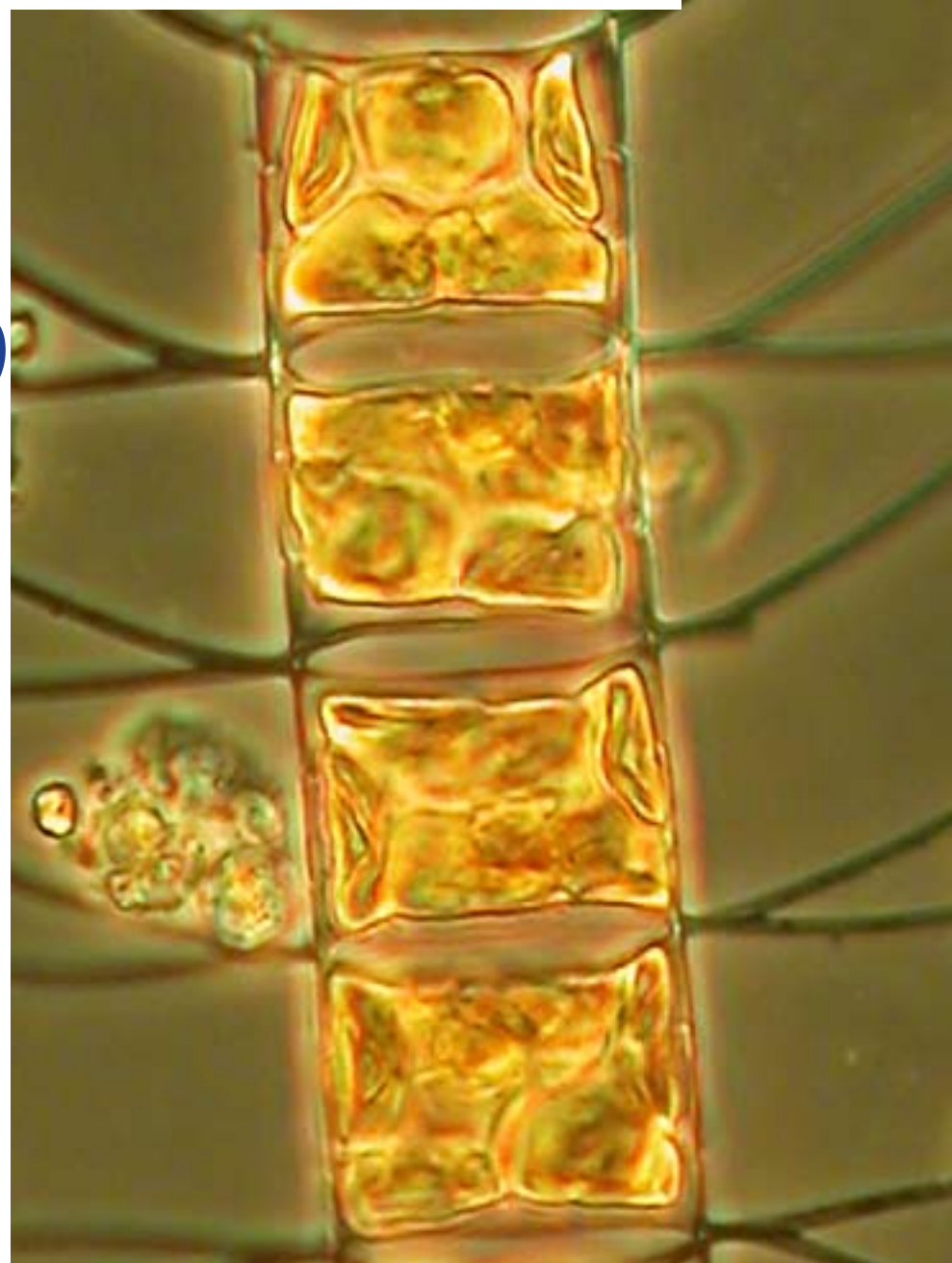




3/2008 ► When Water Gets Warmer ► The Financial Crisis and Academic Research ► The Digital Pentagon ► Focussing on Fatty Acids ► Codex by Codex ► Vikings in the Land of Amber ► New Help for Fidgety Philip



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Baroque Fortifications

Even to the present day, the fort and the city of Kronach in Upper Franconia are defined by enormous fortified walls. The historical Fortress Rosenberg consists of an impressive "pentagon keep". Engineers are trying to retrace the architectural history of these baroque fortifications and, in doing so, have even coaxed stories out of ancient stone-masons' marks. **Page 4**

Looking for Clues

The manuscripts from the Benedictine monastery of St. Emmeram's Abbey in Regensburg are an important part of Germany's cultural heritage. They reflect a wealth of nuances of the culture and of everyday life in the Middle Ages. What the monks wrote and collected long ago now bears witness to pronounced literary interests and far-reaching contacts beyond the local region. **Page 12**

Coping with ADHD

More than 650,000 children and teenagers suffer from ADHD in Germany. But it is not only the children who are affected by the attention deficit and hyperactivity disorder – the people around them suffer as well. Researchers from a number of different disciplines are studying the complex causes and the background to this disorder and are looking for new therapies to treat it. **Page 29**

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Cover: Sommer / IFM Geomar

The Impact of Climate Change on Water Resources

Diatoms are a form of phytoplankton. They may be solitary or chain-forming, such as the Chaetoceros pictured. Increasing water temperatures will significantly affect these organisms. **Page 21**

Late in the summer of 2008, as the signs of what had become a global financial crisis within the span of just a few weeks became clear for all to see, questions were quickly formulated, and with them, the accusations: Why didn't anyone predict the credit crunch and the crash in the international markets? Why didn't anyone implement the proper corrective measures in good time? And why isn't anyone able to name the spe-

studies published that assumed undiminished growth. Some received attention, some were ignored. In the current crisis of global scale, scientists are at best advisors, not actors – unless a scientist has been appointed to a high political office, such as Ben Bernanke, chairman of the U.S. Federal Reserve.

But the scientific community must accept the role of an advisor, a task for which it is perfectly suited. Viewed in this way, the financial

to the market economy. A futurologist announced that he had warned of the financial crisis ages before it occurred, its sole cause being the greed of the global financial acrobats. Greed is one of the seven mortal sins: a topic, perhaps, for theologians as well?

Business ethics is on the advance not only as a buzz word, but as a research field as well. Long ago, I saw the following graffiti sprayed by squatters on a house: "Profit-

anisms, learning curves and peer pressure. In recent years, economics and psychology have been increasingly joined into behavioural economics. Psychologists Kahnemann and Tversky were awarded the 2002 Nobel Prize for Economics for their "Prospect Theory", which explains human decisions under different conditions and circumstances on the basis of empirical studies, a concept that clashes with the rational maximisation of benefit as the initial

mercial law, civil law and regulatory law. Corporations, insurance companies or mortgages don't grow on trees; they are useful inventions.

Everything that is traded on the financial markets is, in one way or another, a product of law. The individual transactions follow legal rules. The institutional framework (stock market, central banks, etc.) is not built of brick and mortar, but rather of law, legislation, and contract. The state can create a prod-

acutely at the moment. Legal scholarship examines governance options and the need for legal control, often using international comparisons and collaborating with other disciplines.

In light of the financial and economic crises, there are ad-hoc rescue measures and economic stimulation under consideration. To implement such measures, an appropriate legal framework must be in place. From a scientific perspective, all spotlights point to long-term regulation: What rules are necessary in order to avoid the tipping of conventional market risk into systemic risk? After all, that individual deals go sour cannot be prohibited by law. When do individual economic mistakes lead to downward spirals, to system failure? Scholars of commercial law, political economists and business economists agree that the financial service providers must be better equipped with own funds. Implementation of this requirement, in turn, requires legal tools: e.g. international treaties, EC directives, regulation of the financial industry, endorsed accounting standards, etc. But this is just a small first step.

The upcoming research projects are, thus, very interdisciplinary. The physicist or epidemiologist may be able to assist in determining how and when simultaneous individual events trigger an avalanche effect. Natural scientists and psychologists can help lawyers and management scientists assess risks. There is little room for such endeavours in day-to-day university operations. The diverse funding portfolio of an organisation such as the DFG, with quality-safeguarding selection procedures, is much better suited for such work. Researchers should take advantage of the opportunity that is open to them here.

Ch. Windbichler

Prof. Dr. Christine Windbichler is Vice President of the DFG.

Christine Windbichler

The Financial Crisis and Academic Research

The disaster in the financial markets is of concern not only to economists – science, in all its diversity, is challenged as well

cific causes of the disaster in the financial market?

Criticism focussed first on managers of large banks and financial institutions and then later increasingly on politicians and the government for its role as a regulator. Nevertheless, the scientific community must ask itself if the prediction, the fighting, and the prevention of such global downturns are not among its most fundamental duties.

Having asked the question, one quickly arrives at an equally surprising as double-edged finding: There was, by all means, an abundance of scientific publications available that warned of a financial crisis, suggested measures, and analysed the causes. But there were just as many

crisis quickly becomes an opportunity for science in all its diversity – a diversity as is represented and promoted under the umbrella of the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation), the central, self-governing organisation of science and research.

All disciplines can serve the role of an advisor, not only the economic sciences, which naturally come to mind first, or the historical sciences and mathematics, which one might think of next. But specialists from other disciplines feel summoned, too, sometimes the right people, sometimes the wrong people. A sociologist recently called for an end

addiction is curable." A topic for medical doctors, psychiatrists in particular? Is there a pathological greed syndrome? And who has it? Certainly not only bank managers are susceptible, but also people who buy houses that they cannot afford, the mortgage brokers who provide them with financing and who then earn a commission, the auditors who evaluate the mortgages without even looking at the houses, and the sellers of financial products who provide services for their employers and their employers' customers.

If the general human inclination towards money is at issue here, the topic would be better served by psychologists. It is a question of decision processes and incentive mech-

assumption in Neoclassical economics. Kahnemann and Tversky demonstrated, for example, the overestimation of one's own abilities as well as, depending on the situation, an increased willingness or aversion to accept risks. Which brings us back to the financial crisis.

The call for governmental sanctions is fuelled by rage and disappointment. What do legal scholars have to say about the financial crisis? Criminal law deals with the behaviour of individuals who have committed a previously defined criminal offence. Crimes have certainly been committed. What often escapes the legal layperson, however, is the broad field of com-

uct through laws or administrative acts. On a private level, contracts or articles of association can establish a binding set of rules for the participants. In this vein, commercial law represents an element of infrastructure in the same way as do utilities, transportation facilities or a telecommunication system. Such elements of infrastructure can be provided by the government itself or by the private sector, in which case it is subject to government regulation.

Law is tightly linked to the state, governmental action and enforcement – i.e. it is essentially a national affair. But the real economy and the capital markets interplay internationally, a fact that we are feeling



Foto: HU Berlin



For centuries massive ramparts have protected Fortress Rosenberg in Upper Franconia. Now building archaeologists are reconstructing the history of the baroque walls. They are also deciphering mysterious symbols hewn in the stones by the masons. The final result is a virtual model

By Philip S. C. Caston

The Digital Pentagon

The fear of war has always been a driving force. It has forced people to build defences, although, in retrospect, the state of weapons development and the defensive structures built were closely interdependent. The town of Kronach in Germany's Upper Franconia region looks back on an almost 3000-year history of fortification, mirroring the fundamental developments in this field. Kronachs citizens first built what are probably the oldest excavated stone fortifications in Europe, originating as early as the late Urn field culture of the 10th and 9th centuries before Christ. This was followed, around the middle of the 13th century, by a castle with a

These fortifications are still well preserved today and define the image of the fortress and the town. The fortress consists of a "core pentagon", in turn consisting of five angular defensive platforms (bastions), separated by five straight walls (curtains). A short time later, further forward defence platforms were erected in the north of these fortifications (so-called ravelins, weapons areas and a contregarde), in order to put greater distance between attacker and defender at this main point of attack.

the bastions around 70 metres wide and up to 20 metres high. And the stone blocks, placed end-to-end, add up to a total length of one kilometre.

Internal gangways, whose walls are penetrated at regular intervals by small, approximately 20 centimetre wide, vertical openings, i.e. slits, are located in the foundation area inside the outer stone block shell of the bastions. They extend down several metres to solid rock. Understanding the original function of these slits in the walls is an important, but still unresolved problem for the building archaeologists. The "slits" in the north-west bastion extend more than 10 metres down to the foun-

courtyard and keep: Rosenberg Castle.

The war of most consequence for Kronach and its citizens was probably the Thirty Years War. In its course, the town was besieged in May 1632. Rosenberg Castle had been fortified shortly before this by low, angular, earth and timber defensive platforms and ramparts. This enabled a number of enemy attacks to be warded off. Nevertheless, many of Kronach's citizens lost their lives, some in a particularly gruesome manner. Tradition has it that four prisoners of war were actually skinned alive. The town and the fortress, however, could not be captured. To honour the town and reward its courageous citizens Kronach was awarded a new coat of arms, showing two flayed shield bearers.

The constant threat of war made a new and modernised stronghold necessary.

A new system of ramparts was erected to this end around the mediaeval castle between 1656 and around 1740.

The new walls were not only larger than their predecessors, but also considerably better built. They were built as solid walls from thousands of intricately manufactured rectangular stone blocks.

A project has been attempting to decipher the design of the walls since 2001, using a variety of methods, and to clarify the details of their building history. This is necessary, first and foremost, for monument conservation, and to allow the walls to be efficiently repaired. The principal problem here is the size of the defences. The main pentagon alone has a diameter of 300 metres. The curtain walls are between 20 and 50 metres thick,

Water, which has infiltrated through the bastion and is routed from there into the soil, is found at the lowest points. However, this is a very awkward wastewater disposal system and can therefore only have represented one of its functions. Similar slits can be seen only in very few walls of other fortifications, although these did not function as wastewater systems. It is highly likely that the slits were built for so-called anti-mine operations. That means that the attacking enemy approaches the castle's foundations through subsurface tunnels. His aim was to place explosive charges below the foundations, to detonate them and thus to force the collapse of the walls. The slits may have made the precise localisation of the attacker's tunnels possible and, simultaneously, provided a chance to either flood the tunnel or to destroy it using hand grenades. In the worst case scenario a detonation would have lost some of its force.

Left: The main pentagon of Fortress Rosenberg in the virtual model. The building archaeologists found 2,500 stonemason's marks on the walls, which they digitally documented. Right: A massive stone wall is surveyed using an electronic "tachymetre" in a narrow gangway in the foundation zone of the walls.

The differing slit designs, or the non-existence of slits in the walls of the newer east bastion, poses questions as to the building of the anti-mine system. The building history of the castle may provide indirect evidence. If it is possible to determine the exact building date and identify the builder it may also be possible to understand the purpose of the slits. In order to do this, knowledge of the detailed sequence of construction is required.

A part from some rudimentary dates regarding the laying of cornerstones and the building inauguration, further detailed knowledge of the building progress of the walls is lacking. However, the builders immortalised themselves in the stone blocks using stonemason's marks, distributed over the visible surfaces of the blocks. A rough estimate gives around 50,000 surface blocks on the 25 surfaces of the main pentagon and every twentieth of these displays stonemason's marks. These marks and their spatial distribution on the main pentagon were recorded and mapped in a virtual 3D model. Interestingly, the



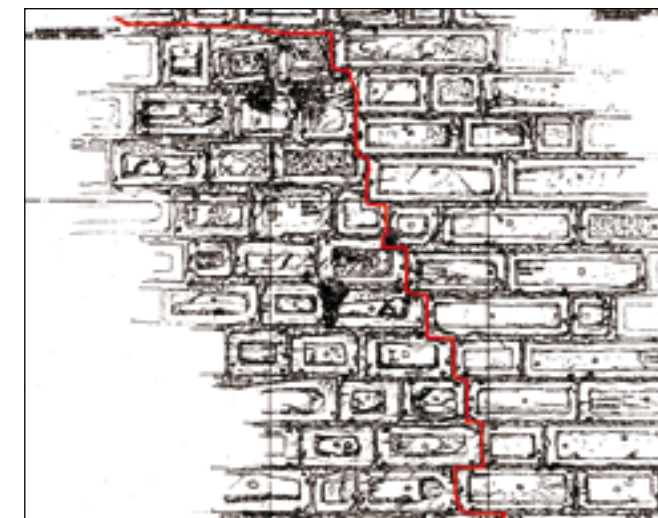
Illustrations: Caston

2,500 stonemason's marks can be assigned to around 160 types. Some of the stonemason's marks appear only once on the entire pentagon, others are distributed over several faces.

It is generally assumed that stonemason's marks are a method of settling up accounts of either individual stonemasons or teams. This can be pictured thus: the stone blocks completed by a stonemason or a team in a defined time were stacked together and one of the blocks would be chiselled with the manufacturer's mark. After invoicing, the blocks were released for building. Distri-

bution was random, but only within the respective construction phase. Under certain circumstances, evaluation of the stonemason's marks may thus allow a mapping of the stonemason's work or help to visualise different construction phases. However, the evaluation can only

Visible damage from the past: A junction bears witness to a mishap while building the south-eastern bastion of the fortress. Stonemason's marks providing information about the building history are found to the left and right of the joint. Below: A measured drawing records the stone surface at a scale of 1:25.



extremely difficult to analyse and many of these substances are not available for physiological studies. Owing to their low concentrations, they can only be isolated with great difficulty from natural sources and only then in small amounts. Moreover, the chemical synthesis of some of the interesting representatives of this group is complicated and expensive.

Minor fatty acids of interest to food chemists include trans-fatty acids and conjugated linoleic acid isomers. Fundamental research in past years has focussed on their occurrence, formation, analysis and physiological role. What sort of fatty acids are they, and how do they differ from those described above? Most monounsaturated and polyunsaturated fatty acids occurring in natural sources have a so-called cis configuration, which means that the fatty acid molecule has a particular three-dimensional structure. Vegetable oils contain almost exclusively cis-configured unsaturated fatty acids.

Trans-fatty acids have a different three-dimensional structure. Such structures are either formed by microorganisms or are produced by partial hydrogenation of oils. This method was formerly used to manufacture vegetable fat spreads. We still do not know for certain whether and at which temperature such trans-fatty acids are produced, e.g. from deep frying oils or during refining of vegetable oils (bleaching). They are thus particularly abundant in products in which hydrogenated oils or fats are used. Furthermore, they are also known to be present in products from ruminants.

Why are trans-fatty acids found in ruminant products such as milk and dairy products as well as meat and meat products? The explanation is simple: they are synthesised by micro-organisms (*Butyrivibrio fibrisolvens*) that live in the rumen, the largest of the three forestomach compartments in ruminants. The trans-fatty acids produced in the rumen enter the animal's metabolic system and are transported into their milk and muscle tissue. The

content of trans-fatty acids in ruminant products is usually less than 5 percent with respect to the total fatty acid content. However, there are also extreme values. For example, in the DFG project "Lipide und Phytosterole in der Ernährung" (Lipids and Phytosterols in the Diet), up to 15 percent of these fatty acids were found in a Greek cheese. The trans-fatty acids in ruminant products and those in partially hydrogenated vegetable oils differ with respect to the acid composition. In other words, the trans double bonds within the fatty acid molecules are found in different positions.

One fatty acid is dominant in ruminant trans-fatty acids: vaccenic acid. In contrast, partially hydrogenated vegetable oils contain a wide variety of trans-fatty acids. The main component in these oils is elaidinic acid. In most cases, this enables analytical differentiation of the origin of these trans-fatty acids in foods.

How high is the amount of trans-fatty acids in our diet? In a national dietary study carried out in Germany in 1994, the calculated uptake was about 1.9 g/day for women

and 2.3 g/day for men. The main sources are ruminant products and food prepared by frying or heating with cooking oils. A recent Swiss study gave values of up to 5 g/day. There are a series of studies which indicate that such a daily intake increases the risk of cardiovascular disease. There are also indications that the vaccenic acid dominant in milk and dairy products is considered less of a risk because it can be converted fairly easily into a different unsaturated fatty acid, the harmless "rumenic acid". This acid belongs to the group of conjugated linoleic acids, which are doubly unsaturated fatty acids based on linoleic acid.

Some results of previous studies are conflicting because most experiments were carried out with cell cultures and only

Dietary recommendation: fish, like this salmon, is rich in omega-3 and omega-6 fatty acids. Right: Measuring the cholesterol level in blood. Fatty acids in the diet appear to have different effects on the formation of the dreaded LDL cholesterol.



Illustration: Steinhart



Illustration: Unilever Germany

a few with animals or people. On the other hand, many experiments have been carried out with different mixtures of trans-fatty acids. Our investigations showed that humans are able to synthesise several conjugated linoleic acids from various trans-fatty acids in red blood cells. However, this would imply that humans are indeed able to eliminate at least some of the undesirable trans-fatty acids taken up in the diet. Nonetheless, their controversial role in food has led to

a global discussion as to whether their maximum values in foodstuffs should be specified or whether their content should be given on the packaging.

Denmark is the first country in Europe to pass a law limiting the content of trans-fatty acids from industrial production to 2 percent of the fat content in a foodstuff. This law does not apply to dairy products. Discussions are also under-

way in the European Union as to whether "health claims" made for foodstuffs with elevated contents should include corresponding labelling.

In addition to trans-fatty acids, the above-mentioned conjugated linoleic acids are another important group of minor fatty acids in

To date, 28 conjugated linoleic acids, claimed to counteract common illnesses, have been detected in various foods.

foods. These are always polyunsaturated fatty acids whose molecular structure is characterised by alternating single and double bonds. The double bonds can occur in different spatial arrangements. These fatty acids are derived from linoleic acid; however, some foods contain conjugated fatty acids of other polyunsaturated fatty acids.

To date, 28 conjugated linoleic acids have been detected in various foods. They are claimed to counteract cancer, diabetes or even thrombosis. Furthermore, they are said to boost the immune system and promote growth. Most

investigations, however, were carried out with cell cultures, and once again, there have been only a few animal studies and hardly any with humans. Furthermore, most experiments were carried out with undefined mixtures of fatty acids. In most of the studies reported in the literature, the composition of the conjugated linoleic acids is unknown. Overall, the available results are contradictory. Recent studies have shown that individual conjugated linoleic acids have negative physiological effects, for example, they cause extreme changes of the liver with respect to size and colour.

The aim of our studies was to develop or optimise analytical methods to determine the individual isomers of the above-mentioned minor fatty acids in a reasonably uncomplicated manner. Coupling of several gas chromatography and liquid chromatography techniques in combination with modern detectors allow a high separation efficiency for both groups of fatty acids. Particular care was taken to ensure that positional isomers were not formed during the analysis, that is, the double bonds did not migrate within the fatty acid molecules.

Synthesis protocols were created with which many of these minor fatty acids can be synthesised in a pure form. This allowed the first synthesis of conjugated linoleic acids that were previously unobtainable as single compounds. Cooperation partners used cell culture studies to gain first insights into the metabolism of these compounds. In summary: minor fatty acids remain an attractive topic of research that still requires answers to many unsolved questions – in the interests of basic research as well as health and consumer protection.

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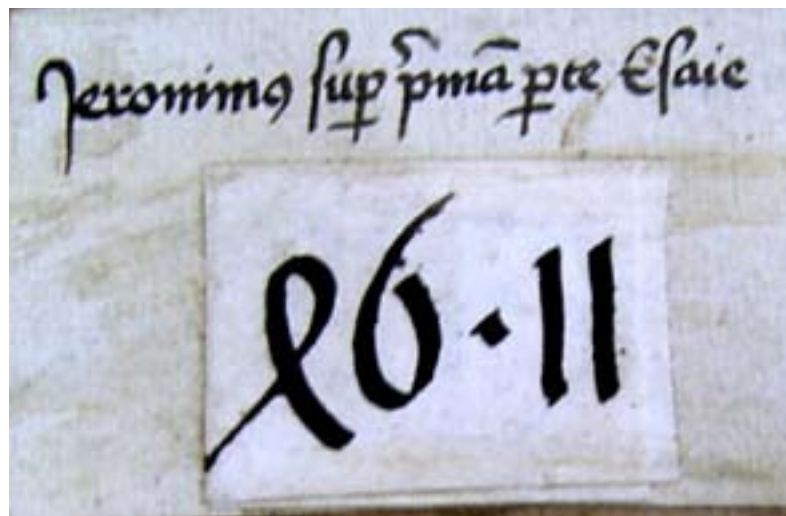
Codex by Codex – Witnesses of the Past

The manuscripts from the Abbey of St. Emmeram, a Benedictine monastery in Regensburg, reflect the culture and everyday life of the Middle Ages. What the monks wrote and collected long ago is now being reconstructed in painstaking archaeological detail

By Bettina Wagner

The Old Town of Regensburg is one of Germany's most outstanding cultural monuments and was declared a UNESCO world heritage site in 2006. Impressive Romanesque and Gothic buildings, most of which escaped destruction in World War II, still convey a lively impression of the culture of the Middle Ages to the present day. What is less well-known is that numerous documents of Regensburg's past are also still in existence, although they are far less accessible than the historic town itself. These documents are now preserved in various libraries and collections, not all of them in Regensburg. This makes it all the more important to investigate these valuable manuscripts in order to be able to reconstruct and thus reach a better understanding of their original context. The vast number of documents that have survived and been passed down through the ages is both a blessing and a curse, as their scholarly evaluation is an enterprise that will take decades. Nevertheless, they promise a wealth of new insights into intellectual and cultural life, and even into everyday life in the Middle Ages.

All of the major religious orders of the Middle Ages were represented in Regensburg, and it is thanks to the monastic libraries that written records have been so abundantly preserved. The Benedictine Order, the mediaeval bookmakers par excellence, played a central role in this. The most important Benedictine monastery in Regensburg was the Abbey of St. Emmeram, which



dates back to the 8th century. More than 550 years before Regensburg was granted the UNESCO seal of quality, the well travelled humanist Enea Silvio Piccolomini considered St. Emmeram to be one of the most important sights of the town – second only to the cathedral and the stone bridge. Piccolomini, who subsequently became Pope Pius II (1458–1464), visited Regensburg in 1454, at a decisive time of change. He was travelling to Frankfurt

am Main, where he was to meet the man who sparked the “media revolution” of the 15th century, Johannes Gutenberg. He probably showed the future pope the page proofs of his 42-line Bible in person, not without mentioning that he already had customers lined up for every copy.

The Benedictine monks in Regensburg were also very interested in innovations in the manufacture of books. Since the late Middle Ages, instead of costly parchment, they had been writing increasingly on paper, which was manufactured in Nuremberg, not far from Regensburg, since 1390. In the 1470s they started systematically purchasing printed books. Both of these factors boosted the growth of the monastery's library; as the records show, the library catalogue from 1346 lists 236 manuscripts, whereas by 1450 the number of volumes held by the library had grown to 350. By the

Colourful and artistic: the mediaeval poet and playwright Roswitha of Gandersheim presents a manuscript of her writings to Otto the Great. This wood engraving dates from 1501. Above: Old manuscript shelfmarks provide valuable clues on the history of books and the library itself.

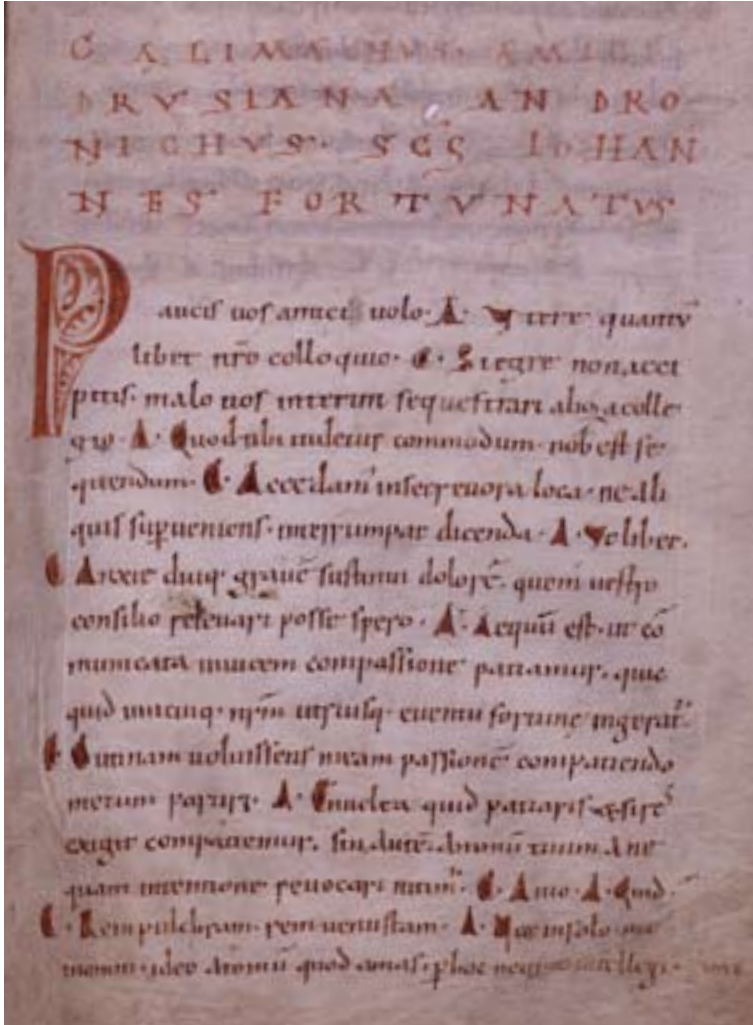


end of the 15th century this number had more than doubled, and in addition to 580 manuscripts, the monastery library also had more than 200 printed books. This expansion slowed again in the 16th century. Although the monastery developed into a centre of the Counter-Reformation after Regensburg became protestant in 1542, even opening its library to visitors from outside the order, the age of manuscript production was over and done. The printed library catalogue from 1748 lists a total of 922 manuscripts, while the number of printed works is estimated to have been between 20,000 and 25,000 volumes.

Whereas most of the printed books were sold after the monastery was dissolved in 1810/11, and were thus spread around the world, the mediaeval manuscripts remained as an almost intact "historical ensemble", as the most valuable volumes had been moved to the Munich court library, and its successor, the Bavarian State Library, today holds about 1,000 manuscripts from St. Emmeram. The monastery's long tradition and the broad range of interests of the monks who lived there now make this collection of manuscripts a unique source of materials on mediaeval intellectual life as well as a worthwhile object of study for medieval historians.

The most remarkable item in the collection is, without a doubt, the Codex Aureus of St. Emmeram, a lavishly-illuminated Gospel Book from the Court School of Charles the Bald, dating from around the year 870. The Codex, the binding of which is richly decorated with

precious stones, is recorded as having been at the monastery in Regensburg as early as the late 10th century. At that time there was also another rather plain codex there, whose contents are nevertheless of very great significance: the only complete copy of the works of the early mediaeval poet and playwright Roswitha (Hrotsvit) of Gandersheim (circa 935–973), which



A priceless treasure: The only complete copy of the Dramas of Roswitha of Gandersheim stems from the library of the Benedictine Abbey of St. Emmeram in Regensburg.

the humanist Conrad Celtis borrowed from the monastery's library 500 years later and had printed, illustrated with woodcuts by Albrecht Dürer. Even the very oldest manuscripts at the monastery bear

witness to its far-reaching contacts and distinctive literary interests. Intellectual life at St. Emmeram reached its first climax in the 11th century. The focal point of this climax was a monk named Otloh, a rather bellicose personality and a prolific scribe. Among the roughly 20 Munich codices he wrote, there is also a remarkable testimonial: the Liber de temptatione cuiusdam monachi, an autobiographical text listing the manuscripts he had written.

After Otloh's time, a prolonged period of stagnation followed, and it was not until the late Middle Ages that the monastery experienced another revival. Not only were the changes in book manufacturing decisive for this revival, but also the new contextual developments in Germany, such as the monastic reform movement, the expansion of academia and universities, and the reception of humanism. In 1452, St. Emmeram joined the Kastler Reform ("Consuetudines Castellenses"), which not only called for a return to strict adherence to the order's rule, but also had an impact on the educational system in the monasteries. After this time, numerous monks went to study at the newly established universities of Leipzig (1409) and Ingolstadt (1472), where they came into contact with new academic and scholarly influences and obtained books for the monastery library. The librarians attempted to make the new additions more easily useable by reordering and cataloguing the collection. Bringing together the information contained in these catalogues and the surviving books makes it possible

to follow the expansion of the monastery library all the way through to the dawn of the modern era in great detail.

The reconstruction of such a historical ensemble that grew through the ages relies, as does the preservation of ancient monuments, first and foremost on a precise survey of the historical record. This should look not only at the contents of the manuscripts, but also at their physical properties and condition. Initially incomprehensible sequences of letters and numbers can often be deciphered to yield catalogue numbers, which then make it possible to identify when a certain book was in the possession of the monastery's library. Entries on ownership, purchase and donations provide information on how and when books entered the collections of the monastery, thus giving an insight into the network of contacts the monks maintained. Not only did they write codices themselves, they also purchased books or received them as gifts from relatives or pious benefactors. For instance, the collection of printed books at St. Emmeram includes an edition of the Canon Medicinæ of Avicenna, a Persian physician and polymath (980–1037), donated to the monastery by a chemist from Regensburg in memory of his deceased wife – a rare piece of evidence documenting the ownership of books by a "practitioner".

The work of cataloguing the manuscripts repeatedly throws up discoveries that make it necessary to revise researchers' past assumptions. For instance, it was discovered that an abbot who initiated the construction of a new building for the library in the mid-14th century purchased manuscripts for the new building not only in Paris, but also in Northern Italy. Evidence was also

found that, during the 15th century, significantly more monks at St. Emmeram had university degrees than was previously supposed. Precise investigation revealed that several codices had originally been used for teaching at the universities of Bologna, Leipzig, Ingolstadt and Vienna. Even the exterior of these books indicates that this was the case, as some of these lecture transcripts are bound in the inexpensive late mediaeval "Kopert" binding made from flexible vellum, probably by the students themselves.

Such findings concerning the history of the books and the li-

become evident; for instance, how receptive the monks were to writings about monastic reform, or their interest in the contemporary natural sciences. Time and time again, documentary evidence that had previously been overlooked is discovered in the texts.

Faced with around 1,000 manuscripts with a broad spectrum of content, whose individual history needs to be investigated in detail, cataloguing such a collection is most certainly a long-term task. Since the day-to-day business of modern research libraries is primarily geared towards providing services for the library users, basic medieval research, such as cataloguing these manuscripts, can essentially only be carried out by specialists dedicated solely to the task.

Thanks to the ongoing support of the DFG, which has provided project funding to the Manuscript Cataloguing Centre at the Bavarian State Library for over 30 years, the third volume of the catalogue of manuscripts from the Benedictine Abbey of St. Emmeram is now close to completion. However, over half of the monastery's codices held in Munich are still waiting to be catalogued according to the present state of research. Only when this work has been completed can the findings we already have be used to compose an overall picture, based on the original sources, of the history of the library and intellectual life at one of the most important mediaeval monasteries in South Germany.

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The mediaeval ensemble of buildings which constituted St. Emmeram, in a copper engraving dating from the early 17th century. The monastery's library – on the left in this view – is marked by the letter "P".

brary can only be brought to light by studying a large, complete collection of manuscripts, since this allows comparisons to be drawn between different scribes, shelfmark systems and types of binding based on a broad range of material. Of course, the job of cataloguing is not restricted to simply performing detailed analyses. Only by analysing the contents of the codices do the interrelationships

Vikings in the Land of Amber

The graves of Scandinavian merchants and warriors in Wiskiauten have been known for a long time. Now, German and Russian archaeologists have discovered remains of the settlement – an important piece of evidence for past trade relations in the Baltic Region

By Timo Ibsen

A bucket of the muddy water that is pouring non-stop from a solid stone structure at the bottom of an excavation trench that is already four metres deep is passed from hand to hand. Russian and German students are searching for evidence of a Viking settlement not far from a graveyard of burial mounds from the early Middle Ages in what was once East Prussia. Completely covered in mud, they are busy excavating a well from the early Middle Ages that appears to still be in working order even about a thousand years after it was built.

In the well shaft they not only find remnants of charcoal, but also innumerable animal bones, shards of pottery, glass and amber pearls as well as tools such as combs made of bone and iron. About a kilometre away, a second team is working at a site that was once on a lakeshore. Surrounded by mosquitoes, the archaeologists and volunteer helpers are gradually uncovering layers of a settlement that were covered by sediment and debris in German and Soviet times, layer by layer. These layers of culture have been

lying silent in the ground for more than 1200 years.

Together with the well, these remains form part of an extensive complex that was once home to the Prussians, a West Baltic tribe that settled in what later became East Prussia at around the end of the first millennium AD, giving the region its name. Today, the region is part of the Russian enclave of Kaliningrad. The former city of Königsberg, home to famous philosophers, is now called Kaliningrad.

The site of the dig is about three kilometres south of the Baltic coast in a moraine landscape at the base of the Curonian Spit, a sand spit which starts at the north-eastern corner of Sambia and extends about 100 kilometres towards Klaipėda – formerly Memel – separating the Curonian Lagoon from the Baltic Sea. A branch of the lagoon used to extend further inland, forming a shallow lake close to the former German village of Wiskiauten (Viskautai, the modern-day Mokhovoye) that is now silted up. From its shores you can see a little wood on a nearby hill, the highest point in the region, in which a cemetery with hundreds of graves lies concealed. It is currently estimated that there were originally more than 500 burial mounds here.

It was discovered in the mid-19th century by a lieutenant and his troops stationed nearby, who found rusty swords and lances, bronze buckles, coins and silver

jewellery in the ground while a road was being built there. These finds originated from burial mounds that had already been destroyed. Shortly thereafter, archaeologists from Königsberg began with the first archaeological excavations of what was described at the time as “Germany’s largest Viking cemetery”, as it soon became clear that the treasure trove of richly decorated artefacts had once belonged to Scandinavian merchants and warriors who had found their final resting place in the Prussian region between 850 and 1050 AD. The necropolis was thus soon taken as indirect proof of a colony of Vikings who had been engaged in trade with the Prussians in Sambia, the area with the richest occurrence of amber in the world.

However, in spite of much searching, it has so far proved impossible to locate the suspected trading settlement. After the work of the German archaeologists had been interrupted by the Second World War excavations were continued by the Russians, but it was not until the 1980s that the archaeologist Vladimir Iwanowitsch Kulakov managed to find the first traces of settlement in the area surrounding the hill cemetery. The size and nature of the settlement remained a mystery, however, as did its age.

Building on the experience he had gained in scientific methods of studying archaeological finds

Archaeologists hard at work in sub-zero temperatures: If a promising site has been identified in the field by geomagnetic scanning, a core is drilled in the hope of finding evidence of Viking settlements.

Illustration: Ibsen



while excavating the major Viking trading settlement of Haithabu, Claus von Carnap-Bornheim from the State Museum of Archaeology in Schleswig and the foundation

Above: An aerial view of the area around Wiskiauten in former East Prussia showing the cemetery of burial mounds dating from the early Middle Ages. Bottom: Russian and German students excavate an old well from a settlement dating from the pre-Roman Iron Age. Pottery is clearly visible.



“Stiftung Schleswig-Holsteinische Landesmuseen Schloss Gottorf” initiated a pioneering research project in the region in cooperation with the Russian Academy of Sciences in Moscow. For the first time a large-scale survey was launched to search for the village of Wiskiauten, in an effort to identify its precise position, size, age and layout of the settlement.

The potential area where it may once have been covered an area of two and a half square kilome-

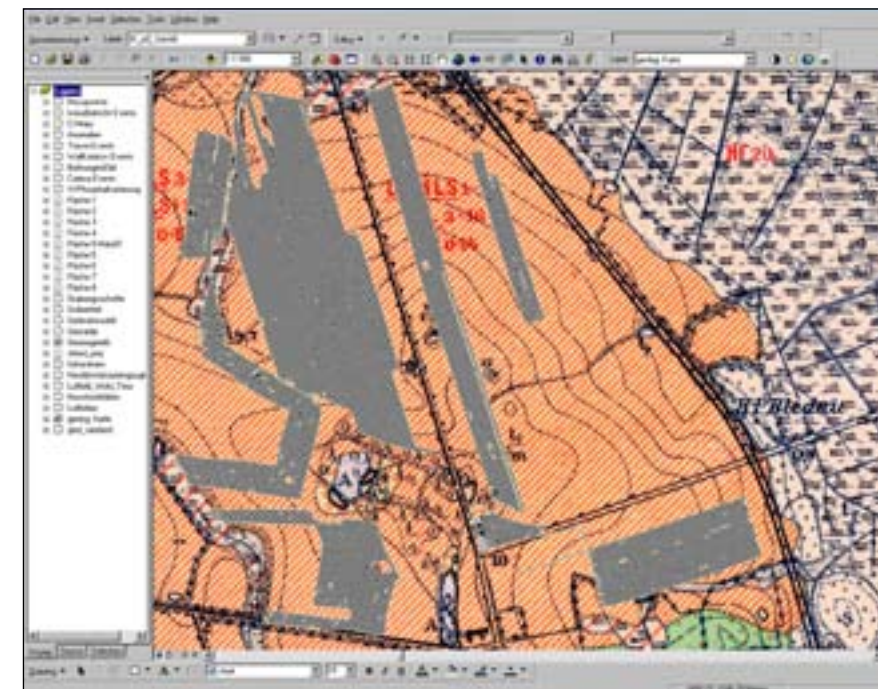
tres, making it almost impossible to examine using conventional archaeological methods. The most promising approach was the state-of-the-art method of geomagnetic measurement, which can be used to obtain a kind of “x-ray image” of a large area very rapidly. This is useful because the natural magnetic field of the earth is altered wherever mankind has disturbed the geological structure of the soil by digging or building, and the resulting anomalies can be revealed by such measurements.

Since the project began, the team from the Institute of Geosciences of the University of Kiel has surveyed an area of 70 hectares. The conditions are ideal in the early months of the year, when the ground is still frozen and the fields and meadows are covered by a thin layer of snow. This makes it easy to cover the area by tractor, pulling a trailer on which the measuring equipment with the high sensitivity sensors is mounted, as the driver can follow the previous tracks in the snow, thus ensuring that there are no gaps in the measurements. This gathers an immense amount of data. On a computer screen this data is represented either as individual points or, in some cases, as dense clouds surrounding linear structures. These images are then projected onto topographical maps of the area in order to identify the coordinates of the anomalies

in the magnetic field. In the field a core can often be drilled the very next day. These cores are examined immediately for material such as pieces of bone or charcoal, which can then be analysed by radiocarbon dating to provide an estimate of the age of the artefacts. At the sites with the most promising finds, archaeological digs are then planned for the summer.

So far the researchers have been able to locate two features from the pre-Roman Iron Age in the last centuries BC as well as a large number of remains from a settlement dating from the early Middle Ages from between the 8th and the 12th centuries AD.

This has already led to the concept of a pure Viking settlement needing to be revised, because even before the Scandinavians had arrived, which is thought to have been some time in the early to mid-9th century on the basis of finds in the cemetery, evidence has been found of at least two native villages that existed on the shores of the lake that was connected to the Curonian Lagoon. Not far from the old shoreline of the lake, excavations at two different sites have revealed remains from settlements with a large number of animal bones and fragments of hand-made ceramics as well as remnants of metalworking. They are thus evidence of extensive



craft and manual work. These settlements date from the late 7th and 8th centuries. Graves that match these early remains of settlements have not yet been found, however. The earliest evidence of a settlement that can be linked to the hill with the burial mounds dates from the middle of the 9th century.

The large well, which lies a mere 150 metres south of the cemetery, dates from this later period. Radiocarbon dating of the artefacts found in the well show that the well was filled in during the latter part of the 11th century. The well was probably built in around 1050 AD and would certainly have been capable of supplying a large settlement with fresh water. It remains unclear at this stage, where the buckets of water filled from it were carried. So far no houses have been found in its immediate vicinity. However, there certainly is evidence of houses elsewhere, for instance to the north of the barrow cemetery on a step in the landscape that led down to the former lake in a terraced fashion. In total, 60 wooden posts, now only identifiable as inconspicuous round areas of discolouration in the yellowish loamy soil, suggest that the houses were built using posts, a typically Scandinavian method of construction. The numerous finds from the buildings, however, all date from the late 11th century and early 12th century, and thus from a period after the last burial mounds were added to the cemetery.

However, there is a separate burial ground of typical Prussian cremation graves to the east of the large necropolis, which do date from the same period as the buildings that have been discovered. This fits in well with the fact that the artefacts found around the houses are more typical of the native Prussians. In ad-

Above: Looking for clues using modern technology. A geomagnetic scanner is pulled over the snowy field by tractor. A geographical information system is then used to process the measurements by computer and produce an image of the data on screen – seen here as grey areas.

dition to the typical Prussian ring brooches, belt buckles and rings made of bronze, pottery shards, whetstones and animal bones, a Byzantine silver coin dating from the end of the 11th century and

a jet bead have also been found, which are most remarkable as they provide evidence of trade with far-flung regions.

After three years of study the settlement of Wiskiauten can no



Illustration: Ibsen



Illustration: Ibsen

Finds from the area around the suspected "post houses" in Wiskiauten. Above: A distinctive belt or clothing buckle made of bronze (11th or 12th century AD) and, below it, a Byzantine silver coin from the late 11th century. Right: An equal-armed brooch decorated with a stylised animal motif that was found in a burial mound before World War II.



Illustration: Archive State Museum of Archaeology Schleswig

longer be described as a Scandinavian trading post that only existed for a short time. Rather, the researchers now assume that there was a pre-existing Prussian settlement here, which was founded long before the Vikings arrived. The existing infrastructure was merely expanded by the traders from the north, who mostly came from Birka in Central Sweden and from the island of Gotland, connecting this site to the existing trade routes that extended far beyond that region across the Baltic, and the Scandinavian population must have been well integrated with the local Prussian population of the settlement.

A surprise for the archaeologists is the absence of the typical Scandinavian artefacts in the settlement that are so numerous in the cemetery. But, sooner or later, the settlement of Wiskiauten is bound to give up its secret, once more extensive excavations of the areas that for the time being remain "suspect areas" begin in 2010, which aim to reveal what as yet remains concealed. For the time being, however, the combination of exploratory investigation by geomagnetic measurement and archaeological drilling and small-scale excavation that has proved so successful so far will continue. By the time that has been completed, the dense network of grey and black points on the map will contain so much information that it will be easy to dig in exactly the right place. Even now, it has already been possible to link the famous cemetery of Wiskiauten to clear traces of settlement that date from the same period and which cover an area and age range that far exceeds prior expectations.

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► www.wiskiauten.eu



Test rig of the Ludwig Maximilian University of Munich on Lake Brunnsee. The researchers are using experimental methods to study warming of the "water ecosystem".

Illustration: Berger

When Water Gets Warmer

The various effects of climate change on seas, lakes and rivers are already apparent. Even tiny changes in the food chain have a considerable impact on the ecosystem

By Ulrich Sommer

Hardly anyone still doubts that the earth's climate will become warmer. Only the extent of this heating is still unclear. There are lively debates as to whether and how we can master the increasing emissions of carbon dioxide and other climate-relevant

gases. The scenarios predicted by climate researchers for Central Europe forecast warming by up to five degrees Celsius within the next 100 years, with most of the warming likely to occur in the winter half-year. Global warming will also affect the planet's water.

The climate change is already becoming increasingly apparent in

surface waters. For example, the mean temperatures of the North Sea near Helgoland have risen by 1.1 degrees Celsius over the last 40 years. Even if this trend only marks the beginning, the repercussions of warming are clearly visible. Whether in the water or on land: most biological reactions are associated with an earlier seasonal begin of the growth and activity phases or with a spread of heat-loving organisms towards the poles.

Should we be worried about these changes? After all, local bodies of water are very temperate ecosystems that would only become more temperate in winter due to warming. What damage might occur if events such as the spring bloom of phytoplankton – which are microscopic algae suspended in water – starts a few weeks earlier than usual? Can a longer growth season even be disadvantageous? These issues are being addressed

by the DFG Priority Programme AQUASHIFT – “The impact of climate variability on aquatic ecosystems: Match and mismatch resulting from shifts in seasonality and distribution” – which commenced in 2004.

The starting point of all studies is the “match-mismatch” hypothesis put forward by the English fisheries biologist David H. Cushing to explain the variations in year-class strength of fish. According to Cushing, the critical phase in the development of a fish year class comes when the larvae have resorbed their yolk sac and start feeding. For many species of saltwater fish in this phase, the most important food is the nauplius larva of the copepods (small planktonic crustaceans). If the nauplii develop too late, a large proportion of the fish



Illustration: Lengfeller



Illustration: Saage



Illustration: Sommer

Food supply in the sea. Top left: Nauplius larva of a copepod. Next to it: The tiny crustacean with the huge antennae is only one millimetre in size and is the prey of small fish. Left: Large-cell diatom algae dominate the phytoplankton spring bloom; they are the main food source of these crustaceans.

larvae die of starvation. The same thing happens if the nauplii grow too quickly and become too large for the fish larvae to eat. A strong year class can only develop if a sufficient number of nauplii are available at the right time.

However, Cushing’s example illustrates only one of many possibilities. In a climate with pronounced seasons, the activity, growth and reproduction of most organisms follow seasonal patterns. Particularly the special feeding requirements of sensitive juvenile stages are often limited to relatively short periods and are adapted to seasonal fluctuations of the food organisms.

Changes in the climatic conditions may shift seasonal cycles as well as the ratio between predators and their prey. Thus the hitherto existing temporal coincidence (“match”) between supply and de-

mand would be lost (“mis-match”). Such a shift can occur at all links in the food web and has far-reaching consequences, particularly for organisms higher up in the food chain, such as fish. These shifts would thus be the Achilles’ heel of ecosystems. The identification of such sensitive points in freshwater and marine ecosystems is the most urgent goal of AQUASHIFT. Studies are being carried out in seas, lakes and rivers; the individual projects of the Priority Programme are conducted at 17 sites throughout Germany.

One example of such an Achilles’ heel has already been identified at the experimental facilities of the Leibniz Institute for Marine Sciences in Kiel: one of the characteristic events in the course of a year is the spring bloom of phytoplankton in the Baltic. These phytoplankton are the major food source for both the zooplankton and the fish. The time of the spring bloom is only insignificantly altered by a higher water temperature. It is accelerated by about one day per degree centigrade. On the other hand, hatching of nauplius larvae from the eggs of the overwintering copepods is accelerated by about nine days per degree centigrade. On top of that, the species composition in the phytoplankton also changes from large-cell diatom algae to small flagellates. Unfortunately the latter are rarely eaten by copepods. Warming by 4 and by 6 degrees centigrade results in the nauplius larvae hatching before the phytoplankton spring bloom because the latter have to wait for more available light for their growth spurt. In summary: if increasing warming causes the times of maximum food supply and maximum food demand of the nauplius larvae to drift ever further apart and the composition of the food becomes increasingly inade-



Illustration: Kathol

Experimental containers in the Rhine Station of the Zoological Institute of the University of Cologne. “Aquashift” researchers are studying the effects of increasing climate warming on the food chain in the Rhine River.

2006. It remains to be seen whether this is a transient phenomenon or whether problems similar to those in the Black Sea can be expected. Whereas a “constructive” immigration can be regarded as matching to the ecosystem, from the viewpoint of microevolution, matching on the species level must take place via gradual shifts in the gene pool of the different species. Until now, it was generally accepted that microevolution was too slow, at least for multicellular organisms, in order to be effective on ecological time-scales. This assumption is now being questioned because there are increasing indications that ecological and evolutionary time-scales do indeed overlap. Evolutionary ecology projects were thus included in the AQUASHIFT Priority Programme. One of the model organisms being studied is the seagrass *Zostera marina*, which is a keystone organism in marine shallow-water systems.

Overall, the currently available results indicate one thing in particular: increasing temperatures in bodies of water have far-reaching consequences, even if the lethal limit for important keystone species is not exceeded. Even within the tolerance range of many species, subtle shifts in interactions between the organisms can lead to significant changes in the overall ecosystem. In times of climate change, the associated consequences for seas, lakes and rivers must be continuously studied and elucidated.

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► www.ifm-geomar.de/?id=1985&L=1

quate, the transfer of matter and energy could already be compromised at this point in the food chain. And if the nauplii die of starvation, the fish larvae have nothing to eat.

An interesting case of climate-related shifts in the food webs was found in the Saldenbach Reservoir in Saxony. In years with rapid warming of the water in May and June, the older perch can choose between the generally strongly pigmented pupae of large chironomids (non-biting midges) and their own young of about the same size – approximately 17 millimetre. The young perch are, however, transparent and are thus less conspicuous than the chironomid pupae. This means that the chironomid pupae are the preferred prey and the predation pressure on the young perch is low. In years with a warm winter followed by a relatively cold spring, the chironomid pupae and the young perch do not occur simultaneously. Without an alternative prey, the old perch then eat their offspring, thus leading to a weak year class.

It is not known whether evolutionary adaptations within existing species or the invasion of new species with more closely matched

time patterns could close this gap. Such an immigration could be regarded as being “constructive” because mis-matched species would be replaced by those with a better match. This would assist in maintaining the functions within an ecosystem.

Unfortunately, experience in recent years has shown that not all immigrations have been “constructive”. There is an increasing number of destructive invasions, some of which have had dramatic consequences. One example of this is the warty comb jellyfish (*Mnemiopsis leidyi*), which is assumed to have hitched a ride more than 20 years ago in merchant ships that carried them into the Black Sea and from there into the Caspian Sea. It not only competes with schooling fish for zooplankton, but it also eats fish eggs and larvae. The extensive proliferation of this jellyfish in the Black Sea coincided with a reduction in the fishing yields by approximately 90 percent. However, it is still not known whether *Mnemiopsis* has caused this decimation of the fish stock or conversely, whether overfishing has paved the way for the population explosion of *Mnemiopsis*. This species started appearing in the Baltic in October

Portrait

When Mouse and Keyboard Become Obsolete

Intelligent solutions for everyday life in the digital age: Andreas Butz, a media informatics professor from the University of Munich, is investigating the future of the computer

By Rembert Unterstell

The days of the "personal computer" with a keyboard and mouse are counted. A claim of which Andreas Butz, a professor at the Media Informatics department at the LMU in Munich is absolutely convinced. For the friendly researcher, who comes across as even younger than his 41 years, the traditional PC is set to be replaced, in future by more or less intelligent everyday objects. This will make computers ubiquitous – for example in interactive coffee machines or PDAs – but they will be so miniature, they will be almost invisible. At the same time, in the post-PC era the keyboard and mouse, the PC's control interface, will become insignificant. This means that "new and innovative user interfaces are called for", Butz emphasises.

A graphic example is the "interactive beer mat". The electronic beer mat, the prototype of which was developed by Butz along with a Ph.D. student and two undergraduate students, is fitted with a gravity and weight sensor. If your beer glass is empty, the mat automatically orders a refill from a computer at the bar via a wireless link. "Actually the intelligent beer mat was just meant as a bit of a joke", Butz says, looking back, but it has long since been patented, and the intelligent coaster has enjoyed international success in the media. The German tabloid "Bild" even presented the smart coaster on its front cover – but Butz was easily able to take the hype in his stride thanks to the media training he had received from the DFG.

But it isn't the publicity that the researcher is really after, what he is interested in is applications that are applicable to everyday life in the shadow of fundamental problems of human-machine interaction.

Butz, who won the Bundeswettbewerb Informatik (the German annual computer science contest for high school students) way back in 1988, studied computer science at the University of the Saarland. He also went on to obtain his doctorate there in 1997, with a PhD on the automatic generation of informative 3D animations. This was followed



Illustration: Unterstell

by a year spent as a postdoctoral researcher at Columbia University, New York, after which he became a project leader as part of the Collaborative Research Centre "Resource-Adaptive Cognitive Processes", based in Saarbrücken. The team working on the project developed an infra-red pedestrian guidance system. The promising results of this project gave Butz the confidence to take the leap of setting up his own business, and in 2000 he became the co-founder of the spin-off company Eyeled GmbH, of which he was the CEO for two years.

He then returned to academia, and since 2003 has led a junior research group funded by the DFG under the "Action Plan in Computer Science"; in late 2004 he was appointed as a C3 (tenured) professor of computer graphics and visu-

alisation at the LMU University in Munich.

The objectives of his junior research group "FLUIDUM" (Flexible User Interfaces for Distributed Ubiquitous Machinery, www.fluidum.org) are to devise, test, and realise novel user interfaces. Whether it is an interactive conference table, a virtual photo album or a living cookery book, Butz is always interested not only in intelligent applications, but also intelligently simple, that are as intuitive to operate as possible, and thus in the interests of the user.

The PC is based on the paradigm and control concept of the desktop with windows, folders and the mouse, Butz explains. "We started out with the goal of finding a universal and beneficial interaction metaphor for environments with ubiquitous computing." But the team has since departed from this "perhaps rather overambitious goal". Instead, they are working on studies into generally applicable principles of use. The findings are attracting a lot of attention. In 2007, Butz was awarded the Alcatel Lucent Research Award.

Should everyday objects be equipped with computer intelligence? Butz is no advocate of an all-digital futuristic world, full of huge display panels, flashing walls and surveillance cameras that speak to you. On the contrary! He describes such visions as a "horror scenario", making reference to Steven Spielberg's science-fiction thriller "Minority Report". One thing is clear for him, "the breathtaking development into the computerised world of tomorrow ought to be based on humans and their needs, so that it remains a humane world".

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



At the tree line in Finnish Lapland: An approximately one and a half metre high pine has become established in its frugal habitat, although repeatedly exposed to climatic injuries, especially in winter.

Illustration: Holtmeier

Mountain Birch, Tree Line and Climate Change

Surprising news from Finnish Lapland: landscape ecologists have been investigating northern European birch forests for 30 years. Tree lines respond to the continuous environmental changes slower than anticipated

By F.-K. Holtmeier, K. Anschlag, G. Broll und H.-J. Brauckmann

Climate change, currently much discussed, has a global impact – and yet displays many regional facets. How does it reveal itself in terms of the tree line in the far north of Europe for example? For the observer, whether tourist or landscape ecologist, the tree line is the most conspicuous vegetation boundary in the mountains and simultaneously an impor-

tant boundary zone in the habitats of animals and humans.

In the northern hemisphere, the tree lines are caused by the decreasing temperature associated with elevation and geographic latitude. If warming continues the forest will advance to greater altitudes and more northerly latitudes. How fast and to what extent this will happen remains an open question. These developments, which can be observed in the forest boundary zones, are influenced by regional peculiarities, not least in the Finn-

ish subarctic. Researchers have been following these ecological developments for the past 30 years.

The harsh landscape of Finnish Lapland is characterised by undulating peneplains. For the most part they lie at altitudes between 250 and 350 metres, overtopped here and there by gently climbing, rounded mountains (Finnish: 'tunturi', Norwegian: 'fjell'), reaching several hundred metres in height. Sandy-skeletal deposits left by inland ice, which only retreated 9000 years ago, cover the bedrock. Ero-

sion has dissected the sediments; what is left is a diversified mosaic of small hilltops, ridges, valleys and shallow depressions.

Wind blown areas with little snow often alternate with snow-rich sites, sheltered from the wind. Short summers, long, cold winters, strong winds and rapid changes in the weather characterise the climate in this subarctic region.

The tree line generally occurs as a more or less wide transition zone (treeline ecotone) reaching from the scattered forest to the tree line proper, where only a few stunted trees survive. While mixed stands of spruce, pine and mountain birch form the tree line at a height of 450 to 500 metres on the higher fjells in south-west Finnish Lapland, for example in the Pallas-Ounastunturi National Park, and only stunted trees are found at 600 metres, the mountain birch is the only tree species at the northernmost tree line in Finnish Lapland.

The uniform birch forests generally end at only 250 to 300 metres. Individual birch trees still manage to grow in sheltered locations at greater heights. Young pines or stunted old ones may also be found locally in the treeline ecotone. The main objective of this long-term research is to find out how the different, morphology-related site



Illustration: Neuvonen

conditions and other factors are influencing the spatial structure of the treeline ecotone and the 'distribution pattern' of birch regeneration and mortality. The distribution of plant communities and birch in representative areas was mapped. Parallel to this the researchers analysed the physical and chemical properties of the soils and their nutrient conditions. Detailed investigations focussed on the distribution of birch seedlings and young trees. The age structure in particular, the development of the root system and climate-related damage were studied.

The results were then correlated to the site conditions. With the aid of radiocarbon dating it was possible to determine the age of the peat and wood remains from areas that are treeless today. The results provide a detailed picture of the ecological conditions and their history at the current treeline.

Four thousand to five thousand years ago the tree line was 100 metres and more higher than today. Climate cooling was followed by forest retreat, a phenomenon that has continued into the modern age. In poorly drained depressions on the slopes, and in small valleys, decimetre-high hummocks developed in which the normal sequence of soil horizons was disturbed to large degree by seasonal freezing and thawing. At the end of the 'Little Ice Age' (around 1900), and with increasing temperatures, the forest began to reconquer lost territory.

During the relatively favourable 1920s to 1940s, intensive rejuvenation of tree stands at the tree line occurred primarily on the 'southern' fjells, 200 to 300 kilometres north of the arctic circle, and many of the previously suppressed stunted trees were able to develop vertical trunks. However, the majority subsequently either died back or

Left: Voracious caterpillars of the autumnal moth on a mountain birch. Right: This approximately 100 year old pine has grown in the shelter of a rock. To this day it has not managed to grow further than the sheltered zone.

Illustration: Anschlag



Illustration: Holtmeier



Illustration: Holtmeier

Left: An approximately 7 centimetre high, but already 14 year old birch seedling. It has already been eaten at least twice by reindeer to just above the ground. Top: Section of a trunk infected by rot.

suffered severe damage as a result of climatic impacts. Following this setback regeneration within the treeline ecotone increased rapidly once again at the end of the 1970s. Seedlings and young trees remain rare above the tree line and especially on sites with little snow and high exposure to wind – despite increasing temperatures during the last two decades.

The variable relief and soil permeability represent 'key factors' for any given location. They 'control' the distribution of water in the ground; even the microclimatic conditions are directly morphology-dependent. The mosaic of vegetation clearly reflects the given site conditions. They are most unfavourable on windswept hilltops and terrain divides, where the wind has exposed the highly permeable glacial deposits. Lack of water and nutrients further impedes the growth of birch seedlings. Dryness due to evaporation is enhanced in clear, summer weather.

In their 'search' for water and nutrients birch seedlings invest considerably more carbon in developing their root system than they do

in surface shoot growth. In winter these sites remain generally snow free and the few birch seedlings are entirely exposed to the extreme climate conditions. Because the ground freezes to great depth, the frost-sensitive roots are also damaged. Many seedlings are eaten and trampled by reindeer. During the summer months the reindeer seek out windy areas in order to escape from the otherwise omnipresent tormentors, principally warble flies and bot flies.

The heavy erosion of the soil by the wind in the current forest boundary zone and in the treeless fjell heath above was initiated by degradation of the birch forest which previously extended much higher. This is proven by the radio-carbon dated remains of birch wood and peat cover, as well as by the soil samples from the now un-forested zones. The Autumnal Moth (*Epirrita autumnata*) has probably played a decisive role here. It appears in great numbers every eight to ten years. Its caterpillars then defoliate the birch forests. If this defoliation coincides with cool summers, the trees can no longer recover and die back. New shoots often grow from the old root stock and develop into trunks. However, if rot spreads from the old roots into the new trunks, they die back again after several decades. In less exposed

By A. Warnke, T. Renner,
M. Romanos und K.-P. Lesch

The story of "Struwelpeter" is one of Germany's best-known children's books. Having been translated into 110 languages, generations of children have grown up with this popular picture book for more than 150 years. The author Heinrich Hoffmann (1809–1894), a physician from Frankfurt, a liberal-conservative revolutionist and the father of the constitution of St. Paul's Church ("die Paulskirche"), and one of the delegates of the National Assembly, the first freely elected German parliament, which met in St. Paul's Church, wrote and illustrated the book in 1844, after searching in vain for a suitable present for his son, Carl, aged three at the time. The book "Struwelpeter" (Shaggy Peter) tells the stories of "naughty" children who will not listen to their parents – and who get up to all kinds of mischief. Memorable characters such as Fidgety Philip or "Hans Guck-in-the-Air" (John Look-in-the-Air) have since become proverbial.

In Fidgety Philip we encounter a boy who would, in modern-day terminology, be described as a hyperactive child. Philip is unable to sit still at the table, swinging backward and forward on his chair, until finally he falls over and lands on the ground, along with the table cloth and his soup bowl – "and the mother looked very grave to see Philip so misbehave".

While Fidgety Philip's problem is hyperactivity, for John Look-in-the-Air it is his lack of attention that has serious consequences. On his way to school he watched the birds in the sky and didn't pay attention to where he was going, and ended up falling headlong into the river, with his satchel still under his arm. From a medical point of view, he had become a victim of his attention deficit disorder.

The World Health Organisation's list of diagnoses and diseases includes "Attention Deficit Hyperactivity Disorder", or ADHD. This is characterised by extreme psychomotoric restlessness of a degree



Illustration: Superbild

New Help for Fidgety Philip

Hyperactive and distracted: Over 650,000 children and adolescents in Germany suffer from ADHD. Researchers are investigating causes – and seeking new forms of therapy

that is inappropriate for the sufferer's age and which occurs in all situations, accompanied by impulse control disorder and an inability to pay attention. In Germany, approximately 650,000 children and teenagers and about two percent of the adult population are affected.

Hyperactivity means that a child is constantly restless in situations where it is expected to sit still, for example in the classroom, and moves around aimlessly. The child stands up, runs around or fidgets, often disturbing adults by doing so.

It is very easy to distract children with attention deficit disorder. They fail to finish tasks that they started doing, and their parents and teachers complain that they don't listen, especially in group situations when things don't go according to their wishes. On the other hand, they are perfectly able to play alone "for hours and hours" with Lego®.

The excessive impulsivity keeps both the child and those around him on tenterhooks. Impulsivity means "no sooner thought than done". Anticipatory behaviour just doesn't

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Illustration: Holtmeier

areas, on the snow-covered leeward slopes of the hilltops and ridges, as well as on the low slopes of small valleys, competition with the dense dwarf shrub lichen heath impedes birch settlement. The roots of some dwarf shrub and lichen species excrete substances which impair both the germination of birch seeds, and the root growth and nutrient uptake of the birch seedlings. In level and poorly drained areas numer-

ous seedlings may be observed in some places; however, after only a few years they are all dead. This is primarily a consequence of oxygen deficiency.

The contrast between the sites exposed to wind and those sheltered from it has been considerably exacerbated by the retreat of the former birch forest boundary. The once open birch stands acted as 'snow traps', capturing the snow blown in from the treeless fjell heath. Now that these birch stands have disappeared, snow is carried further and only deposited on leeward slopes, in depressions and other accumulation areas.

The windswept locations are thus even dryer, while in sheltered areas the snow depth and the duration of snow cover, and with these the volume of melt water, have increased. In addition, intense grazing by reindeer impedes revival of the mountain birch population.

Altogether, the investigation results indicate a delayed response of the birch forest boundary to climate change in northernmost Finnish Lapland. It is currently only possible to make assumptions regarding the consequences of upward displacement of the tree line. Whatever the case, it will influence the habitat in general, the mass reproduction of the autumnal moth, the reindeer and overall biodiversity. Once again, long term studies prove that regional field research is indispensable for differentiated considerations of global phenomena, if ecological transformations related to climate change are to be understood.

Prof. Dr. Friedrich-Karl Holtmeier was employed at the University of Münster; Dr. Kerstin Anschlag is employed at the University of Bonn; Prof. Gabriele Broll and Dr. Hans-Jörg Brauckmann are occupied in research at Vechta University.

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Illustration: Broll



work for them and needs have to be met immediately. The child's emotions fluctuate between "on top of the world" and "down in the dumps". In classroom situations the children annoy the class not only by their persistent talking, but also by impertinent answers and squabbles, as if the child was badly brought up or even "malicious". Punishment seems to be nearly ineffective, and little accidents are frequent.

"Mischief", "class troublemaker", and "underachiever" are just a few of the terms commonly used by parents when describing their child's behaviour at school. Social rejection and poor marks take their toll on the child's self esteem. In the end the parents are exhausted and doubt their own parental skills. But these problems have very little to do with any kind of "fault". Both the children and the parents need supportive understanding and help. The problem affecting their entire life is called "ADHD".

The statistics speak for themselves: As many as 46 percent of children with ADHD are expelled from school and up to 35 percent drop out of school. Their level of education is also lower than that which they would be able to achieve according to their abilities. Individuals affected by ADHD also run four times the risk of having a road traffic accident, either as a pedestrian or, later, as a motorcyclist or car driver. They are also at much higher risk of becoming addicted to drugs. Problems at work and arguments at home are commonplace, and the divorce rate is higher as well.

Researchers from a number of disciplines are involved in a Clinical Research Unit funded by the DFG, which is investigating the causes and possible ways of treating ADHD. In cooperation with child and adolescent psychia-

trists, adult psychiatrists and clinical psychologists, the team at the University of Würzburg is studying the behavioural patterns of ADHD sufferers in relation to the brain structures, brain functions ("neural networks") and genetic predisposition (molecular genetic networks).

They are interested in discovering the mechanism behind the

dyslexia, a reading and writing disorder. In adulthood the main problems are development of depression, addictive behaviour including substance use disorders and personality disorders.

A genetic study of several hundred families found that between 25 and 31.5 percent of children affected by ADHD had siblings or parents who were also affected. The heritability of ADHD was found to be about 80 percent. Factors such as upbringing and parenting are only considered to have an impact on the symptoms, but are not seen as causal for the disorder. Alcohol and tobacco consumption during pregnancy are amongst the non-genetic factors that may increase the risk of a child subsequently suffering from ADHD. Adverse care situation in early childhood may play an aggravating role.

In the brain neurotransmitters, biochemical substances transmitting signals from one region of the brain to another one, modulate our perception and mediate our behaviour. In individuals affected

by ADHD, the neurotransmitter dopamine in particular, as well as serotonin and noradrenaline, and their ratios, are thought to influence the development of symptoms. For instance, researchers identified alterations in the metabolism of dopamine in a specific region of the brain, the striatum, focussing the dopamine transporter, a protein regulating the availability of dopamine in the synaptic cleft.

Medical imaging techniques have shown that the dopamine transporter density in the striatum of patients affected by ADHD is elevated by between 16 and 40 percent. Medication by the stimulant methylphenidate (widely known as Ritalin®, Medikinet®, or Equasym®) reduces the dopamine transporter density.

This indicates that these drugs can be used to regulate and normalise metabolic processes in the brain's neurotransmitter system, especially in the striatum.

In a Go/No-go task, a test in which an urge to react to a given stimulus is to be inhibited after a subsequent stimulus, children with ADHD are disadvantaged due to their impulsivity. This can be shown by registering of induced electrical currents of varying frequency and amplitude in the brain, so called evoked potentials.

In children with ADHD the amplitude of the electrical potential approximately 300 milliseconds after the inhibitory stimulus (attention stimulus) was lower than in children of the same age without ADHD. This reduced amplitude of electrical currents in the brain is a measure for the reduced ability of children affected by ADHD to control impulses and concentration. Studies have shown that by administering methylphenidate to a child, the amplitude can be

increased from 300 to 400 milliseconds – a value that is comparable to that one seen in healthy children of the same age. In summary, the reported data indicate the capability of stimulants to normalise brain functions altered in ADHD, determined by electrical signals as well as neurotransmitters.

The treatment of ADHD is based on counselling, behavioural therapy, and in particular on administering methylphenidate. Additionally, close cooperation with the parents is a fundamental necessity in the treatment of children and adolescents. Assistance in the integration of ADHD patients in leisure activities, at nursery, in school, at work and in family life is very important.

Behavioural therapy focusses on providing support in the development of structure, for example by planning a daily schedule as well as training in the control of attention and impulsivity. However,

therapy sessions indicate that motoric hyperactivity, impulse control disorder and inattentiveness can be treated most effectively under supportive medication.

In spite of the benefits of medication, young children suffering from ADHD remain dependent on reliable and stable care from a very early age. Individuals affected by ADHD benefit from a structured daily routine, a supportive environment that recognises their urge for physical activity and their specific creative abilities. Abstinence from alcohol and cigarettes during pregnancy may have a preventive effect. Nevertheless, a risk of developing ADHD in spite of all the parental care or supportive conditions remains, requiring therapeutic help and support during childhood, adolescence and adulthood.

Prof. Dr. Andreas Warnke, Dr. Tobias J. Renner, Dr. Marcel Romanos and Prof. Dr. Klaus-Peter Lesch all work at Würzburg University Hospital.

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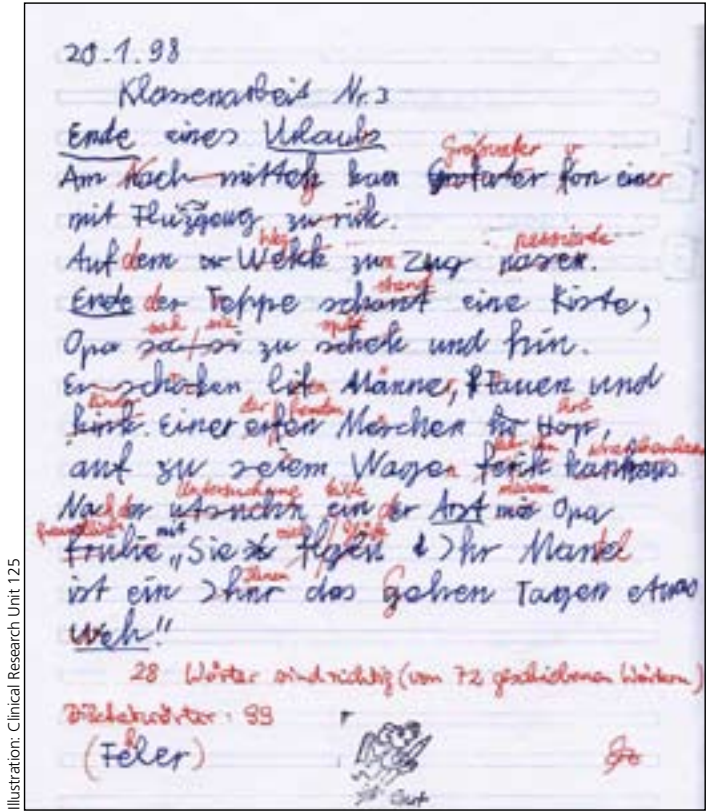


Illustration: Clinical Research Unit 125



Illustration: Superbild

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. *Transregional Collaborative Research Centres* 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 con-



Illustration: Querbach

centrate 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 focuses 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*.

The *Excellence Initiative* aims to promote top-level research and improve the quality of German universities and research institutions in the long term. Funding is provided for graduate schools, clusters of excellence and institutional strategies.

The DFG also funds and initiates measures to promote scientific libraries, equips computer centres with computing hardware, provides instrumentation for research purposes and conducts peer reviews on proposals for scientific instrumentation. On an international level, the DFG has assumed the role of Scientific Representative to international organisations, coordinates and funds the German contribution towards large-scale international research programmes, and supports international scientific relations.

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A real eye-catcher: Not only does this picture, by artist Eva Ohlow, compare its Chinese title, taken from a Chinese-English dictionary a century old, with its English translation, it is also an image that represents the union of light and dark, and of east and west. It was shown at the exhibition "The Rhine and the Yellow River", presented in Bonn by the DFG and the Donors' Association for the Promotion of Science and Humanities in Germany.



Illustration: Querbach