



Projection Media: Telling the Story of Poverty in Pictures | Gender Equality: Making Strides | Mobile Robots: Introducing ... Obelix | Translucent Concrete: Intriguing Transparency | Spotted Hyenas: The Power of the Alpha Mothers | Discourse History: Diving into the Goethe Period | Wastewater Treatment: Nature's Little Cleaners



Cover: Vogl-Bienek / Retouching: Herling
Studying the art and history of projection:
Approximately 100 years ago, the magic lantern was used to fascinate audiences with images and slides, often in combination with live music and recitation.



Commentary

Dorothee Dzwonnek

Making Strides in Gender Equality

2

DFG takes stock: Much has been accomplished, much more to do

News

GAIN: Boost for "Research in Germany"

4

Copernicus Award / Africa: Building Bridges

5

Engineering Sciences

Wolfram Burgard and Cyrill Stachniss

Introducing ... Obelix

6

Navigating Freiburg's pedestrian zone with an autonomous robot

Andreas Roye

Intriguing Transparency

11

Using 3D textiles to produce a new generation of translucent concrete

Life Sciences

Oliver Höner

The Power of the Alpha Mothers

14

How nature prevents inbreeding in spotted hyenas

Humanities and Social Sciences

Rembert Unterstell

Diving into the Goethe Period

20

Simon Bunke studies cultural themes in the mirror of literary discourse

Martin Loiperdinger and Ludwig Vogl-Bienek

Telling the Story of Poverty in Pictures

22

Historical images between multimedia presentation and social documentary

Natural Sciences

Conrad Marx and Peter Krebs

Nature's Little Cleaners

28

How microorganisms contribute to wastewater treatment



Dorothee Dzwonnek

Making Strides in Gender Equality

It's a mixed picture: clear progress has been made in gender equality in German research, but the proportion of women at some career levels, particularly senior positions, remains too low. For the DFG, this is a spur to greater action.

The topic of gender equality in the German research community is like many things in life: we address an issue that has been in need of attention for some time. There is no shortage of good ideas or good intentions, and the wheels are set in motion. Initial successes are soon followed by more, and we are pleased at our progress. At the same time, we know that however much has been achieved, there are still areas that are far from what we and others would have hoped for.

That was the impression at the DFG when we evaluated the final reports of our member institutions on the implementation of the research-oriented standards on gender equality prior to our last General Assembly. Introduced five years ago, these standards are perhaps the most important impetus for more equality at German universities – and a strong counter to discrimination against women in research, which is as unjust as it is wasteful of considerable intellectual potential.

Developed by researchers in a DFG working group and accepted by almost all our member institutions as a voluntary obligation, the standards have two main aims: firstly to raise awareness of the issue of gender equality and implement equality-promoting measures at all levels of universities, their organisation and their activities, and secondly to increase the proportion of women at all levels of the research career ladder by a certain percentage within a certain period. The model for this last objective is the “cascade model”, which is based on the recruitment potential of the next lowest career level and is therefore both research-led and made-to-measure.

Since the gender equality standards were introduced in 2008, much has been done to further their implementation. The extent of the progress that has been made was revealed in the reports submitted by the DFG's member institutions in 2010 and 2011 and now in their final reports. An evaluation of this data reveals that basic standards to promote gender equality have now been introduced in all universities. The importance of the issue is recognised everywhere, and the vast majority of universities have instituted gender equality as a management-level responsibility and developed a recognisable integrated strategy that incorporates individual units such as faculties and departments. Naturally, some differences are still apparent, but overall the German research community is much further along with the institutional and organisational implementation of gender equality than it was five years ago. This is a clear success.

However, the situation is somewhat different in the second area, the proportion of women at individual career levels. There have been improvements here, particularly of late. But overall the figures remain far below what we – the DFG and its member organisations – had hoped for. This is true in general but especially for certain key situations and positions. In the crucial transition to academic independence – from doctorate to habilitation and the first professorship – and in senior roles there are far fewer women than there could be.

This result is disappointing. And the DFG, as the driver and self-governing organisation of the research community, cannot leave the matter there. So over the next few years we intend not only to continue our efforts in the promotion of gender equal-



ity, but to intensify them. Our objective is a significant increase in the proportion of women in all areas.

At our annual meeting we therefore decided to introduce a process that will integrate equality standards more closely in our funding programmes. In the future, all funding proposals for coordinated research must include detailed information as to how many women will be involved at each qualification level. In addition, universities will be required to submit annual equality figures. Both will be taken into account in the review process. Naturally, academic quality will remain the decisive factor in funding decisions. But in the consideration of other criteria, or in choosing between several proposals of equal merit, emphasis will be given to gender equality.

We are not only placing more responsibility on the universities, but also providing them with more support in the form of a “toolbox” with further innovative models (www.instrumentenkasten.dfg.de) and extending the mandate of the DFG working group on gender equality standards.

With these actions we not only hope but expect to see good progress within a short time. In four years, at the 2017 General Assembly, we will re-evaluate this topic. By then we will be able to see whether our

chosen approach has been successful, or whether different measures are called for.

In the past the research community, and first and foremost the DFG, has strongly resisted a fixed, externally stipulated female quota, for various reasons: it would not take account of the very different situations in individual disciplines and institutions; highly qualified women might end up being labelled as “quota women”, which would hinder rather than help their careers; and such a quota would not be compatible with a system that is – and must be – more self-governed than other systems.

However, this clear position can only be sustained in the long term if the research community can show that its own efforts to promote gender equality are yielding fruit. The matter is in our own hands.

A handwritten signature in blue ink that reads 'Dorothee Dzwonnek'. The signature is fluid and cursive.

Dorothee Dzwonnek
is the Secretary General of the DFG.



Boost for “Research in Germany”

GAIN conference in San Francisco appeals for highly qualified researchers to return home / Germany now more attractive as a research location

San Francisco basked in glorious weather on Labor Day Weekend, which traditionally means two extra days off at the end of summer. Not so for some 300 German early career researchers, who came together between 30 August and 1 September for the GAIN (German Academic International Network) conference. But the trip was well worth it, because the young researchers were able to meet around 150 representatives of German institutions, including the most senior representatives of Germany’s major research organisations and

a large number of university presidents. So there was plenty of opportunity to find out first-hand about the academic job market in Germany.

This is exactly the purpose of GAIN, a joint initiative of the DFG, DAAD and Alexander von Humboldt Foundation: to inform highly qualified young researchers about new developments in Germany as a research location and persuade them to pursue their academic careers in Germany. In previous years, in workshops and group discussions, there was

often more criticism of Germany as a place to undertake research than there was desire to return home, but now things seem to have changed.

Germany’s decision to prioritise science and research – which was reflected in the title of the event – can be seen in the statistics. In the past eight years the budget of the Federal Ministry of Education and Research (BMBF) has increased by over 80 percent, as State Secretary Cornelia Quennet-Thielen emphasised. The Excellence Initiative has resulted in some 6000 new

research posts, around a quarter of which went to non-German academics. Many German universities are developing tenure track professorships to attract individuals with internationally outstanding credentials. By contrast, research funding in the US is stagnating or even falling, and the availability of tenure track positions can no longer be taken for granted. The “Research in Germany” brand, as DFG Secretary General Dorothee Dzwonnek called it, has clearly caught up.

It is clear to everyone that, in spite of the best efforts, the number of sought-after professorships will remain limited. Participants and organisers in San Francisco both expressed a desire for more mid-level positions at universities, research institutions and in industry, as well as positions in research management. The question of dual careers is also a pressing one for young researchers. If they go back to Germany they will be looking for support not only for themselves, but also for the professional integration of their partners. Their wish list includes improved employment conditions (salary and long-term contracts), flatter hierarchies and more flexibility.

But praise for the quality and diversity of the German university and research landscape was unanimous. There is no question about it: not only are the doors in Germany wide open to researchers, but the country has also become more attractive as a place to undertake research.

Dr. Eva-Maria Streier

is the director of the DFG Office North America in New York.

www.dfg.de/en/service/press/press_releases/2013/press_release_no_33/index.html



To start her week-long trip to the United States, at the end of August DFG Secretary General Dorothee Dzwonnek visited the research organisation's New York office. At the German House, the headquarters of the German Mission to the United Nations and the Consulate General as well as the DAAD, the DFG, the German Center for Research and Innovation (DWIH) and various university offices, she was able to form a picture of the working environment. She was impressed by the synergy effects generated as a result of the various German organisations working under one roof. At night she addressed an audience of around 70 invited guests including academics, politicians and members of the press on the future of the German research system. This was followed by a reception in the panorama restaurant on the 23rd floor of the German House, with plenty of opportunity for discussion and conversation.

Building Bridges I Building Bridges II

In 2013 the DFG and the Foundation for Polish Science (FNP) are once again calling for nominations for the Copernicus Award. The award is presented to one Polish researcher and one German researcher for outstanding services to German-Polish collaboration, particularly in the area of early career support. The prize money of € 100 000 is shared equally by the two recipients.



www.dfg.de/en/research_funding/programmes/prizes/copernicus_award/index.html

The DFG is once again calling for proposals for international projects with researchers in Africa for the study of infectious diseases and their social impacts.

Funding is available for research projects into neglected infectious diseases in humans and animals and associated research in social science, the key issue being diseases of poverty.

www.dfg.de/en/research_funding/announcements_proposals/info_wissenschaft_13_48/index.html



Wolfram Burgard and Cyrill Stachniss

Introducing ... Obelix

160 centimetres tall, weighing 100 kilograms and packed with cutting-edge sensor technology, this autonomous robot can navigate through a busy pedestrian zone. But computer scientists in Freiburg have even more ambitious plans.

Many things that seem easy to human beings are complex and difficult for autonomous robots: for example navigating on foot from one part of a city to another. What kind of problems might we encounter on such a journey? If you are unfamiliar with the city you will need the help of other people – you might ask for directions or consult a street map. You might also use a satellite navigation system of the type available on most smartphones. There are already efficient algorithms that can compute the optimum route from point A to point B. But these strategies are often based on the assumption that no serious perception problems will occur along the way and that all relevant objects can be detected. In an environment such as this, mobile robots face enormous challenges given the currently available sensors and perception algorithms.

When we walk around a city, we constantly have to avoid other people, cross roads, and locate pavements. We also do not want to collide with the nearest tree or fall down a flight of steps. In addition to this, we need an exact awareness of where we are at any given

time. Robots cannot rely blindly on GPS because the inexactness of this technology can mean the difference between standing safely on the pavement and standing on the busy road beside it. These are just some of the problems that have to be solved before a mobile robot can be sent out into the wide world and find its way around autonomously.

Autonomous navigation for mobile robots has been a key issue in robotics for many years, and over the last few years, we have seen important progress in this area. However, most approaches have focussed on navigation inside a building, on the roads, or in an unstructured terrain such as a desert. So far there have been few systems which venture into busy urban environments such as pedestrian zones and can operate there with any degree of reliability. Due to their highly complex three-dimensional structure and the large number of moving objects, these environments are extremely challenging.

As part of a project funded by the European Commission called EUROPA (EUropean RObotic Pedestrian Assistant), we

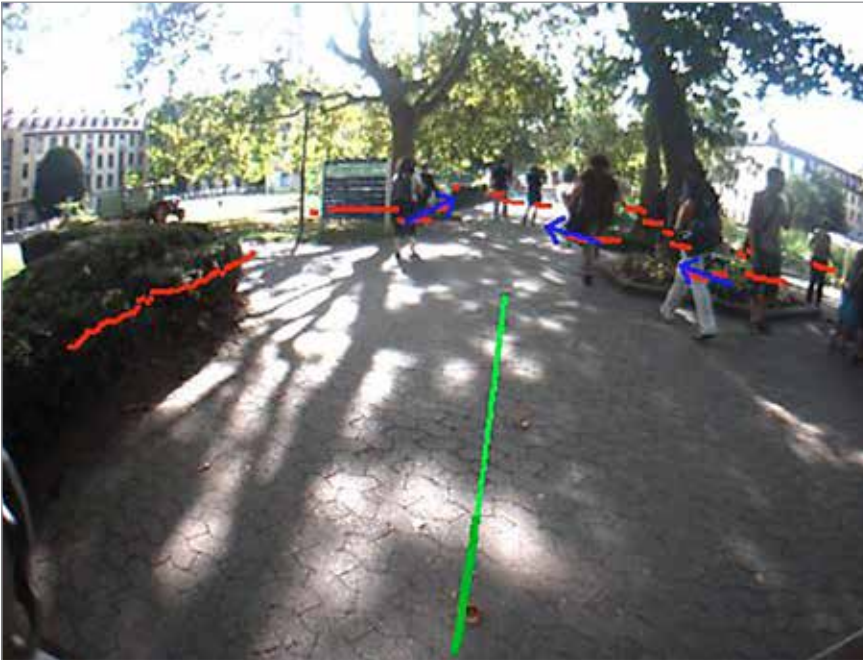


investigated whether it was possible to develop a robot capable of navigating in an urban environment without external assistance. The platform we used is called Obelix, a robot developed

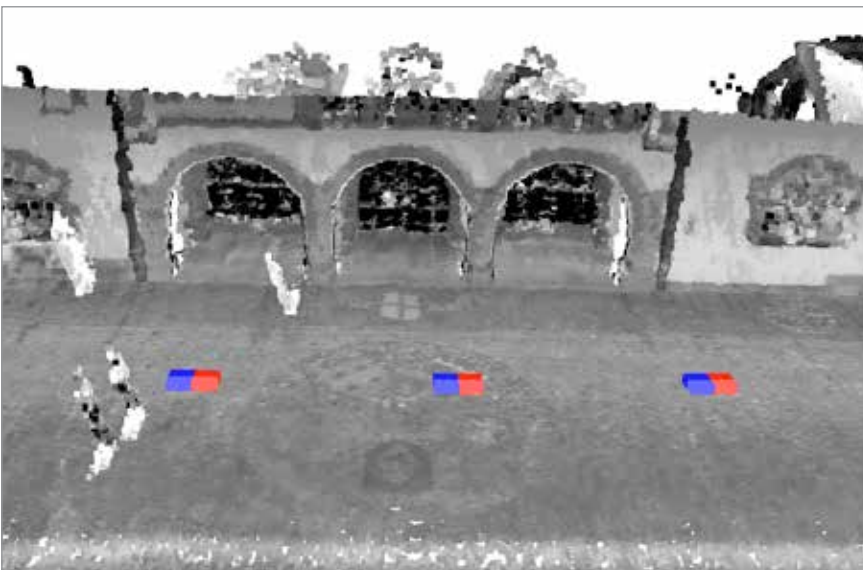
within the scope of EUROPA. Obelix is approximately 1.6 metres tall, weighs about 100 kilograms, and is equipped with cutting-edge sensor technology. Cameras provide the robot with important in-

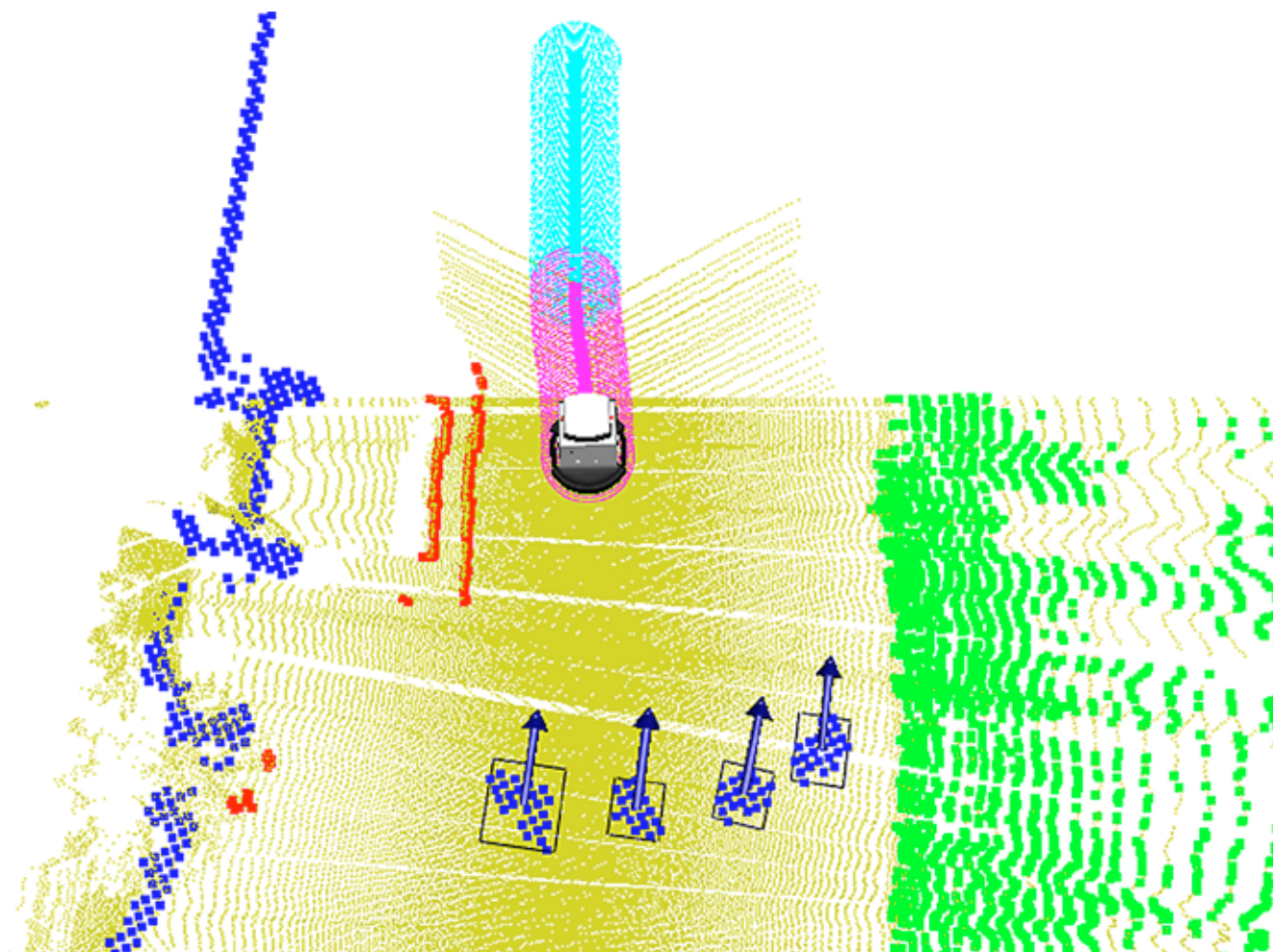
formation about its environment, and it is equipped with laser range finders which scan the environment for obstacles several times per second. Obelix also has a position sensor which is similar to the human organs of balance. This so-called inertial measurement unit can quickly detect changes in position and also vibration, providing Obelix with important information, for instance about uneven areas of the road surface. If there is too much vibration, the robot can reduce its speed to maintain safety.

Obelix controls its own movement with two separately driven wheels, left and right, and two passive wheels similar to those found on supermarket trolleys, one at the front and one at the rear. The robot has a maximum speed of one metre per second, allowing it to move at around 3.5 kilometres per hour – only slightly slower than a pedestrian's normal walking speed. It can cope with low rises of up to 3 centimetres, allowing it to traverse lowered kerbs, although it is currently unable to cope with normal kerb heights. Obelix's intelligence relies on software technology, the development of which accounted for most of the project work. Partly based on existing technologies for autonomous navigation, the software also features many advanced additions to allow Obelix to navigate autonomously in urban areas. For example, the new technology incorporates an accurate mapping system for urban environments, a data structure designed to handle very large maps, and a positioning system that allows the robot to locate itself to the centimetre within



Obelix, a four-wheeled robot, works out its path (above). Thanks to cutting-edge sensor technology, the robot scans its environment (below), detects obstacles and navigates autonomously.





An autonomous robot needs immense artificial intelligence to handle the huge amount of information resulting from highly complex situations.

these maps. All these components must be integrated and able to work together in order to guide Obelix safely to its goal.

For the robot's control system, the team of developers paid particular attention to the analysis of the road surface. Obelix can recognise different types of obstacle: stationary and moving objects, grass, and "negative" obstacles such as potholes, steps leading downward, and the "Bächle" (small water channels) so commonly found in Freiburg. It is able to detect these obstacles and

navigate around them. The ability to detect moving objects and predict their direction and speed also allows Obelix to avoid people who cross its path.

In August 2012, the control software had reached a stage of development where we could present Obelix to the public. Under the curious gaze of numerous onlookers and journalists, it travelled over three kilometres from the University of Freiburg's Faculty of Engineering to Bertold's Fountain, one of the city's landmarks, through a busy urban district. Through this experiment

the team wanted to demonstrate the possibilities already offered by a system of this type.

Obelix the robot was not entirely developed in Freiburg – various European partners were also involved in the EUROPA project. The complete intelligent system was developed under the leadership of researchers in Freiburg with the help of colleagues at ETH Zürich, the University of Oxford, KU Leuven and RWTH Aachen University. As well as the ability to navigate autonomously, it has set new standards in user interaction and the interpretation of sen-



Crossing the finish line after 4 km: Obelix navigated from the Faculty of Engineering to Bertold's Fountain in the centre of Freiburg without any significant problems.

sensor data. The hardware platform is also a new development, designed by robotics firm Bluebotics specifically for use in pedestrian zones. The cooperative approach used in the EUROPA project allowed expertise and experience in various fields to be combined – from environmental modelling and image processing to person recognition and product development. The project, led by coordinator Wolfram Burgard and technical director Cyrill Stachniss, produced a navigation system that is not limited to robots but could also be used in other systems such as fully autonomous wheelchairs.

Obviously, Obelix still has lots to learn and a number of problems remain. For instance, the robot's system of sen-

sors largely determines what it can and cannot detect, and there are still some "blind spots" where it cannot perceive its surroundings. In tricky conditions, Obelix may fail to detect the handlebars of bicycles close to its path, for example. In addition, the robot will often detect something but misinterpret it. Fallen leaves piled sufficiently high above the pavement surface, for example, or thin branches protruding from adjacent hedges or shrubbery, may be interpreted as potential obstacles. Whereas a human being would simply ignore these things and walk over or through them, Obelix does not realise that they are harmless objects. Instead, it treats them like any other obstacle and tries to go around them. It cannot tell the dif-

ference between a pile of leaves and a stone of a similar size. The fact that objects can be "deformable" and must be recognised as such is not yet part of its competence, so Obelix circumvents everything that it understands to be an obstacle.

Crossing roads also presents a particular difficulty. Obelix's sensors do not have an adequate range or high enough resolution to detect approaching vehicles or bicycles from a sufficient distance. The robot's current software is also unable to reliably interpret traffic lights. But in spite of these limitations, Obelix is already able to cover large distances without any human intervention. The reactions of passers-by were positive, and the researchers at the University of Freiburg are confident that their frontier research will allow Obelix's capabilities to be gradually enhanced and make the robot steadily more integrated in its environment.



Prof. Dr. Wolfram Burgard,

Gottfried Wilhelm Leibniz prizewinner 2009, and

PD Dr. Cyrill Stachniss

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Andreas Roye

Intriguing Transparency

With the help of new 3D textiles and manufacturing processes, it is now possible to make translucent concrete elements that are not only strong and durable, but also conduct light. This new generation of translucent concrete opens up a whole new range of potential applications.

Did you know that concrete was invented by the Romans? They used a building material called Opus caementicium, which was used to build the Pantheon – for centuries the largest non-reinforced concrete dome in the world and still standing in Rome today. Concrete, which since ancient times has been made of a mixture of cement, sand and water, has a relatively high compressive strength but a low tensile strength. As a result, it is normally used in situations where only compressive forces arise.

The big breakthrough in concrete technology did not happen until the

mid-19th century, when Joseph Louis Lambot (1814–1887) improved its tensile strength by adding metallic wires. Initially he used rabbit wire fencing from a roll. Reinforced concrete was born. The idea of concrete that let in light was first posited in the 1930s. In the early days fragments of glass were used to conduct light, and the concrete had poor optical properties. Modern translucent concrete is a mixture of cement, water, sand and optical fibres. But it took over 80 years for this material to achieve practical maturity. It was rediscovered in the 1990s at RWTH Aachen Uni-

versity, where the first experiments were carried out with different types of optical fibre. Beginning in 1995, a number of translucent concrete prototypes were created which offered the technical potential of a light-permeable concrete but were not suitable for large-scale production. Translucent concrete combines the strength and durability of concrete with the aesthetic qualities of natural light. It exerts a particular fascination on architects and designers. It can be used as a load-bearing partition to allow daylight into interior rooms; as a fire-proof wall to provide a safe escape

The world's first installation of an interactive translucent concrete façade, which opened in December 2012.





Left: Trademark translucence. New fibre materials and innovative technology are paving the way for translucent concrete. Right page: The material has many possible applications. Here is a corridor made of translucent concrete elements.

route in the event of fire; and as a non-bearing wall cladding combined with energy-saving LED lighting to create a pleasant, distributed lighting effect. Translucent concrete can alter the look of an entire façade and even be used to display traffic information on the front of a building. In short, it has a whole range of potential architectural applications.

So how is it made? Translucent concrete is always manufactured in the form of prefabricated parts, under laboratory conditions, so to speak. This is an important point to note, because people often enquire about ordering two or three mixes of ready-mixed concrete to cast a floor or underground garage – something which is not possible yet. Translucent concrete is made from fine concrete with a maximum particle size of 3 mm and optical fibres. The material is formed into large blocks by building up alternating layers and then cut into slabs. This creates solid cut con-

crete which conducts light through the embedded optical fibres. The unique feature of this material is that it offers the aesthetics of transparency in a solid and extremely durable material. Translucent concrete is usually weatherproof, UV-resistant, abrasion-resistant and non-flammable.

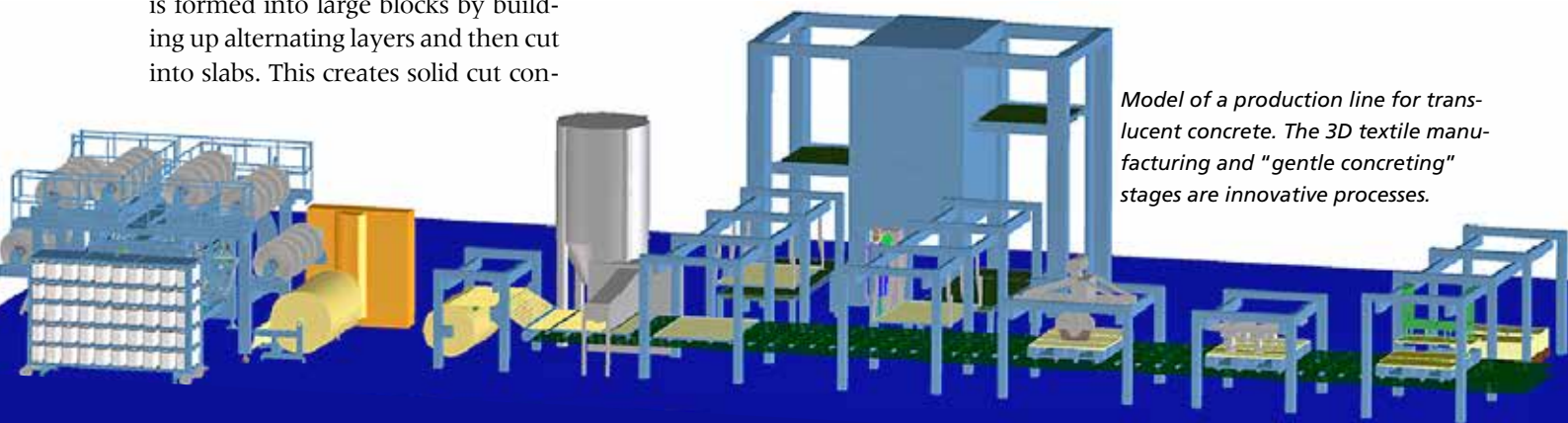
The time-consuming process of manufacturing large blocks of the material with embedded fibres poses two problems. Firstly, the concrete hardens exothermically – in other words, it gives off heat. In extreme cases this can lead to cracks after the material has cooled, and may even require the whole block to be scrapped. Secondly, even if the blocks are free of cracks, a very laborious cutting technique is required to remove large slabs from the block. This process demands circular saws up to 2.5 m in diameter.

In Collaborative Research Centre 532, “Textile-Reinforced Concrete – Foundations of a New Technology”, researchers in the Textiles sub-project sought to lay the foundations for the development of three-dimensional textiles. In the 1990s the Institute of Textile Technology at RWTH Aachen University developed a prototype

double rib loom to make 3D textiles that could be used in concrete applications. By working closely together, the researchers in the Collaborative Research Centre managed to meet the requirements of concrete manufacturing with the textile machine.

In his dissertation, “A High-Output Double Rib Process for Textile Concrete Applications”, the author laid the foundations for an industrially viable machine technology. As part of the DFG-funded project “Production Method for Thin and Light-Conductive Concrete Components through Three-Dimensional Textile Reinforcement”, a collaboration between LUCEM GmbH and RWTH Aachen University launched in 2007, researchers are developing an alternative manufacturing process for translucent concrete elements based on 3D textiles (a technology known as “Translucent Concrete 2.0”).

The basic idea is to incorporate both glass fibre filament yarns to reinforce the concrete and additional functional (light-conducting) fibres. These fibres conduct light from one side of the material to the other, while strong, durable glass fibres positioned just below the surface absorb tensile forces. Several large demonstration pieces were produced towards the end of 2010. This technique has the advantage that there is no need to cast and then cut the blocks. Instead, the translucent slabs can simply be manufactured in the desired form.



Model of a production line for translucent concrete. The 3D textile manufacturing and “gentle concreting” stages are innovative processes.



All illustrations: LUCEM GmbH

The project is concerned with slabs of about 2.5 cm thick, but the technique works for slabs measuring between 1 cm and 6 cm. The use of spatial reinforcement is especially productive with very thin slabs.

Ongoing research work is looking at the development of a usable 3D textile with integrated optical fibres and ways of adding the concrete without significantly deforming the textile. Further processing steps such as calibration, grinding, polishing, formatting and the drilling of holes for assembly purposes are being developed to match techniques used for natural stone.

The development of 3D textiles began with the selection of suitable fibre materials. For the reinforcement yarns, the findings of CRC 532 came into play and alkali-resistant optical fibres with a defined lengthwise and crosswise thickness were chosen. The yarns were embedded in such a way as to produce a practical reinforcement cross-section. A 3D textile also contains binder yarns in the top surfaces and “spacer” yarns that enable it to hold its three-dimensional shape. The gap of about 2 cm between the two reinforcement layers is maintained by a pile yarn made of black

dyed polyester with a diameter of 0.25 mm.

Up to this point existing technology could be used, but the further integration of optical fibres called for new approaches. If the optical fibres are embedded in the same way as the pile yarns, the reversal points end exactly at the level of the reinforcement yarns and as “loop tops” actually interlink with the reinforcement or binder yarns. The material’s developers wanted to make the optical fibres protrude by a few millimetres – ideally up to 5 mm – on either side of the material to allow light to enter above the reinforcement yarns later on. This was achieved by forming the optical fibres into loops on both top surfaces with low-melting auxiliary yarns. The auxiliary yarns can then be removed by heat treatment, making the loop tops of the optical fibres rise to an almost vertical position thanks to previously defined pretensioning.

However, this state is unstable. The heat treatment can only be used immediately before the concreting process (which must be as gentle as possible). The 3D textile is tensioned in a specially designed multi-part mould, then “opened” with a carefully calculated amount of hot air and immediately filled with a low-viscosity concrete suspension. The embedded loops of the optical fibres, which previously protruded from the textile, are now just beneath the two concrete surfaces, while the mesh of reinforcement yarns lying parallel to the top surfaces are spaced 3 mm apart.

After a hardening phase of two weeks the concrete is so hard that the optical fibres cannot be moved from their position even by hard grinding. This is the ideal time to grind both top surfaces down by a few millimetres. As soon as the double point of the optical fibre loop becomes visible on the

surface, light can enter the fibre and is then transmitted through the material. The better the surface is polished, the greater the “light yield”.

In addition to practical testing, the research team drew up a production concept and modelled a complete production line. They were able to demonstrate that all manufacturing processes could be carried out with a high degree of automation in a space of around 800 m². The two 3D textile production methods and the “gentle concreting” method are both new, while the rest of the production line uses familiar processes already used to work natural stone.

Concrete is the world’s most popular building material due to its low price. To make translucent concrete a successful product with its countless applications, innovative and highly scalable production processes are needed in order to reduce the associated costs. Translucent concrete has already been used in major construction projects including the Bank of Georgia in Tiflis and the headquarters of Signal Iduna in Dortmund. Soon we will see whole façades made of multifunctional translucent concrete, bringing daylight into the buildings of the future by day and serving as information boards by night.



Dr.-Ing. Andreas Roye

was a research assistant at CRC 532 in Aachen and is now the managing director of LUCEM in Stolberg.

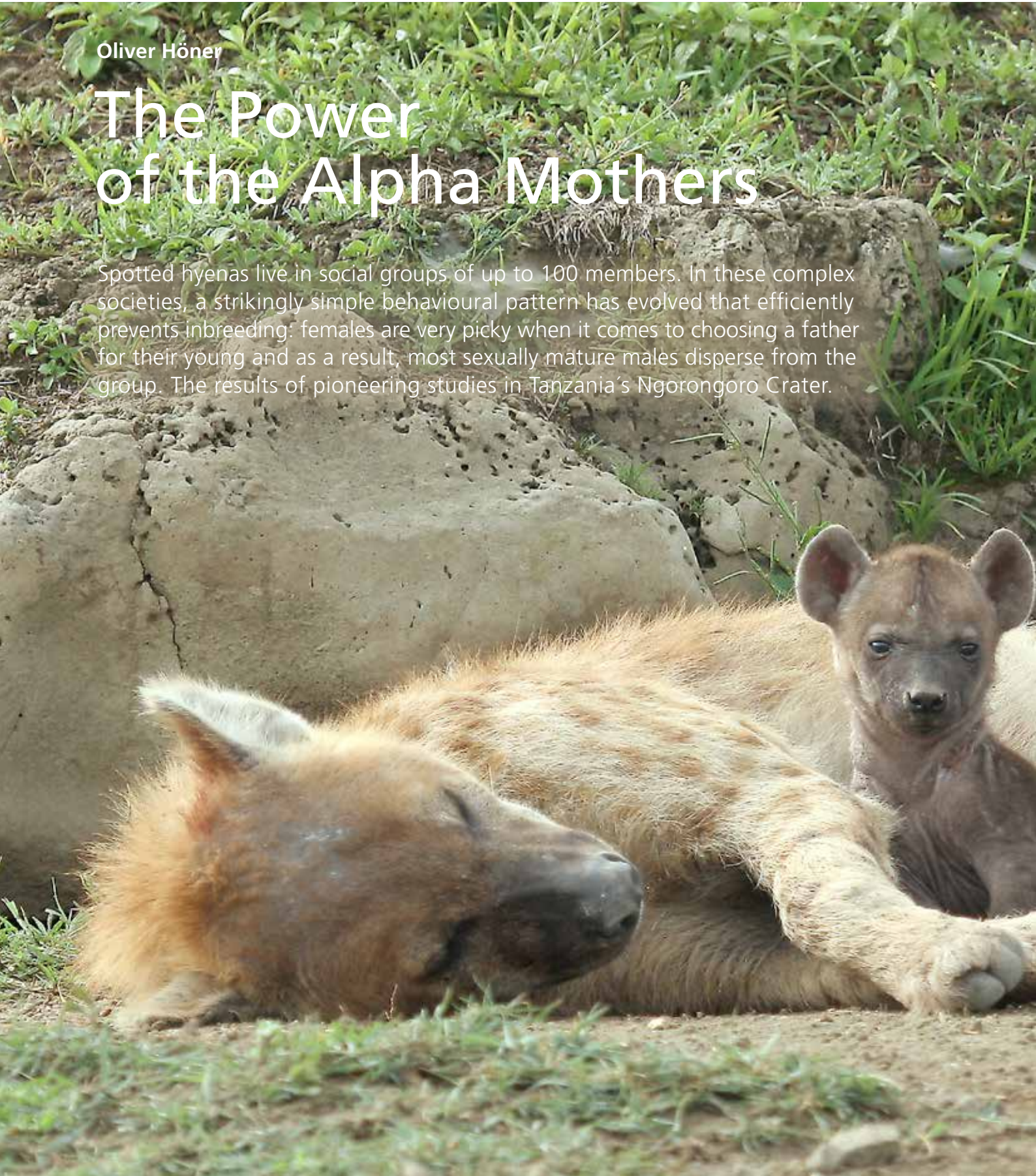
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www.lucem.de

Oliver Höner

The Power of the Alpha Mothers

Spotted hyenas live in social groups of up to 100 members. In these complex societies, a strikingly simple behavioural pattern has evolved that efficiently prevents inbreeding: females are very picky when it comes to choosing a father for their young and as a result, most sexually mature males disperse from the group. The results of pioneering studies in Tanzania's Ngorongoro Crater.





How do you envisage a spotted hyena? All too often they are reduced to an oversimplified image defined by their appearance, feeding habits and unmistakable “laughing” call. Mostly, they are portrayed as ugly and cowardly scavengers. In fact they are excellent hunters, who in some areas provide more food for lions than the other way round. And that’s not all. In terms of their social behaviour spotted hyenas are in many ways very similar to humans. They maintain close friendships and form coalitions; they cheat and they scheme; there are Casanovas and losers – and there are ruling families and palace revolutions. In fact, their lives are the stuff of soap operas.

Spotted hyenas are also a dream come true for behavioural

biologists and evolutionary ecologists, being easy to observe in the wild and easily identified by their individual spot patterns. They also have a shorter life span and generational cycle than other social mammals, and with a little patience, experience and a few tricks up our sleeves, we can take plenty of samples for hormone analysis and parenthood tests. These tests are of crucial importance in research into behavioural ecology, because we can only come to conclusions about the evolution or adaptive value of a particular trait if we understand the effect of this trait on reproductive success.

In this way we have been able to study a question that has been puzzling researchers for a long time: Why is it that among most mammals, it is the males and not

the females who leave the natal group? For a long time it was assumed that males disperse in order to avoid mating with their mothers, sisters or daughters, since offspring of closely related parents have a lower chance of survival than offspring of unrelated parents. However, this contradicts another fact: that mother mammals usually invest much more in their offspring and would therefore have more to lose from inbreeding than the fathers. So we would expect the females to disperse in order to avoid inbreeding rather than the males.

Researchers have not yet been able to answer this question due to the difficulties of tracking a sufficiently large number of males during dispersal and gauging their reproductive success in a new group. However, the spotted hyenas of

Dangerous alone, overwhelming as a group: Spotted hyenas can bring down both huge buffalo (below left) and agile zebras (far right). Clan and living environment. Good social relationships help spotted hyenas to gain or defend power. Scientists have been studying a



the Ngorongoro Crater in Tanzania provided the perfect opportunity. We have been following the life histories of every individual in this population for the past 17 years. The crater, which covers 300 square kilometres, is currently home to 650 hyenas from eight different clans. Gradually, we have mapped the genetic fingerprint of all adult hyenas and the fathers of more than 1000 offspring over seven generations. This gives us the most complete pedigree of a natural population of social mammals anywhere in the world.

We discovered that young male hyenas do not choose a new clan at random, but prefer to join clans with a large number of young females. Here they can expect very high reproduc-

tive success, because new arrivals have particularly good chances with young females. In choosing a mate, females apply the following rule: Choose a male who joined the clan after your birth or who was born after you. Through this very simple rule they avoid inbreeding with their fathers and older brothers. Of the 720 litters, only one was the result of a father-daughter pairing and no female ever mated with her brother. So the reason why it is mainly males who leave the group is that the females exercise their preferences and the males comply in order to reproduce. Because the number of young females in a clan varies, different clans have the most young females at different times.

But why do some males join groups with few young females?

Why are there large differences in reproductive success among males who choose groups with the same or similar numbers of young females? And what are the characteristics of successful males? Among spotted hyenas and other social mammals, there is growing evidence to suggest that the social status of the mother and the social environment have a decisive influence not only on the development of offspring while they are being raised, but also on their behaviour and success as adults. Spotted hyenas live in clans that comprise up to 40 females, 30 males and 30 young. The power relationships within a clan are clearly defined; the females are dominant and there is a strict linear hierarchy. Each clan is headed by an alpha female and her young.

In the African savannah they are skilled hunters, unfairly portrayed as cowardly scavengers. Social coalitions (centre) are vital within a population of 650 hyenas in the Ngorongoro Crater in Tanzania for 17 years.



These are followed by all the other females and their young, and only then come the alpha male and the other males who joined from other groups. Daughters and sons (until emigration) rank just below their mother, who supports them during interactions with other clan members.

In these societies, high-ranking mothers have preferential access to food sources and invest more in their offspring than lower-ranking mothers, increasing their offspring's chances of survival. The maternal influence has a long-term effect on daughters, because high-born daughters reproduce earlier and more frequently than low-born ones.

Until recently we did not know whether high-born sons also enjoyed lifelong benefits from this "silver spoon" because of their tendency to disperse. To answer



A tricky act: Because female spotted hyenas have a pseudo-penis, mating is only successful if the female helps the male.

this question, we analysed data on the growth, dispersal behaviour and reproductive success of more than 300 sons produced by mothers of different social statuses. It was discovered that the sons of high-ranking mothers indeed not only grew faster but also joined groups with more young females, fathered cubs earlier and had greater reproductive success.

But how is it that high-born males disperse to better clans? Are they preferred by females over low-born males and if so, why? Unlike many other social animal societies, physical size and strength are of little use to a male hyena when it comes to fathering offspring. The females are not only

dominant and as large and strong as the males, they also have external reproductive organs that resemble those of the male, and for successful mating, the active assistance of the female is needed. The outer labia are fused to form a pseudo-scrotum and they have an extended penis-like clitoris which points forward and through which they copulate and give birth.

As a result, males have no option but to comply with the preferences of the females and form amicable relationships with them. There is no advantage in squabbling with other males to attain a higher status; they cannot prevent a female from choosing another suitor, even if he is of a lower rank.

Does this mean that the social status of the mother and the social environment in which the males grow up affects not just their physical characteristics but also their



Illustration: Leibniz-Institut für Zoo- und Wildtierforschung

In the lab: The DNA sequencer helps us to genetically determine paternity and maternity in spotted hyenas.



All illustrations: ©. Höner and B. Wachter

Observing behaviour up close: Many spotted hyenas in Tanzania's Ngorongoro Crater are acquainted with the German research team from a young age.

behaviour? A recent theoretical study suggests that social origin affects the ability to handle stress, which impacts on behaviour in adulthood. High-born males might be expected to be more able to cope with extreme stress through behavioural adaptations and return more quickly to a state of internal balance.

Dispersal and integration into a new group is a time of great physical and social challenge for spotted hyenas. New arrivals in a clan start at the very bottom of the social hierarchy. A male may lose up to 100 rank positions when he joins a new clan, and as the lowest ranking member it is more difficult to get enough food. Newcomers also have to form relationships with the females and established males. We know from an earlier study that in spotted hyenas, great social challenges are associated with stress, which can be measured by the

release of large amounts of stress hormones (glucocorticoids).

To investigate the possible effect of social origin on behaviour and the release of stress hormones, we are following the young males on their wanderings and advances and documenting their behaviour. We are also collecting male droppings to measure the concentration of glucocorticoid metabolites they contain and thus the level of stress.

Detailed behavioural and hormonal analyses have yet to be carried out, but we already know that males vary substantially in terms of their behaviour and stress levels during this phase of their lives. There are self-confident males who play an active role in forming relationships early on. Other males are more cautious and rarely take the initiative. Still other males prefer to make advances when the females are otherwise occupied and un-

likely to be aggressive, for example when suckling their young.

If male behaviour proves to be linked to glucocorticoid concentration and social origin, this would not only confirm a theoretical prediction, but also provide an important indication that the "personality" of an individual spotted hyena is shaped by development and experience during adolescence.



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Rembert Unterstell

Diving into the Goethe Period

Germanist and Emmy Noether group leader Simon Bunke studies cultural themes in the mirror of literary discourse. For him, the sheer diversity of his subject is the key.

Paderborn. For some, the city on the Pader in Ostwestfalen-Lippe is a small city with conservative, Catholic leanings, while for others it is a charming, even cosy university town. But does this mean there is no room for academic and intellectual ambition?

At the Faculty of Arts and Humanities, Germanist Dr. Simon Bunke, 37, certainly has an ambitious objective. The leader of an Emmy Noether research group who is dedicated to the literary and cultural history of the Goethe period, he wants to find out how the quality of sincerity (“Aufrichtigkeit”) became a central cultural value in the emerging bourgeoisie of the 18th century, not only influencing social debate but also finding its way into the literature of the period between 1750 and 1830.

Even though the endeavour will not ultimately produce a fundamental reinterpretation of the world-class literature written between the Enlightenment and the Romantic era, Bunke surveys contemporary discourses from an Archimedean point: the independent junior research group, entitled “Sincerity in the Goethe Period”, intends to trace the history of this quality in different areas of discourse – “Erlebnislyrik”, the culture of letters, plays, acting theory, and key texts representing sentimentalism and the classical period. It is an original undertaking.

Bunke speaks as eloquently of the project as he does of his home city of Munich. He grew up in Unterhaching on the city’s outskirts and studied modern German literature, comparative literature and theatre studies at Ludwig-Maximilians-Universität. After achieving a top grade of 1.0 in his school-leaving exams, why did he choose to be a Germanist? The answer is somewhat restrained: he “always liked reading” and was “interested in cultural contexts reflected in texts”.

As a student, his intellectual curiosity and personal ambition became apparent and he developed an interest in cultural themes as reflected in

literature. His interest also extended beyond the borders of his native country to France. This was reflected in his master’s thesis, “Figures of Discourse”, a comparative analysis of the narrative works of Theodor Fontane and Gustave Flaubert. Critics of the book praised the consistent interpretations and its discourse analysis with its obvious debt to Foucault.

A Studienstiftung scholar and doctoral researcher (supervised by Professor Gerhard Neumann), he made a further foray into discourse analysis by studying the cultural history of homesickness. His own interpretation is that the notion of homesickness developed between the end



of the 17th and the beginning of the 20th century, not as a sentimental feeling, but as a fatal illness. Until the 18th century homesickness was known in German as the “Swiss disease” or “*morbus helveticus*”, and mountain-dwellers and soldiers reportedly died from it.

Beginning in 1800, the discourse of homesickness expanded to Germany and the Anglo-American world, gradually being depathologised, before disappearing again around 1900. It was the rise and fall of a medical paradigm with culturally influential qualities, visible in military organisation, court verdicts, lyrical poems and narrative texts. After writing his dissertation, which was based on an extraordinary volume of material (“I analysed 60 000 pages of primary text”) and incorporated long lines of exposition, he was awarded his Ph.D. at LMU Munich in 2006.

This enabled him to move to the Department of Comparative Literature at Stanford University. As a visiting scholar working with Professor Hans Ulrich Gumbrecht and DAAD fellows, he was inspired by the working environment at the elite Californian institution. But his desire to work at Stanford or another Ivy League university was not to be fulfilled, and so, supported by the Stiftung für Romantikforschung, he returned to Munich to work on a project basis before moving to Paderborn – then no more than a name on the map to him – to become academic coordinator of the project group “Dialogicity of Knowledge” at the start of 2009.

Here he has gained experience of applying for third-party funding, learned to appreciate the networking opportunities, and gained teaching experience, which he considers extremely valuable. “The teaching

The Bocca della Verità or “mouth of truth” in the portico of the church of Santa Maria in Cosmedin, in Rome. “Sincerity” became a culturally significant value in 18th-century Germany, even influencing the literature of the Goethe period.

ethos in America is different”, says Bunke. “New incentives could be created at German universities by introducing awards and placing an institutionally established value on teaching, as is already done at Paderborn through teaching awards.” He is currently giving his first lecture on the lyric poetry of the 18th century.

For almost two years, Bunke and his two research assistants have been studying “Sincerity in the Goethe Period”. The notion of sincerity in thought, feeling and action, he explains, was fundamental to bourgeois identity in the 18th century, contrasting with the courtly “culture of compulsion” (and falsehood) of the baroque era. The bourgeoisie developed and propagated a culture of sincerity, understood as a correlation between internal thoughts and external signs, as an ethical standard for the individual and a new, community-forming value orientation and set of objectives. The independent junior research group is scrutinising all of this, studying the basis in moral philosophy and comparing it with French and, in focus analyses, German literature.

Although the project has a broad basis, its multifaceted character is equally important to Bunke. This diversity is demonstrated by the anthology “*Lyrix. Lies mein Lied*”, which analyses song texts, and the publication of the erotic novel “*Ernst und Minette*” by Johann George Scheffner (1736–1820), now a largely forgotten writer and a friend



Illustration: Wikipedia/Roughneck

of Immanuel Kant. He practises the editor’s craft, which he believes to be “undervalued” in terms of an academic career, “to allow forgotten texts to see the light of day again”.

Bringing things into the “light of day” is Simon Bunke’s main concern, although, as he himself says, he is not guided by a museological fascination but the desire to “reconstruct cultural phenomena that are fundamental to the society of today”. The ideal of sincerity as modelled in the 18th century is just one example of this. Digging down into the cultural terrain – even the greats of Goethe’s time would have approved.

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Martin Loiperdinger and Ludwig Vogl-Bienek

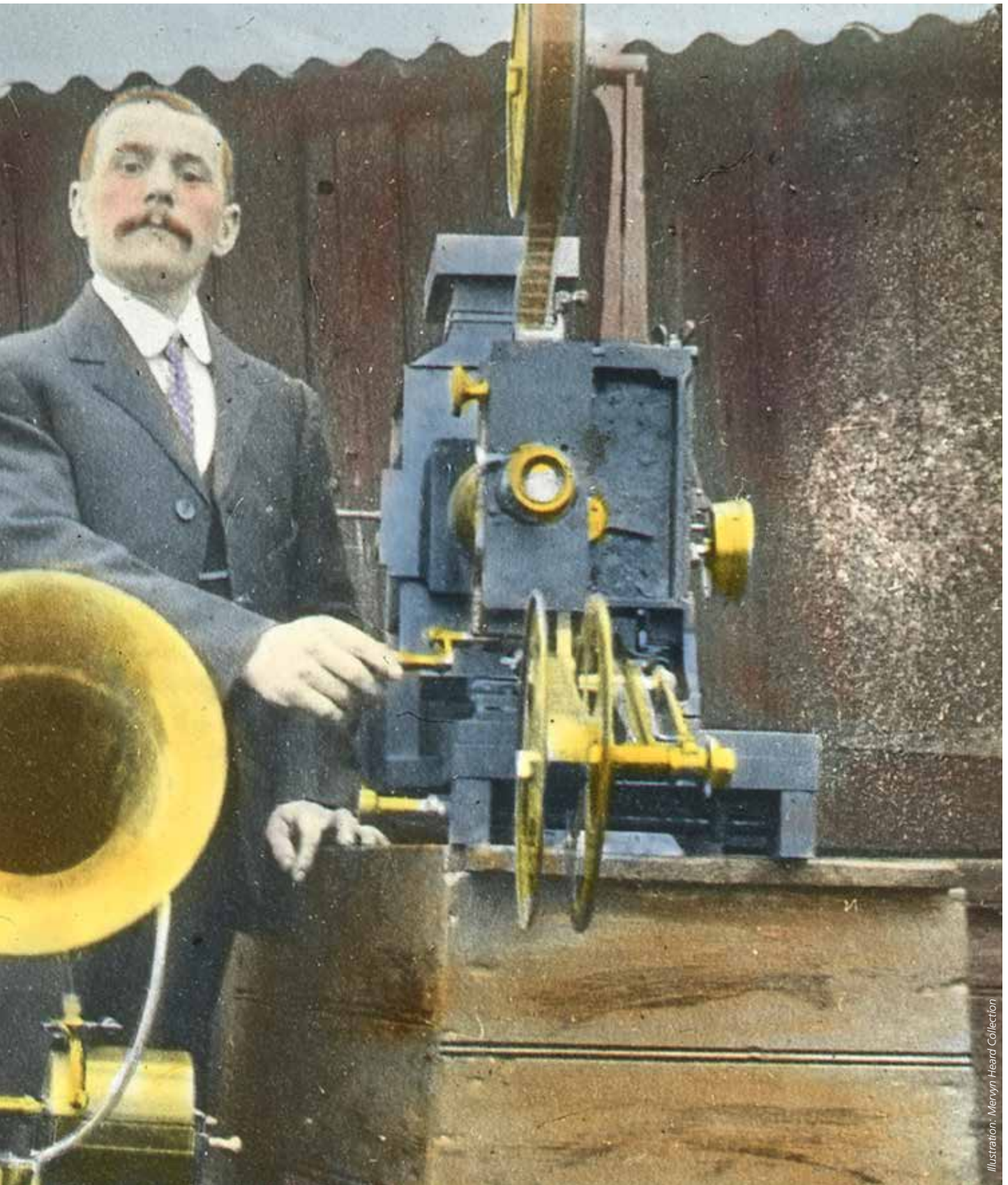


Illustration: Mervyn Heard Collection

Today, as 100 years ago, poverty has many faces: orphans freezing in the snow, drunkards dragging their families into misery, the hungry begging for bread, and mine disasters leaving a legacy of grief and hardship. Circumstances and stories such as these, recorded in pictures, tell us a great deal about the public debate on poverty and the care of the poor in the years either side of 1900. It was during this period that social organisations began to use series of slides and short films, projected on to a screen, to raise the public's awareness of the problem of poverty. In lecture theatres, Sunday schools, music-halls, cinemas and churches, audiences could listen to "illustrated lectures" consisting of slides, films, music, songs and recitations.

The DVD *Screening the Poor 1888–1914*, the result of DFG-funded research projects, documents and illustrates how the omnipresent "social question" was treated in pictorial stories. In Victorian England, well-to-do citizens would make expeditions to the slums to see for themselves the appalling conditions. The same scenes could also be viewed on the screen without the attendant dirt and danger. Many people distanced themselves from the fact that so many children lived in abject poverty; such children were often suspected of being petty criminals.

The media productions of charitable organisations countered this prejudice against poor children, portraying them as needy and worthy of love. Trade union-

ists, social reformers and philanthropists spoke out vociferously against child labour, especially the often life-threatening working conditions and exploitation in factories.

To the people of this time, presenting the suffering of poor children as pictorial stories was the best way of appealing for charity and social care. Stories of old people living in poverty after a lifetime of toil brought the social question of care for the elderly to the screen. Finally, the problem of alcoholism and the Temperance movement also belonged to the standard repertoire of illustrated lectures and early films. Adults were soon suspected of being the cause of their own problems through falling victim to the "demon drink".

Glass slides show the hardships of the late Victorian era. Working and family life in the shadow of the threat of a pit disaster: two images (1st (2nd picture from left) drinks away his family's money. – Children in poverty: churchgoers (4th picture from left) ignore a barefooted orphan in spite





The magic lantern for the art of projection. About 100 years ago, slides were shown to audiences with live music and recitations.

coloured photographs on screen to engage the empathy of their audience and to attract donations and other forms of charity. The accusatory portrayal of social deficits strengthened calls for change, for example the clean-up of the slums, the restriction of child labour, the reform of the poverty laws and the introduction of old-age pensions. The list of social demands was a long one.

their families could eat and called for safer working conditions and provision for their dependants. In many cases, the only escape from poverty was the hereafter. Emigrants preferred to seek paradise in faraway America, embarking upon a hazardous journey to reach their destination. Occasionally a charitable rich person makes an appearance, at least in fictional films.

One well-known activist on social matters was journalist and author George R. Sims (1847–1922). For the purposes of illustrated lectures, his poems about poverty were illustrated with “life model slides”. Ordinary local people served as models, posing in front of painted backdrops to portray scenes of poverty. Re-

Slides and early films on the subject of poverty present a wide range of genres and presentation forms. Religious, charitable, philanthropic and social organisations in Britain all sought to use the sensory appeal of large hand-

Vivid images of mining disasters document the tragedy of miners who had to risk their lives so that

and 3rd from left) from a series with the telling title “Don’t Go Down in the Mine, Dad”. – Poverty is often linked with alcohol abuse: a father of the freezing winter weather. A picture from the series “Ora pro nobis” (1897). Far right: A young girl stands by the bedside of her dying mother.



Illustrations (from left to right): illuminago collection; Mervyn Heard Collection; illuminago collection; illuminago collection; Mervyn Heard Collection

markably, the glass negatives were copied in large quantities, hand-coloured and prepared for use in lectures. These slides and films were even shown during church services. Illustrated songs such as *Ora pro nobis* recalled the Christian duty of charity.

Early films about poverty contributed an edifying element to entertainment programmes at the cinema. Material from high literature such as Victor Hugo's *Les Misérables* provided seriousness and credibility. Real-life stories, meanwhile, showed the beneficial effects of charitable activities. U.S. film director David W. Griffith (1875–1948), for example, portrayed the epiphany of an alcoholic who, watching a play at the theatre, recognises himself and

his own tragic story in a drinker portrayed on stage.

Long before the invention of film, glass negatives and slides from the early years of projection had become a visual mass medium in their own right. The debt owed by early short films to this “mother of the cinema” becomes clear when we make a comparison. Multimedia presentations combining the projection of images with live music and recitation was more important than the distinction between “static” photographs and (apparently) moving cinematographs – the film was born from the way in which the material was presented.

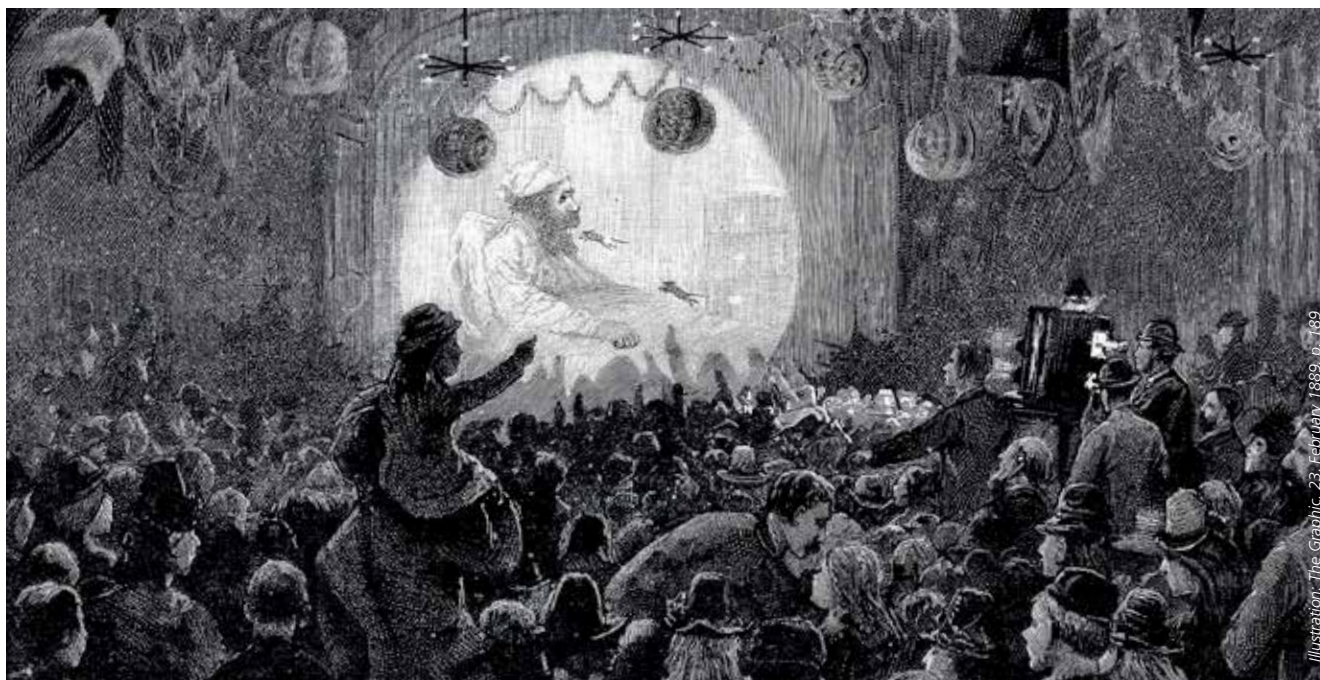
At the Munich Film Museum, inspired by this insight, the *Illuminago* ensemble presented a series of original Victorian slide sets

using authentic projection equipment in a new theatre production, allowing today's generation to gain an impression of the original audience experience. The live performance of this magic lantern show was recorded and produced as a DVD. Digital slideshows with spoken text illustrate the combination of photographs and recitations.

As part of two DFG-funded projects, extensive research was carried out in film archives and media collections and the historical material was carefully indexed. A university research project cannot handle a transfer project of this type on its own, so the researchers joined forces with the German Film Institute to gain access

Dangerous, life-threatening work: A scene from the French movie “Au Pays noir” (“Down in the Coal Mines”) from 1905





A bonding community experience: Children and adults alike are spellbound by the projected pictures. An engraving from 1889.

to material in ten film archives in Germany and abroad. The Munich Film Museum provided much of the driving force behind the live performance by Illuminago and the digital recording. Finally, the Goethe Institute produced the English subtitles, essential for the international distribution of the DVD, which was produced by Edition Filmmuseum.

Any transfer project depends on visibility and usability, not only in the academic sphere but also for the general public. So at an exhibition held in Trier, “Poverty – Perspectives in Art and Society”, organised by the Collaborative Research Centre “Foreignness and Poverty”, slideshows were shown on a monitor. At “Poor Luxembourg?”, an exhibition held at the Luxembourg City History Museum, a cinema was set up where a large part of the DVD could be viewed for a whole year. To accompany

both exhibitions, Illuminago gave a live performance of “Pictures in the Shadow of Poverty”.

For everyday educational purposes it is not practicable to put on performances of this type, so a good substitute is provided by digital slideshows and film recordings of live performances – and the conventional slide, which has been used in the teaching of art history for over a century to show original works of art. For teaching use the DVD also includes documents and materials relating to the slides and films.

The essential ambivalence of these historical images provide a whole range of different perspectives, not only in media studies but also in history, the history of art, English language and literature, cultural studies, sociology and ethnology. Digital editions of historical images have great potential for

research, teaching and the general public – and it is a potential that deserves to be exploited.



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The double DVD “Screening the Poor 1888 –1914” was published in the series “Edition Filmmuseum”. www.edition-filmmuseum.com/product_info.php/info/p130_Screening-the-Poor-1888-1914.html

Conrad Marx and Peter Krebs

Nature's Little Cleaners

Studies carried out by researchers in Dresden have shown that self-cleaning processes in natural water bodies can be significantly improved by adding just the right amount of microorganisms to the water discharged from wastewater treatment plants. But whether this insight will produce a new ecotechnology strategy remains to be seen.

Whether domestic or industrial, wastewater is generally considered unpleasant, unappealing and best kept out of sight. The general view is that wastewater disposal is little more than a necessity associated with substantial costs. In the eyes of the general public wastewater management has a very lowly status, far below the supply of

drinking water, telecommunications and electrical power. Yet efficient and effective wastewater management is vital to public health and the protection of water bodies and water-based ecosystems.

According to the Federal Statistical Office, each person in the Federal Republic of Germany produces an average of 120 litres of wastewater

every day, which is collected, channelled and purified in a highly complex process. In Germany, the water discharged from treatment plants must meet specific standards defined by law. In keeping with the precautionary principle, the stipulated limit values depend on the size of the plant and the current state of technology. They are intended to promote eco-



Left: Aerial view of the treatment plant in Kaditz, Dresden. It is also home to a modern biological wastewater treatment system which went into operation in 2005. Right: Egg-shaped digesters.

logically sound and economically affordable wastewater treatment.

However, in keeping with the principle of “integrated water protection”, the holistic and ecological management of wastewater systems and natural water bodies, sewage treatment plants could be used not merely to minimise pollution but also to support the ecological self-cleaning function of natural water bodies. This idea has prompted ecotechnology strategies which – in simplified terms – seek to influence the food chain in order to improve the self-cleaning of natural water bodies.

The aim of the DFG-funded project “Control of Wastewater Treatment Processes to Support Ecotechnology Measures in Rivers” is to grow microorganisms in a treatment plant’s reactor and add them to the discharged water on an as-needed basis and thus improve self-cleaning processes in natural water bodies. The first microorganisms to be considered were nitrifying bacteria, which convert ammonium (NH_4^+) into nitrate (NO_3^-) through a process called nitrification.

Good nitrification capacity is essential to the functioning of an ecosystem because ammonium is kept in a chemical balance with toxic ammonia (NH_3). Or to express it in more general terms, nitrification plays a crucial role in an ecosystem’s nitrogen cycle.

Biological processes are an indispensable part of wastewater treatment. The activated sludge, which consists mainly of microorganisms,



Illustration: Stadtentwässerung Dresden GmbH

is brought into contact with the wastewater. The dissolved organic components in the wastewater and the oxygen added to the biological reactor enable the microorganisms to grow and proliferate.

To keep the amount of sludge in the system constant, sludge is removed regularly. This “surplus sludge” is further broken down in larger systems through a process of digestion at a temperature of around 35°C , producing methane for energy and heat at the same time. This process releases NH_4^+ which is dissolved in the water phase. After a digestion process lasting 15 to 20 days, the sludge is dewatered. Because of the high temperature of digestion, the process water is still warm with a high NH_4^+ concentration (10 to 25 times the concentration found in municipal wastewater). Because microorganisms grow

faster at higher temperatures and when more nutrients are available, this process water is the ideal medium for growing nitrifying bacteria.

In laboratory tests, the bacteria were exposed (adapted) in artificial and real process water to nitrification inhibitors, which would inhibit growth and subsequent material breakdown in non-adapted microorganisms.

Nitrification inhibitors are added to agricultural fertilisers to prevent nitrification of the plant-available nutrient NH_4^+ and encourage rapid crop growth. Large amounts of nitrification inhibitors are washed out of soils used for agricultural purposes by rainwater, partly inhibiting the nitrification process in water bodies. But adapted nitrifying bacteria would be able to break down ammonium and thus also reduce toxic ammonia in spite of the presence of these inhibitors.



During the study period, ten laboratory reactors were each operated for a period of 12 to 34 months. The nitrification inhibitors investigated were Allylthiourea (ATU), 3-Methylpyrazole (MP) and 1,2,4H-Triazole (TZ), the last two of which are listed in the “Fertiliser Ordinance”. MP exhibits the strongest inhibiting effect, inhibiting nitrifying bacteria by 50% even at low concentration (0.2 mg per litre). Similar inhibiting effects were measured for ATU and TZ.

One key finding was the fact that in laboratory tests, at 30° C almost complete adaptation of the nitrifying bacteria to an inhibitor concentration of 5 mg/l was observed for all inhibitors. After an adaptation phase the nitrification capability of the microorganisms increases again to the same level as would be observed without inhibitors. But when the temperature was reduced to less than the 30° C of the process water, the bacteria adapted much more slowly and even showed no adaptation at 15° C.

To verify these results and the associated question of whether the bacteria added at 30° C can survive and “function” in natural water bodies, they were exposed to an environment with a lower temperature of 10° C and a lower NH_4^+ concentration.

The Dresden-Kaditz treatment plant, which treats domestic and industrial wastewater as well as rainwater. First the sewage passes through a mechanical cleaning stage (centre). This is followed by the biological cleaning stage (bottom), which uses microorganisms that bind organic contaminants in the water by their metabolism. Finally comes secondary sedimentation (top).



Illustration: J.G. Krebs

Monitoring the nitrifying bacteria is a labour-intensive task.

The results showed that lowering the temperature from 30° C to 10° C reduces activity by over 80% but the previously achieved level of adaptation is maintained. Simultaneously reducing the NH_4^+ concentration (from 100 mg/l to 4 mg/l) has the effect of further reducing nitrifying activity to 3%. Given the low nutrient supply, this is unsurprising.

Overall, the results demonstrate that nitrifying bacteria remain active when conditions are fundamentally altered but their effectiveness is significantly reduced.

The research allows us to conclude that producing nitrifying bacteria in the process water treatment system is not sufficient for continual discharge to the environment. We can effectively support self-cleaning processes in water bodies if nitrifying bacteria are added to the discharge water of treatment plants for only a short period, while rainwater

washes out inhibitors from agricultural land and contributes increased ammonium loads to water bodies from overflowing sewerage systems or agricultural areas.

An approach of this type could be used to reduce peak concentrations of ammonia and keep them below a toxic level.

Whether the strategy of adding nitrifying bacteria to water bodies for short periods and on a needs basis can actually be implemented remains to be seen. The possibility of breeding other microorganisms with higher growth rates and lower temperature sensitivity must also be studied to see if they could serve ecotechnology purposes. The methods and experimental setups used in this research project could, in theory, be used for other microorganisms and contaminants.

The research confirms that wastewater treatment plants can be

used as biotechnology reactors for forward-looking water protection in an approach that goes beyond simple sewage and sludge treatment. This would open up new, previously unconsidered possibilities for flexible, immission-based water protection. The concentration of indicator substances in rivers could be measured on a case-by-case basis so that microorganisms stored in the treatment plant's reactors could be discharged to the water as and when required.

The additional complexity of this method would be within reasonable limits, as the only investment required would be the metering and process control technology for the microorganisms in the plant's discharge area, with no additional reactors. However, before a strategy of this type could be implemented, the necessary legal framework would have to be created.



Illustration: UFZ

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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 young researchers. Researchers who work at a university or research institution in Germany are eligible to apply for DFG funding. Proposals will be peer reviewed. The final assessment will be carried out by review boards, the members of which are elected by researchers in Germany in their individual subject areas every four years.

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

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

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

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

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In mid-December, against an unusual backdrop of statues, busts and friezes, the second event in a special series, "Controversies in Art and Culture – Academia in Bonn", took place at the University of Bonn's Academic Museum of Art. DFG Secretary General Dorothee Dzwonnek (seen here giving a few words of welcome) invited psychologist Klaus Fiedler (Bayreuth), medical ethicist Bettina Schöne-Seifert (Münster), sociologist Armin Nassehi (Munich) and literature and media expert Joseph Vogl (Berlin) (seated from left to right with DFG spokesperson and moderator Marco Finetti in the middle) to discuss the highly topical yet age-old phenomenon of "self-optimisation". It was an exciting evening, the particular attraction of which lay in the complexity and diversity of the viewpoints and levels of debate presented. The series of events is designed to strengthen the DFG's links with the city of Bonn and its university. The next event will take place in spring 2014 with the theme "Digital Society".