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Cover: Oliver Dietze

An example of a new interface for human-machine interaction: the wafer-thin, highly flexible iSkin Music Sticker produces a different signal depending on the pressure of the touch applied.



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Peter Strohschneider

# Truth, Impact and Power

*The relations between research and society are undermined by dysfunctionalities within the research system, such as irresponsible research, exaggerated promises and unrealistic expectations. This becomes all the more dramatic in the age of populism. The best way to further consent is an academic attitude of self-limitation and self-distance and being honest and modest.*

Vannevar Bush's report from July 1945 entitled *Science – The Endless Frontier* is one of the most influential science policy papers ever written and it became the foundational text for the idea of "basic" research.

Being tasked with drawing up a blueprint for a national research funding system in the US, Bush succeeded in finding a compromise between active hostility on the part of the scientific community to the acceptance of federal support, stemming from unease about the control that such support might bring, and the political expectation that research funding should impact on the nation's welfare.

He found this compromise between scholarly autonomy claims and political impact claims by moving from the concept of *pure* science to the notion of *basic* science and thus temporalising the tensions between autonomy and impact. The metaphorical field of "purity" is substituted by an architectural metaphor: autonomy is the present basis for future impact.

Bush, as we see, employed a logic of "postdated utilitarianism" or, what is tantamount, a "linear concept". He assumed that the discoveries made by basic research would over time automatically turn into technological, medical or social progress. And thereby he seemed to be able to satisfy both the scientific community's calls for "freedom of inquiry" and the sociopolitical need for impact and accountability in public spending.

Seven decades later, Daniel Sarewitz, in his article "Saving Science" published in *The New Atlantis* in 2016, showed quite nicely that the argumentation Bush employed "provided a politically brilliant rationale for public spending with little public accountability. Politicians delivered taxpayer funding to scientists, but only scientists

could evaluate the research they were doing." The obvious matter Sarewitz is referring to is the idea that freedom of inquiry is only justified if researchers act responsibly vis-à-vis the scientific community and society at large.

It is not surprising that Sarewitz draws attention to a survey of researchers by *Nature* from 2016 which "shows that 80 percent or more believe that scientific practice is being undermined by such factors as 'selective reporting' of data, publication pressure, poor statistical analysis, insufficient attention to replication, and inadequate peer review."

In fact, there are numerous symptoms of dysfunctionalities within the research system (including those forms of fraud that plague modern science). To some degree, they have to do with individual misconduct, but at the same time, they have systemic dimensions.

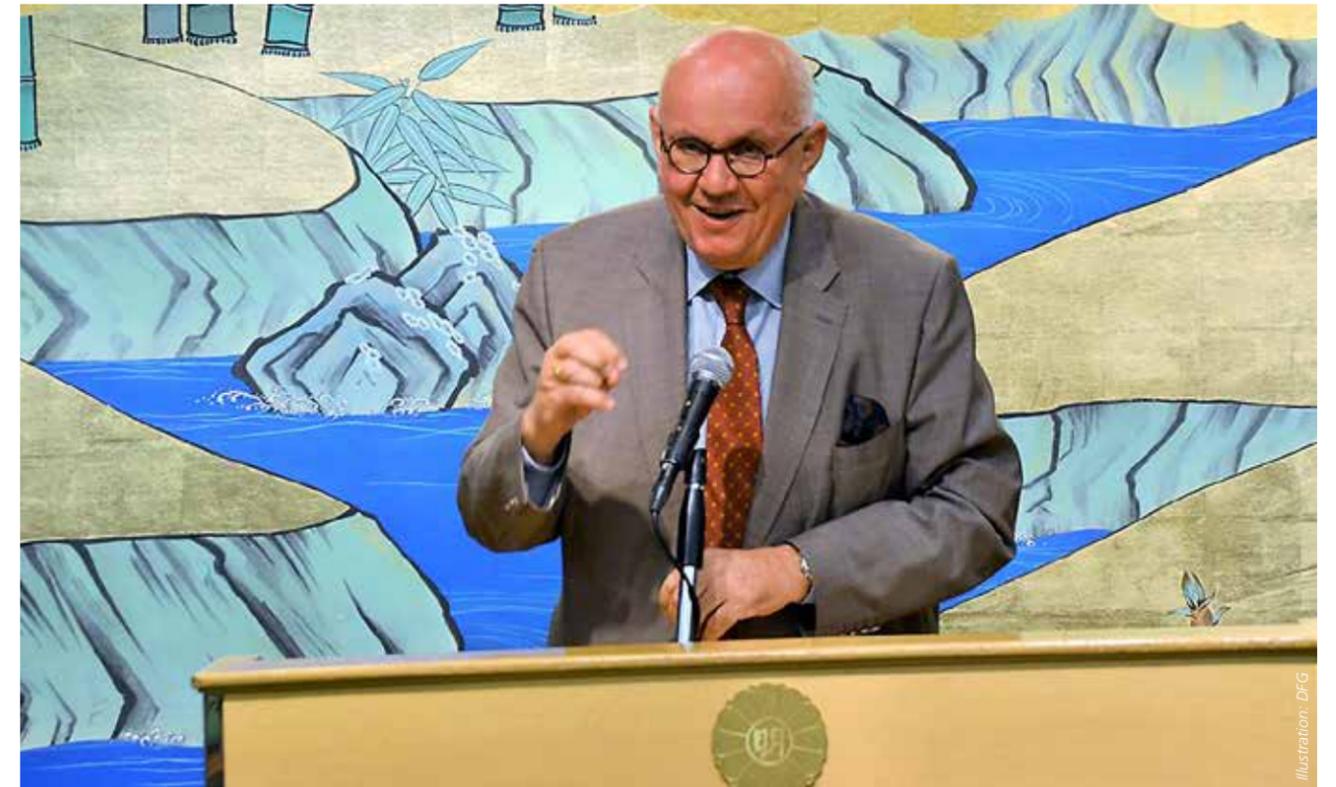
In any case, losing the trustworthiness of research undermines public acceptance of the freedom of inquiry. What is at stake, then, is nothing less than the credibility of the research system as a whole: a trust crisis.

Equally important for the relationship between science and society is a second aspect. Researchers are (and the research system as a whole is) called upon to be critically reflective when expressing the extent to which science can help find truth. It is not helpful to embellish, to exaggerate or to raise expectations that cannot be met.

The desire to do so is all too understandable on the one hand: society's expectations of the impact of science and research are increasing rapidly, while the trust put in them is not.

Thus, the pressure grows to prove the direct and short-term societal impact of invested funds. And it's only natural that the research system responds to this with promises of immediate practical benefits.

However, this leads into a spiral of one-upmanship between impact requirements and impact promises. But



impact promises that cannot be kept produce credibility gaps. Credibility and trust in scientific and scholarly knowledge can only be gained if we also talk about the limits of knowledge claims. This, however, is something that the author of *Science – The Endless Frontier* neglected to address – at the expense of the system that he wanted to build up.

Internally irresponsible research and externally exaggerated promises and unrealistic expectations: these are symptoms of dysfunctionalities within the research system, and they threaten a healthy relationship between science and society.

This becomes all the more dramatic today, as we recognise an increasing tendency of politicians to provide easy answers to difficult questions in order to win the popular vote. This behaviour is what threatens a healthy relationship outside the research system.

These politicians take science and research as an object of insinuation. They massively spread distrust towards the experts while deliberately hindering an open exchange of arguments. It's the inversion of what the Frankfurt School called the dialectics of enlightenment: sound arguments of educated people paradoxically lead to nothing other than resentments against education and against a decent quality of reasoning (Karsten Fischer). I am speaking of what could be called populism. And what they leave behind is

the order of alternative facts. In such an order, validity does not derive from truth but from power.

To be certain, the problem with alternative facts is not that others interpret information differently than we do. This is the pluralism of modernity. Nor is the problem that a president's war against the media would obscure the distinction between truth and lies. To the contrary, this distinction is always presupposed; otherwise, the talk of fake news would be impossible.

The idea of a "post-truth era" is therefore not only misleading, but dangerous: it does not disclose the fact that terms like fake news and alternative facts are causing a substantial political shift.

Instead of referring to an objective world as a legitimate source of understanding, populists and autocrats define the reference to power as the only legitimate source of understanding. Truth becomes a function of power. This function asserts that those who own power and those who follow them even own the truth; those who don't are liars.

In response to this, however, one cannot simply inverse this logic; power must not become a function of truth. This would be the scientocratic fallacy – a stance that can be met, partly, in the context of the March for Science or extensively in books such as Shawn Otto's 2016 *The War on Science*.

## Under Increasing Pressure

DFG holds symposia in Tokyo and Hiroshima on the impact of the humanities and social sciences

In Japan, basic research and in particular the humanities and social sciences are coming under increasing pressure to justify themselves. Applied research with its promises of direct output, innovative achievements and the satisfaction of societal needs is given political priority. To allow for discussion of this situation with Japanese and German perspectives, the DFG held a symposium entitled “The Impact of the Humanities and Social Sciences. Discussing Germany and Japan” in November 2017 in Tokyo (pictured right) and a satellite symposium on the same topic at Hiroshima University, providing academics and policymakers with an opportunity to exchange ideas. The twin symposia raised awareness of the topic throughout Japan, thus serving to strengthen the position of the Japanese humanities.

Prof. Dr. Seigo Hirowatari, the former President of the Science Council of Japan, opened the event in Tokyo and first outlined the current state of

the humanities and social sciences in Japan. Hirowatari described a state of “relative poverty” with regard to the Japanese humanities and social sciences and spoke in favour of enhancing interdisciplinary collaboration in response to the calls for “science for science” and “science for society”.

Symposia speakers included DFG President Prof. Dr. Peter Strohschneider, Vice President Prof. Dr. Julika Griem, Senator Prof. Dr. Joanna Pfaff-Czarnecka and Senator Prof. Dr. Thomas Risse from the DFG. Representatives of Japanese research



organisations, including the Japan Society for the Promotion of Science, the Japan Science and Technology Agency, the Science Council of Japan, and the Ministry of Education, Culture, Sports, Science and Technology, took part in the event.

Strohschneider’s keynote speech on “Truth, Impact and Power” served as the foundation for the discussion. After general comments on the relationships between research, policy and society and between truth and power (see Commentary, beginning on page 2), he spoke of defining the



tasks of the humanities and social sciences in order to form a basis for the justification of their political and public funding and acceptance.

According to Strohschneider, the impact of these disciplines cannot be measured quantitatively. However, the concept of the humanities and social sciences as a place for reflection on spaces of opportunity in culture, politics and society remains central.

Reflecting on today’s populism and on “the populist and as well the scientocratic antipluralism”, Strohschneider stated: “Without the contributions of the humanities and social sciences and their ‘sense of possibilities’, one can hardly imagine

how to newly balance science and society under the conditions of shifting relations between truth and power.”

The discussion session, chaired by Vice President Julika Griem (pictured above), subsequently addressed strategies for tackling the growing political pressure on the humanities and social sciences. In this regard, Thomas Risse urged the research community to establish stringent quality standards and rigorously penalise violations in order to protect society’s confidence in science and the humanities. Prof. Dr. Sayaka Oki referred to the differences in the vocabularies of the respective justification discourses in Japan and Germany: in Japan, there

is predominantly talk of the fulfilment of “societal needs” in the context of research projects, whereas in the English-speaking and European context, the “societal impacts” of research are referred to.

The symposium in Tokyo was well attended, with just under 100 people taking part in the panels and in the audience. In Hiroshima, the event drew in around 70 researchers, students and research managers. A representative of the Japanese Ministry of Education, Culture, Sports, Science and Technology (MEXT) also participated in the discussion.

Values such as academic freedom, autonomy and democracy are highly regarded at Hiroshima University, including in the university administration. The university is therefore currently trying to resist the pressure on the humanities and social sciences and basic research. In this atmosphere, an intensive, stimulating and open discussion took place, during which shared viewpoints and different approaches were discussed.

[www.dfg.de/en/dfg\\_profile/head\\_office/dfg\\_abroad/japan/reports/2017/170912\\_symposium\\_impact](http://www.dfg.de/en/dfg_profile/head_office/dfg_abroad/japan/reports/2017/170912_symposium_impact)

However, the scientocratic approach is not the right answer to the profound shift in the relationship between truth and power in the age of populism. Modern sciences are pluralistic in themselves. They do not provide certainty but instead generate methodologically reliable knowledge. The sciences and humanities tell us what the case is and what that means. They cannot tell us what the case should be.

Unaware of this, the scientocratic response, however, confuses unambiguous facts with ambivalent political consequences. It forgets that what is evident for one individual is by no means evident for everybody else. Most importantly, it does not see that political power is legitimated not through truth but through majorities and the constitution.

Scientocratic tendencies are simply mirroring the anti-plurality of the worldwide populisms.

If Vannevar Bush’s ambition to institutionalise the “freedom of inquiry” can be embraced, then we should also recognise that the autonomy of researchers is nothing natural but hinges on a broader public consent. And the best way to further this consent is an academic attitude of self-limitation and self-distance, being honest and modest.

This attitude is what also matters in an open and pluralistic society, in a constitutional democracy and in all areas of research.

The particularity, i.e. the plurality of scientific and scholarly expertise, the principle of a method-based scepticism, the impossibility to derive normativity from factuality – this is what shapes the space of modern research. We should cultivate it for the best of societal trust in the scientific endeavour.

Society, researchers, and research managers all too easily believed in the Bush narrative, however, as it was designed to please everyone. However, things may have changed. Dysfunctionalities within the research system as well exaggerated promises of societal impact come with the risk of corrupting both the research system and the sociopolitical perspective on it.

An indicator of this is the recent upsurge of anti-intellectualist and anti-scientific movements throughout the globe, ranging from the latest US presidential election and the Brexit referendum in the UK, to the parliamentary strength of national populist parties throughout Europe, or to President Erdogan’s purge of the universities in Turkey.

If, in the age of populism, external pressure on the research system is increasing, then we should pay attention

even more to the standards of good scientific practice and to exercising modesty when it comes to promising societal impact. However, it is hard to build institutional research funding on a public consensus based on promises and expectations, which can always be disappointed. There is too much risk in such a rationale – a risk that Vannevar Bush was ignorant of. It is the time for a new thinking on the multiple and complex relations between society and research.

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



## Growth in Cooperation

More joint projects receive funding / DFG President visits partner organisation in Buenos Aires and local projects

Latin America in focus: Against a backdrop of positive and productive bilateral relations between Argentina and Germany in science and research, DFG President Prof. Dr. Peter Strohschneider paid a week-long visit to Argentina. The fact-finding and consultation visit in the second half of November saw the President and his delegation attend events and meetings in Buenos Aires, La Plata, Córdoba and Salta.

“For some years now we have seen an increase in jointly funded research projects with our Argentinian partners CONICET (National Scientific and Technical Research Council) and MINCYT (Ministry of Science, Technology and Productive Innovation),” said Strohschneider. Commenting on a range of research fields and programmes, he added: “I am very confident that the years ahead will see even greater joint endeavours between researchers and research institutions in our two countries.”

In a meeting with the president of CONICET, Prof. Dr. Alejandro Ceccatto, in Buenos Aires, there was discussion of current and future

jointly funded initiatives, with the focus on calls for new programmes.

As well as concrete issues, more general science policy questions also featured on the agenda. Against the background of two very different national research systems, the discussion covered the funding of interdisciplinary and impact-driven research, and its differentiation from disciplinary and purely knowledge-driven research. Strohschneider expressed the view that in a research and funding organisation like CONICET, which has a much broader funding task than the DFG, an intrinsically pluralistic review and assessment system is necessary for the balanced funding of both types of research.

The International Research Training Group “Surface Processes, Tectonics and Georesources: The Andean Foreland Basin of Argentina (StRATEGy)”, jointly funded by CONICET and the DFG since 2015, is the first of its kind in Argentina and was in the spotlight many times during the visit.

[www.dfg.de/dfg\\_profil/geschaeftsstelle/dfg\\_praesenz\\_ausland/lateinamerika/berichte/2017/171124\\_argentinienreise](http://www.dfg.de/dfg_profil/geschaeftsstelle/dfg_praesenz_ausland/lateinamerika/berichte/2017/171124_argentinienreise)

## Building Bridges

Seibold Prize to Takeshi Tsubata and Thomas Bock

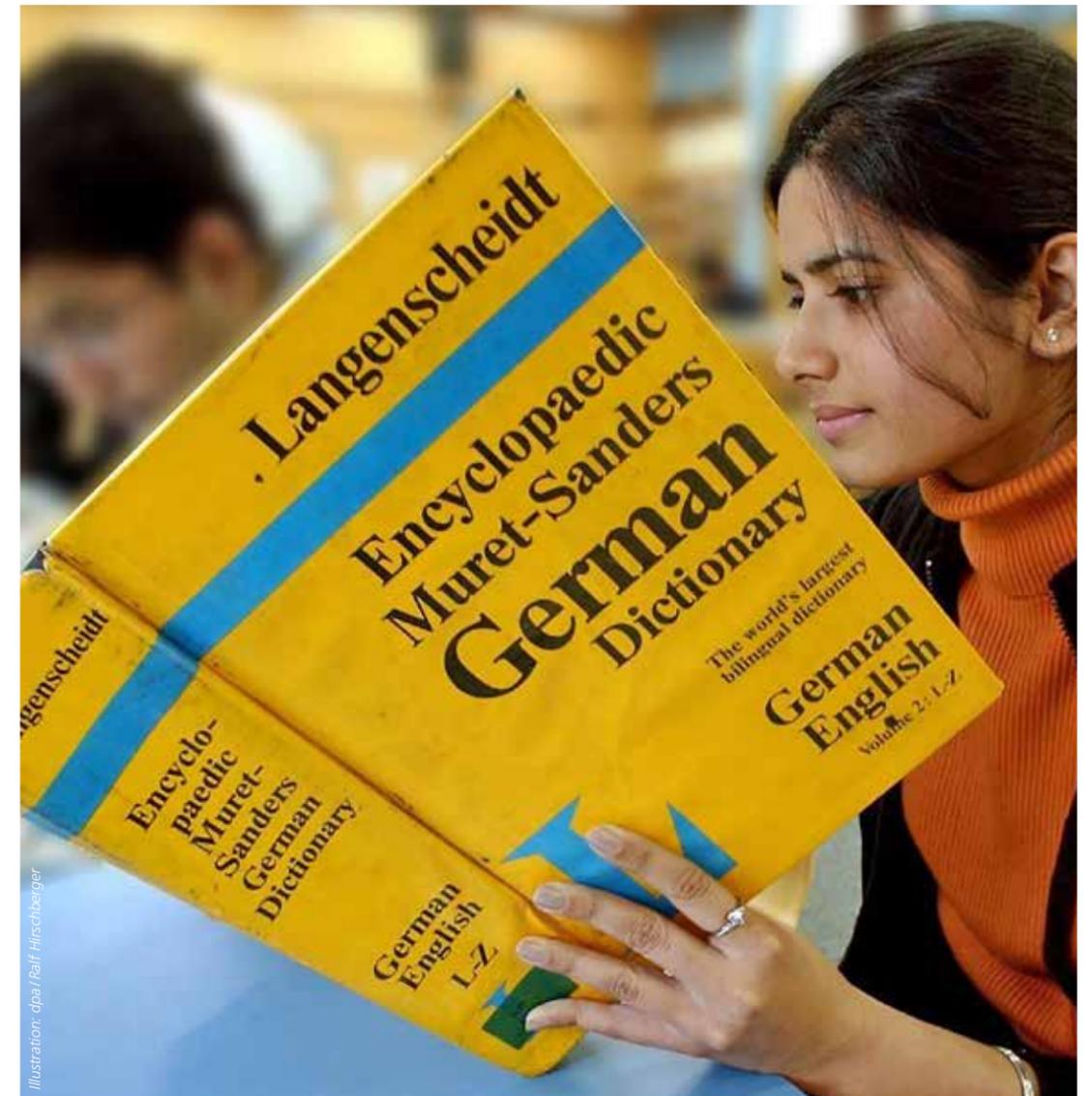
On 10 October 2017, the award ceremony for the Eugen and Ilse Seibold Prize took place in the great hall at the University of Bonn. The award, which is worth €10,000, was presented to Prof. Dr. Takeshi Tsubata (second from left) from the Department of Immunology at Tokyo Medical and Dental University and Prof. Dr.-Ing. Thomas Bock (second



from right) from the Faculty of Architecture at TUM. Both researchers have been actively committed for many years to intercultural cooperation between Germany and Japan. DFG Vice-President Prof. Dr. med. Katja Becker (left) noted: “Japan is an important and long-established partner to German research. The numerous enquiries about possible cooperations with Japanese researchers received on a regular basis at DFG Head Office show that the potential for bilateral cooperation is still far from exhausted, and in fact is steadily growing.” This year the prize was awarded for the tenth time.

[www.dfg.de/dfg\\_magazin/querschnitt/171010\\_seibold\\_verleihung](http://www.dfg.de/dfg_magazin/querschnitt/171010_seibold_verleihung)

# Series: Migration and Refugees / Part 3



What makes it easier for people to leave their homes and seek a better life in a faraway country, and what makes it harder? Language and language skills are among the most important incentives and indeed barriers to migration – and this is what we examine in the third part of our series. We focus not on German language skills per se, but on

the learning of German in migrants' home countries. This change of perspective is as unusual as the source material used: the annual records of Goethe-Institut centres around the world form the basis of this economic approach. We also take a brief look at other DFG-funded projects on factors that facilitate and hinder migration.



## Learn German – And Then What?

It is a truism to say that migrants' language skills often decide how successfully they are able to integrate. But what about the situation prior to migration? Do people who already know German leave their home countries more quickly and more willingly? And what difference does it make when and where they learned the language? Empirical data sheds light on a little-studied question.

The mostly young people queuing up outside a language school exude openness, patience and yet also ambition: they are waiting to sign up for German classes (image above). This photo, taken in Valencia (Spain) in 2013, speaks for itself and also says something about the current economic climate in Spain. After more than five demoralising years of economic crisis on the Iberian peninsula, a growing number of Spaniards – and not just

in the country's third largest city – are seeking a better future abroad. Of Spain's 47 million citizens, the younger generation is particularly interested in embarking on a new life outside their home country. One possible destination is the economically and socially stable Germany. The long lines of people in front of the German language school in Valencia therefore also emphasise a key message: good language skills are of prime importance to success-

ful economic and social integration in a foreign country.

In more general terms, in a global world, skills and qualifications – what is referred to as “human capital” – are of vital importance. At the same time, economic activities in industry and trade often take on an international dimension. This may result in interaction with foreign partners and customers, but also encourage people to emigrate. To put it in economic terms, the transfer

of human capital from one country to another nearly always demands knowledge of the language of the destination country. Multinational companies and special sectors such as scientific research may, to some extent, represent an exception to this.

We can therefore expect migration decisions and knowledge of the languages of potential destination countries to be closely connected. At this point it is important to draw a distinction between two factors, which are not mutually exclusive. Firstly, individuals may already have some language skills, perhaps from language lessons at school. Obviously, in most cases they will not have made a personal choice (as a child) to study a particular language; rather, this choice will be the result of a variety of factors. These

*Left: Demand for German classes – queue in front of the Centro Aleman in Valencia. Below: When peaceful day-to-day life was still possible in Syria – students of German leaving the Goethe-Institut in Damascus; this photo dates from summer 2009.*

include parental preferences and the languages available on the timetable or at a given school. Acquired language skills then form one contributing factor in the decision to migrate (or not) and, especially, the choice of destination country. This choice therefore proceeds from existing language skills, which may have an importance influence on a later migration decision.

Secondly, an individual may start off with no foreign language skills. People choose a destination country on the basis of a number of different criteria, perhaps the economic situation, cultural factors or climate. Linguistic proximity, or the similarity between an individual's native language and the language of the destination country, may also play a role. Some people who intend to migrate specifically seek out language classes. This is different from learning a foreign language at school, because the decision is made by the individual as an adult and may be seen as an investment in individual human capital or “in an improved transferability of human capital”. The likely direction of the

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Institute for Economic Research at the University of Munich, where her research interests include the international comparison of institutions and migration research. Übelmesser studied economics at the universities of Munich and Louvain-la-Neuve. She earned her doctorate (“Unfunded Pension Systems: Ageing and Migration”) in 2003 in Munich, where she also completed her habilitation in 2010 (“Migration and Education: Fiscal and Non-Fiscal Implications”). Her perspective on economics has been influenced by her work as an assistant professor at the Center for Economic Studies and with Prof. Dr. Hans-Werner Sinn. Her research work to date has focussed on education funding, migration and the skilled labour market. The project “Language Acquisition and Migration”, on which this article is based, has been funded by the DFG since 2015.



causal relationship is therefore reversed: the migration decision provides the incentive to learn to speak and write a language.

Here too, it can be observed that a lower degree of “linguistic proximity” presents a barrier to migration as it results in more difficult economic and social integration. At the same time, integration problems can be reduced through acquisition of the appropriate language skills.

In the case of languages that differ more from an individual’s mother tongue, this may be associated with higher monetary and non-monetary costs but potentially also with greater returns. From an empirical perspective, it is critical to know what language skills migrants possess. It is also vital to better understand the language learning process, with an awareness of the causal relationships between migration and language.

*German teacher Frau Kleinert teaches a class at the Goethe-Institut in Leopoldville (now Kinshasa), Democratic Republic of the Congo, in the 1960s.*



Illustration: dpa / Anatol Weil

In the past, studies on migration and language have often resorted to data that documents migrants’ language skills at a particular point after their arrival in the destination

### “The migration decision provides the incentive to learn to speak and write a language”

country. This was primarily due to limitations on the available data. Although this data can generate useful insights, by and large it fails to illuminate the exact relationship between the decision to learn a language and the decision to migrate, and in particular the order in which they happen – learn the language first, or make the decision to migrate first.

Yet the conscious decision by an adult to learn or not to learn

a language as preparation for emigration is also of political and economic relevance. Given the importance of language skills to the integration of migrants, countries have an economic interest in identifying those with less incentive to learn the language and motivating them to acquire language skills through a variety of measures. Governments may have no influence over the curricula in foreign schools, but with adults, there are more options available. Consider, for example, rules requiring a certain level of language competence, such as those introduced in Germany in 2007 for migrants’ families to be able to join them in the country. Another option is to create language-learning opportunities in the home country and abroad.

This is at the heart of a DFG-funded project which is studying “Migration Incentives and Migration Barriers – Language Acquisition and Migration”. The project is based on data generated from the annual records of the Goethe-Institut combined with data on migration into Germany. The Goethe-Institut is the cultural institute of the Federal Republic of Germany, with centres in over 90 countries worldwide and a history going back more than 60 years. Its primary aim is to promote international cultural exchange and the study of the German language abroad.

In particular, the project is concerned with two research questions. Firstly, the research team is investigating whether and how migration decisions are connected with targeted language learning. If this is the case, then a migration visible in the data should be

preceded by attendance at language classes and participation in language assessments, whether at an institute in Germany or in the home country. In other words, the focus is on demand for language classes and assessments as the result of an intention to migrate.

The results point to a difference between migrants from European Union (EU) countries and third countries. For EU countries, preparatory language learning mostly takes place in the home country, whereas migrants from non-EU countries are more likely to attend language classes and sit assessments in Germany. This would appear to be entirely rational, so to speak. Learning a language is an investment, normally made with the expectation that it is highly likely to “pay off”. For EU citizens, freedom of movement presents no legal barriers to migration and thus less uncertainty.

For citizens of other countries, the situation is different. It is not easy to say whether they will ultimately migrate, and this greater uncertainty reduces the incentive to participate in preparatory language learning. For politicians, this provides evidence that migrants from non-EU countries often arrive in Germany without good language skills. It follows that measures to encourage and require language acquisition are especially important for this group.

The researchers on the project are also investigating whether the presence of language learning opportunities in the home country results in more migration to Germany. This aspect therefore focusses on the availability of language classes and assessments with regard to an intention to mi-



Illustration: dpa / WaiTrauk Czubizsch

*Integration course for migrants at the Volkshochschule (adult education centre) in Leipzig. Here, people from Palestine, Afghanistan, Syria, Georgia, Myanmar and Lebanon sit around the same table.*

grate. A positive correlation can be observed between the number of Goethe-Institut centres offering language classes in a given country and the number of migrants to Germany from this country. Interestingly, this does not apply in the same way to centres that do not provide language classes. Although the relationship appears to be somewhat more complex, language learning opportunities could result in more language learning and thus influence, at least in part, the decision to migrate.

However, to interpret the results gathered so far it is important to note that it is only possible to draw conclusions at a macro level. In other words, aggregated data on language learning and migration is being analysed to identify statistically significant and thus economically and socially

relevant connections which will, ideally, allow conclusions to be drawn about causal relationships. It is impossible to say on the basis of the data whether individual language learners ultimately go on to migrate to Germany after completing a language course. However, patterns can be recognised that make it possible to derive insights and political implications. To discover more about individual motives for language learning and potentially associated migration intentions, the next step will be to investigate this micro level with the help of surveys.

**Prof. Dr. Silke Übelmesser**

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## Rural Poverty as a Driver of Migration?

Case study investigates peasant farmer livelihoods in Mexico and Bolivia / Examining land use scenarios

In Latin America, as elsewhere, an agricultural economy is transforming and experiencing tensions between intensified cultivation and new nature conservation areas. Based on regional case studies in Mexico and Bolivia, researchers are investigating “Peasant farmer livelihood strategies as driver and outcome of socio-ecological transformations”. The study aims to make a “qualitative and empirical contribution towards improving land use and land cover modelling”. In other words, it is concerned with scenarios for the economic landscape of today and tomorrow.

The project, led by Greifswald-based human geographer Dr. Anne Cristina de la Vega-Leinert in partnership with local researchers, focuses on livelihood strategies of peasant farmers in the context of local and national value creation chains. It seeks to identify the consequences of land use change and also investigates the role of migration processes. The project team will consider structural opportunities and obstacles which, in their view, can be applied to situations in other Latin American countries.



The project in the DFG database GEPRIIS:  
gepris.dfg.de/gepris/projekt/  
277982814?language=en



Illustration: dpa/Helmut Fohringer

## Next-Door Neighbours

Austria and Germany: incentives and disincentives to unexpected labour migration

When immigration is mentioned, the reference is often to immigrants from non-European countries. But migration into Germany from other parts of Europe is also an economically significant reality. The project “Transnational Labor Markets: Migration of Workers between Austria and Germany” is designed to analyse migration movements between the two countries. The research team is studying individuals with a German and Austrian passport who “are registered in the social insurance systems of both countries and whose careers are based

in both national labour markets”. The researchers are using a networked administrative data pool. The team led by Prof. Dr. Andrea Weber, Vienna University of Economics and Business (WU), and Prof. Dr. Rudolf Winter-Ebmer, University of Linz, is seeking to understand the supporting and inhibiting “determinants of bidirectional migration flows”, including economic motives, length of stay, number of migration episodes and return migration.



The project in the DFG database GEPRIIS:  
gepris.dfg.de/gepris/projekt/  
256806357?language=en

## When the Climate Goes Crazy

How do natural disasters affect economic growth, trade and capital flows, and migration?

In earlier times people migrated due to climatic changes of biblical proportions; today, movements of people are caused by global warming. But what are the direct and indirect consequences of natural disasters, specifically, on mobility and migration? In other words, “how [have] past natural disasters shaped economic outcomes and how [have] these] been conditioned by institutional setups or by trade openness, migration, and capital flows”?

These questions are at the core of the economic policy-oriented project “International Market Interactions, Institutions, and the

Costs of Natural Disasters”, being conducted at the Ifo Institute for Economic Research at the University of Munich. Project leader Dr. Jasmin Gröschl and her partners are using a new database, ifo GAME, which combines geological and meteorological data derived from sources other than insurers. Using this data, the project team intends to answer research questions “at the cross-roads of environmental economics, development economics and international trade”.



The project in the DFG database GEPRIIS:  
gepris.dfg.de/gepris/projekt/  
318600342?language=en

## Yearning for a Better Life

What educated young men expect from migration: the example of the port of Mahajanga, Madagascar / Media consumption and migration patterns

The face of modern migration is young – but the motives and backgrounds of former and current migrants are diverse. For example, what expectations do educated male students and graduates from the Madagascan port of Mahajanga have of life, work and emigration? An ethnological study is examining “Migration Blueprints of Immobile Actors. Desires, Discourses and Practices of Male Juveniles”. Using biographical reports and surveys, Cologne-based ethnologist Dorothea E. Schulz intends to analyse values,

norms and institutions that “inform students’ visions and projects of migration”. The research will cover the period from the country’s independence in 1960 to the present day. In this way she will pose culturally critical questions about “(im)mobility, tying an analysis of changing constructions of masculinity and youth to explorations of the constitutive role of media consumption for migration patterns and practices”.



The project in the DFG database GEPRIIS:  
gepris.dfg.de/gepris/projekt/  
219941374?language=en

For refugees, mobile phones continue to be a vital way of staying in touch with family.



Illustration: dpa/JFK

Read part 4 of the series in the next issue:

**Children of Migrants –  
A European Comparison of Environment and Reality**

Jürgen Steimle and Gordon Bolduan

# The Touchscreen on Your Skin

Integrated, powerful and often barely visible: soon there could be a computer inside almost any conceivable object. Computer scientists are seeking to improve the interfaces for human-machine interaction. The trend is towards solutions which are quite literally flexible.

Smartwatches and fitness trackers are enjoying huge popularity – and according to the advertising, they are designed to make the user's day-to-day life better. Whether relaxing on the sofa, cycling to work, or working out at the gym, smart watches with their intelligent apps are everywhere. Are these the new watches for the digital age?

In summer 2015 the Apple Watch, for example, was launched in Germany. And while business

analysts speculate on the potential economic success for the US company, experts in the field of human-machine interaction see smart watches like the Apple Watch from a different perspective. Their diagnosis: "fat thumb problem". If you want to operate a smart watch by touch, you have only a small display at your disposal, most of which is covered by the fingers.

The general realisation is that what might be a technically obvi-

ous step isn't automatically the best thing for human users. The same is true in other areas too. For instance, modern information technology can be used to control your heating at home. This in turn affects the design of thermostats, which in this case are the user interface. Instead of being controlled with a simple, intuitive rotary movement as before, thermostats now often resemble a confusing keypad which is impossible to understand without a user manual.

*An example of wafer-thin printed electronics: the iSkin Music Sticker with its amazing flexibility.*



Illustration: Oliver Dietze

The Human-Computer Interaction group in the cluster of excellence "Multimodal Computing and Interaction" in Saarbrücken has set itself the challenge of developing new forms of interaction which don't simply replicate the restrictions and established conventions of current technologies. The group is investigating solutions which can be perfectly integrated into objects that people use in the real world. Their chosen tools include empirical user studies and the use of new technologies which are themselves still in development. At the moment this is primarily printed electronics, including structural parts, components and applications which are partially or entirely printed. The process is similar to an inkjet printer, but instead of ink on paper, conductive fluids are printed on to thin flexible films known as substrates. Using this technique, the computer scientists in Saarbrücken can create electronic components with entirely new properties which can be readily integrated in real-life objects.

Wafer-thin, formable and even stretchable, these new components have little in common with the computers we know today. The research team is therefore conducting basic research on two levels. Firstly, on the basis of empirical studies they are designing completely new forms of interaction and turning them into reality with the aid of new technologies. Secondly, they are systematically studying how these almost invisible computers of the future can be controlled in an efficient, user-friendly way.

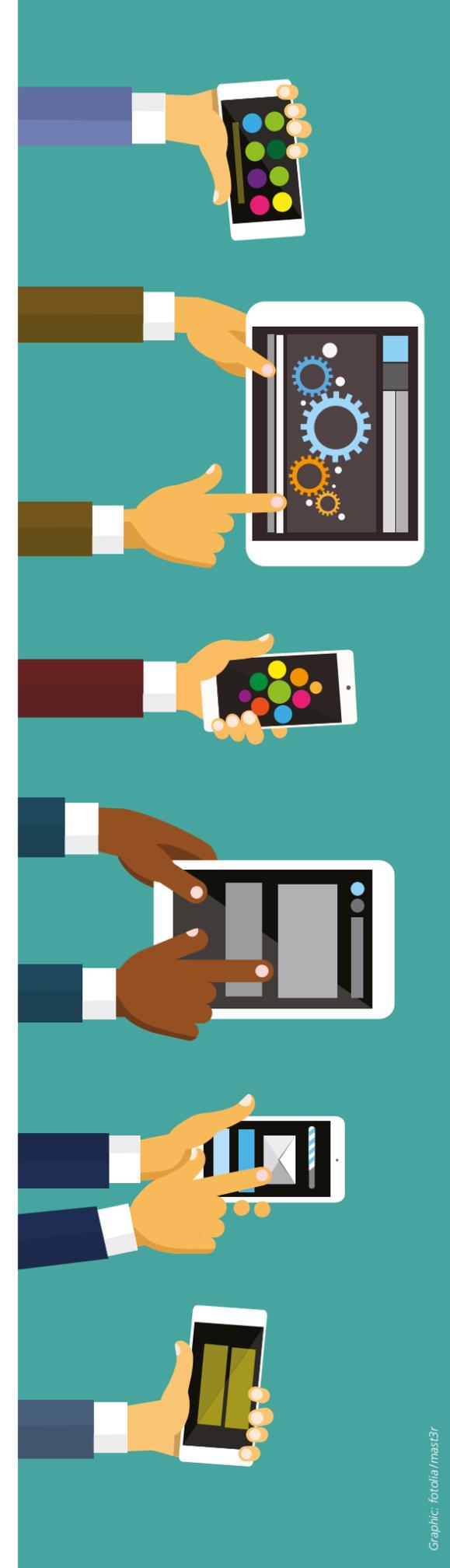
The current research on "interactive skin" is a perfect example. During discussions on the Apple Watch and similar devices, the idea

came about of using the skin as a natural medium. It has a larger surface area and is very easy to access for input purposes. So the researchers asked people how they would perform actions on the skin, assuming that this could be used as an input sensor for mobile end devices. Surprisingly, the responses weren't limited to touching: users also wanted to press, drag and even rotate the skin. So the researchers developed a prototype sensor known as iSkin – the first elastic sensor that can be worn on the skin for touch interaction with computers.

The elasticity was a major challenge as it required conductors that would not break when they were stretched. To overcome this problem, the computer scientists collaborated with materials scientists from Carnegie Mellon University in the USA. The US team developed a method that combines different types of silicone to create an elastic conductor. Silicone is skin-friendly and can therefore be safely attached to the skin using a medical adhesive.

Using this as a basis, the researchers in Saarbrücken developed a multimodal technique which allows both light touch and stronger pressure to be detected. By pressing a predefined spot on the sensor, it is possible to accept a call or adjust headphone volume, for example. But the researchers weren't satisfied with this basic functionality. They wanted to build a sensor that would respond to human aesthetic sensibilities. It had to look attractive and make a visual statement with which the wearer could identify.

So the research team also developed techniques that allow de-



Graphic: fotolia/mast3r

signers to turn the lines, shapes and silhouettes of their choice into iSkin sensors. The result is semi-transparent control interfaces that look like artistic tattoos on the skin rather than conventional controls.

The technology is now being further developed as part of an ERC Starting Grant project, through which Steimle's research on interactive skin is being funded by the European Union. The group's latest results have made it possible to produce sensors on wafer-thin films. Being thinner than human skin, these mould themselves to even the smallest wrinkles, allowing them to be worn comfortably.

Another important question was how to enable a non-expert user to adapt the technology to their needs and thus create customised products. Simon Olberding, a doctoral researcher in the group,

supplied an answer with the prototype of the PrintScreen project. On a postcard is a picture of a vintage car. When a button is pressed, the rear axle and steering column light up in the same colour. This is made possible by two segments on a flexible display that exactly match the shape of the car parts. Olberding printed the display on an ordinary inkjet printer. The display is electroluminescent, which means that it emits light when an electrical voltage is passed through it. Previously it was only possible for displays to be mass-produced, not customised for the individual user.

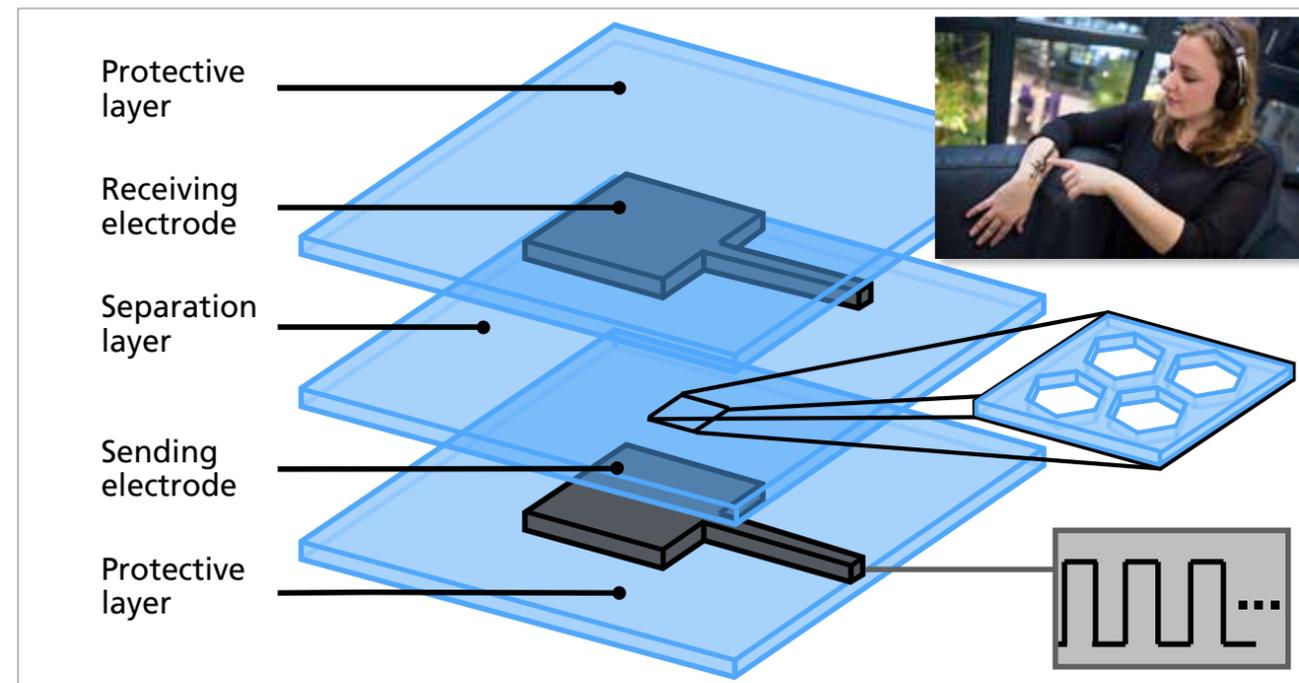
So the researchers moved into previously unexplored territory and developed a new process. The user designs a digital template for the display using a graphics programme such as Adobe Illustrator or PowerPoint. This template can

then be printed out using two digital production processes developed by the research team. The result is a display just a fraction of a millimetre thick. As the same process can be used to print on materials such as paper, plastics, leather, ceramics, stone, metal and wood, any number of two-dimensional and three-dimensional forms are possible.

Even touch-sensitive displays can be printed, opening up a whole host of potential applications: these displays can be integrated in almost any everyday object, not just paper objects but items like furniture, bags or objects worn on the body. For example, a watch strap could be made to light up when a text message is received.

If users could customise electronic components not just digitally but in a direct physical way, this would represent a true innovation. Together with researchers

*The touch-sensitive iSkin sensor consists of multiple layers. It produces a different signal depending on the pressure of the touch. This enables a distinction between options such as no touch, light touch and firm touch.*



Graphic: Steimle/MMCI

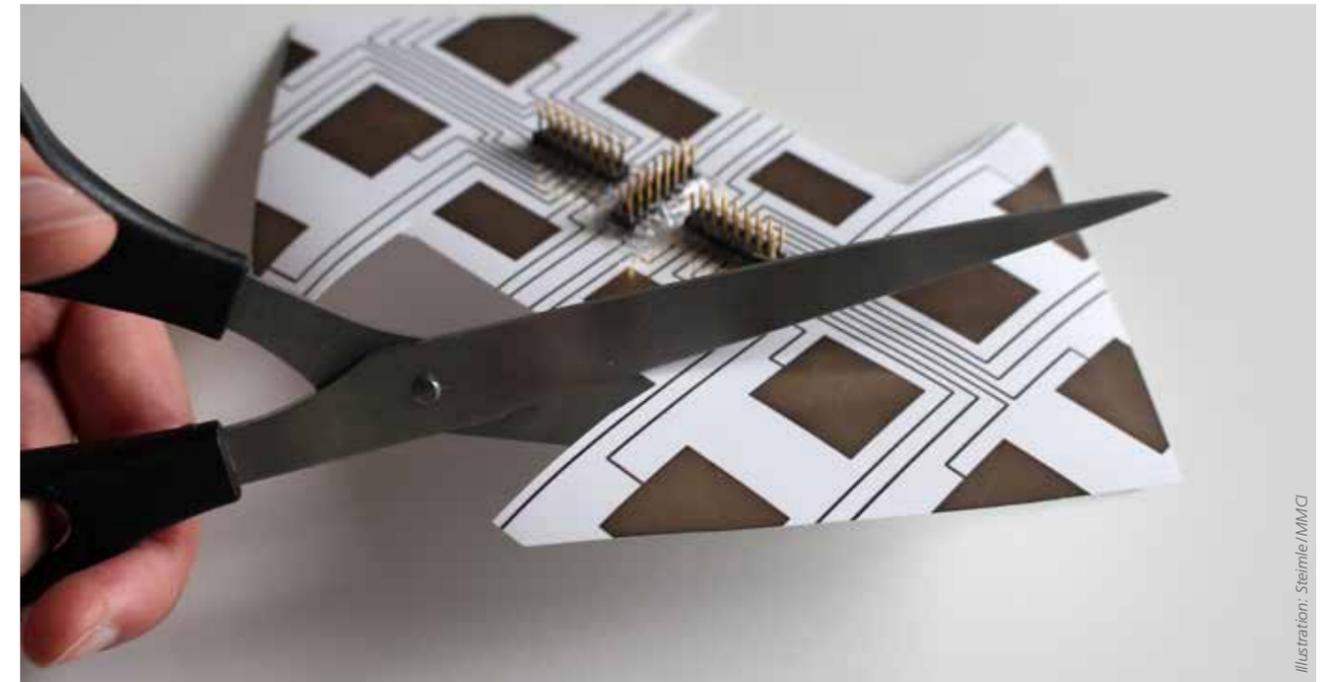


Illustration: Steimle/MMCI

*The "cuttable sensor" can be cut to the desired size and shape. Crucially, it continues to function as before and responds to touch.*

from the MIT Media Lab in the USA, the project team developed a touch-sensitive sensor which can be cut to the desired size and shape with scissors. An innovative arrangement of the printed circuits allows the electronics to function in spite of being cut and areas being removed. "Imagine a child taking a piece of our sensor paper and cutting out the shape of a flower complete with stem and leaves. If the child now touches the flower petals, you hear the buzzing of a bee", says Olberding, describing one possible application.

With a simple app, the printed sensor can be linked to sound effects or other digital functions. Other potential applications relate to prototyping and model making: architectural models or items of furniture, for example, could be easily transformed into interactive objects. Again, the basic technology is printed electronics. But this on its

own isn't enough to make the sensor impervious to cutting, damage and the removal of entire sections.

Until now, the circuit diagram of a multi-touch sensor resembled the squared paper used in maths class. The wires run vertically and horizontally and where they intersect are the touch-sensitive electrodes, forming rows and columns. This means that maximum damage is sustained even if only one wire is cut.

In their search for alternatives, the researchers took inspiration from nature, including the human nervous system and the root networks of fungi. Their aim is to create a new type of material that users can buy in stationery shops. It should be affordable enough to be used in interactive applications or simply as a blotting pad. According to a forecast by the Organic and Printed Electronics Association, this

vision could soon become reality. This international industry association predicts that flexible electronics for end users will be available between 2019 and 2022 – which isn't long to wait.



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Michael P. Manns



Illustration: HMS/Press &amp; Public Relations

# Organ Transplantation – A Bright Future Ahead

When the kidneys, liver, heart or lungs are incurably diseased, an organ transplant is often the last hope. But despite the many advances in modern medicine, the risks are still high – and the primary goal of doctors and patients is still to maximise “transplant survival” while minimising impact on quality of life.

Transplantation medicine has achieved great successes, but still faces some major challenges. In 1954 the first successful kidney transplant was carried out between identical twins. In the 1960s, the first liver transplant took place in

Denver, USA, and the first heart transplant in Cape Town, South Africa. It caused a sensation in the world of medicine and among the general public. Later came lung transplantation. At the same time, bone marrow transplantation was

being developed, then came its further development: stem cell transplantation for the treatment of leukaemia, other diseases of the blood-forming system and tumours.

We now know that the success of an organ transplant depends on

a range of factors, for example the blood group identity of the donor and recipient and the compatibility of transplantation antigens in the kidneys, heart and bone marrow. Otherwise there is a risk of early organ loss due to rejection in spite of immunosuppressive drugs. The aim of an organ transplant is to maintain the life of a patient with incurable acute or chronic organ damage by removing the sick organ and replacing it by the surgical transplantation of a donor organ. Initially, donor organs came exclusively from deceased donors, but later it became possible to harvest organs from living donors, too.

In transplantation medicine of “solid organs” such as the kidneys, liver, lungs and heart, the shortage of donor organs is a major and growing problem. This shortage has become much more acute in Germany in recent years due to falling numbers of donors, partly as a result of the “transplant scandal” involving alleged breaches of guidelines at various transplant centres. Overall, Germany is bottom of the league when it comes to organ donation. Transplantation medicine therefore urgently needs a combination of awareness-raising and trust-building measures.

Today there are various approaches to closing the gap between the number of available organs and the number of donor organs needed. In the case of kidneys this is living donation, which already accounts for almost 40 percent of kidney transplants. In liver transplantation, the living donation of part of the liver, mainly from parents to children, has become an established practice. But with the exception of the kidneys, living donation among

adults represents the exception in Europe; in the case of the heart it is obviously not possible.

When an organ can be transplanted, what is the prognosis for the patient? The short-term prognosis for a transplant recipient depends on the organ function, acute rejection responses, infections and surgical complications. Due to the growing shortage of donor organs, patients in Germany are receiving transplants at a much later stage in their illness, with the result that complications before and after transplantation occur much more frequently. To maintain long-term organ function, rejection responses and the return of underlying diseases in the transplanted organ must be prevented and the usability of so-called marginal organs must be improved. With all organ transplants, the normally lifelong suppression of the immune system by the use of drugs, with their various side-effects, is required to prevent rejection and loss of the donor or-

gan. Consequently the patient is more vulnerable to infections as well as organ damage resulting from side-effects of the immunosuppressive drugs, for example cyclosporin or tacrolimus, both drugs still being the backbone of post-transplant immunosuppression. These so-called cyclophilin inhibitor drugs can cause kidney and nerve damage, diabetes, high blood pressure and even tumours.

So the maintenance of tolerance to the donor organ without the use of toxic immunosuppressants is an important vision for the future. It is referred to by specialists as “operational tolerance”. Selected patients can already be “weaned” off chronic immunosuppression. There is also the hope that the donation of immunomodulatory cells known as regulatory T-lymphocytes (Tregs), will enable tissue-specific tolerance while maintaining general immunocompetence.

Lives can also be saved by stem cell transplantation, as the result of

*Open chest surgery: transplants are challenging operations.*



Illustration: HMS/Junge

which most childhood cases of leukaemia are now curable. It is also necessary to “condition” the recipient prior to a transplant. Radiation or chemotherapy not only destroys the malignant leukaemia cells but also the bone marrow, the blood-forming organ, putting the immune system out of action. This must then be replaced as quickly as possible with healthy donated bone marrow cells. During this phase the patient is exposed to a high risk of infection. Another serious complication that can follow stem cell or bone marrow transplantation is known as graft-versus-host disease (GvHD). This is caused when the newly transplanted immune system attacks the recipient tissue. So the major challenge lies in quickly restoring the immune system while preventing GvHD and at the same time maintaining or indeed strengthening the infection defence and the graft-versus-leukaemia (GvL) response to destroy remaining tumour cells.

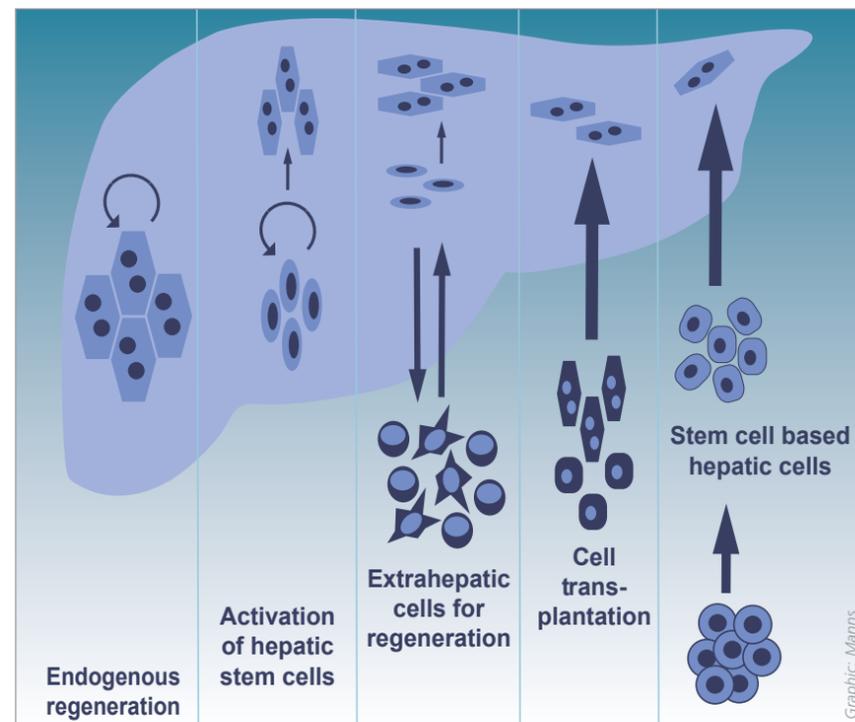
The decisive factor is that transplanted organs must be accepted by the recipient in the long term and the body prevented from rejecting them – ideally, in future, without the use of toxic immunosuppressive drugs and with an intact infection resistance. We also need to improve conditioning for transplanted organs. This means that better ways are needed of bridging the so-called cold ischaemia time, the period of several hours during which a donor organ is removed and then transported to the recipient. During this time the donor organ must be protected from damage.

The surgical technique of organ transplantation has scarcely changed over the last few decades. At the same time, attempts are being made to transplant parts of organs or individual cells rather than complete organs. Examples include islet transplantation in cases of diabetes mellitus and hepatocyte transplantation

for certain liver diseases. Hepatocyte transplants are mainly used for acute liver failure and genetic liver diseases in which cirrhosis, or scarring, of the liver has not yet occurred. As an alternative to organ transplants, researchers are also developing gene therapy corrections for congenital diseases, for example those affecting the liver. Genetic diseases require a range of approaches, with the result that very different gene therapy strategies are used. In the case of haemophilia, for instance, the genetic defect is localised in the liver but the often life-threatening consequences are manifested outside this organ. In haemophilia, only a certain percentage of the defective gene needs to be replaced with functional material. There are many and various future issues and challenges in transplantation medicine in research and clinical practice.

This is the starting point of Collaborative Research Centre 738 “Optimization of Conventional and Innovative Transplants”. For the past nine years, this group based at Hannover Medical School has been applying a combined and interdisciplinary approach to the challenges of transplantation medicine. One project is looking at the early detection, prevention and early treatment of graft-versus-host disease (GvHD) following bone marrow or

*Cell-based liver regeneration: physiological (endogenous) regeneration takes place in the liver through the division of mature hepatocytes. Only under special circumstances are hepatic stem cells activated which can contribute to liver regeneration. It is unclear whether other (“extrahepatic”) cells are involved in liver regeneration, and this is a cardinal question in cell transplantation.*



### Postmortal Organ Donations 2014



ORGANSPENDE –  
DAS IST MEINE ENTSCHEIDUNG.



When compared, the numbers tell a story: Germany ranks very low in terms of organ donations. The Federal Centre for Health Education is trying to encourage people to make a personal, responsible decision in favour of organ donation.

stem cell transplantation. A protein pattern (known as a peptide pattern) has been defined in urine which can predict GvHD before it develops. Early treatment can then prevent the onset of the disease.

Other projects are working to maintain specific functions of the immune system such that the body retains its defences against infections and immune responses to remaining tumour cells. This is being investigated using a variety of mouse models. The recurrence of viral hepatitis B, C or D in a transplanted organ represents the return of an underlying disease. This is still a significant clinical problem. The Collaborative Research Centre wants to help prevent the renewed infection of donor organs with the aid of antiviral drugs and a detailed understanding of immune responses. The long-term goal is of course to cure viral hepatitis infections at a sufficiently early stage through prompt treatment that a liver transplant does not become necessary.

Other projects are seeking to identify special molecules which accelerate the maturation of T-lymphocytes after a stem cell transplant.

It is hoped that this will support the faster rebuilding of bone marrow and the immune system – and therefore restore the infection defence and ability to destroy remaining tumour cells. One very topical avenue of research is the use of individual cell populations of the immune system to prevent rejection responses. The centre of interest is the regulatory T-lymphocytes mentioned previously. More of these are found in the liver tissue of patients who can be successfully weaned off long-term immunosuppression without a rejection response occurring.

This “operational tolerance” is characterised by the accumulation of regulatory T-lymphocytes in the liver tissue following the gradual cessation of immunosuppression. Actively regulated inflammation in the tissue therefore mediates organ tolerance without the use of drugs. Finally, a number of projects are devoted to developing innovative transplant material using gene and cell therapy. Cell transplants use modern technologies derived from stem cell research and gene transfer.

For our patients, as for everyone, the dream of eternal life will remain

out of reach. But what this networked field of research does aim to achieve is maximum “transplant survival” and as far as possible a normal life expectancy for transplant patients while at the same time maintaining a good quality of life. Transplantation medicine has achieved some great successes – but there are still some major challenges ahead.



**Professor Dr. med. Michael P. Manns** is the spokesperson for Collaborative Research Centre (CRC) 738 “Optimization of Conventional and Innovative Transplants”, director of the Department of Gastroenterology, Hepatology and Endocrinology at Hannover Medical School, clinical director of the Helmholtz Centre for Infection Research (HZI) Braunschweig and founding director of the Center for Individualized Infection Medicine (CIIM) in Hannover.

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www.sfb738.de



Rembert Unterstell

# Before and After the Shoa

Michael Brenner studies modern Jewish history and culture from diverse perspectives. This also benefits his work as International President of the Leo Baeck Institute. An interview on paradigm shifts in German-Jewish historiography, Theodor Herzl and Zionism, and challenging Israel Studies.



When I arrive for our interview in the department of history at LMU Munich, he has already packed for his trip. Two suitcases are placed “discreetly” in the corner of the office next to a desk that dominates the room. In 48 hours’ time, Professor Michael Brenner will be boarding another transatlantic flight. In addition to the

professorship in Munich, he holds the Seymour and Lillian Abensohn Chair in Israel Studies at American University in Washington D.C. In specialist circles and beyond, Brenner is considered one of the most distinguished scholars of Jewish history and culture of the 19th and 20th centuries. However, his research interests extend well beyond

Jewish history as a story of minority and victims. In his studies, he seeks to understand Jewish life and survival before and after the Shoa in as many different dimensions as possible and with complex networks of effects in politics, business, culture and society. In his own words, he is driven by the desire to progress “from one Jewish history to many

Jewish histories”. Sitting opposite him in a corner of his office, set up for meetings with black couches and a glass table, you sense immediately that Brenner is a subtle intellectual with an American influence who is highly focussed and combines wit with calm modesty.

*Your field is Jewish history. You began studying Jewish life in your home town of Weiden in der Oberpfalz while you were still at school, when you wrote an essay for the Federal President’s history competition. How did that come about?*

Brenner: It wasn’t a random choice of topic. My father and mother were survivors of the Holocaust – and this chapter of German-Jewish history was present in various ways. In about tenth grade, when a history teacher came up to me and

said “Why don’t you write about the Jews in our town?”, I was excited. I wrote about the Jews from Weiden prior to 1945 and those who came to Weiden after 1945. It was also the first time I had engaged in detail with the story of my own family.

*Did your competition essay, which won the Oldenburg Youth Book Prize, motivate you to study history?*

It certainly provided me with an important confirmation. I was 16 at the time and I could imagine studying history. The timing was also important. In the early 1980s there were numerous attempts to understand local day-to-day life during the Nazi period.

*You’ve raised the point that historical topics go through fluctuations of popularity. Which phases would you*

*define in the scholarly examination of the Jewish community in Germany?*

After the war and up until the mid-1960s there was a phase in which people shrank from looking at topics in German-Jewish history. In the academic sphere, the first Jewish studies seminars were set up in Berlin, Cologne and Frankfurt in the mid-’60s, which initially dealt with ancient history. In the field of history, people began looking at basic issues of emancipation and anti-semitism – I’m thinking of the generation of Reinhard Rürup, Monika Richarz and Stefi Jersch-Wenzel. In 1979 the Hochschule für Jüdische Studien [College of Jewish Studies] was established in Heidelberg, which amounted to a turning point. There was also growing media interest – think of the Holocaust series on TV – as well as the first Jewish museums.

## The Scholar and His Work

Professor Michael Brenner holds the Chair of Jewish History and Culture at LMU Munich, where he also leads Germany’s first Center for Israel Studies, established in 2015; he is also the director of the Center for Israel Studies at American University in Washington, D.C. The historian is the International President of the Leo Baeck Institute, a place for documentation and research in the history and culture of German-speaking Jews with three institutes in the centres of Jewish emigration in Jerusalem, London and New York.

Born in 1964, Brenner studied at the Hochschule für Jüdische Studien in Heidelberg, the Hebrew University of Jerusalem and

Columbia University in New York, where he also obtained his doctorate. He became an Assistant Professor at Indiana University in Bloomington, then at Brandeis University in Waltham, MA, before accepting the chair in Munich in 1997.

His studies are concerned with modern and contemporary Jewish history and culture. In DFG-funded projects he has examined topics such as “Jewish Historiography in the 20th Century” and the Zionist movement. He is the author of several

successful books, which have also proved popular with non-specialist readers. Examples include *The*

*Renaissance of Jewish Culture in Weimar Germany* (Yale University Press, 1996), *A Short History of the Jews* (Princeton University Press, 2010), *Zionism: A Brief History* (Markus Wiener, 2nd edition, 2012), *A History of the Jews in Germany since 1945* (Indiana University

Press, 2018), and most recently, *In Search of Israel: The History of an Idea* (Princeton University Press, 2018).



During this period people started examining the Holocaust in new ways, but also the question of what was actually destroyed. In the next step, starting in the 2000s, historians have begun looking at Jewish life outside Germany and in a new way.

*One key area of your research is the Zionist movement. In your new book In Search of Israel: The History of an Idea, you develop the hypothesis that after the State of Israel was established in 1948, the Zionists strove for normality but ultimately couldn't break free of the overpowering shadow of the Jewish past.*

Yes, there was an important tension between the desire for normality and the reality. The Zionists were exploring the idea of being a normal state, a "nation like all nations". But there was also the ambition to be, in biblical terms, "a light unto the nations". These visions and ambitions contrasted with resentments and prejudices that had developed. This resulted in conflicts and tensions.

*Was Theodor Herzl, the founder of the Zionist movement, also affected by these tensions? Was he more of a utopian or a realist?*

Among his contemporaries, few thought of him as a realist. In the short term he was entirely unsuccessful with his ideas. In retrospect, which sounds paradoxical, he was far more realistic than many of his intellectual opponents.

*You are prolific in terms of research output and publications. To what do your books owe their success?*

I don't know how one measures success. The relative success has to do with the fact that there is public demand for my topics, although this might be declining. There is also the fact that there are relatively few specialists in Germany compared with the centres of research in the USA and Israel. With a feeling of nostalgia, I would add that the field of 'Jewish studies' that was born in Germany, which was at the heart of this discipline until 1933, never fully recovered. Today there is again a landscape for Jewish studies, but it's still very modest.

*Isn't the success of your books also due to your writing – accessible, comprehensibly bringing out long-term developments and with an awareness of ambivalences in the representation?*

Others must be the judge of that. Yosef Hayim Yerushalmi, my dissertation supervisor at Columbia University said to me: "You're not just writing your dissertation, you're writing your first book." I try to convey that to my doctoral students too. I've always tried to write for a wider audience.

*You decline to give political comment on the Middle East conflict. Why?*

*The Old Synagogue in Essen, now a "House of Jewish Culture".*

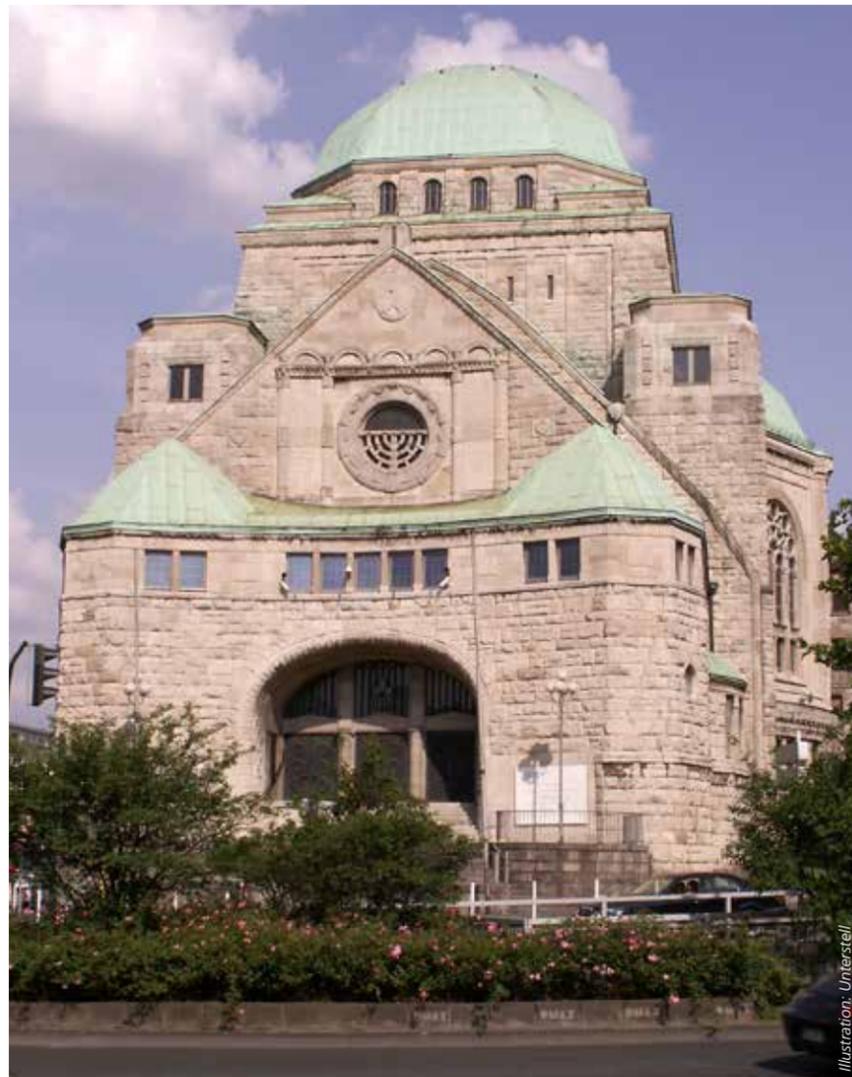


Illustration: Unterstell

*Rebuilt Torah shrine in the Old Synagogue in Essen. The mosaic reminds the visitor in large Hebrew letters: "Know before whom you stand."*

My priorities are in scholarship. There's definitely a danger of getting lost in media debates. I don't avoid media requests, I occasionally write for the SZ [Süddeutsche Zeitung], the F.A.Z. [Frankfurter Allgemeine Zeitung] and the NZZ [Neue Zürcher Zeitung], but when you devote most of your energies to the media, you can quickly fall out of your academic environment. I don't see myself as a political commentator.

*You've been the president of the Leo Baeck Institute since 2013. You have a voice in research policy, and presumably an agenda too?*

There has never been a German president before. The Leo Baeck Institute is like the umbrella over the three autonomous institutes in London, Jerusalem and New York. We are united by a common interest: representing the German-Jewish legacy internationally. The founders made the deliberate decision not to establish an institute in Germany, but it's important to have a presence here too – and to make the Leo Baeck Institute visible as the leading research institute for German-Jewish history.

*In what topics will the challenges lie in years to come?*

Much of the work at the Leo Baeck Institute and in Jewish history has to do with migration. I can imagine that we will carry out migration studies from a comparative perspective too.



Illustration: Unterstell

*What was the background to the establishment of the first Centre for Israel Studies in Germany?*

It's a logical continuation of the study of Jewish history, because Israel is now home to the largest Jewish community and because the history of Israel over the last 70 years, in most of its aspects, is part of modern Jewish history. In a non-academic sense, it served to mark 50 years of German-Israeli relations. The Middle East conflict should not be ignored, but our research work won't be limited to that.

*What can we learn from German-Jewish history?*

I think what we can learn from the German-Jewish experience is what a minority can bring to a society, and from a wide range of perspectives. This can be applied to other minorities today – religious or ethnic minorities. It's important to see not just problems and burdens but also the potential that can enrich a society. German-Jewish history can help to understand that.

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

Nadia B. Fröbisch

# Ancient Bones and New Legs



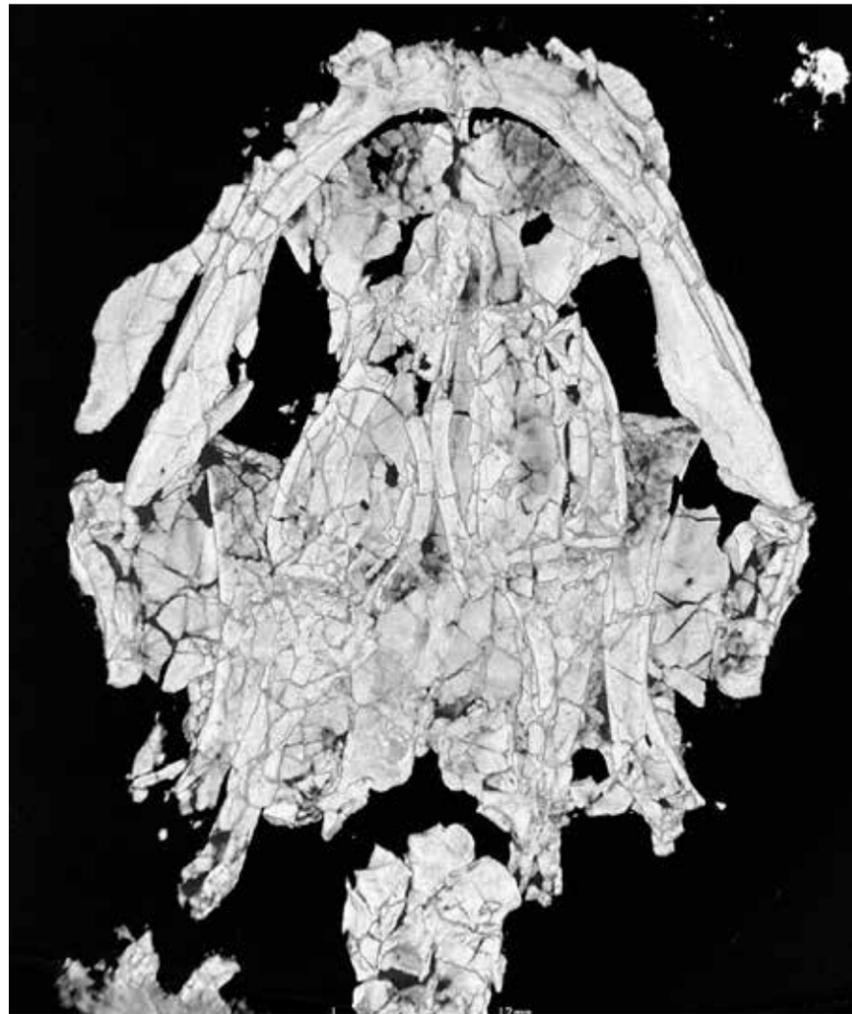
The linking of research data from evolutionary biology and palaeontology is shedding new light on the origin and development of amphibians. For scientists working in this area, salamanders are a fascinating object of study – from the unusual development of their extremities to the regeneration of entire limbs.

Palaeontology is the study of the evolution of life on Earth. Fossils are the most important objects of study in this field, which was established in its scientific form by the French naturalist Charles Cuvier (1769–1832). Since then, palaeontologists have been seeking to understand the evolutionary changes that have taken place in the living – from the first appearance of life 3.6 billion years ago to a period just a few thousand years ago. So it's hardly surprising that palaeontology has played and continues to play a key role in the ongoing development of the theory of evolution first propounded by Charles Darwin and Alfred Wallace in 1859.

The discovery of DNA, the carrier of genetic information, has added greatly to the classic theory of evolution, allowing an understanding of genetics and population biology to be combined with palaeontological data. Molecular biology then arrived on the scene. Since the 1970s, the focus has been on links between the individual development of an organism and evolutionary changes. This has produced crucial insights, including the discovery of developmental genes, which control the realisation of the body plan in embryonic development.

In 1995, the Nobel Prize in Physiology or Medicine was awarded to Christiane Nüsslein-Volhard, Eric Wieschaus and Edward B. Lewis for this work. A whole new branch of biology was quickly established:

*Left hand and forearm of the modern salamander *Cryptobranchus*. Cartilaginous elements appear in blue and ossified elements in red.*



Above: CT scan of the skull of a fossil salamander. Below: View of the fully preserved fossil of a branchiosaurid Apateton.



Illustration: Fröbisch

evolutionary developmental biology, known in specialist circles as evo-devo. As attention shifted to the links between genetic changes and their possible impacts on body plans, it became clear that the combination of molecular and palaeontological-morphological data offered enormous untapped potential to shed light on many areas of evolutionary biology.

An independent junior research group funded through the DFG's Emmy Noether Programme and based at the Museum für Naturkunde – Leibniz Institute for Evolution and Biodiversity Science, is applying this approach of integrating data from palaeontology and developmental biology in a project on the origin and evolution of modern amphibians. The data is being amalgamated using a variety of techniques: palaeontological excavations, detailed studies of fossil amphibians, and developmental biology experiments on salamanders.

Today, amphibians are represented by three characteristic groups: frogs and toads, salamanders, and the legless caecilians.

These animals play an important role in ecosystems, as amphibians have a very long evolutionary history starting in the Late Devonian around 360 million years ago. Over the course of their evolution they have developed an enormous range of body shapes and habitats and have dominated the Earth's ecosystems for long periods of time. In spite of a relatively good fossil record, there is controversy as to their origins. This is partly due to the astonishing diversity displayed by amphibians in their individual development. This makes it more difficult to reconstruct relationships – and also makes the animals interesting objects of study for the purposes of combining data from palaeontology and developmental biology.

One aspect of the research programme is the development of the legs of salamanders. All tetrapods (four-limbed vertebrates) go through a very similar process during the development of their legs. This is in spite of the huge variety of forms and functions which they must achieve in the adult animal – be it as a wing, a paw for digging, a leg for walking or a human hand. The internal anatomy is also essentially the same, consisting of one upper arm bone, two forearm bones, carpal and metacarpal bones, and fingers – or the corresponding elements in the leg.

The generation and formation of these elements takes place in stages, starting with the elements

An impressive head on a once moving body: a *Micromelerpeton credneri* from Permian lake deposits in the Saar-Nahe Basin.

nearest the body and progressing towards the fingertips. In the hand, the fourth ray (ring finger) develops first, followed by the little finger or middle finger, the index finger and the thumb or first ray. The same pattern is seen in all vertebrates with legs; only salamanders are different. Their hands and feet form in the reverse order, starting the process with the second ray (index finger).

From the viewpoint of the developmental biologist, this seems astonishing – as the process is based

on a complex system in which genes are activated and deactivated inside cells with precise spatio-temporal coordination. What mechanisms underlie the different developmental process in salamanders? To answer this question, we need to know when and where specific genes are activated in the development of the legs.

Why do a salamander's legs develop differently from all other tetrapods, and for how long has this been the case? Clues



Illustration: Fröbisch



Illustration: Fröbisch

When it comes to tracing amphibian evolution, modern species are also of interest. Below: Two larvae of the Mexican axolotl (*Ambystoma mexicanum*).



Illustration: Christian Mitgutsch

can be found in the fossil record, which reveals that as long ago as the Permian period 290 million years ago, a group of amphibians known as branchiosaurs exhibited this type of leg development. However, although branchiosaurs is likely a distant ancestor of salamanders, it is possible that this type of leg development didn't evolve just once but in parallel in both groups, effectively as an adaptation of the water-dwelling larvae of branchiosaurs and salamanders, which were exposed to similar environmental conditions. To further unravel this link, and therefore the evolution of the vertebrate leg including the arms and legs of humans, we need a better understanding of the genetic basis.

In addition to their leg development, salamanders have another special feature: an unusual ability to regenerate internal organs (liver and heart tissue), the lenses of the eyes, and even entire legs. The extremities can even be regenerated repeatedly throughout an individual's life span. This regenerative capability is unique among tetrapods, and the molecular mechanisms of leg regeneration are being intensively studied, for example at the DFG Center for Regenerative Therapies in Dresden.

For a long time it was assumed that this ability was unique to salamanders, but recent data suggests that *Micromelerpeton*, a very distant relative of modern amphibians, was already able to regenerate its legs 290 million years ago. The evidence for this is provided by fossils from lake deposits in the Saar-Nahe Basin in southwest Germany. The fossils exhibit certain malformations in the legs which



Illustration: Fröbisch

Regenerated left hand of a *Micromelerpeton* with visibly fused metacarpal bones.

are also found in regenerated extremities in modern salamanders, where initial wound healing was irregular: the fusing together of various bone elements and/or extra or missing fingers and toes. These are characteristic of faulty regeneration but do not occur in this form during normal leg development.

This evidence tells us that leg regeneration must already have been present in the early Permian (290 million years ago), long before the evolution of modern salamanders. It also indicates that the ability to regenerate may have been an original trait of tetrapods

that, for various reasons, has been lost during the course of the evolution of different vertebrate groups.

All life on Earth is interconnected through evolutionary processes. The key to understanding this diversity lies in the integration of different sets of data, which ideally would fit together like pieces of a multidimensional jigsaw puzzle of space and time. Fossils are more than just random snapshots or curiosities: they are essential pieces of this puzzle. As records of the evolutionary history of life, they provide modern palaeontology with a basis on which to construct and test hypotheses in evolutionary biology. Palaeontological data provides a

deep time dimension which can crucially influence our perspective on evolutionary processes.



Illustration: Hweja Götz

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## 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 early career researchers. Scientists and academics 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. *Humanities Centres for Advanced Studies* are designed to support the transition in the humanities to an integrated cultural studies paradigm. *Transfer Projects* 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 early career researchers by actively involving them in research work. This focuses on a coherent, topically defined, research and qualification programme. Research Training Groups are designed to promote the early independence of doctoral researchers 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 early career 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.

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On 15 January 2018 the DFG ushered in the new year with its traditional New Year's reception at the Berlin-Brandenburg Academy of Sciences and Humanities. DFG President Prof. Dr. Peter Strohschneider addressed some 400 guests, representing science and academia, politics, society and the media, on the topic "Science and Humanities in the Digital Age". In this context, he coined the term "Weltenwandel" to refer to a fundamental and ongoing change brought about by technological advancements but affecting all areas of society. This, he remarked, affects policy on innovation, investment, law, education and democracy. He noted that digitality presents a special challenge for the organisation of research and for science policy, a challenge which the DFG is tackling at its various levels. The President also called attention to a related project at the DFG Head Office and a future expert committee on science and academia in the digital age.

## Impressum

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