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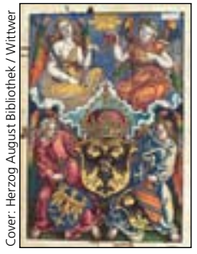

Cover: Herzog August Bibliothek / Wittwer

The Virtual Print Room

"Sancta Iusticia, Allegorie mit den Wappen des Reiches und der Stadt Nürnberg": The hand-coloured woodcut of a sketch by Albrecht Dürer (1471–1528) is one of the many thousands of works being digitally collected by researchers in Braunschweig and Wolfenbüttel. **Page 26**

Matthias Kleiner

Quality over Quantity

The flood of publications is detrimental to science. The DFG now responds in its own way: Our mandatory rules for publication lists in funding proposals and final reports mark a paradigm shift

I don't want to sound grandiose, but what the Senate of the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) decided at its first session this year, upon suggestion by the DFG Executive Committee and with subsequent approval by the Joint Committee, is nothing short of a paradigm shift. The issue: scientific publications – how researchers deal with their publications and how scientific publishing is done in general.

Beginning on 1 July of this year, new rules on lists of publications will apply to all funding proposals, draft proposals and final reports submitted to the DFG – and we are talking about over 23,000 submissions per year. These rules will limit the number of publications which researchers can list in their proposals and reports to a few relevant key publications. There used to be no such limit; researchers were free to list as many publications as they saw fit. Now we provide specific guidelines.

In doing so we want to send a clear signal to show that we value quality over quantity and that it is all about scientific substance.

These new guidelines concern two important sections within all proposals and final reports:

In their biographical sketches, researchers can now cite a maximum of five publications – the ones they consider the most significant and relevant to their research career.

As part of the actual description of the proposed or finished project, only two publications can now be included per year of funding. In other words, if a researcher applies for a three-year individual grant, he/she can list up to six publications. In case of multiple applicants, up to three publications may be listed per year.

In addition to this limit, another important rule will be introduced: A work may only be cited if it has already been published, or is demonstrably about to be published. In the latter case, the manuscript must be submitted along with the publisher's acknowledgement of acceptance. Manuscripts that have been submitted for publication but not yet accepted cannot be included.

But we want more than just to limit the number of listed publications and thus reduce the weight (even in the literal sense) of publication lists. We also want to place greater emphasis on the main body of the proposal or report, i.e. the description of the applicant's objectives, preparatory work, or project activities. This main part should consist of a self-contained text that can stand on its own. It may cite publications, but reviewers will not be required to read them. The review and evaluation will therefore be based on the main body.

Why these precise rules? For quite a while now, we at the DFG have been thinking hard about what we can do, using the means at our disposal, to counter developments in the publishing area that worry us and are detrimental to science and research.

Publications are the currency, the gold standard of research. They disseminate scientific findings and provide insights into the work of researchers and the quality of this work. So far, so essential. But for many years now, quantity has been gaining the upper hand over quality when it comes to scientific publications and their evaluation. We see this in many areas, from performance-based allocation of funds to professorial appointments to reviews of funding proposals – everywhere we look, the role of indicators such as the Hirsch factor and the impact factor has grown in importance. And it has become fashionable to take a piecemeal approach to publishing by chopping up findings into ever smaller publishable units.

The first question asked is often no longer "What did they investigate?" but "Where and how much did they publish?" This puts enormous pressure on researchers to publish as much as possible. This pressure isn't new, but it has become stronger and taken hold in all subject areas and at all levels of research.

This is not only harmful to science and scholarship in general, but also in particular because it provides incentives for scientific misconduct. For example, funding proposals may claim that certain articles have been submitted for publication even though they have not. This actually happened last year at a DFG-funded Collaborative Research Centre in Göttingen. Yet this special incident and the general issue of misconduct related to publications were not the only or even the most important reasons for our discussions. Those began much earlier and were far more wide-ranging.

Incidentally, these developments are not specific to Germany, let alone to the DFG. In many places the quantity-based approach has gained in importance and led to debates and rules to counter it. In the US, proposals submitted to the National Science Foundation may cite no more than five publications related to the proposed project and up to five additional publications; for the National Institutes of Health, the maximum is 15 publications; and in both cases, all works must have been published or at least accepted.

Back to our new DFG rules: We are aware, and we consider it a good thing, that these rules will change the work, even the lives, of thousands of researchers. Applicants will have to be more selective; they will have to limit and restrain themselves. And they will have to change the way they approach their own writings and publications. The work of reviewers will change as well; we hope that they will look more closely at the few publications that are listed.

All of this can only be good for research and our funding activities. This alone is reason enough for us to insist on the new rules and make sure they are adhered to.

Specifically: Those who continue after 1 July to list 50 publications instead of five will have their proposals sent back to them, with a friendly but firm request to edit them. We do hope, however, that this won't be necessary very often.

Illustration: Frenz

Prof. Dr.-Ing. Matthias Kleiner is President of the DFG.

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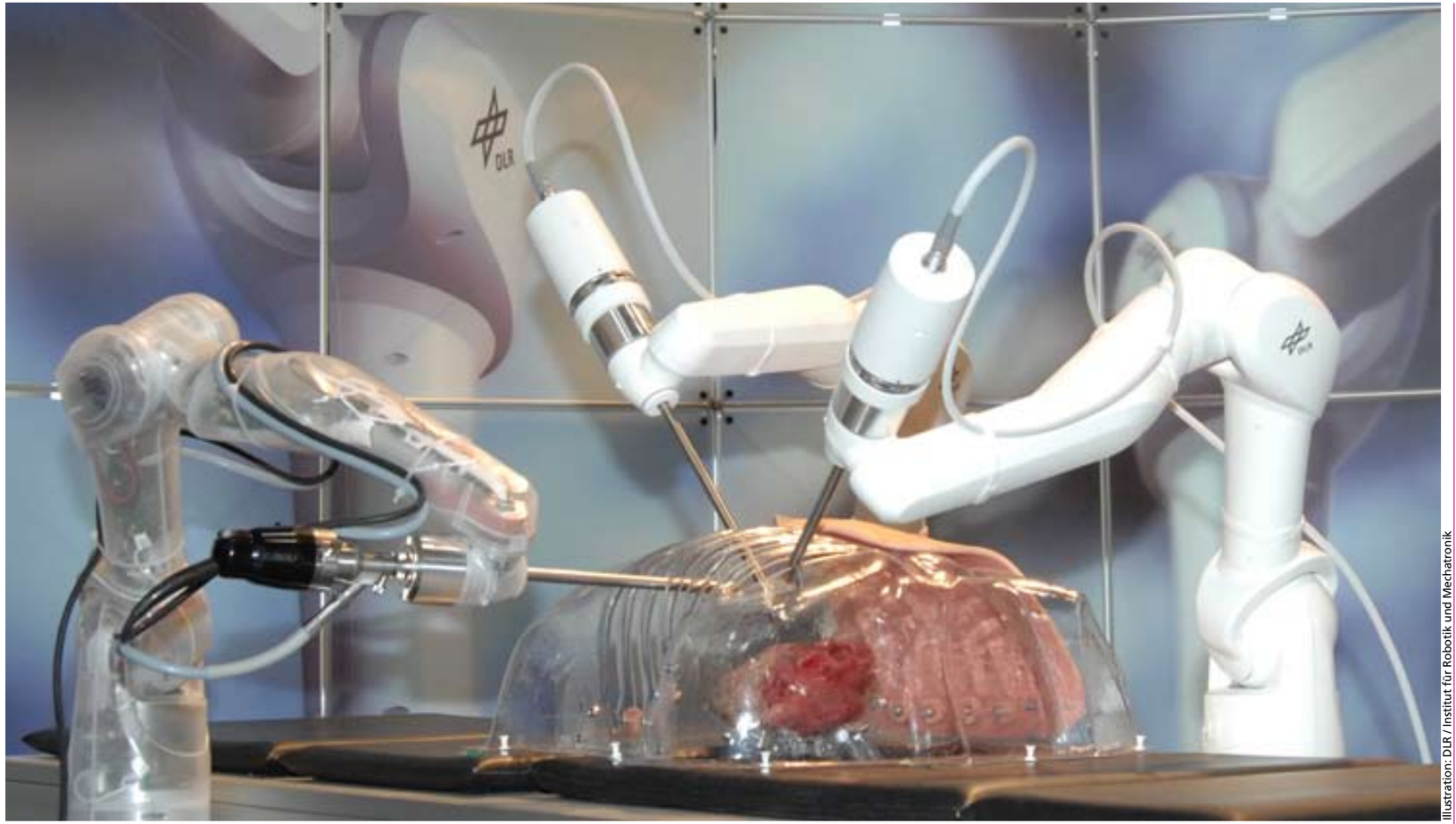

Illustration: DLR / Institut für Robotik und Mechatronik

A versatile telerobotic system for state of the art endoscopic surgery: MiroSurge, developed at the German Aerospace Center (DLR)

Flexible Heart Surgery

Basic research in medical technology: An innovative robotic platform makes minimally invasive surgery even more intelligent and efficient / By Gerhard Hirzinger and Ulrich Hagn

Keyhole surgery is well established and much more than just a buzzword that doctors and their patients like the sound of. It was over ten years ago that market researchers such as McKinsey highlighted the potential of minimally invasive surgery (MIS). Performing operations through very small incisions and using special rod-shaped instruments is seen as being easy on patients, but also as a great challenge for surgeons.

One of the main things that prevents surgeons from working intuitively is the so-called chopstick effect (which gets its name from the chopsticks that the Asians eat with). In other words, the maneuvrability of the long surgical instruments is limited by the incision in the skin. This causes some movements to be inverted or reduced in scale, resulting in the surgeon needing to make unnatural and exaggerated arm movements, while working on the basis of the video image provided by the endoscope. The endoscope is normally fed into the patient's body through a third incision, made in addition to two incisions made for the instruments.

Conventionally, this endoscope is controlled by a second doctor, who follows the tips of the instruments being used by the surgeon performing the operation, allowing him to keep a good eye on the area of the operation. Although these minimally invasive techniques have been slower to catch on than predicted, many surgeons expect that MIS will really take off and become widespread in the 21st century. The main key to this happening is the use of mechatronics and robotic systems, which give the surgeon a realistic sense of touch, or haptic sense, as if he was working on an open body, via so-called telepresence techniques. Additionally, these techniques will allow the surgeon to sit comparatively comfortably at a "surgeon's console", instead of laboriously bending over the patient, perhaps for hours at a time – a great boon to everyday surgical practice.

Research groups were already publicising the possibilities of telerobotics for use in minimally invasive surgery as early as the 1990s. The principle on which it is based is simple: The surgical instrument is more or less cut in half and the tip attached to a robot, while the other end, the handle, is attached to an input station.

Noteworthy examples of the first developments in this field include the ARTEMIS system developed at the Karlsruhe Research Centre (FZK) and the ZEUS system from Computer Motion in America. One of the most successful systems today is the "da Vinci Surgical System®" from Intuitive Surgical Inc., which is used in the field of urology. The German Aerospace Center (DLR) is working on the telepresence system MiroSurge in a number of DFG projects. The main component of this system is the medical robot MIRO, a lightweight robotic arm designed especially for surgical applications. This apparatus, which mimics the human arm (with seven joints rather than six, as most industrial robots have) allows flexible positioning in the operating theatre. It is also possible to reconfigure the arm without needing to change the position of the tip of the instrument or even interrupt the operation.

Intelligent sensors allow the robot to follow the instructions of the OR staff with great sensitivity, and any risk of a collision between the robot and objects in its environment can be detected and reacted to very rapidly – preventing damage to the OR equipment or injury to the patient. Thanks to its light weight, weighing in at just ten kilogrammes, the robot can be set up and removed by a single person, cutting down on set-up time and saving money.

The arrangement of the robotic arm's joints and the layout of the arm segments were designed to permit a wide variety of different operations, for instance in heart or abdominal surgery. This ensures that the robotic arm can be used for a wide range of surgical applications. It was therefore designed with a simple and in future open instrument interface, which will allow different instrument manufacturers to use the robotic arm as a platform. It is anticipated that a wide range of surgical instruments will soon be available for it, allowing companies and research institutions to become involved with this innovative technology, even on a limited budget and with a minimum of risk.

At the same time, the range of applications is also expanding. The MiroSurge system currently

Illustrations: DLR / Institut für Robotik und Mechatronik

Left: The surgical console where the manipulator can work with both hands with tactile input. Above: Powered forceps with two additional degrees of freedom as well as miniaturised force torque sensors

has three MIRO arms, one for the left and one for the right surgical instrument and one to guide the endoscopic stereo camera. The MICA actuated and sensorized surgical instruments developed by the DLR have two additional degrees of freedom within the patient's body, integrated force torque sensors and an extracorporal drive unit. This gives the surgeon complete dexterity – similar to open surgery – accompanied by drastically reduced traumatisation of the patient.

The instruments, which are just 10 mm in diameter, are fed through small incisions in the patient's skin. They are fitted with miniaturised force torque sensors (which can be sterilised), which allow realistic acquisition of the manipulation forces acting within the patient and presenting this data to the surgeon either haptically or visually. In addition to the contact force, it is also possible to measure the gripping force of instruments such as tweezers and forceps. These instruments will, it is hoped, make this system unique. The further development of flexible instruments for gastroenterological applications also aims to significantly expand the range of this novel robot.

MiroSurge has taken two approaches to force feedback: On the one hand, haptic hand controllers provide sensitive force feedback, while on the other hand, the forces can also be overlaid on the stereo image as a virtual reality component. This is an attempt, currently undergoing testing, to realise a technically less complex interface without haptic force feedback, where the surgeon controls dummy instruments in his hand and the movements of these instruments are recorded by cameras and then transmitted to the actual instruments inside the patient's body.

Another key factor in giving the surgeon the feeling that he is working on an open chest is the spatial representation of the operation site. This is achieved using both stereoscopic displays with so-called polarisation spectacles as well as novel 3D displays, for which the DLR is developing a reliable method to capture head and eye movements using cameras (without the need for special spectacles). In order to be able to use the robotic techniques in the operating theatre effectively, the developers are still working on an optimised method for placing the robot and the incisions, or "ports". To do this, the patient first needs to be measured by computer tomography, before the operation.

The sequences of actions during an operation, for instance a heart operation are particularly challenging. The actions involved in performing such an operation are not only manually very difficult and painstaking, they also need to be repeated several times, making them very tiring. Surgeons would consider it a great step forwards if individual parts of operations, for example tying knots, could be done autonomously.

As a result of many years of preliminary work at the Institute of Robotics and Embedded Systems at the Technical University of Munich, it has been possible to demonstrate in experiments on real organs that this is technically possible. Not only does this make automated sequences of actions possible, this method can also be applied – in full or in part – to other scenarios. The results of these experiments will be integrated in the DLR's new MiroSurge system in the final phase of the Collaborative Research Centre "High-Fidelity Telepresence and Teleaction".

The benefits are evident. Autonomous functions in minimally invasive surgery will relieve the surgeon of routine tasks, allowing him to concentrate on the actual operation. There are two particularly promising applications on the horizon: Automatic sewing of blood vessels and "motion compensation" of the beating heart. The latter permits extremely minimally invasive operating techniques, as it means that the use of a heart-lung machine can be done away with. A factor that has proven to be particularly disconcerting for surgeons is the continued movement of the mechanically stabilised heart. The researchers therefore aim to record the movements of the heart optically and then compensate for it with the robot so that the motion of the tips of the instruments is synchronised with the beating of the heart. If they can also manage to stabilise the video image, then the surgeon could operate on a virtually stationary heart – excellent conditions for successful treatment.

Telepresence can be used to give the surgeon a realistic impression of performing open surgery on the patient. At the surgeon's console he also has a stereoscopic display. In the background the three MIRO robot arms are visible.

It is expected that the duration of operations will be drastically reduced and the quality of operations increased. Particular attention needs to be paid to the ruggedness and the fault tolerance of this method, for instance by including additional sensory data such as ECG data.

The conclusion of numerous studies is that it is possible, in principle, to apply the findings obtained to date to other clinical applications, for example motions of the liver. The researchers aim to complete the development of the MIRO arms, with all of the necessary optimisation, controller setting and safety-related aspects as well as the necessary medical approvals, in the next four to five years. At the same time, they also plan to integrate MiroSurge in a complete OR system and bring it to market readiness – for the benefit of the patients and in the interests of basic research of the future.

Prof. Dr.-Ing. Gerhard Hirzinger, winner of the Gottfried Wilhelm Leibniz Prize in 1995, is the director of the DLR's Institute for Robotics and Mechatronics, which is also where **Dipl.-Ing. Ulrich Hagn** works.

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Illustration: DLR / Institut für Robotik und Mechatronik

Illustration: Marine Science Center / Hanke

Do It Again, Nick!

At Europe's largest pinniped research station, zoologists are investigating the highly developed sensory world of common seals – often right in front of enthralled spectators / A visit to the station in Warnemünde

By Rembert Unterstell

Three inquisitive common seals push their snouts out of the water to watch the arrivals. Thirteen school kids from the fourth to sixth grades are standing with their teachers on the visitor's platform. They are watching the seals being trained in the open-water pen from the sundeck of the research ship. Pointed fingers, open mouths and busy digital cameras. Biological object lessons can be so motivating; self-experiments included. "You'll never guess what I've been doing", says the tousle-haired eleven-year old to his somewhat intimidated classmate. "When the seal dived, I counted quietly up to 36 – without taking a breath!"

At first sight, Nick, Luca and Marco as well as their six companions give the impression of being incredibly agile and "really cute". The nine seals, who are jokingly referred to as the "aquatic colleagues", are the greatest attraction at the Marine Science Center, which was officially opened on 11 June 2009 in the Warnemünde Marina at the gates of Rostock. "However, we must not lose sight of the fact that they are predators and they can bite", underlines Professor Guido Dehnhardt, head of the Pinniped Research Center. Nevertheless, the specialist on marine mammals speaks of them with awe: "seals are tremendously friendly, relaxed and eager to learn."

Dehnhardt, 48, has been the incumbent of the Lichtenberg Endowed Chair at the University of Rostock since 2007, and heads the research group on "Sensory and Cognitive Ecology". The group are researching the sensory world of marine mammals. The scientists carry out their experiments in the open-water pen, which is separated from the Baltic Sea only by a net. The decommissioned and converted excursion boat "Friedrich Wolf" from the Berlin-based "Weiße Flotte" is used as the team's research station.

Illustration: Marine Science Center / Hanke

Illustration: Marine Science Center

The Marine Science Center offers a novel and unusual opportunity of working with the common seals, aged between two and 26 years, in their marine habitat. The open-water laboratory measures 60 x 30 metres, is up to six metres deep and its 10,000 cubic metres of seawater provide almost natural living conditions. As Dehnhardt emphasises, the pen is "Europe's largest research laboratory for pinnipeds."

Everyone who has visited the North Sea coast has seen seals sprawling across the sand banks. There are still large gaps in our detailed understanding of *Phoca vitulina*. For a long time, these animals, who belong to the family of true seals, were considered to be dull-witted, quite unlike the sea lions who entertain us with their ball tricks at zoos and circuses. However, it became increasingly clear that common seals also have remarkable and highly developed sensory abilities.

Illustrations: Unterstell

Left page: Three common seals, curious and absolutely in their element. Above: Visitors, young and old, are invited to watch the experiments with the marine mammals from the sundeck of the research ship. To the left: The perception experiments often bring surprising results.

How do the animals orient themselves? This is the key question for Dehnhardt's research group. Common seals are very good swimmers and can dive for up to 30 minutes at a time. The researchers want to find out how they navigate over long distances in the ocean and how they are able to catch fish in murky waters and in the dark at great depths. One approach is to investigate the animals' sensory capabilities – sight, hearing, touch and smell. The team of scientists is also investigating how this information is processed. "It's like a journey of discovery," says Dehnhardt with a smile in his voice, "rather like a research expedition driven by the search for hitherto unknown sensory and orientation mechanisms."

For example, since 2004 and in continuation of previous research, Dehnhardt and his team have been participating in the CRC project "Grundlagen visueller Wahrnehmung bei marinen Säugern" (Principles of visual perception in marine mammals). One important result has emerged: the conspicuous saucer eyes of the seals are "highly sensitive, but only with regard to light/dark perception," sums up young zoologist Friederike Hanke. In her recently completed thesis, she was able to prove that common seals also have a marked lack of visual acuity in combination with poor colour vision under water and in air. But what does this finding imply for the interplay between the seal's senses?

In order to answer these basic questions experimentally, "the researchers have to be in daily contact with the seals", says Hanke. The animals in the pen are constantly being confronted with new challenges. Dehnhardt: "The seals have to learn to operate the scientific apparatus and to follow certain workflows, which often means they have to process complex information, bringing them to the limits of their perception." The seals participate with great enthusiasm, as long as a shoal of herrings hasn't strayed into the pen from the open sea. "Do

Left: Seal research in the open sea: panorama view of the "Hohe Düne" Marina with the recently opened Marine Science Center in Rostock-Warnemünde. Far left: A converted excursion boot, surrounded by an open-sea pen, serves as a research laboratory for the zoologists.

it again, Nick!" If he performs well, the ten-year old seal is rewarded with a fish. Titbits of fish are used as the "primary reinforcer" and a short high-pitched whistle from the trainer's mouth is the "secondary reinforcer".

Dehnhardt has been researching marine mammals for the last 20 years, starting with dolphins and sea lions. However, neither a German university nor a non-academic research institute had an experimental facility for large marine mammals. The zoologist, an associate professor at the University of Bonn since 2000, was working with his animals in the Cologne zoo for nine years.

Fascinated since an early age by the creatures of the sea and their ways of life – as an adolescent, he dreamed of having his own research station in the open sea. Resolute, persistent and with passion, he pursued and found his way. But he is no stranger to painstaking and ultimately unsuccessful attempts to put his ideas into practice. Nevertheless, the basic researcher stayed true to his vision.

The pinniped research centre became a reality after the Volkswagen Foundation created an endowed chair at the University of Rostock in 2006. The zoologist hit upon the unusual idea of using a ship as a research station after he learned of the construction regulations for maritime stone buildings. All the animals and the entire Cologne team relocated from the Rhine to the Warnow estuary, where the nine-membered team will continue to carry out experiments in the sea and during boat excursions into the Baltic with the seals.

Ten years ago, Dehnhardt, then research fellow and subsequently habilitation fellow of the DFG, discovered the peculiar sensory characteristics of the whiskers (vibrissae). The whiskers of a seal are more than just a tactile organ, such as those of a cat. In water, the far more sensitive vibrissae are an "active hydrodynamic receptor system and are vital for catching prey," sums up Dehnhardt.

But what does this imply? Using their whiskers, which may be up to 20 centimetres long, seals can detect the tiniest water movements, so-called hydrodynamic flows. The vibrissae serve as stimulus sensors. Striking proof was obtained with trail-following studies in water. Blindfolded seals were able to exactly follow the route of a remote-controlled model submarine using only the wake left behind in the water.

Further studies have added new stones to the mosaic. The present understanding: even if the seals are swimming fast and swirling the water themselves, they can still "feel" the turbulence caused by fish, thus allowing them to locate and track their prey. Details of how the animals are able to differentiate between the stimuli and process the information is the focus of an interdisciplinary project group in the DFG Priority Programme "Nature-Inspired Fluid Mechanics" that started in 2006. The Rostock zoologists and fluid dynamics specialists are working together, "with special optical measuring instruments to analyse flow processes on a seal vibrissa, and also to elucidate the mechanism of how turbulence is suppressed," outlines project coordinator and zoologist Dr. Wolf Hanke. The results could also be used in future for bionic applications based on the vibrissa mechanism. For example, Hanke and Dehnhardt envisage flow sensors for gas or water meters or potential applications in underwater robotics.

Creative, nature-inspired construction plans are gaining in popularity with engineers. But where do practical zoologists get their inspiration? Dehnhardt's answer is short and to the point: "primarily from our closeness to the animals," and he adds, "the most interesting research questions arise from the perspective of the seal's way of life."

For the zoologist, this is more than a charming bon mot. Dehnhardt lives at the station, where working hard is easy, but getting enough sleep can be a problem because the seals are often happy to give night-time choral concerts now that they have noticed what a wonderful sounding board the underside of the research ship is. "My night is sometimes over at five o'clock in morning," says Dehnhardt wryly. Indeed, he does not sound particularly unhappy about this. "It is simply a part of the job."

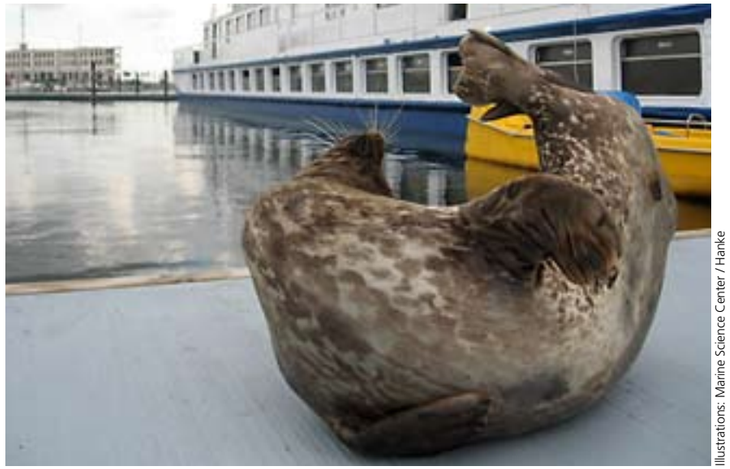
The job description at the Marine Science Center also includes active public relations, which are to be gradually expanded. Visitors are invited to watch the experiments in the pen from the nearby sundeck of the research ship. They are given informative explanations of what they are seeing. "I want to make our science generally accessible," stresses Dehnhardt. He has to deal with financial planning security – from state funding, grants, third-party funding as well as self-generated earnings, such as entrance fees. The combination of science and funding from the private sector could set an example. The effects are already noticeable: for example, the Marine Science Center received an award as one of the "Selected Landmarks 2009" from the initiative "Germany – 365 Landmarks in the Land of Ideas".

There are also indications that the new Marine Science Center is attracting appreciative visitors of all ages. Whatever happens, the inquisitive seals will continue to welcome them.

Dr. Rembert Unterstell is publishing executive editor of "german research".

▶ www.marine-science-center.de

Left: With his big, dark, saucer eyes, "Sam" quickly wins over everyone's hearts. Right page: Guido Dehnhardt – shown here with "Malte" – has been working with marine mammals for over 20 years. Below: The conspicuous whiskers still hide plenty of secrets. The sensory abilities of the animals are being researched experimentally. Below: The eager seals are completely at ease – morning dryland gymnastics at the edge of the research pen



Illustrations: Marine Science Center / Hanke

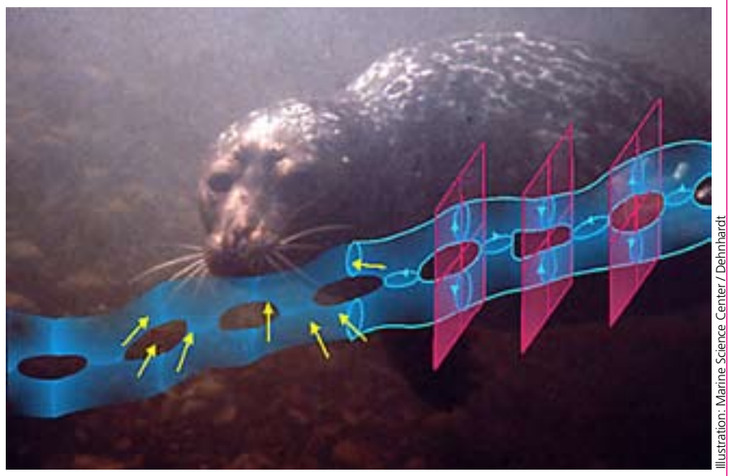


Illustration: Marine Science Center / Dehnhardt

Illustration: Marine Science Center / Dehnhardt

In the Rhythm of the Vegetation

Many savannahs are considered to be threatened. But the massive areas, covering a fifth of the earth, have a dynamic of their own: The apparently unstoppable encroachment of scrub appears to be just a natural transitional stage

By Kerstin Wiegand

Illustration: Katrin M. Meyer

Savannahs? For many people, the term brings to mind the cradle of mankind or perhaps the "big five": elephant and rhinoceros, buffalo, lion and leopard. But for the inhabitants of the savannah, daily life is somewhat less romantic. Most people sustain themselves through ranching, and the well-being of their cattle, goats and sheep is heavily influenced by the rhythm of the recurring periods of drought and weather extremes.

Savannahs used as ranches serve as the basis of nutrition for a growing population that lives from the land, particularly in southern and eastern Africa. This basis for sustenance is increasingly at risk; many savannahs are threatened by encroaching scrub vegetation. This is particularly a problem for cattle, because they graze almost exclusively on grass (and herbs) and avoid thorny bushes.

Until now, the encroachment by scrub vegetation has been explained as an effect of "overgrazing". Heavy grazing causes the grasses to be eaten so that they cannot regenerate. It is suspected that the competing bushes and trees profit from this. In the case of extreme overgrazing, "trampling" occurs, causing the ground to become compressed. This is observed near waterholes that serve grazing livestock. Excessive ranching offers an important explanation for scrub encroachment. But does this imply that scrub encroachment is always caused by overgrazing?

The search for the answer leads to the much more fundamental "savannah question": why do savannahs exist? After all, they cover 20 percent of the earth's land surface and more than half of Africa. The vegetation on the savannahs consists of a mixture of trees and grasses – i.e., neither pure forest nor pure grassland. How is it possible that two plant life forms – trees and bushes on the one hand and grasses on the other – can coexist over very long periods of time and on such expansive areas? Biologically, this is not self-evident. Studies of savannah grasses show that they can prevent the germination of seeds and the growth of tree seedlings. On the other hand, savannah trees, with their strong competition for water and the shadows they create, suppress grass growth considerably.

This begs the question: why aren't savannahs a marginal and temporary phenomenon in a given geographic area that quickly develops into either a pure grassland or into a forest? The classic attempt at an explanation goes back to observations made by the geobotanist and ecophysiologist Heinrich Walter in Namibia. In the 1930s, Walter, who earned his PhD in 1919 in Jena, took some of the first research trips to what was then South West Africa. In 1939, he first authored an article in which he offered his explanations for the tree-grass coexistence.

He explained that the competitive equilibrium of trees and grass is determined primarily by precipitation. The more precipitation, the more water can penetrate into the deeper layers of soil, which is reached only by tree roots. Thus, in the dry savannahs, which receive less than 250 millimetres of precipitation per year, shallow-rooted grasses have an advantage over trees. In the savannahs with more moisture – i.e., those receiving more than 500 millimetres of rain – the grasses are at a disadvantage. The underlying distinction between a grass- and a tree-dominated soil layer, which serves as the basis for this theory, could, however, only be confirmed in some savannahs. This "two-layer hypothesis" can, therefore, not provide a general explanation for the tree-grass coexistence or for the diversity of the savannah.

Dry savannahs are characterised by a cycle alternating between grass- and tree-dominated vegetation (left to right): Over time, vegetation in areas alternates between grasses, growing tree seedlings, spreading bushes and individual trees. This results in a mosaic of patches. Right: Measuring and analysing, biologists track vegetation patterns.

Illustrations: Wiegand

The key idea for a new attempt at an explanation came to the author during studies of a dry savannah in Namibia. These savannahs are characterised by localised areas of vegetation, or "patches", that are dominated by trees of the same size. The savannah is, thus, a "patchwork" of encroaching scrub vegetation (extremely densely packed, very small bushes), patches with many small trees, and patches with a small number of trees and a large amount of grass. Such a pattern can be explained by the "patch dynamics theory" for dry savannahs.

According to the theory, savannahs consist of a mosaic of patches in which there is a cycle alternating between grass dominance and tree dominance. The dynamic is driven by two factors: precipitation that is highly variable with respect to space and time and competition among trees. In patches dominated by grass, sufficient precipitation can result in conditions that are favourable for renewing the tree population and may, thus, result in localised scrub encroachment (or a "closed" savannah). Over a number of years, the trees grow and compete against one another, causing scrub encroachment to subside and allowing a grass-dominated patch with a small number of very large trees to form again. This is a so-called 'open' savannah.

The patch dynamics theory explains the patchwork pattern of the savannah vegetation with a space-time mechanism and unites it with the frequent phenomenon of localised incidents of extreme precipitation. On the landscape level, a "steady-state" condition is assumed to exist: the vegetation in the individual patches changes, but the total number of patches in a given stage remains approximately constant on the landscape. The aforementioned asymmetries – trees suppressing grasses and grasses suppressing tree seedlings – are a component of the savannah dynamic and combine with forces that alternate in dominance during the course of a cycle. Here, precipitation plays a decisive role. South African biologist David Ward was able to demonstrate through experiments that the suppression of tree seedlings by grasses is greatly weakened by high amounts of precipitation.

Because field studies and experiments are only able to provide short-term insight and the study of a complete patch cycle would exceed the working lifetime of a researcher, the patch dynamics theory has been tested with simulation models specifically developed for this purpose. Katrin M. Meyer, at the time a doctoral researcher in

Illustration: Wiegand

On the way to the savannah: Katrin M. Meyer (doctoral researcher in the project, right) and Cara Nieuwoudt (Stellenbosch University, left) together with local staff. Bottom: The imposing root structure of this thorn bush extends well beyond its crown – up to 15 metres in the horizontal plane.

Jena, together with David Ward developed, among others, the simulation model SATCHMO for a study area located near Kimberley, South Africa. The model describes how, in their daily fight for water, trees and grasses compete, grow and die within a vegetation patch.

It was questioned whether this model, too, would show cyclical changes in vegetation. In fact, such changes were found to form with a cycle time of about 33 years. It must be noted, however, that the duration of the cycles is heavily dependent on local features, namely on precipitation and on the composition of species. In other words: the existence of cycles can be observed as a general phenomenon in savannahs, however, the duration of those cycles cannot.

The patch dynamics theory was helpful on the landscape level as well. The unexpected result of the savannah model developed by doctoral researcher Aristides Moustakas: no constant "steady-state" condition develops between the cycles that occur locally in the patches. Instead, depending on the annual precipitation, cycles with periods ranging from 200 to 300 years are observed. Further support for the theory is deduced from the analysis of aerial photos of a camel-thorn savannah from the years 1940, 1964, 1984 and 2001. Through paleontological studies, researcher Lindsey Gillson, from Oxford University, independently came to the same conclusion as the author: that East African dry savannahs are patch dynamic systems.

Illustration: Meyer

The explanatory power of the patch dynamics theory for dry savannahs is considerable. How can it now be used to contribute to the understanding of scrub encroachment? Scrub encroachment is not necessarily a phenomenon that is caused by "overgrazing", provided the grazing does not reach extreme levels, as is the case in the immediate vicinity of many waterholes. In light of the patch dynamics theory, scrub encroachment is a permanent part of savannahs. According to this theory, it is a transitional stage between grass dominance and open savannahs with a small number of large trees. This transition may last well over 30 years. For farmers with a working lifetime of barely more than 30 years, this appears to be a permanent problem.

Scrub encroachment as an integral part of savannahs is, however, not a free ticket for unbridled grazing. Particularly in open, grass-dominated savannah patches, farmers should exercise great restraint with grazing during years with plentiful rainfall. This is because tree seedlings require a large amount of water; and if competing grasses are consumed by cattle or sheep, ideal conditions arise for a new cycle of scrub encroachment.

One thing is certain: in the end, nature is much more complex than a patch dynamics theory on the patch and landscape levels. Furthermore, each savannah consists of a range of different grass and tree species, each of which has different ecological characteristics. Nevertheless, there is every indication that a basic pattern has been found for describing the dynamics of savannahs. This pattern must now be described and researched in greater detail.

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▶ www.uni-goettingen.de/EcoMod.html

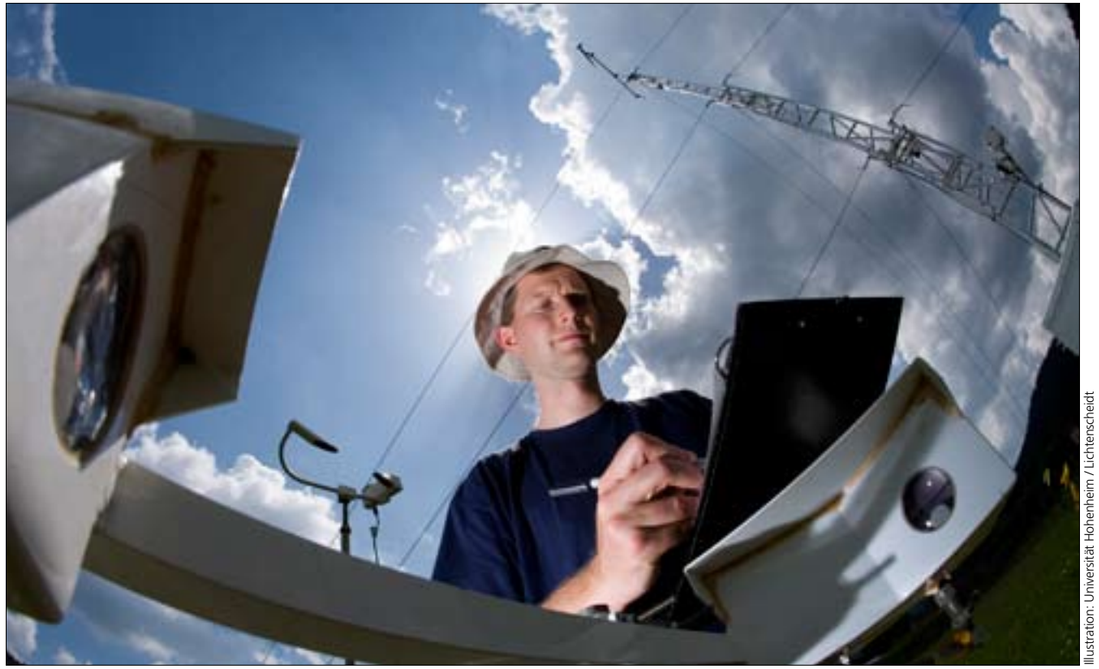


Illustration: Universität Hohenheim / Lichterscheidt

Clouds, Wind and Precipitation

Weather forecasting is a complex process. Modern predictions are based on increasingly precise data and a lot of fundamental research. Above all, meteorologists need to have an even better understanding of natural phenomena occurring in the atmosphere

By Andreas Hense

Weather forecasts: not only when hurricanes or tornadoes leave a trail of destruction or when people and property are threatened by floods or hailstorms, they are the focus of everyone's attention, indeed, they are indispensable. However, if the number of extreme weather incidents should increase in future, the consequences may be dramatic, if not devastating. Thus the timely development of reliable methods of predicting the weather is critical. Weather forecasts are of daily interest and importance; after all, everyone talks about the weather.

From a meteorological point of view, it is particularly difficult to provide accurate precipitation forecasts because the formation processes of both precipitation and clouds are considered to be some of the most complicated natural processes occurring in the atmosphere. However, recent research has enabled a deeper understanding of the physical processes involved in the formation of precipitation and thus points the way to a more reliable weather forecast.

Efforts to make precise weather forecasts go back a long way: as early as 1904, the physicist and

meteorologist Vilhelm Bjerknes, who later became the first Director of the Institute of Atmospheric Physics at the University of Leipzig, described the physical principles of weather forecasting. He tried to describe and predict the weather on the basis of physical laws for the conservation of mass, energy and momentum. Bjerknes suggested to investigate the atmosphere at ground level and at various altitudes and then to feed the observed data into a mathematical model. In 1922, the mathematician Lewis Fry Richardson was able to make the first weather forecast based on these mathematical and physical principles. Unfortunately, his approach and results gave rather unrealistic results.

It wasn't until after the Second World War that the problem of numerical weather forecasting could be addressed using the new methods because the Electronic Numerical Integrator and Computer (ENIAC), the first digital electronic computer, was available with the required computing power. In 1948, the ENIAC calculated the first successful numerical weather forecast for a period of 24 hours. However, forecasts of parameters such as the air temperature close to the ground, precipitation or degree of cloud cover were not possible. At the end of the 1950s, Richardson's original model was revisited by supplementing it with the findings from numerical mathematics. This development culminated in the founding of the European Centre for Medium-Range Weather Forecasts (ECMWF) in Reading near London in 1975. Its objective was to increase the global weather forecast to the theoretically possible time horizon of one to two weeks.

New numerical models were developed in subsequent decades as computers became more powerful. Better weather observations also lead to advances in weather forecasting. A classical example of this is satellite data, which has been available since the end of the 1970s. It provides important information on wind and temperature, particularly in the tropics. However, the greatest improvement was achieved by assimilating measured data into numerical weather forecasting models. This processing of data prior to the actual weather forecast has become so complex that calculations for the forecast itself take only a fraction of the total computing time.

Illustration: Universität Hohenheim / Lichtenscheidt

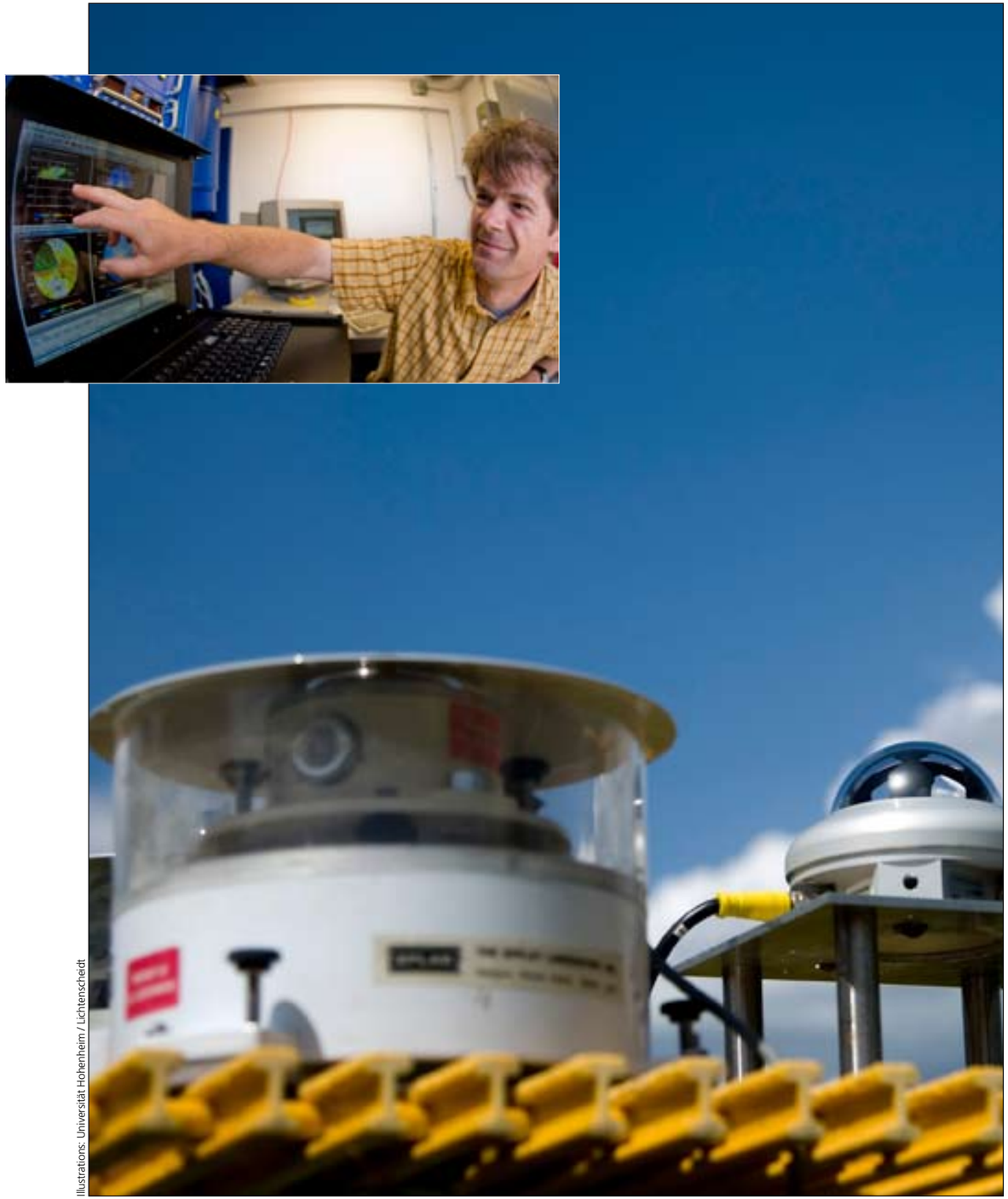
Weather forecasting has a huge advantage: the calculations can be validated directly by comparing actual weather conditions

Weather forecasting has one huge advantage compared to other scientific fields: the calculations can be validated directly by comparison with the actual weather conditions. Already in 1950, the success of the forecasts was checked by comparing them with the actual weather conditions during the next day. Forecasts have improved considerably in the last decades: nowadays, the pressure at an altitude of 5.5 kilometres can be predicted for a period of eight to ten days with the same accuracy as the 24-hour forecasts 40 years ago. In the 1950s, the northern hemisphere was covered with a computational grid where the points spaced about 250 kilometres in three to five layers between the ground and an altitude of about 15 kilometres. In contrast, a global weather forecasting model is used nowadays that has a grid spacing of 25–40 kilometres and approximately 60–100 layers between the ground and an altitude of 50 kilometres.

Precise weather information, particularly for very active "weather systems" (such as summer thunderstorms or winter storms), is predicted with models that describe a small section of the Earth's surface in detail. For example, the German Weather Service in Offenbach am Main uses a weather forecasting model several times a day that is based on a network of points over Germany that have a horizontal separation of approx. 2.8 kilometres and with 60 layers between the ground and an altitude of 20 kilometres.

Meteorologists find it particularly difficult to make accurate precipitation forecasts. The formation

Left: The radiosonde used to measure the upper air weather data is checked with a trained eye. Right: Sunlight can also be measured with a sensor located underneath the transparent dome. All measured values are evaluated on the computer screen (insert).



Illustrations: Universität Hohenheim / Lichtenscheidt

Illustration: Hankers

of both, precipitation and clouds, are some of the most complex natural processes occurring in the atmosphere and many details are still not understood. Different factors, such as water vapour molecules and water droplets, influence this process as well as upwind regions in individual clouds or low pressure zones. Whereas the quality of the forecasts for wind and temperature have been continuously improving due to the development of new meteorological forecasting methods and observation systems, the reliability of precipitation forecasts is still variable. They still had the same shortcomings in the year 2000 as in the mid-1980s.

In view of this, a joint initiative between meteorological institutes of German universities, major research centres and the German Weather Service was launched in 2001 with the objective of improving quantitative precipitation forecasting using scientific resources.

But what can be expected from a quantitative precipitation forecast? It should provide the following initial information: When, where and how much precipitation will occur? With which probability and in which form can it be expected? Experience gained by weather researchers shows

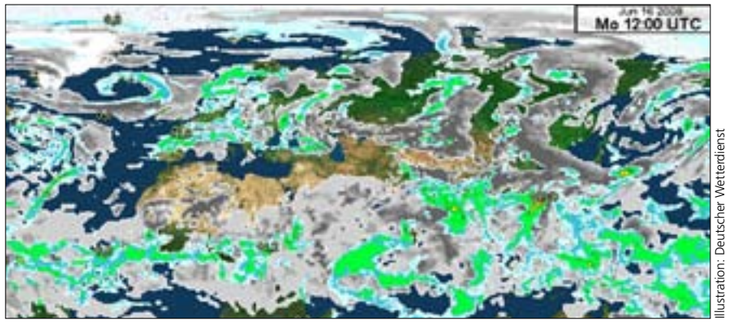


Illustration: Deutscher Wetterdienst

Above: View out of a research aircraft. A grey thunderstorm front lies above the Black Forest. In the map below: cloud cover and precipitation according to the forecast of the German Weather Service. Right: A weather balloon and its radiosonde are just about to be launched.

Illustration: Deutscher Wetterdienst

that in addition to the formation of clouds and precipitation, the water input from the Earth's surface into the atmosphere causes problems in predicting precipitation. This particularly applies to water vapour in the atmosphere.

Scientific studies within the Priority Programme "Quantitative Precipitation Forecast" are thus concentrating on significantly reducing these errors using modern methods of observation. Data sources not previously used in weather fore-

Illustration: Deutscher Wetterdienst

Illustration: Universität Hohenheim / Lichtenscheidt

Illustration: Universität Hohenheim / Lichtenscheidt

Above: Comparison of electronic and non-electronic methods of precipitation measurement. Middle: Modern laser technology in weather forecasting – view through the mirror of a wind lidar owned by the Leibniz Institute for Tropospheric Research. Left: A weather balloon is transported to its launching site.

casting could be helpful for this: for example, the precipitation measuring networks of the water management authorities, weather radar or laser remote sensing.

The COPS project ("Convective and Orographically induced Precipitation Study") was started in Southwest Germany and Alsace for this purpose in the summer of 2007. The COPS experiment had an international scope from the start, and more than 300 scientists from ten countries participated. Together they aimed to systematically measure all precipitation-relevant processes using research aircrafts and dense standardised measuring networks at five "supersites". Parallel measurements carried out with various remote sensing methods gave wide-ranging and highly differentiated basic data. The researchers also continued developing innovative numerical weather prediction methods that consider and include random dynamic elements in the atmosphere to a greater extent.

Theoretical scientists are still facing major challenges: evaluation of the measurements from the COPS project and checking the quality of the new precipitation forecasts against reality. Ultimately, the results of the basic research studies are to be applied to practical situations by the German Weather Service so that the quality of future weather forecasts can be improved.

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▶ www.meteo.uni-bonn.de/projekte/SPPmeteo
▶ www.cops2007.de

The Ichthyosaur Cemetery

Some 120 million years ago, the ichthyosaurs died at the edge of the Tyndall Glacier. Now, palaeontologists are getting to the bottom of how such mass mortality in such a confined space came about – looking for clues in the Torres del Paine National Park in Chile

By Wolfgang Stinnesbeck, Eberhard Frey and Marcelo Leppe Cartes

The helicopter, an old Bell belonging to the Chilean Air Force, makes a tremendous noise in the air as it flies over branched rivers that wend their way through the yellowish-green southern beech forests. Our destination is the camp close to the Tyndall Glacier. Gradually we approach the Torres del Paine National Park, with its 20 imposing rocky towers. The forest rapidly becomes thinner and this is then followed by bare, black rock and a lake with small icebergs floating in it. Finally, we fly over the vast expanse of a glacier – it is the Tyndall Glacier at the southern end of the Patagonian Ice Field. The ice shimmers in shades of blue as darkness falls. The research camp can just be made out in the distance, initially just as tiny coloured dots at the edge of a black cliff. We land there briefly, before continuing our flight to the site of the find, higher up the mountain. Here, the layers of rock have been planed down by the glacier, leaving steps in the rock. The landscape looks like a model, as if it were made up of layers of cardboard stacked up on top of each other.

Our team is among the first to arrive. The second flight brings some high-ranking visitors: Crown Prince Willem Alexander and Princess Maxima of the Netherlands accompanied by the Dutch Minister of Education, Ronald Plasterk, and the Chairman of the Netherlands Organisation for Scientific Research (NWO), Jos Engelen. The previous evening the delegation had already heard about the ichthyosaurs in the glaciers, now this is followed by a field visit to see for themselves. Their visit lasts for three and a half hours, and then the Bell's lights disappear over the mountains again.

Retrospective: Glaciologists first found ichthyosaur remains on the edge of the Tyndall Glacier back in 2003. Since visitors to the area have found numerous skeletons and skeletal remains of these "fish lizards" as well as innumerable fossils, for instance of belemnites (fossilised cephalopods), ammonites, mussels and fish as well as plant remains. The first DFG-funded expedition started the work by sounding out the potential of the new site. Now we are here to reveal the secrets of the ichthyosaur cemetery. We want to find out and understand what happened here about 120 million years ago, in the Lower Cretaceous Period.

Our doctoral researchers Judith Pardo and Christian Salazar as well as the student assistants Luchio, Pato and Esteban from the Universidad de Concepción have already been here at the site for a few days. They have done an excellent job of organising the camp. The kitchen tent is equipped with two gas cookers and there is a dining tent, with a dining table and chairs. A generator provides power for lighting, battery chargers and laptops. Food, cooking and cleaning supplies and toiletries are professionally stowed away in plastic drums. The gas and petrol supplies are stored at a safe distance from the camp. The Rio Tyndall, at just 5 °C, serves as the source of our drinking water, our dishwasher, our shower and, last but not least, as a fridge for our supply of meat.

The fossils we find during the first few days in the field exceed our wildest expectations. Pitch black, the fossilised bones of the extinct fish lizards stand out from the smooth grey surface of the sandstone. Many of the dinosaurs are preserved completely – or at least they were until the glacier started carving the rock away. The skull with the eye sockets and the long, beak-like nose, the rib cage with the long, slender ribs, the mosaic-like skeletons of the rounded fins, and finally the long vertebral column with its characteristic kink, which supported the lower lobe of the semilunate tail fin. Most of the bones are still in exactly the position where they once have belonged anatomically.

The more carefully and precisely we look, the more fossils we discover on the black surface of the polished sandstone. The bright white thunderbolts, also known as "devils fingers" are most obvious fossils. They are belemnites, distant relatives of the modern day squid. Masses of these calcite cones peek out of the dark rock. Ammonites and mussels, on the other hand, are only preserved as flat impressions of their shells. Despite the fact that they are so poorly preserved, it is still possible to identify several different species of ammonites with the naked eye, even here in the field. They are particularly important for identifying the age of the strata and prove that this sediment must be Early Cretaceous.

So far we have found 30, almost completely preserved ichthyosaur skeletons here at the Tyndall Glacier as well as fragments and isolated fins and individual bones. The largest are more than four metres long, but individual vertebrae suggest that there were some ichthyosaurs that exceeded five metres in length. Remains of baby ichthyosaurs less than a metre long are extremely rare.

Such a number on fossilised skeletons in an area of just a few square

Left page: An impressive fossil – the well-preserved front half of an ichthyosaur. The head, with its large eye socket and the spine stand out visibly. Right: The researchers measure the fin of a fish lizard whose fossilised skeleton from over 110 million years ago was revealed and polished by the Tyndall Glacier.

kilometres is unique for Chile and for South America and indicates that this is a fossil concentration area of international significance. The hunters and the hunted are concentrated in a very small area – a fossilised ecosystem that is coming to light step by step.

Especially in the light of this significance there are a multitude of questions to be answered, such as: How did the Tyndall ichthyosaurs die? How did such a high concentration of skeletons come to be fossilised in this area? A few of the skeletons are found lying together in the same geological layer. Because each layer of sandstone was the result of a mudslide, the animals must have died more or less simultaneously. In the profile images we discover several layers of differing ages with ancient fossil beds like this. How can these repeated layers of mass mortality be explained? Does the site of these finds reveal any new insights into the lives of the ichthyosaurs?

Firstly, the geological conditions in the area of the finds are important. The Cretaceous strata in the Tyndall area were formed at the base of a continental slope at a depth of around 1000 metres. They were formed by undersea currents of mud, sand and rubble. Triggered by earthquakes, perhaps even due to their own weight, vast quantities of sediment fell from the edge of the continental shelf and slid into the depths. On their way down, the constituents of these underwater avalanches sorted themselves by weight and size. On the ocean bed, the coarse rubble was deposited first, followed in turn by sand and then mud. Geologists call rock formed in layers like this "turbidites". The sandstone in the Tyndall area lies on the bed of an ancient canyon, which evidently became a death trap for ichthyosaurs. Thousands of these sediment avalanches took place in the Cretaceous ocean in the Tyndall area and carried away everything that came into their path.

Due to the abundance of plankton, the edge of the shelf sea was evidently teeming with life. Shoals of fish and belemnites hunted baby fish and small crabs and were themselves hunted by the large marine reptiles, especially ichthyosaurs. When an earthquake triggered a mudslide, everything was sucked down into the depths, including the mighty ichthyosaurs. Despite the fact that they were probably able to dive some 500 metres, these large-eyed creatures hardly stood any chance of survival in the masses of mud and rubble. At a depth of 1000 metres their rib cage and lungs collapsed. At the foot of the slope the mudslide finally came to a standstill with the dead animals buried in and under it. As time passed, the mud solidified and turned into rock and the carcasses were compressed under an immense weight of sediment.

The search for sea reptiles from the Lower Cretaceous Period demands hard physical work too: Eberhard "Dino" Frey sawing out one of the skeletons

Left: A horseback expedition over rough terrain in the Tyndall area at the southern end of the Patagonian ice field. The researchers have to brave the elements too. During a storm, fossilised bone fragments can only be stuck back together under the cover of a plastic sheet (right).

All illustrations: Arbeitsgruppe Stinnesbeck

Millions of years passed before the ocean floor deposited in the Lower Cretaceous Period was squeezed together at the end of the Cretaceous Period, folded, lifted out of the ocean and partially eroded again. In the earth's more recent history, the Pacific plate pushed the layers of rock once again, this time lifting them up to form a mountain range. Volcanic fissures broke open and filled with magma and then the ice came. Glaciers eroded the rocks bare and eventually revealed the ichthyosaurus skeletons again.

Today, now that the Tyndall Glacier has receded, the fossils are on the surface and are exposed to the elements. If they are not rescued they will have been eroded away within a few decades, making it all the more important to salvage them.

After enjoying ideal conditions at the outset, the weather breaks. It becomes stormy, rains non-stop, there are sleet and snow showers. This lasts for nine days, turning the ground around the tents into a quagmire. Little streams flow down the drainage ditches around the tents. There is no hope of doing any field work and even in the camp every step is a hazardous, slippery affair. This weather is unusual for late summer in Patagonia. Not until our final week are we able to do any more work. On our last day there we discover two more ichthyosaur skeletons in a different place. One of them is over five metres long! We dismantle our camp in the rain and await the horses that will finally carry us back to civilisation at the end of a five-hour ride.

The team will be back though. They are already planning another expedition top the Tyndall area next year, with better equipment and more people to help recover the finds. The ichthyosaur cemetery still holds a lot of secrets.

Prof. Dr. Wolfgang Stinnesbeck researches and lectures at the University of Heidelberg. **Prof. Dr. Eberhard Frey** is the head of the Department of Geosciences at the State Museum of Natural History/Research Institute in Karlsruhe. **Dr. Marcelo Leppe Cartes** is the leader of the international cooperation project at the Instituto Antárctico Chileno in Punta Arenas, Chile.

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Illustration: Herzog August Bibliothek / Wittwer

Old Masters, Modern Methods

Creating the "Virtuelles Kupferstichkabinett" ["Virtual Print Room"]: in Braunschweig and Wolfenbüttel, more than 40,000 prints are being digitally collected to benefit research and the general public

By Ad Stijnman and Thomas Stäcker

It seems self-evident: libraries preserve books, museums pictures. But this hasn't always been the case. Way back in our cultural history, books and pictures were long considered a single entity and were only recently separated. It was not until the emergence of royal print rooms at the beginning of the 18th century that engravings, etchings and drawings were removed from the mature book collections and placed into new contexts.

This was the case with the collection of Duke August the Younger (1579–1666), for whom the Herzog August Bibliothek in Wolfenbüttel was named. This library lost a large portion of its collection of prints in this manner. Duke Karl I – one of Duke August's successors – moved the ducal residence from Wolfenbüttel to Braunschweig in 1753, where he founded a museum and, shortly afterwards, a print room.

The concept of an institutionalised collection of loose prints came from France and was adopted in Germany for the first time in 1720 with the founding of the Dresdner Kupferstich-Kabinett [Dresden Print Room]. In Braunschweig, Karl I became a passionate collector of prints of all types and had many of the prints from the library sent to him. After his death in 1780, however, the Wolfenbüttel librarians halted the transfer of prints to Braunschweig. Half a century later, they began to systematically organise and expand the remaining inventory themselves. Furthermore, after the completion of the new library building in 1887, several of the collection's highlights were put on display in the new art salon.

The library's attempt at the end of the 19th century to recover the prints previously handed over to the Braunschweig Print Room failed, however. A "Museum and Library Foundation" was established in 1927 to oversee both institutions. In order to concentrate the collecting and cataloguing of old master prints in the printroom of the Herzog Anton Ulrich-Museum (as Duke Karl's museum has been called since then), an idea long held by leading art historians, that of transferring the library's graphic collection to Braunschweig, was realised in 1928. In exchange, the library received manuscripts, objects attributed to Luther, and fine old bindings from the museum. This historical complexity is the reason behind the fact that today both institutions – the Herzog August Bibliothek in Wolfenbüttel and the Herzog Anton Ulrich-Museum in Braunschweig – are working closely together on the digital indexing and unification of their collections. The project is being carried out in cooperation with the Fotoarchiv Marburg [Marburg Image Archive], with the aim of establishing a joint Virtual Print Room "Virtuelles Kupferstichkabinett".

In addition to describing each object using keywords, the project team are also cataloguing various data pertaining to each item, such as title, dimensions, the name of the engraver and its provenance. A digitised version of the image is placed into the database of the "Virtuelles Kupferstichkabinett" internet portal, where users can access the Virtual Print Room and all of its metadata online.

Left: An artful eye-catcher – the "Monattäffelein" ["Little Table of Months"] calendar, an engraving from the mid-17th century. Below: A large-format printed work is illustrated by a mezzotint from France, which was printed in colour. Below right: A small, pasted-in engraving decorates the inside of an old book.

The oldest illustrations printed on paper are woodcuts, the earliest examples of which can be dated back to the period between 1410 and 1420. Shortly thereafter, texts and images were being carved into the same wood blocks to be printed by hand. Soon people were producing whole series of this type of woodcut. These were bound together and are now known as "block-books". This technique was developed in the mid-15th century parallel to Gutenberg's invention of printing books using moveable metal type. Gutenberg's printing process spread rapidly, to the detriment of the block-books. Today there are still around 400 15th-century block-books in existence, 16 examples of which survive in the Herzog August Bibliothek. In addition, people also began to publish and to collect print series made up of woodcuts or copperplate engravings.

There has, to a certain extent, always been a contextual relationship between texts and images which maintains that they do not stand alone. Instead, each relates to, complements and elucidates the other. This idea is also the basis for our modern concept of the relationship between text and images. This was, however, not the case at the beginning of the 18th century. At that time, a fundamental separation of printed texts and images took place. Both were considered to be independent entities and were, therefore, designed to be self-explanatory. In accordance with this idea, people also separated pictures from previous eras physically from their books. They even went so far as to cut pictures out of the bindings into which collectors had bound and pasted them.

In today's print rooms, the graphic works are usually kept loose, with the individual sheets being mounted on acid-free cardboard and stored in boxes. Visitors view the images through the window of a mat, but learn nothing more about their physical appearance or provenance at first glance. Associated texts and information on a print's context remain unknown. As the separation of the ducal collections in Wolfenbüttel was never fully completed, the Herzog August Bibliothek still retains some Sammelbände [bound anthologies], which show how prints were preserved at the time of their origin: in a binding with other prints.

There is another reason why the reconstruction of the original relationship between texts and images in the ducal collections is of such fundamental significance: the collection in the Herzog August Bibliothek is remarkable not only in its documentation of printing and the history of science, but also for its collections of individual artists' works. The cult

Illustrations: Herzog August Bibliothek / Kredovica

surrounding Albrecht Dürer, for example, did not pass the ducal family by. Particularly after his death in 1528, the Wolfenbüttel dukes collected Dürer's prints. Almost all of them are now in the Braunschweig print room.

The ducal collection included the "Triumphal Arch", which Dürer produced for Emperor Maximilian I. This gigantic woodcut, which shows a magnificent gate – a triumphal arch, as it were, for the Emperor – comprises 192 woodcuts printed on 36 sheets of paper. Joined together, they form a single image measuring 3.5 x 3 metres. It wasn't until 1928 that the "Triumphal Arch", together with around 10,000 other prints, passed from the library into the collection of the Herzog Anton Ulrich-Museum in Braunschweig. Today, only traces of Dürer remain in Wolfenbüttel.

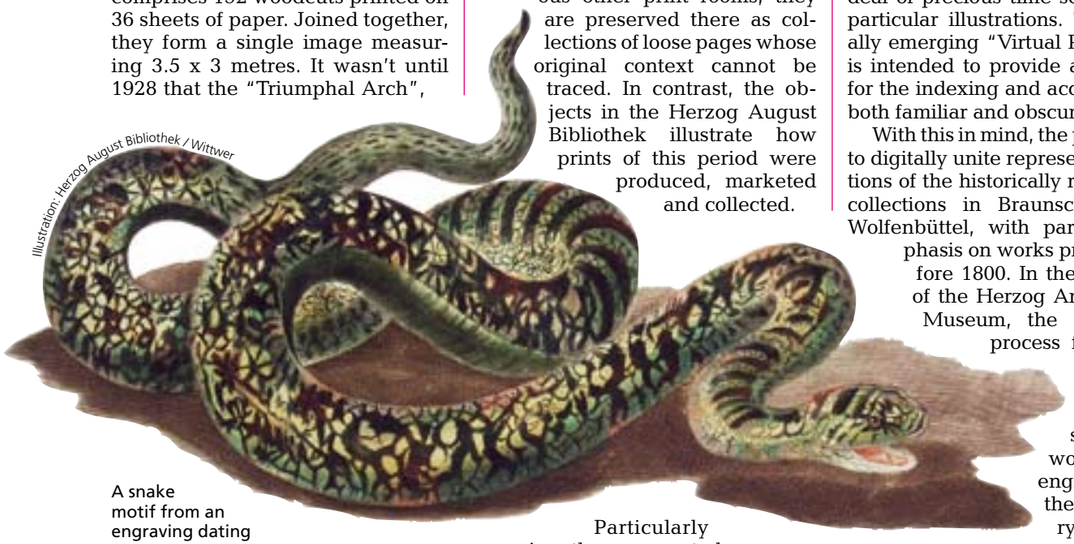


Illustration: Herzog August Bibliothek / Wittwer

A snake motif from an engraving dating from around 1700

Like text, engravings are usually printed entirely in black. There are, however, striking exceptions. One Florentine engraving, which was printed in blue in around 1475, is, therefore, a rarity and one which would be among the most precious objects in any collection. It depicts a dish, in the centre of which are a centaur and a woman surrounded by cherubs. Its owner at the time pasted the page into a Sammelband together with paper sundials made in Nuremberg. On the opposite page is a sundial which could also have been used in Florence. This context supports further interpretation of the blue Florentine print.

The Bibliothek is also well-stocked with high-quality prints produced in Antwerp during the 16th century. Several hundred print series are preserved here in almost pristine condition, bound in their original Sammelbände. While the same series are also found in various other print rooms, they are preserved there as collections of loose pages whose original context cannot be traced. In contrast, the objects in the Herzog August Bibliothek illustrate how prints of this period were produced, marketed and collected.

Particularly prominently represented in the Wolfenbüttel collection are print series modelled on designs by the Dutch architect Hans Vredeman de Vries. During the three years de Vries spent in Wolfenbüttel (1586-1589) he designed the canal system, and one of his buildings, the old Kanzlei [chancellery], still stands today. Virtually combining the series of drawings created by Vredeman de Vries in the Herzog August Bibliothek and the Herzog Anton Ulrich-Museum will render an almost complete portfolio of his multifaceted work publicly accessible.

The Bibliothek's print collection has, at least in part, long been known to insiders and, since the end of the 1980s, the Herzog August Bibliothek has been increasingly cited as a source in the lists of illustrations of scientific publications. Due to the lack of systematic itemisation in the catalogues, however, these were usually chance finds, and despite all the automation, locating material remained difficult and time-consuming.

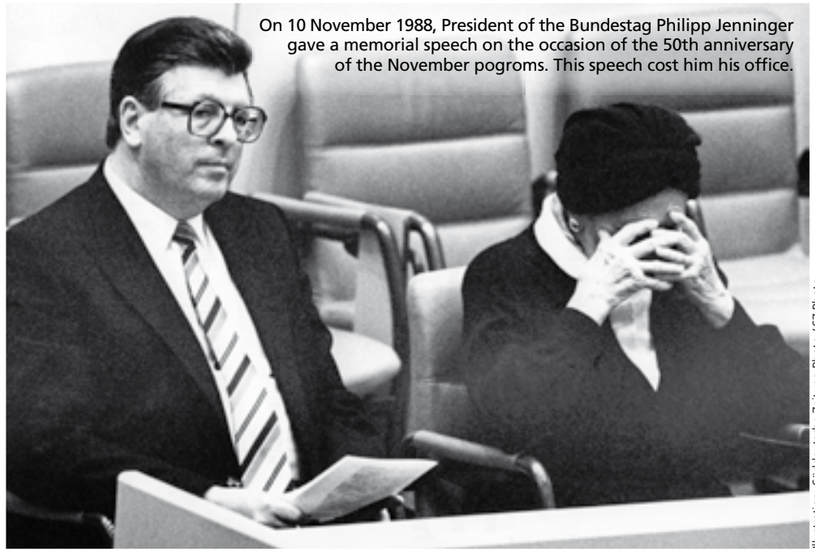
Like books, bound print series were entered in the publicly-accessible digital library catalogue (OPAC) using only general descriptions as titles, such as: "201 etchings; animal studies". This means that historians, art experts and even artists themselves waste a great deal of precious time searching for particular illustrations. The gradually emerging "Virtual Print Room" is intended to provide a new basis for the indexing and accessibility of both familiar and obscure treasures.

With this in mind, the project aims to digitally unite representative portions of the historically related print collections in Braunschweig and Wolfenbüttel, with particular emphasis on works produced before 1800. In the print room of the Herzog Anton Ulrich-Museum, the cataloguing process focusses on German artwork, from the single-leaf woodcuts and engravings of the 15th century to the end of the era in around 1800. Work at the Herzog August Bibliothek is centred on the important connection between prints and books in a European context. Altogether around 40,000 of the more than 200,000 prints preserved by both institutions are to be digitised and indexed over the next few years – in the interests of both basic research in various disciplines and the interested public.

Ad Stijnman is a DFG-funded project team member whose research focusses on the field of historical printmaking techniques. **Dr. Thomas Stäcker** heads the department of Old Printed Books and Digitisation at the Herzog August Bibliothek.

Contact: Herzog August Biobliothek Wolfenbüttel, Lessingplatz 1, 38304 Wolfenbüttel, Germany

▶ www.virtuelles-kupferstichkabinett.de



On 10 November 1988, President of the Bundestag Philipp Jenninger gave a memorial speech on the occasion of the 50th anniversary of the November pogroms. This speech cost him his office.

Illustration: Süddeutsche Zeitung Photo / SZ Photo

Words that Won't Go Away

Coming to terms with the past: A dictionary of "Vergangenheitsbewältigung" illustrates how "charged" German terms have been used publicly in Germany since 1945

By Georg Stötzel and Thorsten Eitz

On 9 January 2009, German daily newspapers headlined with "Cardinal Compares Gaza to Concentration Camp". At the time, commentators expressed concern as to whether Cardinal Renato Raffaele Martino's concentration camp comparison had placed the Pope's intended visit to the Holy Land in jeopardy. Then, at the beginning of March 2009, Augsburg Bishop Walter Mixa made headlines when he compared the number of Holocaust victims to the number of abortions performed in Germany, thus, according to his critics, making an "objectionable comparison between abortion and the Holocaust".

In its own way, each of these two examples serves to illustrate the controversy that exists over the use of terminology from and comparisons with the Nazi past. At the same time, they demonstrate that references to history under the swastika are frequently made, not in isolation, but instead to comment on current issues and problems. In other words, the use of these comparisons in speech and argumentation serves, in the first instance, not to explain history, but rather to express current political opinion.

In two comprehensive volumes and 65 keywords (from *Anschluss* ["Annexation"] to *Zigeuner* ["gypsy"], with an index of around 2000 related words), a just-published dictionary of *"Vergangenheitsbewältigung"* ["Coming to terms with the past"] compiled with the aid of the DFG illustrates the linguistic attempts by both Germans and non-Germans to deal with Germany's troubled past. The work covers the period from 1945 to the immediate present.

Germany's struggle to come to terms with its history became apparent in the public debates which took place after the end of the war. This contention often culminated in scandals, some of which are imprinted indelibly on the public's memory. The case in 1983, for example, in which Franz Josef Strauß branded one of Achternbusch's films as *"entartete Kunst"* ["degenerate art"], unleashing a media frenzy. Or the incident involving Chancellor Helmut Kohl, who in 1986 provoked months of party and media controversy by likening Gorbachev to Goebbels in a diplomatically charged debate. Finally, there is the former President of the German Bundestag Philipp Jenninger who, during his 1988 speech on the occasion of the 50th anniversary of the violent actions known today as the (Imperial) Night of Broken Glass or (Imperial) Pogrom Night, literally talked himself out of a job.

The dictionary brings these and similar "communicative events" vividly to life, placing each in its historical context. In doing so, the dictionary distinguishes between four different levels of linguistic "coming to terms with the past". The first type addresses persistent post-war issues: "How could the Nazi dictatorship and their crimes have been allowed to happen?" and "How can we prevent this from happening again?" The "Wiederaufbau-Deutschen" ["Germans of the reconstruction"] saw themselves as victims who had been linguistically seduced and abused by the National Socialists. Against this backdrop, the Allied occupying powers were not alone in calling for the denazification of the language.

Terms which were considered typical "Nazi" words and therefore "charged", were, in future, to be

avoided. The list of such words included, for example, terms such as *heroisch* [heroic], *heldenhaft* [heroically, valiantly], *fanatisch* [fanatical – in the positive sense], as well as expressions such as *betreuen* [to guide or supervise], *durchführen* [to carry out, perform, execute], and *organisieren* [to organise], whose appeal seems less obvious. All these words were consigned to the "Wörterbuch des Unmenschen" ["Dictionary of the Inhuman"] in 1945.

The second type of linguistic Vergangenheitsbewältigung deals with a different type of "charged" vocabulary. This category includes those words and phrases which evoke negative associations from the Nazi era. While their use is not prohibited, these words are deliberately used to compare current phenomena and personalities with Nazi dictators, thus vilifying them. Comparisons with Nazis have, incidentally, been the order of the day since 1947, when a Nazi-sympathising CSU denazification minister was publicly denounced as a "blond Hitler". Another example: in 1948, the Western press described the division of the Senate of Berlin as a "Machtergreifung der SED" ["seizure of power by the SED"], likening it to the events of 1933. In 1949, politicians went so far as to brand heckling at Ludwig Erhard's campaign speech a "Nazi method". From the mid-1950s, politicians also, for example, began to exploit the past. They did this, for instance, by deliberately describing the Saarland question as the *"Anschluss an Frankreich"*["Annexation of France"], thereby relating it to the *"Anschluss an Österreich"* ["Annexation of Austria"], which was declared an act of violence after 1945. In 1990, the Humanist Union protest movement proceeded along similar lines, criticising the "accession" of the GDR to the Federal Republic of Germany through their campaign slogan "Art. 23. Kein Anschluss unter dieser Nummer" ["Article 23. No accession under this number", which is the standard German phrase for "The telephone number you have dialled is not available", and a pun on the dual meaning of the word "Anschluss", which can be either an "annexation/accession" or a "connection".]

Within Germany in the period that followed, those phenomena which – particularly through increasing public consensus – were perceived as unique and unparalleled were exploited through the use of comparisons. After the construction of the Wall, the GDR was branded a "concentration camp" and, in 1976, the zoo director and well-known animal rights activist Professor Bernhard Grzimek won his right to criticise the confined conditions of caged laying hens using the expression *KZ-Eier* [concentration camp eggs]. By the same token, women who had undergone abortions were vilified by Catholic bishops as "mass murderers". In 1979, after the broadcast of the neologism-inspiring Holocaust series, anti-nuclear power protestors coined the slogan "Gorleben is the Holocaust". Pro-life activists ultimately won the right to demonstrate outside abortion clinics carrying "Babycaust" placards. This overuse of Nazi comparisons is illustrated in detail in the dictionary under keywords like *Hitler*, *Goebbels*, *SS*, *Auschwitz*, *Endlösung* [Final Solution], *Gestapo*, and *Selektion*. Their discursive development is described in detail, with lines drawn right up to the present day.

What is conspicuous is that the overuse of Nazi comparisons established itself despite public criticism and the gradual development of a consensus on the unparallelable scale of Nazi crimes. The development of this public criticism of Nazi crimes spawned a whole series of words which indicate that this practice is perceived by the general public as "impermissible" and "inappropriate". These words include *unvergleichbar* [incomparable], *belastete Wörter* [charged words], *relativieren* [relativise], *verharmlosen* [downplay] and *Verhöhnung der Opfer* [mocking of victims].

It is, however, obvious that these pervasive comparisons have not, however, undermined the Dictionary's third category, which involves dealing with the past in a critically reflective manner. In the wake of this contradictoriness – which is made apparent in many places in the dictionary – an almost schizophrenic process for the public airing of Nazi comparisons has developed. Once public sensitivity and journalistic interest have been aroused by a loudly-proclaimed Nazi comparison, and the "éclat guarantee" has been fulfilled, public criticism, either by the perpetrator themselves or by a third party, generally follows. This "self-criticism" is aired the day after the incident and is combined with the explanation that the person making the comparison had no intention of comparing or equating the person or subject in question with a Nazi phenomenon; that in fact insulting them was the last thing they wanted to do. In no way, furthermore, had they intended to contravene the "politically correct democratic consensus". After all, the explanation continues, the Nazi crimes against humanity were unique and incomparable.

The fourth category of linguistic Vergangenheitsbewältigung involves what are known as "historical words". These words clearly illustrate German society's attempts to achieve an "appropriate" or "true" historical interpretation of its past through public and political controversy. The discussion over the amount of responsibility the Germans should bear for the Nazi dictators' rise to power, therefore, leads to a terminology debate of fundamental significance and import: was it a *Machtergreifung* [seizure of power], a *Machtübernahme* [takeover of power] or a *Machteroberung* [conquest of power]? Is it correct to speak of *Machterlangung* [attainment of power], *Machtübertragung* [handing-over of power] or *Machtüberlassung* [transfer of power]?

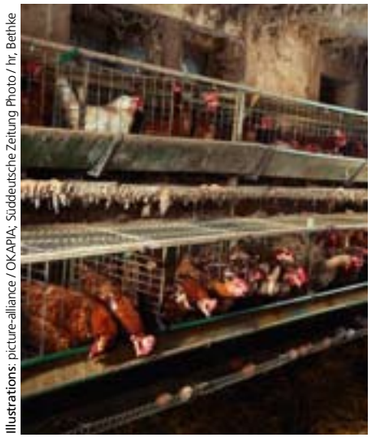
The dictionary traces who used which phrase, who argued for which option and who against, and finally, how often which expressions have been used in public. It also applies similar treatment to the competing descriptions of the end of the tyranny in 1945. Was it a *Niederlage* [defeat] or a *Befreiung* [liberation]? The same holds true, too, for the numerous attempts to use a historical vocabulary to draw a *Schlussstrich* [a final line] and to proclaim the *Ende der Nachkriegszeit* [end of the post-war period].

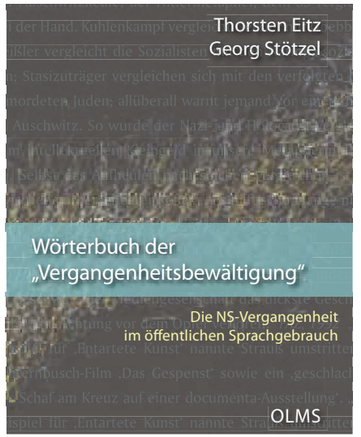
While it is possible to consider the controversy over such historical terms as *Befehlsnotstand* [the problem of blind obedience], *Kriegsverbrecher* [war criminal], *Nestbeschmutzer* [whistle-blower] or *Stunde Null* [literally "zero hour", a term which refers specifically to the capitulation of the Nazi government] as a genuine attempt to define or confirm a view of history, Nazi comparisons are to be perceived more as a type of historical destruction.

Overall, this historico-linguistic dictionary illustrates the tremendous extent to which language itself is both a contentious issue and the object of a democratic society like the Federal Republic of Germany.

Illustration: Süddeutsche Zeitung Photo / Scherl

Propaganda through vilifying vocabulary: "Entartete Kunst" ["Degenerate Art"]. Interested visitors attend the opening of the travelling exhibition of the same name at Berlin's Haus der Kunst in 1938.





Illustrations: picture-alliance / OKAPIA; Süddeutsche Zeitung Photo / hr, Bethke

Above: Battery hens. Wildlife film-maker and zoologist Bernhard Grzimek (centre) won the right to describe eggs produced under such conditions as "concentration camp eggs". The "Dictionary of Coming to Terms with the Past" addresses 2,000 words to document the German-speaking world's attempt to deal with its linguistic history.

Prof. em. Dr. Georg Stötzel headed the research project at the University of Düsseldorf, with **Dr. Thorsten Eitz** serving as research assistant.

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Thorsten Eitz/Georg Stötzel: Wörterbuch der „Vergangenheitsbewältigung" – Die NS-Vergangenheit im öffentlichen Sprachgebrauch ["Dictionary of Coming to Terms with the Past – the Nazi Past in Common Parlance Today"], Volumes 1 and 2, Published by Olms, Hildesheim 2009 (also appeared as a licensed edition published by the Wissenschaftliche Buchgesellschaft, Darmstadt).

The Deutsche Forschungsgemeinschaft

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DFG Research Centres are an important strategic funding instrument. They concentrate scientific research competence in particularly innovative fields and create

Illustration: Querbach

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The first Leibniz Lecture in India, hosted by the DFG Office in New Delhi and the German Embassy in India, was held at the end of March 2010. Professor Jürgen Rödel, a materials scientist from the Technical University of Darmstadt and 2009 Leibniz prizewinner, presented his ideas concerning future ceramics applications in science, industry and everyday life. The DFG's Leibniz Lecture series contributes to enhancing scientific dialogue and cooperation with countries abroad, one of the DFG's key tasks.