five centuries became accessible: New structures came to light among the debris, and the team faced a confusing jumble of plastered ceilings, floors made of soil and plaster, garbage pits and graves.

The so-called Field O of the excavation site with its four farmhouses turned out to be particularly interesting. It revealed an extremely complex development over the course of two centuries, in which the family apparently grew, rooms were re-arranged and the architecture was changed. There is a spot where a courtyard area became a living space, and living areas were possibly converted for use as stables. Cooking installations were found all over the place. The ruins of the Roman, Byzantine and early Islamic buildings were integrated into new buildings from the 13th and 14th century. Some houses became production facilities for ceramics and evidently also for glass.

Findings including a so-called grenade (a glazed medieval incendiary weapon), an Ottoman musket ball and fragments of cannon balls are evidence of past conflicts. A few storage jugs in the “pantry” of a house on the southern slope of the tell even contained olive oil and goat’s milk residues. The pungent smell of one of the jugs showed clearly that even after 600 years, the milk was still undergoing a fermentation process to become cheese! The residents had buried the jugs. They had to quickly leave the house, possibly during an earthquake. It is likely that they had planned to return, but in the end they never did.



Interdisciplinary field schools play an important role in the excavation work in Tell Hisban.

A research priority of the project is to reconstruct the details of everyday family life, in particular those that are not directly revealed by written sources. To this end, work to analyse plant residues and to reconstruct environmental conditions began in 2010. It was in the context of this programme that an event took place at which students of the University of Bonn started to use the name “Operation Betty”, inspired by the pseudonym of a US advertising icon and baker of the same name.

“Betty” has since become the name of a large cooking pot from the 14th century that the excavation team of the 2018 campaign found in one of the rooms of the farmhouse in Field O. The pot had been buried under the floor and it still contained the remains of the last meal the residents had eaten before the house came under attack from cannon fire. In the course of “Operation Betty”, project botanists

from the USA, Greece and Berlin came to Bonn to take samples of “Betty’s” contents. The samples have been subjected to residue and starch analyses, along with the study of macro-botanical residues and isotopes to identify not only what the residents ate for this last meal, but also how exactly it had been prepared. This means: Which spices and oils were used? At which temperature was the food cooked? And how long did it take to prepare the food? The author is going to use background information gathered from 16th century Arabic-language cookbooks to interpret the results of the laboratory analysis.

It is just one of many examples that illustrate the important role that the field school of Tell Hisban has been playing in interdisciplinary training in the field of Mamluk Studies. Former students are now working on their own or on interdisciplinary joint research projects, striving to find out more about the

everyday life of the farming population that lived in the shadow of the fortress. Owing to the coronavirus pandemic, the next field school has been postponed until June 2021. It will be dedicated to preparing the final excavation reports.



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Helene Loos, Roman Lang, Thomas Hofmann and Andrea Büttner



Illustration: Shutterstock/asph

Influenced by Breast Milk

How do food preferences develop? An intervention study using curry as an example is dedicated to examining the transfer of flavour compounds into breast milk.

A traditional German expression for something acquired very early in life is that it has been “absorbed with mother’s milk”. This figure of speech is worth reflecting upon, also in the literal sense and from the point of view of various scientific disciplines, which are seeking clarification based on hard biochemical facts and data. What else does a baby absorb with breast milk, apart from the vital macro- and micronutrients it contains? It appears to be the case that many

habits and skills have their origin in early childhood. Sensitive time frames in human development are well-known with regard to language acquisition, but similar phenomena can be observed regarding the acceptance of foods.

US researchers have found that there is a period within the first few months of human life, in which consumption of infant formula with a bitter taste will give rise to increased acceptance despite its flavour being perceived as unpleasant by grown-

ups. However, breastfed infants can also come in contact with different sensorial impressions, via the breast milk. Together with other aspects, this can have an impact on future food preferences. This is the starting point of a joint study conducted by working groups from the Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU) and the Technical University of Munich (TUM). It builds upon past studies, some of which were also funded by the DFG, in which the aroma of breast

milk and its influencing factors were comprehensively explored at the molecular level. Under examination were changes in aroma that occur after a certain period of storage of breast milk in a refrigerator or freezer, as well as diet-related aroma changes that occur in breast milk, for example, after eating garlic or wild garlic: it was found that aromatic substances consumed through food enter the breast milk without modification to a certain extent. Some substances, however, are metabolised in the body in the same manner as other food components.

This gives rise to new metabolic products that can also enter the milk. Furthermore, there are cases in which a food consumed by the mother does not cause any significant changes to the milk’s aroma, as some aromatic substances are de-

graded in the body, or because the changes in concentration in the milk are small enough to be negligible. It is therefore not possible to make any general statements about the transfer of aroma into breast milk. Fundamental analytical research must be carried out for a range of representative individual cases. The studies conducted in this area of research to date are mostly concerned with the transfer of aromatic substances into the breast milk. In the current cooperation project funded by DFG, researchers from FAU and TUM are examining the transfer of chemosensorially active substances into breast milk in their entirety for the first time, studying not only a potential transfer of aroma, but also of other chemosensory impressions.

Chemosensorially active substances comprise odour compounds, tastants and the so-called trigemi-

nally active compounds. Odour compounds usually have a relatively low molecular mass of less than 300 daltons (atomic mass unit) and they are sufficiently volatile to be able to reach the olfactory mucosa in the upper nasal cavity. This can take place either orthonasally via the nose, or retronasally via the throat (such as when eating a food item). Odour compounds cause an olfactory perception when they interact with G-protein coupled receptors on the olfactory mucosa.

Among the tastants there are many non-volatile compounds, such as element ions and amino acids, sugars and alkaloids. These cause a gustatory perception by interacting with ion channels (for sourness and saltiness) or with G-protein coupled receptors (for sweetness, bitterness and umami) in taste buds that are located on the tongue, for example.

Realistic study design: a curry dish with ginger, sunflower oil, coconut milk and rice.



Illustration: Pixabay/Larry White

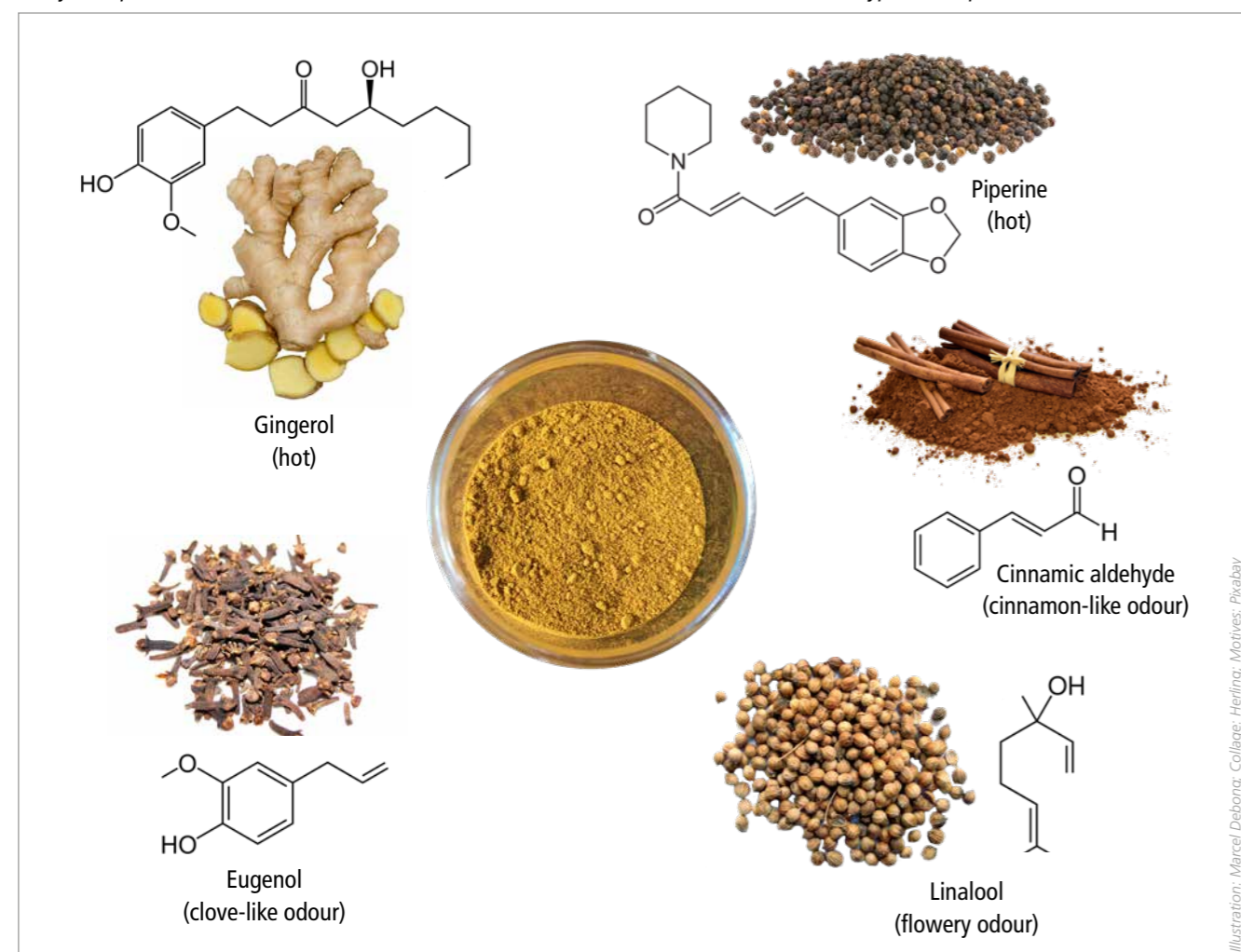
Trigeminal compounds, meanwhile, give rise to cool, pungent or related sensory impressions via the trigeminal nerve (*Nervus trigeminus*). Some compounds also feature multiple sensory properties: a compound can elicit odour and taste perception at the same time, or also be cooling, stinging or pungent. In order to explore, which chemosensorially active compounds pass over from food into breast milk, and are therefore sensorially recorded or absorbed by the infant, it must first be determined which of these are constituents of the original diet. Sensory-analytical methods are used

for this purpose, which allow for chemosensorially active substances to be distinguished from other substances, using methods for the chemical analysis of food in combination with the human sensory system. Input from human beings is in fact essential here: the human nose or tongue is used in both the so-called gas chromatography-olfactometry/mass spectrometry and in the liquid chromatography taste dilution analysis.

The team of the DFG project "Tracing the transfer of dietary chemosensory molecules and their metabolites from the maternal diet into

human milk and urine by means of a curry spice intervention study" uses a scenario that is as realistic as possible: the participants are asked to eat a curry dish. Individual odour substances were often used in past studies. However, this does not correspond to normal dietary behaviour with actual meals. This situation has been reconstructed using a dish that contains a curry spice mixture, as well as ginger, sunflower oil, coconut milk and rice. To be able to clearly relate the sensory impact, the participants were asked to refrain from consuming any of the ingredients of the curry dish,

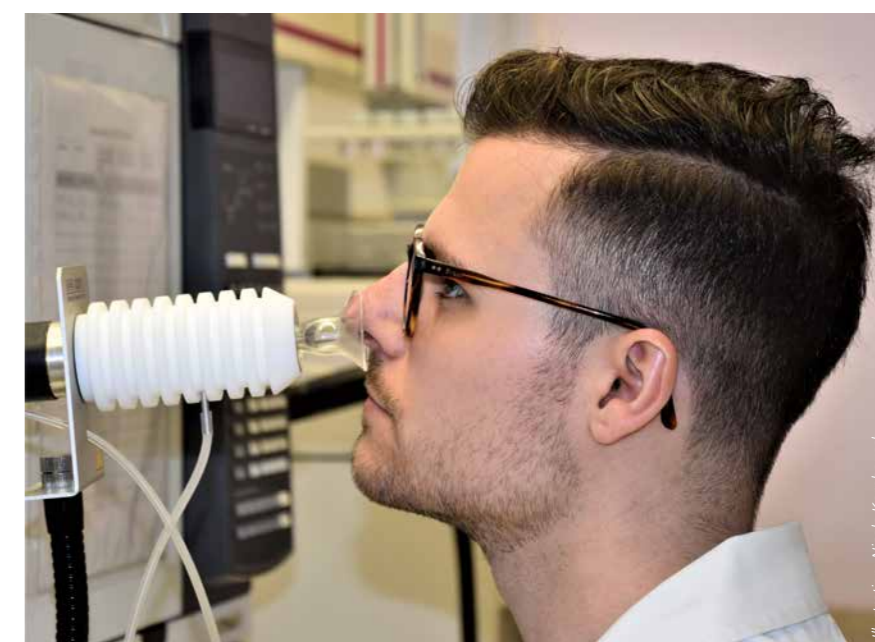
Curry is a spice mixture that contains various flavour substances. Shown here are a few typical components.



two days prior to taking part in the study. This enables the researchers to trace the effects in detail, that eating the curry dish has on the composition of breast milk.

Curry contains a wide range of odour and taste substances with distinct chemical structures. The excretion routes of these substances are traced in the intervention study. Odour substances can be excreted in a number of ways – not only via breast milk, but also through urine, the skin or the breath. Tastants are usually primarily excreted via urine after metabolism. Investigations of the different excretion routes allow for insights into the metabolic processes in the body, including the elucidation of metabolites.

A number of questions can be answered thanks to these examinations, which are relevant not only to early childhood nutrition, but also to our understanding of human digestion, and of metabolic and excretion processes in general. Another question investigated in the study that directly refers to the human senses is, whether the concentrations of chemosensorially active compounds that enter the breast milk are high enough to be



Gas chromatography-olfactometry. So far, only the human nose is able to distinguish odour-active and non-odorous volatile compounds.

perceived by the infants. This would be the basic prerequisite to attain a kind of training effect in infants, concerning particular aroma or taste impressions, and to assume that sensory imprinting is taking place in early childhood in this manner.

In addition to this, the physiological effects of chemosensorially active substances and their metabolites are of interest. Some chemosensorially active substances are known to

affect human physiology and health, e.g. by being anti-inflammatory or antioxidative. This gives rise to research questions regarding the possible effects that such compounds and their derivatives have in human beings. Especially concerning bioactive substances, the question arises, what impact these may have on infants when ingested via breast milk, besides their chemosensory effects through odour and taste.



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www.chemistry.nat.fau.eu/aroma-smell-research/current-projects/#sprungmarke6



The Deutsche Forschungsgemeinschaft

The Deutsche Forschungsgemeinschaft (DFG, German Research Foundation), a registered association, is the largest research funding organisation and the central self-governing organisation for research in Germany. Its mission, as defined in its statutes, is to promote “all branches of science and the humanities”.

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For more information, visit www.dfg.de/en

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Co-initiated in 2012 by then DFG President Matthias Kleiner and officially launched in 2013 in Berlin by his successor Peter Strohschneider and others, the Global Research Council, or GRC for short, has been closely associated with the DFG from the very beginning. The current DFG President Katja Becker has now been elected Chair of the Governing Board of the GRC. The heads of research funding organisations from around the world will convene in 2022 to celebrate the GRC’s tenth anniversary – at a time when it is probably more important than ever before. In the words of the new Chair: “The world is increasingly asking for scientific advice, but many questions can only be answered through global cooperation.” In future, therefore, the research organisations participating in the GRC are to cooperate even more closely, share data and experience, try out new modes of collaboration and improve communication among themselves. The GRC will have a catalytic role in promoting global cooperation in research, Becker stressed at the beginning of her term as Governing Board Chair, saying she is delighted to be a part of it.