

# uni wissen<sup>02</sup> 2016

The research magazine of the University of Freiburg | [www.wissen.uni-freiburg.de](http://www.wissen.uni-freiburg.de)

## Musical Mainstream

The *Encyclopedia of Songs*  
explains the sociocultural  
context of popular songs > page 4



Inundation: Towns need  
to protect themselves better  
against heavy rainfall > page 8



In flight: Airborne wind  
energy systems promise  
high power output > page 12



Inequality: European  
citizenship provides access  
to special privileges > page 16

UNI  
FREIBURG



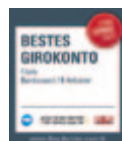
Bundesweit für Sie da:  
Mit Direktbank und  
wachsendem Filialnetz.

## Für mich: das kostenfreie Bezügekonto<sup>1)</sup>

<sup>1)</sup> Voraussetzung: Bezügekonto; Genossenschaftsanteil von 15,- Euro/Mitglied

Banken gibt es viele. Aber die BBBank ist die einzige bundesweit tätige genossenschaftliche Privatkundenbank, die Beamten und Arbeitnehmern des öffentlichen Dienstes einzigartige Angebote macht. Zum Beispiel das Bezügekonto mit kostenfreier Kontoführung.<sup>1)</sup>

Informieren Sie sich jetzt über die **vielen weiteren Vorteile** Ihres neuen Kontos unter Tel. 0 800/40 60 40 160 (kostenfrei) oder [www.bezuegekonto.de](http://www.bezuegekonto.de)



**BB** Bank

Die Bank für Beamte  
und den öffentlichen Dienst



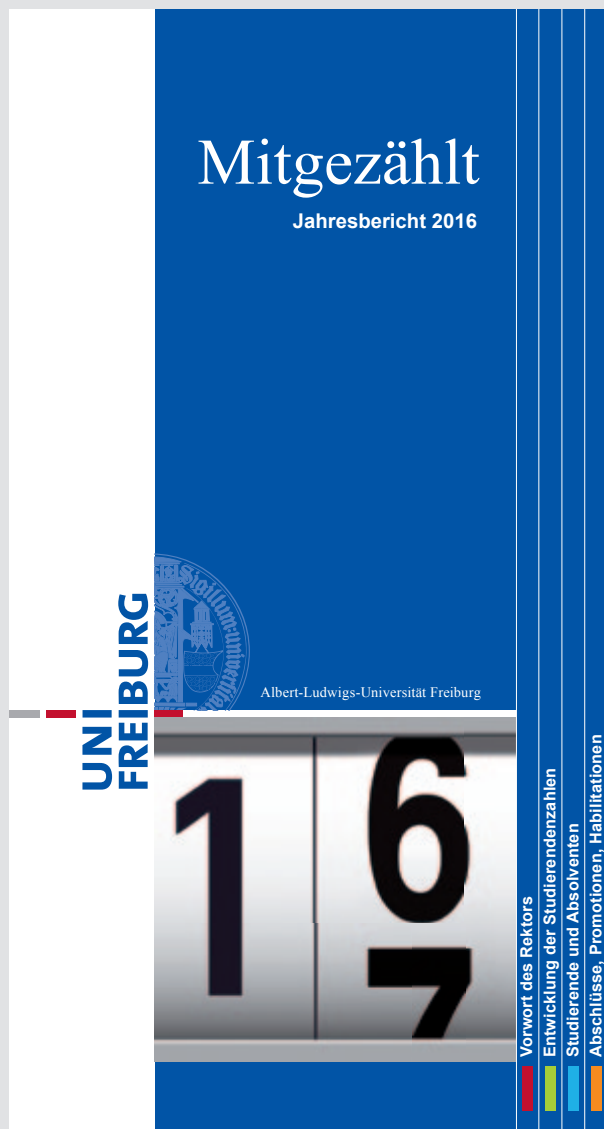
Neue  
Produkte im  
Sortiment

# uni<sup>!</sup>shop

Produkte finden Sie im Online-Shop: [www.shop.uni-freiburg.de](http://www.shop.uni-freiburg.de)  
und in den Buchhandlungen Rombach und Walthari

## Yearly Report 2016: The Numbers Stand for People

The positive development of the University of Freiburg cannot be represented by means of numbers alone, because the numbers stand for people and their achievements. All the same, the university would like to give you an idea of these developments in compact form. The detachable yearly report presents data and facts from the past year.



The Yearly Report 2016 of the University of Freiburg should be attached to this page. The report is also available on the university website:  
[www.pr.uni-freiburg.de/go/jahresbericht\\_2016](http://www.pr.uni-freiburg.de/go/jahresbericht_2016)

### Research

#### What's So Special about the Mainstream 4

*A new encyclopedia of songs analyzes the musical and social significance of popular songs*

#### Ready for the Flood 8

*How municipalities can achieve a natural water balance and prepare for flood disasters*

#### The Sky's the Limit 12

*Airborne wind energy systems promise high power output that can be maximized with the right controls*

#### Exclusive Club 16

*How the principle of citizenship reinforces global inequality*

#### Social Insects Defy Old Age 20

*Fecundity and longevity are usually negatively correlated – but not for ants, bees, and termites*

#### Tapping Into a Wealth of Data 24

*The university spin-off Geospin helps companies find the right location*

#### Crime, Punishment, and Yearning 28

*The postcolonial crime novel has outgrown its status as genre fiction and describes cultural conflicts in modern Africa*

#### Keeping Tabs on Fat 32

*Scientists are using chip platforms to simulate the surroundings of the human body and cultivate cells*

#### Thinkers and Debates 36

*Writings from medieval Arabic culture afford insight into an open and diverse Islam*

### Teaching

#### Flexible Training for Museum Work 40

*"MuseOn" is Europe's first continuing education program for museum personnel*


#### Teaching with Films 44

*Videos illustrate the daily life and personal experiences of patients in palliative care units*

#### Finance from a Practical Perspective 48

*Master's students work out solutions for financial institutions and investment consultants in a seminar*





*"Knights of Cydonia" is a staple of Muse's live sets – the song's music video mixes stylistic elements from westerns and science fiction films.*

*Photo: Hans Peter/Warner Bros. Records*

# What's So Special about the Mainstream

A new encyclopedia of songs analyzes the musical and social significance of popular songs

by Sarah Schwarzkopf

There's an electric buzz in the air. Horses gallop over hard ground. Shots are fired from lasers. Storms, explosions, sirens. The intro is replaced by vocals over a slow melody evoking the fateful mood of a wide steppe. A rhythmic guitar riff breaks through the calm atmosphere again and picks up the fast ride from the beginning, remaining until the end of the song. "Knights of Cydonia" by Muse employs a mix of musical styles that is strongly reminiscent of the music of Ennio Morricone, but synthetic futuristic sounds set it apart from the Italian composer's spaghetti western aesthetic. The song tells a story of rebellion against authority and is a staple of the British band's live sets.

### Hit Single and Prologue

The *Encyclopedia of Songs* provides background information and analyses of songs like these. Published by the University of Freiburg's Center for Popular Culture and Music (ZPKM), formerly known as the German Folk Song Archive, the online encyclopedia includes interdisciplinary articles on internationally known popular songs from the early days of sound recording to the present decade. It documents more than 150 songs originally recorded between 1930 and 2012. The oldest is "Veronika, der Lenz ist da" by the Comedian Harmonists, the newest "Survival," also by Muse. "Besides making a contribution to scholarship, we also want this project to benefit the general public," says the historian and literary scholar Dr. Dr. Michael Fischer, managing director of ZPKM. He and Prof. Dr. Fernand Hörner from the Düsseldorf University of Applied Sciences initiated the *Encyclopedia of Songs* in 2011, and the two are still co-editors today. "The articles are written in a style that everyone can read. Since many youths already show great enthusiasm for music, the encyclopedia also makes an outstanding interdisciplinary educational tool." Only songs that appeal to a very broad audience are considered for inclusion in the encyclopedia. In addition, they must be available on media and industrially produced.

"Great songs often lose something of their monumental character when one knows how they were produced," reports the musicologist Dr. Christofer Jost from the ZPKM, who is in charge of the project. An example is the title "Goldfinger," the quintessential James Bond song. It took a very long time to compose the two simple chords at the start of the song that have become so famous. "But the film producer hated the song. It was only included because there wasn't enough time to record a new song," says Jost.

### Stylization in Music Videos

A traditional musical analysis like those written on works of classical music is not a sufficient means of explaining popular music. The articles of the *Encyclopedia of Songs* therefore explain how the songs came into being and place them in their sociocultural context. Bond songs, for example, have to perform a balancing act between the criteria of two different genres: As film music they are commissioned works and need to support the plot of the film, but as popular music they have to stand on their own as songs on the music market. "When a Bond song is not a hit single, it is not necessarily helpful for the film," sums up Jost. "The song is the prologue to the film – a classic example of cross-media marketing: The film and recording industry work together on it from the outset."

**"We want to be pioneers."**

The explanation of the song's context in the encyclopedia article is followed by analyses of the music, the video, and the lyrics. Finally, the article examines the song's impact and critical reception. The song "Goldfinger" describes the characters in the film musically and also sets the tone for the plot. "The two ominous chords at the beginning create an atmosphere of mystery and suspense. They limit the associations immediately and allude to the film's villain," explains Jost. Singer Shirley Bassey set the standard for Bond



title songs with her powerful, soulful voice. The song was often covered and remained her only hit in the USA.

**“Many hits seem quite simple but evoke strong emotions in their fans.”**

The authors of the *Encyclopedia of Songs* include scholars from cultural studies, linguistics, history, and ethnology. This means that the musical analysis is longer in some articles than in others, which instead perhaps place more emphasis on the historical background. However, it is important that the authors take a comprehensive look at each song. “The way the band stylizes

itself in the music video should receive as much attention as the song’s cultural and historical context or musical analysis,” stresses Fischer. For example, the video for “Knights of Cydonia” emphasizes the references to the spaghetti western while at the same time employing futuristic elements to play down these references. Between opening and closing credits, it tells the story of a cowboy who engages in battle with his antagonist and saves a beautiful woman from the gallows. The story is set in the wild west but quotes mostly science fiction classics like *Star Wars*, *The Matrix*, and *Barbarella*. Poker games and barroom brawls contrast with robots, martial arts sequences, and laser duels. The band plays in the desert but also appears in other places as a hologram.

#### **Covering a Wide Range of Genres**

The project partners plan to add genres to the encyclopedia one by one to cover as many different genres as possible. As this involves working with a lot of authors, they are already cooperating with other universities. “We would also like to work more closely with partners in Freiburg and establish a strong local network,” says Fischer. “There are a lot of other disciplines we would like to get involved in the project.” The authors are free to choose which songs to analyze. “Our aim is not to make the encyclopedia representative or complete. More importantly, the authors should be able to develop a scholarly interest in a song, while not taking the perspective of a fan,” finds Fischer. As a consequence, the encyclopedia has gaps in certain areas. Genres that are currently underrepresented include schlager music and German-language pop music. “It also lacks songs that are frowned upon by mainstream society but are still incredibly successful. Many hits seem quite simple but evoke strong emotions in their fans. There is unfortunately only little research on such phenomena,” says Jost. Yet it is particularly important to analyze songs whose success is difficult to understand or which raise political controversy to find out just what makes them so popular, explains Fischer. “Scholarship needs to start focusing more on the mainstream to find out how people develop their individual taste in music.”

#### **An Educational Tool**

The *Encyclopedia of Songs* is also being used in university courses. Since songs are influenced



“Goldfinger” is the quintessential James Bond song. It illustrates how the title melody can support a film’s plot. Illustration: Svenja Kirsch

by social trends and are born out of political contexts, they have a lot to say about the times in which they were recorded. The study of music can therefore be valuable for many disciplines. Several fields of study at the University of Freiburg, for example Romance studies, offer special seminars on popular music. The students have the option of writing their own article about a song instead of a research paper to earn credit for the course. This is how the entry on “Knights of Cydonia” originated. “This gives the students unique insight into interdisciplinary scholarship, and it can even lead to their first publication,” says Jost. But the *Encyclopedia of Songs* is more than just an educational tool. “We want to be pioneers. It is remarkable when a single research project unites interdisciplinary work and international cooperation so well, while at the same time benefiting the public and combining research and teaching.”

[www.songlexikon.de](http://www.songlexikon.de)



*From the golden age of the gramophone:  
The oldest song described in the  
Encyclopedia of Songs is by the  
Comedian Harmonists.*

*Photo: Patrick Seeger*

### Further Reading

Hörner, F. (Ed.) (2016): *Kulturkritik und das Populäre in der Musik*. Münster.

Appen, R. von / Grosch, N. / Pfeleiderer, M. (Eds.) (2014): *Populäre Musik. Geschichte – Kontexte – Forschungsperspektiven*. Laaber (= Kompendien Musik 14).

Jost, C. (2012): *Musik, Medien und Verkörperung. Transdisziplinäre Analyse populärer Musik*. Baden-Baden.



**Dr. Dr. Michael Fischer** studied theology and history at the University of Freiburg and earned a doctorate in ecclesiastical history in 2003. He then spent a year in Mainz on a scholarship from the German Research Foundation, before accepting a position at the German Folk Song Archive (DVA) in 2004. In 2012 he earned a second doctorate in literary studies at the University of Bielefeld. He has served since 2014 as managing director of the Center for Popular Culture and Music (ZPKM), which evolved out of the DVA, and teaches media culture studies at the University of Freiburg. He is also joint founder and co-editor of the *Encyclopedia of Songs*. His research interests include the history of popular music and the interplay between music and media. Photos: ZPKM



**Privatdozent Dr. Christof Jost** studied music and English in a teacher education program in Mainz and then spent several years working as a professional musician. After completing the practical stage of his teacher education in Frankfurt am Main, he went on to earn a PhD in music education in Mainz in 2008. In 2011 he completed his habilitation qualification in media studies with an emphasis on popular culture and media in Basel, Switzerland. He began working at the German Folk Song Archive in Freiburg in 2012 and also worked as a temporary replacement for a media and communications professor in Mannheim in 2013. He has served as co-editor of the *Encyclopedia of Songs* since 2013 and as research assistant at the Center for Popular Culture and Music (ZPKM) since 2014. His research focuses on popular music, media analysis, the combination of music and performance, and music pedagogy.





# Ready for the Flood

How municipalities can achieve a natural water balance and prepare for flood disasters

by Jürgen Schickinger

*Flooding on 17 April 2016 in Freiburg: Heavy rainfall often washes large amounts of water, soil, and rocks from the surrounding area into the streets and sewers. Photos: Patrick Seeger*





**“The biggest problem for cities is what comes from outside.”**

**T**orrents of water, mud, and detritus can kill people and bury homes and cars. It can happen anywhere, says Prof. Dr. Markus Weiler. The University of Freiburg hydrologist studies heavy rainfall and water cycles: How can tragedies be prevented from happening? What consequences do violent rainstorms have? How can municipalities achieve a natural water balance? Weiler and his team sprinkle water over various types of soil, measure drainage and evaporation, and model various scenarios on the computer. The risk of flood disasters is unevenly distributed, says the heavy rainfall expert: “There are great differences within Baden-Württemberg.” The results of his research formed the basis for a guide on municipal heavy rainfall risk management published by the state in August 2016: “Baden-Württemberg is much further along on this issue than other states.”

Braunsbach was hit hard in the spring of 2016. The images of the flooded town in the district of Schwäbisch Hall have become engraved in residents’ memory. “Braunsbach is located in a very sensitive area,” explains Weiler. The clay soil in and around the town hardly allows any water to filter through. It can only drain off into local streams. After a cloudburst, these streams swell up into raging torrents, taking earth and rocks with them. “The risk is lower in the Black Forest,” says the hydrologist, “because most of the soil there is more permeable.” Other local factors that influence the risk of flood disasters include a hillside or valley location, high average rainfall, the cultivation of certain plants, and the sealing off of ground in and around built-up areas, drainage routes, and watercourses.

### Scientific Rainmakers

Up to now, many municipalities were unable to foresee what could happen in a worst-case scenario. “The flood risk map only included larger streams and rivers,” says Weiler. “We are using a computer simulation to improve the risk distribution.” He and his team of 25 researchers develop the models and programs themselves. Their results were integrated into the state environment

ministry’s heavy rainfall risk management guide. The guide also provides information on how to prevent damages. This involves assessing several details: How high is the local root density? How many cavities have worms, insects, and mammals created in the soil? “However, most of the data is based on findings from observations and experiments,” stresses Weiler.

These experiments include measurements of natural variation: Weiler and his team install probes in agriculturally developed and natural terrain, such as Kaiserstuhl or the Black Forest, in order to determine how much rain falls where and how much water seeps into the ground or drains off. The measurement instruments are also used in cities, for instance under paved, partially sealed surfaces. The hydrologists also



*Installation of probes under a paved surface: The hydrologists use the measurement instruments to determine how much it rains and how much of it seeps into the ground or drains off.*

*A mobile measurement system  
collects data on evaporation.*

*Photo: Patrick Seeger*



need to make aboveground measurements on things like evaporation. To do so, they built a bicycle trailer that can collect meteorological data even on narrow city streets. In other experiments they try their hands as rainmakers, sprinkling water on various types of soil. For small spots, this involves taking a steel cylinder and filling it with a defined amount of water. "We can tell how much water has percolated through the soil by measuring the water level," explains Weiler. For larger areas, the researchers use sprinklers to simulate rainfall. They then measure the water content of the subsoil and the rate at which water and sediment flow through drainage channels.

**"Every kind of sealing  
is detrimental."**

The results of the experiments indicate that the biggest problem for cities is what comes from outside. Heavy rainfall often washes large

amounts of water, soil, and rocks from the surrounding area into the streets and sewers. "This intensifies the effects of the rainfall," says Weiler. Other contributing factors include natural conditions like the properties of the soil and man-made conditions. For example, downhill logging roads without drainage ditches can turn into raging torrents during heavy rainfall. In addition, the cultivation of certain varieties of legumes, corn, and other grains that are not sowed until spring leaves farmland defenseless against flooding. The soil can become impermeable, leading more water to run off faster and take valuable soil with it. Planted fields and forests, on the other hand, serve to prevent flooding and mudflows, explains Weiler: "The best defense is thick vegetation and good root penetration."

Cities also benefit from vegetation – for instance green roofs or trees. "Urban trees hold back a large part of the rain," says Weiler. His team took measurements on this aspect in the Freiburg neighborhood of Vauban. "They helped to achieve



an optimal water balance there." Green roofs are another way of preventing water from running off too quickly. They store water and reduce the intensity with which it enters the sewers during heavy rainfall. Gutters that divert water to gardens or other permeable surfaces can also be helpful in principle, says Weiler. However, it is important to ensure that not too much water drains into a small area, because otherwise the water table could rise and cause flooding in cellars.

### Surface Runoff

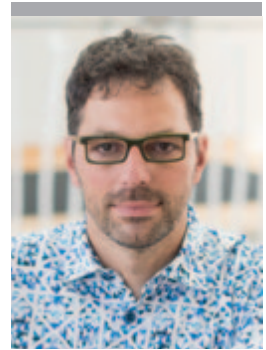
Weiler is largely satisfied with the plans for converting Freiburg's Platz der Alten Synagoge into a pedestrian zone: "It is generally good when surfaces are paved with blocks and therefore only partially sealed." Spaced paving blocks at least allow some water to seep into the ground. Completely sealed surfaces like concrete streets and squares, on the other hand, cause water to flow unhindered into the sewer system, where it is joined by water from roofs whose gutters empty directly into storm drains. When it rains hard, the sewers are soon overfull: Water bubbles up from storm drains and seeps into garages and cellars. Sealed surfaces also make cities warmer, because increased surface runoff causes the water table to sink, leading to less evaporation. "Every kind of sealing is detrimental," sums up Weiler, "so I'm always happy when the steamrollers stay in the garage."

The scientist also criticizes the fact that urban planners often neglect the aspects of water storage and evaporation, focusing most of their efforts instead on runoff. Whenever drains are included

in plans, they should be located at the surface if possible – for instance canals or streams: "This raises awareness among the inhabitants of potential risks." Alternative drainage routes can also make good sense. There is a Swiss highway that is built to fill up with water during heavy rainstorms and is therefore closed to traffic once or twice a year. "But the effort involved in realizing such measures must be proportionate to the risk," Weiler emphasizes. The probability that an individual city will flood on account of heavy rainfall is low. It is hardly possible to produce statistical evidence showing that severe rainstorms like that in spring 2016 are becoming more frequent, says the hydrologist: "Locally, such storms can happen every 50 to 100 years."

Weiler's interest in water is not confined to heavy rainfall and flooding: "I would find it fascinating to add marked water, carbon, and nitrogen to various small drainage areas and observe them." Where would these substances end up? Where would they stop along the way and for how long? What exchange processes with plants and animals would take place? His duties as a professor unfortunately do not leave him enough time for extended field research of this kind. "But I haven't thrown out my rubber boots yet."

[www.naturnahe-regenwasserbewirtschaftung.info](http://www.naturnahe-regenwasserbewirtschaftung.info)



**Prof. Dr. Markus Weiler** completed a diplom degree in hydrology in Freiburg in 1997. Eleven years later, he returned to the University of Freiburg as a professor at the Institute of Hydrology. Weiler spent the intervening years abroad: first in Switzerland, where he earned his PhD at ETH Zurich, then as a postdoctoral researcher at Oregon State University, USA, and later as an assistant professor at the Canadian University of British Columbia. His research interests include tracer hydrology, the effects of heavy rainfall, and natural rainwater management for more sustainable cities.

Photo: Patrick Seeger

### Further Reading

Jackisch, N. / Weiler, M. (2015): The hydrologic outcome of a Low Impact Development (LID) site including superposition with streamflow peaks. In: Urban Water Journal. <http://dx.doi.org/10.1080/1573062X.2015.1080735>

Merz, B. / Aerts, J. C. J. H. / Arnbjerg-Nielsen, K., et al. (2014): Floods and climate: emerging perspectives for flood risk assessment and management. In: Natural Hazards and Earth System Sciences 14/7, pp. 1921–1942.

Steinbrich, A. / Weiler, M. (2009): Ausweisung der für die Hochwasserentstehung wichtigen Abflussbildungsprozesse für Baden-Württemberg. In: Casper, M. / Grönz, O. (Eds.) (2010): Abflüsse aus extremen Niederschlägen. Beiträge zum 2. Trierer Workshop zur Niederschlag-Abfluss-Modellierung am 14./15. September 2009 in Trier. Hennef, pp. 171–185. (= Forum für Hydrologie und Wasserbewirtschaftung 28/10).

# The Sky's the Limit

Airborne wind energy systems promise high power output that can be maximized with the right controls

by Nicolas Scherger



The metal arm rotates slowly at first, then faster and faster. An airplane with a wingspan of around two meters is attached to a thin tether, initially only about a foot from the end of the arm. The rotation lifts the plane onto its flight path. Now the winch below the metal arm starts unreeling the tether, causing the plane to fly in larger and larger circles. Finally the rotating motion of the arm stops and the plane begins flying in a figure-eight pattern. This continues until the 600-meter-long tether is completely unreeled, and then the plane goes into a descent. The winch starts reeling the tether back in. The airplane makes a curve and returns to a figure-eight

pattern. The winch starts unreeling the tether once again, and the cycle starts from the beginning, like a yo-yo.

**“Our airplane reduces a wind turbine to the wing tips.”**

There are not yet any systems of this kind in operation today, but if Moritz Diehl succeeds in his aims, airborne wind energy will be used to generate electricity in just a few years. The Frei-





*The Freiburg researchers have built a prototype of a rotating arm that launches a tethered airplane into the air to harvest energy. Photo: Patrick Seeger*

burg professor of systems theory, control engineering, and optimization is convinced that his airplanes, which fly through the air like fully automated stunt kites, are superior to conventional wind energy systems. "Our airplane reduces a wind turbine to the wing tips, the part that rotates fastest and generates the most energy," says Diehl. That saves material and thus money.

### **Strong, Steady Wind**

In addition, the wind blows stronger and more steadily several hundred meters above ground than it does at ground level. Airborne wind energy

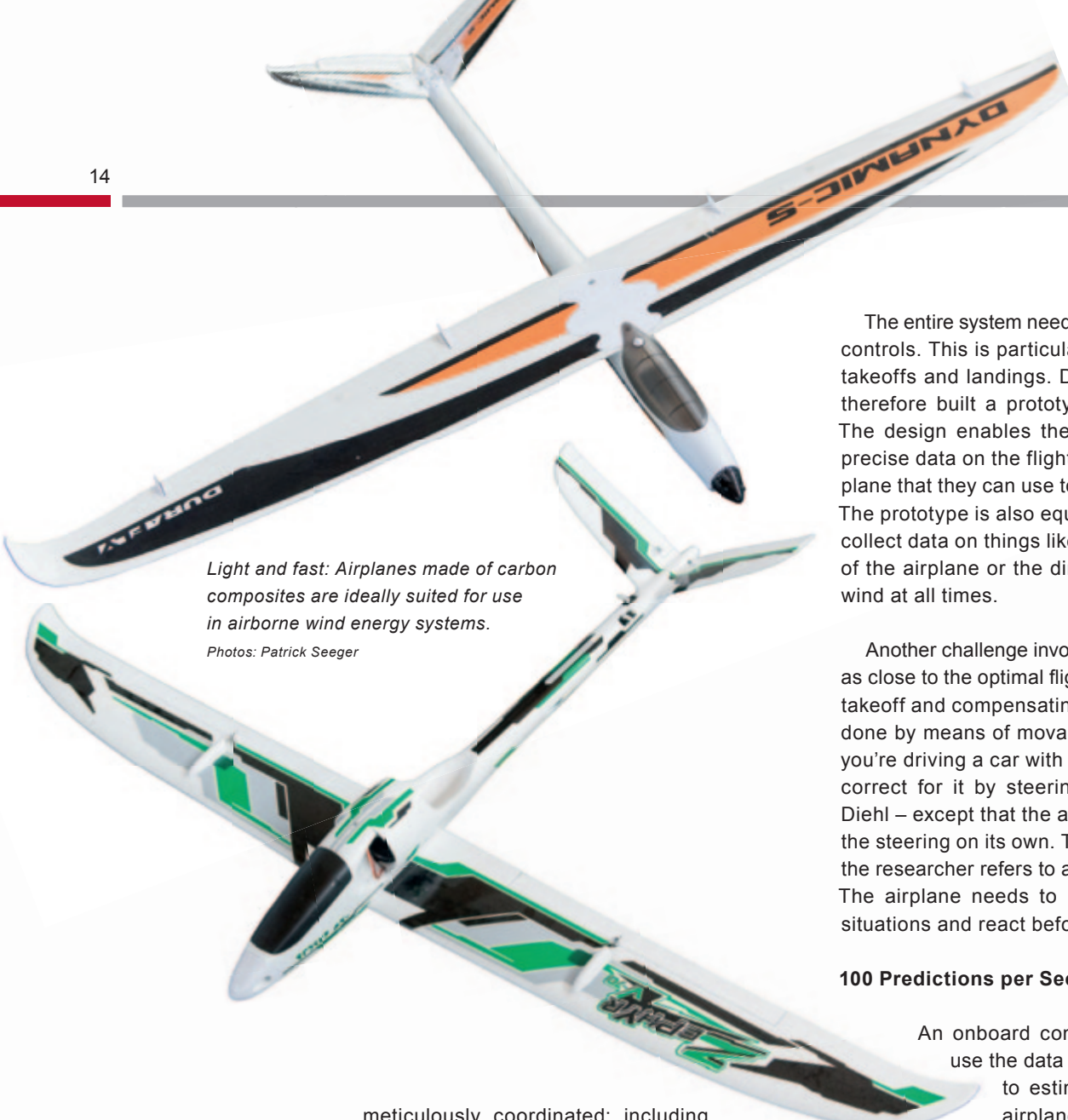
systems are therefore capable of generating energy practically nonstop and do not even stand still when the wind calms down or comes from the wrong direction. Their yearly output is estimated to be at least twice that of wind turbines. The expectation is that they should thus be more efficient, make energy production less expensive, and help to reduce the price of electricity. The systems could potentially be built on land, but they make more sense on the sea: They need a free space with a radius of at least the length of the tether around the arm and the winch.

Two systems for harvesting airborne wind energy are currently under development. One of them involves placing propeller-powered generators on board the airplane. The propellers make it easier to launch and steer the aircraft, and there is no need for a rotating arm to get it off the ground. In addition, it can remain in a flight path that allows it to harvest a maximum amount of energy, instead of having to go into a descent between each cycle. However, the generator also makes the airplane much heavier. Moreover, it can no longer be attached to a simple tether but needs a cable to transmit the power to the ground.

### **Mathematical Models**

These drawbacks are why Diehl is concentrating his efforts on the other system, described at the beginning of this article: The generator is located on the ground and harvests energy as the tether is reeled out during the airplane's ascent. This requires alternating phases of ascent and descent. However, the net energy gain is still positive, explains Diehl: "Although we need to use some energy to reel the tether back in, it is still much less than what we gained as it was reeled out." This system works with two types of aircraft: soft kites built like a paraglider and hard airplanes made of carbon composites. The kites are lighter but also slower, and the material of the thin sail membranes wears out more quickly. The faster airplanes produce more tensile force, but this also makes them more difficult to control.

This is the aspect Diehl is focusing on in his research: "We are simulating the systems with the goal of optimizing the controls to enable maximum power output." A high power output is only possible if all the parts and settings are



*Light and fast: Airplanes made of carbon composites are ideally suited for use in airborne wind energy systems.*

*Photos: Patrick Seeger*

meticulously coordinated: including the length and thickness of the tether, the speed with which it is reeled out, the size and shape of the airplane, and its flight patterns – and all of these factors need to be adjusted to the wind conditions at the site where the system is installed, which of course fluctuate over the course of the year. The team at the Department of Microsystems Engineering (IMTEK) develops mathematical models for these complex calculations and uses them to simulate the systems on the computer until it has found the ideal design. For

**“Harnessing the power of airborne wind is an old dream of mine.”**

example, the team determined in this way that the tether needs to be reeled out at one-third of the current wind speed to ensure a maximum energy harvest.

The entire system needs to have fully automated controls. This is particularly tricky in the case of takeoffs and landings. Diehl and his team have therefore built a prototype of the rotating arm. The design enables the researchers to collect precise data on the flight path of the tethered airplane that they can use to improve the simulation. The prototype is also equipped with sensors that collect data on things like the altitude and speed of the airplane or the direction and force of the wind at all times.

Another challenge involves keeping the airplane as close to the optimal flight path as possible after takeoff and compensating for turbulence. This is done by means of movable flaps. “It’s like when you’re driving a car with a side wind and need to correct for it by steering slightly into it,” says Diehl – except that the airplane needs to correct the steering on its own. This involves a capability the researcher refers to as “predictive regulation”: The airplane needs to be able to predict new situations and react before they arise.

### 100 Predictions per Second

An onboard computer first attempts to use the data collected by the sensors to estimate where exactly the airplane is located, how it is moving, and what the current wind conditions are like. For example, it registers sudden turbulence and calculates what the airplane can do in the next seconds to come as close to the ideal flight path as possible in spite of the disturbance. This leads to new data, to which the computer reacts again. The result is a control circuit: The planning is revised every ten milliseconds, 100 times per second. This makes the flight smoother and more stable.

However, the possibilities for influencing the airplane in this way are relatively modest, says Diehl. The most important factors for power output are the design of the system and the take-off procedure. “The flight path of a ball also depends essentially on how large and heavy it is, how hard I throw it, and at what angle. Once it is in the air, it has its own dynamics.” What is important in any case is that the airplane should not hang statically in the air but fly in circles or figure-eights. This increases the tensile force many times over, as with a kite.



The scientist sees great potential in airborne wind energy systems. "One square meter of flight area can cover all the energy needs of two people with a European lifestyle. That is the power generated by 125 square meters of photovoltaic modules." But he envisions even more powerful systems involving up to three airplanes revolving around a tether. This will increase the power output due to the higher tensile force, but it will also make it even harder to control the system and prevent the airplanes from getting in each other's way.

Diehl is currently collaborating on two airborne wind energy projects: Highwind, for which he is receiving a Starting Grant from the European Research Council (ERC), and Awesco, a joint research project with eight scientific and four industry partners that is also receiving European Union funding. The next biennial "Airborne Wind Energy Conference" will be hosted by the University of Freiburg from 5 to 6 October 2017. "Harnessing the power of airborne wind is an old dream of mine," says Diehl. "I'm happy so many people are working on the topic now."

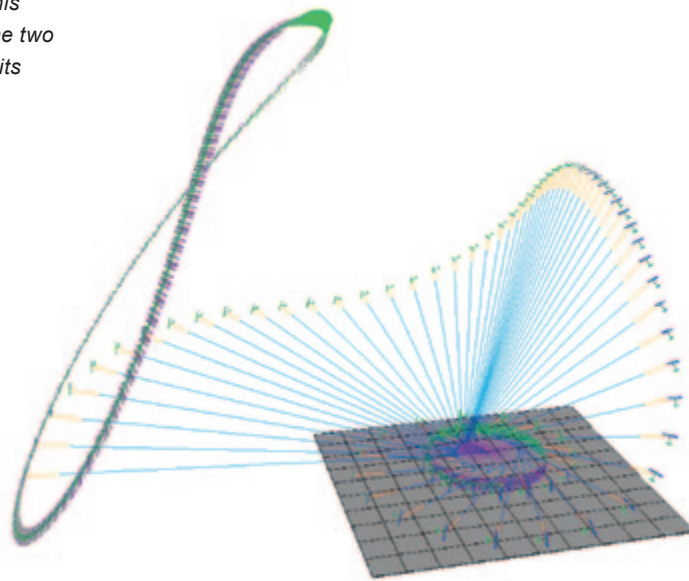
[www.syscop.de](http://www.syscop.de)



**Prof. Dr. Moritz Diehl** studied physics and mathematics in Heidelberg and Cambridge, England. In 2001 he earned his PhD at the University of Heidelberg's Interdisciplinary Center for Scientific Computing. From 2006 to 2013 Diehl held a professorship at the Department of Electrical Engineering at the KU Leuven in Belgium, also heading the Optimization in Engineering Center (OPTEC) at that institution. Since 2014 he has served as professor of systems theory, control engineering, and optimization at the University of Freiburg's Department of Microsystems Engineering (IMTEK). His main research interest is the development of fast algorithms for real-time optimization of dynamic systems and their application to control and estimation problems in engineering disciplines like process engineering, robotics, power engineering, and microsystems engineering.

Photo: Patrick Seeger

*First circles, then figure-eights: This simplified representation shows the two figures the airplane flies in during its ascent. Illustration: Greg Horn*



### Further Reading

Erhard, M./Horn, G./Diehl, M. (2016): A quaternion-based model for optimal control of the SkySails airborne wind energy system. In: Zeitschrift für Angewandte Mathematik und Mechanik. doi: 10.1002/zamm.201500180.

Stuyts, J./Horn, G./Vandermeulen, W., et al. (2015): Effect of the electrical energy conversion on optimal cycles for pumping airborne wind energy. In: IEEE Transactions on Sustainable Energy 6/1, pp. 2–10.

Ahrens, U./Diehl, M./Schmehl, R. (Eds.) (2013): Airborne Wind Energy. Berlin/Heidelberg. (= Green Energy and Technology).

University Freiburg video presentation: [www.pr.uni-freiburg.de/go/hoeohenwindkraft](http://www.pr.uni-freiburg.de/go/hoeohenwindkraft)

Valuable document: Holders of Maltese passports have the right to live, work, study, or go to school in all 28 countries of the European Union and in Switzerland. In addition, they can travel to 151 countries without having to first obtain a visa.

Photos: Maksym Yemelyanov, keki, 12ee12 (all Fotolia); Montage: Kathrin Jachmann

16

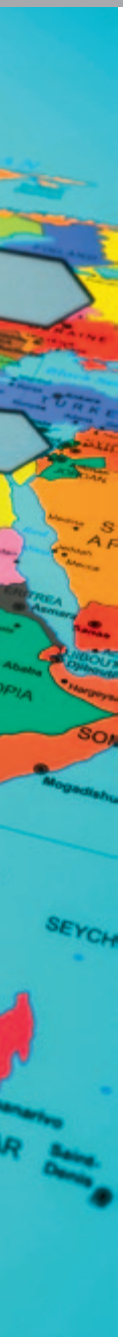


# Exclusive Club

How the principle of citizenship reinforces global inequality

by Yvonne Troll





The 25-year-old Fatuma slings the empty container over her shoulder. Like every day, she will cover the five kilometers from her village in Ethiopia to the closest watering place by foot. Her hut has neither running water nor electricity. But Fatuma is lucky: A few days ago she survived a severe case of diarrhea, although there are no doctors nearby. Greta, also 25 years old, sits in her Swedish hometown several thousand kilometers away studying German in front of her computer. She recently completed a degree in business administration and will start a position at an IT firm in Frankfurt in a few weeks.

**“I’m interested in the double standard wealthy countries apply when poor and rich people want to migrate.”**

An Ethiopian and a Swede – two very different life realities. Prof. Dr. Manuela Boatcă is interested in how this inequality comes about and why it persists. The main aspect the Freiburg sociologist is focusing on is citizenship. “Fatuma’s and Greta’s nationalities determine what possibilities they have to travel without a visa or migrate.” Even more importantly, at least for people who do not live in an industrialized country, citizenship also determines whether one has access to clean water, food, education, healthcare, and security.

In other words, citizenship is a valuable asset. Several countries of the European Union (EU) have recognized this: Since the financial crisis of 2008, more and more economically stricken member countries have been using the sale of citizenships or residency permits qualifying the holder for later naturalization as a profitable source of revenue. This practice in particular caught Boatcă’s attention. “I’m interested in the double standard wealthy countries apply when poor and rich people want to migrate.”

Boatcă analyzes migration flows and political developments that dictate what conditions people from poor countries need to fulfill to migrate to an EU country. Greta can travel through most countries around the globe without a visa, and thanks to the Schengen Agreement she doesn’t

even need special permission to work in Germany and many other countries. Fatuma, on the other hand, can travel to just 36 countries with an Ethiopian passport – all of them poor like her native country. Entering the EU legally or living there is practically impossible for her. She would need to work many hours even just to earn the money to purchase a passport. Greta, by contrast, can buy a passport with a single hour’s wage.

Fatuma’s situation would be completely different if she were rich. Then she could become a citizen of Malta by investing 650,000 euros in government bonds, 350,000 euros in sovereign wealth funds, and 150,000 euros in real estate. The important thing here is of course not Maltese nationality as such but the fact that Maltese nationals have the right to live, work, study, or go to school in all 28 EU countries and in Switzerland, as well as to travel to 151 countries, including Canada, without having to first obtain a visa. Other EU members, like Hungary, Latvia, Greece, Portugal, and Cyprus, also do business with these coveted papers. Latvia offers a five-year residency permit with the possibility of an extension for a mere 140,000 euros.

### Male Privilege

“EU citizenship is like a bundle of privileges in an exclusive club,” says Boatcă. Those who have the luck of living on EU territory enjoy these privileges. Those who do not are excluded from them. However, the sale of citizenships has opened up a loophole in the past years for a small number of non-EU citizens, particularly from China, Russia, or the Arab world, who are already privileged as it is. “For impoverished people from underdeveloped regions who are often motivated by existential concerns, by contrast, an EU passport is an unattainable luxury.”

And it is not just poverty that is standing in Fatima’s way. Besides citizenship, Boatcă is studying another determinant of living conditions that is generally predetermined at birth: gender. This can be an important factor for privileges like an education, because many poor families in developing countries send their sons to school first. Only if they can scrape together enough money for the school fees can their daughters

also enjoy a school education. Sons have priority even with regard to food. If there is not enough to eat for everyone, the girls often have to make do with whatever is left over after their brothers

### “The borders should be opened.”

have finished eating. This places them at a greater risk of malnutrition and of dying before they reach the age of five. By contrast, food shortages are generally not an issue in rich countries, so gender is not relevant in this regard. In addition, Greta is required to go to school until her sixteenth birthday in Sweden.

Boatcă goes one step further: She is studying the relation between affluence and gender. “The vast majority of investors who can afford to purchase EU citizenship and thus greatly improve their prospects are male,” she stresses. The American business magazine *Forbes* lists just eight women in the 2016 edition of its annual ranking of the world's 100 richest people. “That is the logical consequence in a world in which women are denied access to many steps in the accumulation of capital.” It should not come as much of a surprise that this list of the superrich is dominated by people from the USA and from EU countries. There is only a single investor from the African continent – a man from Nigeria.



Citizenship limits the possibilities of people from poor countries to travel, let alone migrate. It therefore also determines who has access to clean water, food, education, healthcare, and security. Photo: africa/Fotolia





*The sale of citizenships has opened up a loophole for a small number of privileged non-EU citizens, particularly from China, Russia, and the Arab world, says Manuela Boatcă. Photo: Dangubic/Fotolia*

### Stronghold with Loopholes

So what does citizenship have to do with this? Boatcă sees it as an instrument rich countries use to protect their wealth by denying the poor access to their territory and the privileges it offers. "Citizenship reinforces global inequality; in fact, it even exacerbates it." To describe this phenomenon, she speaks of the "coloniality of citizenship." This expression goes back to the term "coloniality of power," coined by the Peruvian sociologist Aníbal Quijano to describe how the hierarchies between colonial powers and the countries subject to their rule continue to exist after the latter achieve their independence. "The EU contains all of the countries that divided the world up among themselves not all that long ago. They accumulated a lot of wealth via military intervention, colonial expansion, and imperialism. The awarding of citizenship to these countries keeps this colonial divide intact," explains Boatcă. The EU increases the obstacles for the poor in the same measure as it creates loopholes for the migration of the rich. "For me, that is a paradox that cannot be reconciled with the principles of liberal democracy." The sociologist is of the opinion that the coincidence of birth should not determine what opportunities people have for the rest of their lives.

But what is the alternative? "I don't think citizenships are the problem. The problem is borders. This should also become the basis for policies. To state it in very simplified terms: the borders should be opened." While this would lead to more migration, the horror scenarios one would no doubt hear in reaction to such a decision would have no basis in reality, stresses Boatcă. Open borders would not result in the mass migration to Europe many people fear. After all, only about three percent of the world's population is currently attempting to migrate. Most people would not have the means to reach Europe or would see better opportunities for their immediate future in a neighboring country. The positive effects of open borders would greatly outweigh the negative ones: "The current practice in wealthy countries of sealing themselves off from the rest of the world creates a lot of competitive pressure among people living outside of the West who would like to migrate to Europe. Opening the borders would take this pressure away – at the global as well as the national level."

[www.pr.uni-freiburg.de/go/boatca](http://www.pr.uni-freiburg.de/go/boatca)



**Prof. Dr. Manuela Boatcă** studied English and German studies at the University of Bucharest, Romania. In 2002 she earned her PhD at the Institute of Sociology of the Catholic University of Echstätt-Ingolstadt. After a period conducting research in the USA and Brazil, she accepted a position as research assistant at the Institute for Latin American Studies at the Free University of Berlin, where she was appointed as a professor in 2011. She came to the University of Freiburg in 2015, where she serves as professor of sociology with an emphasis on macro-sociology. Boatcă studies issues of global inequality, migration, and racism in connection with European colonial expansion since the 16<sup>th</sup> century.

*Photo: Michael Fahrig*

### Further Reading

Boatcă, M./Roth, J. (2016): Staatsbürgerschaft, Gender und globale Ungleichheiten. In: Feministische Studien 34/2 (in press).

Boatcă, M./Roth, J. (2016): Unequal and gendered: notes on the coloniality of citizenship. In: Current Sociology 64/2, pp. 191–212.

Boatcă, M. (2015): Globale Ungleichheiten und gekaufte Staatsbürgerschaft. Zum Mechanismus eines knappen Gutes. In: Robertson-von Trotha, C. (Ed.) (2015): Die Zwischengesellschaft. Aufbrüche zwischen Tradition und Moderne? Baden-Baden, pp. 147–160.





*Termites of the species Macrotermes bellicosus cultivate fungi in their nest to feed the colony. Photo: Judith Korb*



# Social Insects Defy Old Age

Fecundity and longevity are usually negatively correlated – but not for ants, bees, and termites

by Stephanie Heyl

It is perhaps the least understood phenomenon of biology: To this day there is no scientific answer to the question of why organisms age. The disposable soma theory, an evolutionary theory of aging, provides one possible explanation. It states that every body has to budget the energy available to it. "Organisms need to distribute limited food resources among various bodily functions, like growth, self-preservation, and reproduction," says the biologist Prof. Dr. Judith Korb from the University of Freiburg's Institute of Zoology. Energy allocated to metabolism and repair is no longer available for breeding. It is not possible to attend to everything at once – a long life is a result of a lack of fertility and vice versa.

## Fecundity, Longevity, or Both?

The "trick" is then to invest enough energy in self-preservation to remain capable of coping with the strain of life without neglecting reproduction and growth. Aging is a result of this trade-off. "The evolutionary pressure should have the effect of maximizing the product of life lived and the amount of eggs laid," explains Korb. Experiments on the model organism *Drosophila melanogaster*, a species of fruit fly, show that when fecundity – fertility over an entire lifespan – is

high, the lifespan of individuals is shorter. The life expectancy of flies that do not mate or that cannot lay eggs for genetic reasons is 50 percent higher than their egg-laying peers: They live for around three instead of two months.

**"Larvae that develop into queens also live longer."**

However, eusocial insects, like bees, ants, and termites, do not seem to have to choose between fecundity and longevity. They form colonies numbering hundreds to millions of insects and distribute tasks like the search for food, defense of the nest, and reproduction among specialized castes. Although all members of the colony have the same genetic background, they have different life spans, hormone compositions, and physical characteristics. A termite queen, who along with the king is alone responsible for reproduction in the nest, can become up to 20 years old, whereas the sterile workers and soldiers usually only live for a few months, much like other solitary insects.

Korb has served since fall 2015 as spokesperson of a project funded by the German Research Foundation involving the question of how sociality neutralizes the trade-off between longevity and fecundity in social insects. Nine teams of scientists are conducting a common set of experiments on a variety of eusocial insect species, like bees, ants, and termites, as well as on a group of solitary insects from the *Drosophila* genus. The team led

a previous state. From an evolutionary standpoint, this is the more primitive state from which the higher termites have developed. *Macrotermes*, on the other hand, possesses a complex social system that has lost its dynamic nature. The queen “knows” she will develop into the queen even while still inside the egg. She mates with the same king for her entire life and lays up to 20,000 eggs per day. The workers tend to the

Workers of the termite species *Cryptotermes secundus* can develop into queens (white) or kings (dark).

Photos: Judith Korb



A long and fruitful life: A queen (white) of the termite species *Macrotermes bellicosus* lays 20,000 eggs a day and can, like the king (brown), become more than 20 years old. The small insects are workers. They are sterile and live for just two to three months.



by Korb is concentrating on life, death, and reproduction in two termites species: *Cryptotermes secundus*, native to Australia, and *Macrotermes bellicosus*, from Africa. Termites are not from the Hymenoptera order like bees and ants but from the same order as cockroaches, Blattodea. They thus developed their eusociality independently of the hymenopterans. *Cryptotermes* lives in and also feeds on dead wood without ever leaving its nest. *Macrotermes* is a rung higher on the evolutionary ladder, building elaborate clay mounds and cultivating fungi for food.

### The Colony as a Superorganism

The *Cryptotermes* queen lays 100 eggs a year, roughly the same amount as a solitary insect. The plasticity of development in the colony is unique, stresses Korb: “All of the members are totipotent, meaning that any of them can develop into a king or queen.” The workers are larvae that can molt to become soldiers, kings, or queens depending on what environmental stimuli they are exposed to. Stationary or regressive molting causes them to remain workers or even return to

fungus garden and feed the queen, king, and offspring, while the soldiers form a protective shield around the colony.

How do social insects succeed in remaining fertile over the course of a long lifespan? “It must have to do with their social life, as this phenomenon has developed in several insects independently,” says Korb. The workers invest all of their resources in immune defense and food collection; the queen does not come into contact with germs and concentrates on laying eggs. The termite colony thus appears to serve as a superorganism, because damage is distributed among different individuals rather than among different organs of a single individual, and this enables some individuals to age more slowly. Moreover, the plasticity of *Cryptotermes* with regard to development also influences aging processes. “Larvae that develop into queens also live longer,” says the evolutionary biologist.

One method Korb’s team uses to arrive at such findings involves applying marker proteins that are typical for the aging process. These are



usually proteins that cause oxidative stress. Oxidative stress has a direct influence on the aging of cells and develops when so-called free radicals – short-lived and highly reactive molecules that can form as a result of metabolic processes in the cell – damage components that are important for the function of the cells. One such marker is the aging pigment lipofuscin, which forms when free radicals attack and oxidize proteins.



Superoxide dismutase (SOD), on the other hand, removes oxidative damages and is also a suspected aging marker. If an insect has a high concentration of lipofuscin and SOD, it is probably an older individual.

### Signaling Paths and Switches

The researchers are also following up on another lead. It is known that various signaling pathways in the body check to make sure food is available and distribute the available resources among various body functions. The insulin/insulin-like peptide signaling pathway (IIS) is an indicator of carbohydrates, the target of rapamycin signaling pathway (TOR) an indicator of proteins. IIS and TOR serve as central switches that interact with hormones and with each other to determine whether genes should be activated for immune defense, DNA repair, or egg laying. The scientists suspect that these signaling pathways interact differently in eusocial insects than in solitary insects, thus influencing the link between fecundity and longevity. The researchers are manipulating the fertility of the queens in experiments to test this assumption.

This involves either removing the eggs so that the queen has to produce new ones or mating them with sterile males so that they no longer lay fertilized eggs. They then observe how these measures influence the aging process.

Artificial means of inducing stress the researchers employ to cause aging include temperature fluctuations, food scarcity, and substances that increase oxidative stress through the formation of free radicals. It remains to be seen whether the researchers will succeed in confirming their hypothesis about the superorganism principle in social insects or whether the trade-off between fecundity and longevity also appears here. Scientists are not even certain whether social insects experience a phase of aging at all: "The little available data indicates that termites lay eggs right up to the point where they suddenly fall dead."

[www.bio1.uni-freiburg.de/oeko/evo-eco](http://www.bio1.uni-freiburg.de/oeko/evo-eco)



**Prof. Dr. Judith Korb** studied biology at the University of Würzburg, earning her PhD in 1997. Postdoctoral scholarships from the German Academic Exchange Service (DAAD) and the German Research Foundation (DFG) took her to the Ivory Coast and to Australia. After leading an Emmy Noether Junior Research Group at the University of Regensburg from 2000 to 2004, Korb earned her habilitation qualification at the same institution in 2004 with a thesis on the development and maintenance of cooperative relations in termites. From 2008 to 2013 she held a position as professor of behavioral biology at the University of Osnabrück. In 2010 she was appointed by the DFG as a member of AcademiaNet, a database for excellent female academics. Since 2013 she has served as a professor at the University of Freiburg's Department of Evolution and Ecology. Photo: private

### Further Reading

Monroy Kuhn, J. M. / Korb, J. (2016): Aging and the re-shaping of the fecundity/longevity trade-off with sociality. In: Current Opinion in Insects Sciences. <http://dx.doi.org/10.1016/j.cois.2016.06.002>.

Rensing, L. / Rippe, V. (2014): Altern: Zelluläre und molekulare Grundlagen, körperliche Veränderungen und Erkrankungen, Therapieansätze. Berlin/Heidelberg.

Keller, L. / Jemielity, S. (2006): Social insects as a model to study the molecular basis of ageing. In: Experimental Gerontology 41/6, pp. 553–556.

One of Geospin's trademarks is its aesthetically pleasing and easily understandable visualizations of data, particularly in the form of geographical representations.

*Illustration: max\_776/Photolia, Kathrin Jachmann*

# Tapping Into a Wealth of Data

The university spin-off Geospin helps companies find the right location

by Claudia Fäßler



**“We’ve always been imbued with an entrepreneurial spirit.”**

We leave an enormous trail of data behind us every day – when we shop, tweet, ride the train, or purchase theater tickets. Companies collect this information, but they often do not make as much use of it as they could. “There is a great wealth of data here, but one can only tap into it if one knows how to read it,” says Dr. Christoph Gebele, head of sales and marketing at the company Geospin. He is one of five University of Freiburg researchers who founded the spin-off in March 2016.

“Ninety percent of all enterprise data have a spatial component,” the Geospin website states. What the young entrepreneurs do is analyze data collected by companies to determine where – from a purely geographical standpoint – it would be worth it for them to open up new locations. If a gumball machine company wants to determine the most profitable places to install its next machines, for example, the experts at Geospin can take a look at how many gumballs have been sold from the company’s existing machines so far.

#### **Integrating Open Data**

They also take into account other factors. “In addition to the data provided by the company itself, we also use so-called open data,” explains Dr. Tobias Brandt, expert data scientist at Geospin. This is data that is generally available for public use and often also includes spatial information, such as census, weather, or traffic data. Brandt and his colleagues also include data from Twitter. The team might then come to the conclusion that gumball machines are in particular demand in parts of town with a lot of movie theaters – or perhaps this is not an important factor and they will instead determine that more gumballs are sold on hot days.

“We work with explanatory and predictive methods to help the companies derive maximum benefit from the data they collect,” says Gebele.

The partners received funding for the idea from the German Federal Ministry for Economic Affairs and Energy and the “University-Based Business Start-Ups” initiative, and it’s taking off: Geospin’s services are in demand. The company now has clients in Germany and Switzerland.

#### **Developing Statistical Models**

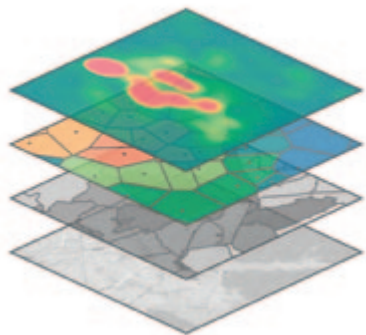
The idea of founding a company was born during a two-week road trip to a conference in New Zealand. “We’ve always been imbued with an entrepreneurial spirit and decided to just try it out,” says Gebele. A previous project in which the scientists had cooperated with a German car sharing provider had evoked considerable interest. This could be a good business idea, they thought.

“A lot of companies collect and store a vast amount of internal data over the years, but they are often unaware of all the things this data can reveal when one considers it from certain angles and with the right tools,” says Brandt. The tools he is speaking of are special analytical tools for adjusting the data according to the desired criteria and establishing connections between various factors. The experts at Geospin then take the results as a basis for developing statistical models. “This works better when a company already knows exactly what it wants,” says Brandt, “but we can also follow an open approach and just analyze the data to see what we can find.”

One of the startup’s trademarks is its aesthetically pleasing and easily understandable visualizations of data, particularly in the form of geographical representations. For example, the partners helped the aforementioned car sharing company with a planned expansion of their service area by predicting and then visualizing vehicle demand to find the most promising areas of the city – thus sparing the company the trouble of conducting expensive test phases.



*What's the best place to install gumball machines? Where are appropriate locations for car sharing parking spaces? Spatial data can be used to answer such questions. Photos: Thomas Kunz*



*The partners use statistical methods to analyze various data sources, filter out the relevant factors, and piece together the results to obtain an overall picture. Illustration: Geospin*

"The idea of course has its limits," says Prof. Dr. Dirk Neumann, the University of Freiburg business informatics professor who supported the spinoff. He enabled the five founders to take a business development course free of charge. "What is possible stands or falls with the available material: What format is the data available in? Are there statistical models that could be used to make inferences?" If the data is sufficiently good and extensive, it can be used to make reliable predictions. It is usually possible to play through several possibilities in the manner of "what if" scenarios. "Geospin combines machine learning with econometric methods," says Neumann. What helps the entrepreneurs is their experience with data: "We have come to see fairly quickly which method is appropriate for addressing certain questions and which is not," says Gebele.

#### **A Common Basis for All Data**

Before the data can be analyzed for the secrets it harbors, the Geospin team needs to conduct several complex procedures. The seemingly simplest of them often turns out to be quite a challenge: transferring the data from the client to Geospin. "The data usually contains sensitive customer information. It can't simply be sent by

email," explains Gebele. Then the team has to check the data for cleanliness. Are there gaps? Erroneous data? Conspicuous outliers in one or the other direction? After that, the team determines the dimensions of the data. Does it allow conclusions in terms of hours, days, weeks? Is it point data or route data? Does it refer to times, amounts, places? "This screening is very time-consuming, but it is necessary. Not until we have reduced all available data to a common basis can we conduct a reliable analysis that allows us to draw valid conclusions," says Brandt.

**"Geospin combines machine learning with econometric methods."**

The data analysis itself can be a tricky task too. "Much of the information in a data set is superfluous and irrelevant for what we are attempting to find out," says Gebele. "There is a danger of making connections that are not necessarily causal. This is something we naturally want to avoid."





Once the data has been successfully analyzed, the cooperation with the client can be expanded into a long-term partnership. “We want to help solve problems that have a certain relevance,” stresses Brandt. “That’s why we’re conducting applied research.”

[www.geospin.de](http://www.geospin.de)



**Dr. Christoph Gebele** studied economics at the University of Freiburg, earning his doctorate at the Department of Marketing and Health Management. His dissertation dealt with consumer information processing and consumer decision-making behavior. He has applied his expertise in quantitative market research and market and competition analysis in several business consulting projects.

*Photos: Thomas Kunz*



**Dr. Tobias Brandt** studied economics at the University of Freiburg. He earned his PhD at the Department of Business Informatics with a dissertation on synergies between regenerative energy production and electro-mobility, supported by a scholarship from the “Stiftung der Deutschen Wirtschaft” (German Business Foundation). He then led the “Smart Cities & Industries” research group at the Department of Business Informatics. Since September 2016 he has served as assistant professor at the Dutch Rotterdam School of Management, Erasmus University.



**Prof. Dr. Dirk Neumann** studied economics at the University of Gießen and the University of Wisconsin–Milwaukee, USA. He completed his PhD in economics in 2004 at the University of Karlsruhe, which merged with the Karlsruhe Research Center in 2009 to form the Karlsruhe Institute of Technology (KIT), writing a dissertation entitled Market Engineering – A Structured Design Process for Electronic Markets. He earned his habilitation qualification at the same institution four years later and was then appointed at the University of Freiburg as professor of business informatics. His research group focuses among other things on digitalization and data analysis.

### Further Reading

Wagner, S./Brandt, T./Neumann, D. (2016): In free float: developing business analytics support for carsharing providers. In: Omega 59, pp. 4–14.

Pemberton Levy, H. (2015): Add location to your analytics. [www.gartner.com/smarterwithgartner/add-location-to-your-analytics](http://www.gartner.com/smarterwithgartner/add-location-to-your-analytics)

Bendler, J./Wagner, S./Brandt, T., et al. (2014): Informationsunschärfe in Big Data. Erkenntnisse aus sozialen Medien in Stadtgebieten. In: Wirtschaftsinformatik 56/5, pp. 303–313.

University of Freiburg video presentation: [www.pr.uni-freiburg.de/go/geospin](http://www.pr.uni-freiburg.de/go/geospin)




# Crime, Punishment, and Yearning

The postcolonial crime novel has outgrown its status as genre fiction and describes cultural conflicts in modern Africa

*by Rimma Gerenstein*





Clemencia Garises is young, black, smart, and good at solving crimes. She's a thorn in the side of the Namibian police, and in the capital Windhoek she has a reputation of being a bit strange: The investigator lives on the fringes of society, in a township the "blacks" and the "coloureds" were forced into during Apartheid, where hunger, poverty, and crime are widespread. However, Garises received part of her training not in Namibia but in Finland – among affluent, efficient Europeans who always arrive at the scene of a crime prepared to apply the whole gamut of modern criminal investigative methods.

One day the investigator is called to a farm to the southwest of Windhoek. The owner Gregor Rodenstein, a descendant of German colonists, lies dead on the ground. The Namibian police don't even have a stretcher with them; they touch the corpse without gloves. It's clear what happened anyway, they say: A gang was trying to steal the solar panels at night, the farmer caught them, and he paid for it with his life.

Now Garises does what she does best: She secures evidence, looks for clues, and refuses to be taken in by the various clans and their agendas. The further she gets in her investigation, however, the more she realizes what a big can of worms she has opened. The governing party SWAPO has ordered an agrarian reform; the owners are supposed to be dispossessed – after all, the Rodensteins originally took control of the property during the colonial era. This raises interesting questions: Was it really a group of small-time crooks who wanted to rob a family they supposed to be rich, or was it members of the ethnic group Herero searching for the graves and remains of their ancestors on the farm? Or was the murder perhaps even part of a government-sanctioned terrorist campaign to drive the Rodensteins off the land?

#### **Fascination with the Foreign**

For Prof. Dr. Michaela Holdenried, Bernhard Jaumann's *Steinland*, the second volume of a trilogy featuring investigator Clemencia Garises, is

a good example of the direction the modern crime novel is taking. While many of her colleagues regard the crime novel as an example of commercially driven genre fiction, the Freiburg intercultural German studies professor sees the genre as "an ideal laboratory for postcolonial themes and narratives."

For an interdisciplinary conference on cultural encounters and cultural conflict in the (post-) colonial crime novel at her host university in Stellenbosch, South Africa, a conference also attended by several of her Freiburg colleagues, Holdenried examined different forms of the genre, like the detective and spy novel or the thriller. Her aim was to find out how cultural encounters and cultural conflicts unfold in novels set in Africa.

### **"The crime novels present several truths."**

She had plenty of examples to choose from: "The crime novel is probably one of the most popular genres of all. Just take a look at the current bestseller lists," says Holdenried. Respected authors like Patricia Highsmith and Friedrich Dürrenmatt have long since raised the genre's standing, and there are many examples of crime novels with literary merit. Books like *The White Masai* and the *The Constant Gardner* have been made into movies, the actress Christine Neubauer experiences amorous adventures and the wilderness of Namibia in her role as a bush doctor on German television, and travel agencies advertise all-inclusive safaris and guided tours. "What was once regarded as the 'dark continent' is now accessible for many as a place of yearning and exoticism," sums up the researcher.

Yet the fascination with the foreign and the schematic structures of the crime novel do not seduce German-language authors like Bernhard Jaumann and Wolfgang Herrndorf, the Swedish best-selling author Henning Mankell, or the South African writers Deon Meyer and Roger Smith into embellishing their stories with clichés. On the



*Settlement in South Africa: During Apartheid, the “blacks” and “coloureds” were forced into townships marked by hunger, poverty, and crime. Most of the inhabitants live on the margins of society even today.*

*Photo: Delphotostock/Fotolia*

that is unchanging, certain, and binding for all,” Holdenried explains. In Herrndorf’s novel *Sand*, for instance, it is not even clear what country the plot is set in; all of the characters are corrupt and violent. Things are particularly difficult for investigator Polidorio: A blow to his skull has taken away his memory – he can’t even remember whether he’s one of the good guys.

“The crime novels present several truths that all have a right to exist,” says the literary scholar. Clemencia Garises is at home in the world of professional crime-solving but is also familiar with the tradition of black magic due to its importance in her family. The conflict between landless people and landowners also provides scope for several truths: The Herero lay claim to the graves of their ancestors, which they expect to find on the farm, and want to bury their remains in accordance with their tradition; the descendants of the colonists see themselves as having long since become Namibians and defend the farm they work on – and on which their families are also buried. Human remains incidentally also play a role in *Der lange Schatten* (“The Long Shadow”), the third part of Jaumann’s trilogy, but the setting has shifted to Freiburg. Here a skull is dug up in the name of historical truth. It belongs to Eugen Fischer, who taught anatomy at the University of Freiburg for twelve years, traveled to “German South West Africa” to conduct research, and helped pave the way for National Socialist theories with his findings on “race hygiene.”

#### **A New Look at Old Heroes**

The proceedings of the conference in Stellenbosch are scheduled for publication in spring 2017. The volume will contain a wide range of research on the postcolonial crime novel – including scholarship on the role of seeds and Torne

contrary: “These authors use elements of the crime novel in the postcolonial style more for social than for criminological investigations – or the two go hand in hand with each other in the plot.”

**“Today other media forms have evidently made the travelogue superfluous.”**

The search for the perpetrator of a crime – in other words, the search for truth – is of course also a typical element of the postcolonial crime novel. The culprit is usually found in the end, but the postmodern world remains chaotic, confusing, and complicated. “There thus cannot be a truth



Valley Finns in Swedish crime novels, the portrayal of German migrants in South African novels, and a series from the 1930s whose investigator yearned for "faraway lands and their colorfulness."

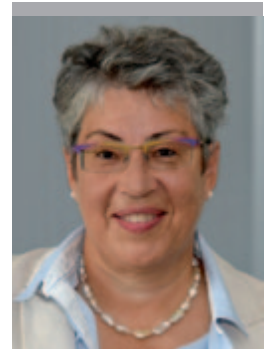
However, first Michaela Holdenried will publish another book to close a gap in research that has long been occupying her: She just finished co-authoring an introduction to travel literature of the 20th and 21st centuries along with Prof. Dr. Alexander Honold from Basel, Switzerland, and her Freiburg colleague Dr. Stefan Hermes – another of her research interests that deals with cultural encounters and the understanding and misunderstanding of the other. Formerly, the purpose of the travelogue was to introduce readers in Europe to countries far away from known borders, exotic animals, and strange customs. "Today other media forms have evidently made the travelogue superfluous, so the travel literature genre had to change."

Holdenried is especially interested in literature on research expeditions – such as those of John Franklin to the Arctic, who perished with his crew off King William Island on his third trip there in 1847. "Explorers like James Cook or Alexander von Humboldt used to be described as real-life heroes who overcame all of the adversities of nature and accomplished unthinkable feats at great speed." The German studies professor wants to show how contemporary authors like Christoph Ransmayr present these old heroes in a new light without condemning them – an accusation leveled against other authors, such as Daniel Kehlmann and his novel *Measuring the World*. "Instead, they also show the hardships, the madness, and the expenses these 'discoveries' involved, both for the people and for the previously untouched regions." Hence, the encounters and conflicts between cultures are not decreasing – but writers are constantly changing our perspective on them with their texts.

[www.pr.uni-freiburg.de/go/holdenried](http://www.pr.uni-freiburg.de/go/holdenried)

*Herero woman in traditional clothing: In his crime novel Steinland, Bernhard Jaumann describes a conflict between descendents of German colonists and members of the ethnic group Herero over their cultural heritage.*

*Photo: poco\_bw/Fotolia*



**Prof. Dr. Michaela Holdenried** has held the first professorship of inter-cultural German studies at the University of Freiburg's Department of German since 2009. In addition, Holdenried was appointed as an extraordinary professor at Stellenbosch University in South Africa in 2010. Her education took her to the Netherlands, Austria, Brazil, the USA, and finally back to Germany. After earning a degree in German studies, political science, history, and Latin American studies in Tübingen and Berlin, Holdenried went on to complete her PhD and her habilitation in the latter city in 1990 and 2002, respectively. Her research interests include interculturality, alterity in the European and non-European context, autobiography, and postmodern authorship.

*Photo: Thomas Kunz*

## Further Reading

Holdenried, M./Honold, A./Hermes, S. (Eds.) (2016): Reiseliteratur der Moderne und Postmoderne. Berlin (in press).

Holdenried, M. (2016): Inszenierungsformen des status viatoris als Nichtwissenskunde. Thomas Stangls Timbuktu-Roman „Der Einzige Ort“. In: Gradinari, I./Müller D./Pause, J. (Eds.) (2016): Versteckt – Verirrt – Verschollen. Reisen und Nicht-Wissen. Wiesbaden, pp. 199–211.

Korte, B./Paletschek, S. (Eds.) (2009): Geschichte im Krimi. Beiträge aus den Kulturwissenschaften. Cologne.

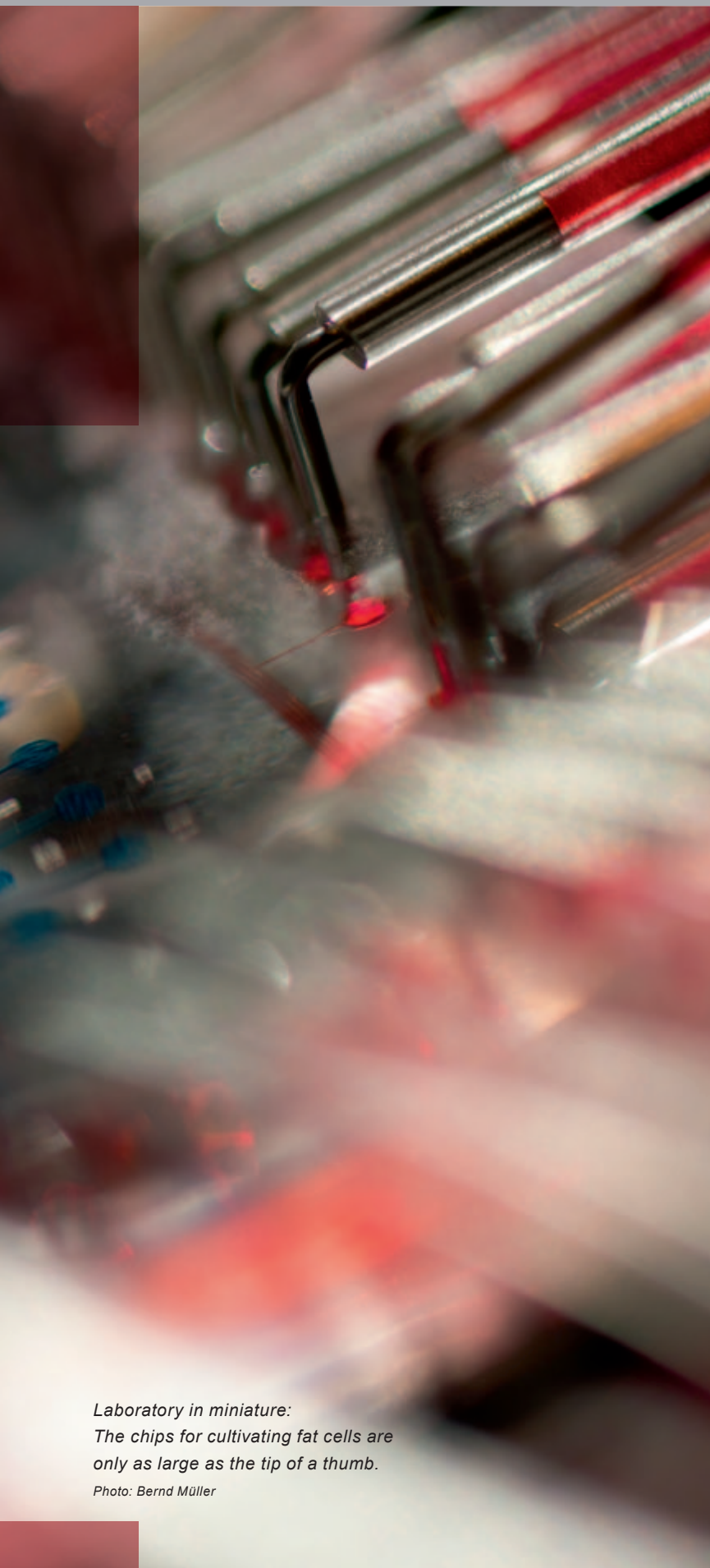
# Keeping Tabs on Fat

Scientists are using chip platforms to simulate the surroundings of the human body and cultivate cells

*by Katrin Albaum*







*Laboratory in miniature:  
The chips for cultivating fat cells are  
only as large as the tip of a thumb.*

*Photo: Bernd Müller*

The body of an adult human of average weight contains around 20 to 27 billion fat cells. An overweight adult may have more than 300 fat cells, and they are up to one-third larger than the cells in the fatty tissue of a person of normal weight. Adult stem cells within the tissue guarantee a constant supply by dividing. They or their successors then become fat cells. But how can we determine precisely what environmental conditions lead a stem cell to divide or develop? Is it perhaps even possible to influence this process to fight fat? What influence does a calorie-rich diet have on adipocytes, as fat cells are termed in cell biology?

The Freiburg biophysicist Dr. Matthias Meier and his team are developing microfluidic platforms that work with tiny amounts of fluid to address these and other questions. The chips are no larger than the tip of a thumb and contain more than one hundred cell culture chambers. The entire platform is covered with razor-thin fluid channels that provide the cells on it with nutrients. The scientists use these chips to cultivate and study various kinds of cells, including adipocytes. "Microfluidics enables us to control the environmental conditions the cells on the platform are exposed to," explains Meier. "At the same time, it is also a tool we can use to obtain measurable data and analyze precisely which signals the cells produce." The microfluidic chips are an example of the methods and instruments of quantitative biology, which Meier and his team are using for their research at the interface between microsystems engineering and biophysics.

### **Sugar for the Cell**

When researchers want to make cells grow, they usually place them on a culture medium in a petri dish or a large cell culture flask. The culture medium generally provides the cells with a steady supply of energy, for instance glucose, until it is used up and needs to be changed. "When a low-capacity medium no longer contains any sugar molecules, the cells soon begin to starve," explains Meier. If the cells are on a large nutrient medium, on the other hand, they have too much

food available: In the body, their supply of nutrients fluctuates. "The chip simulates the body's own environment. It allows us to control and adjust the influences the cells are exposed to," says Meier. "The platform supplies the cells with a nutrient medium automatically by way of the fluid channels, so we don't need to exchange anything during an experiment." The microfluidic chip also serves as an alternative to experiments on animals.

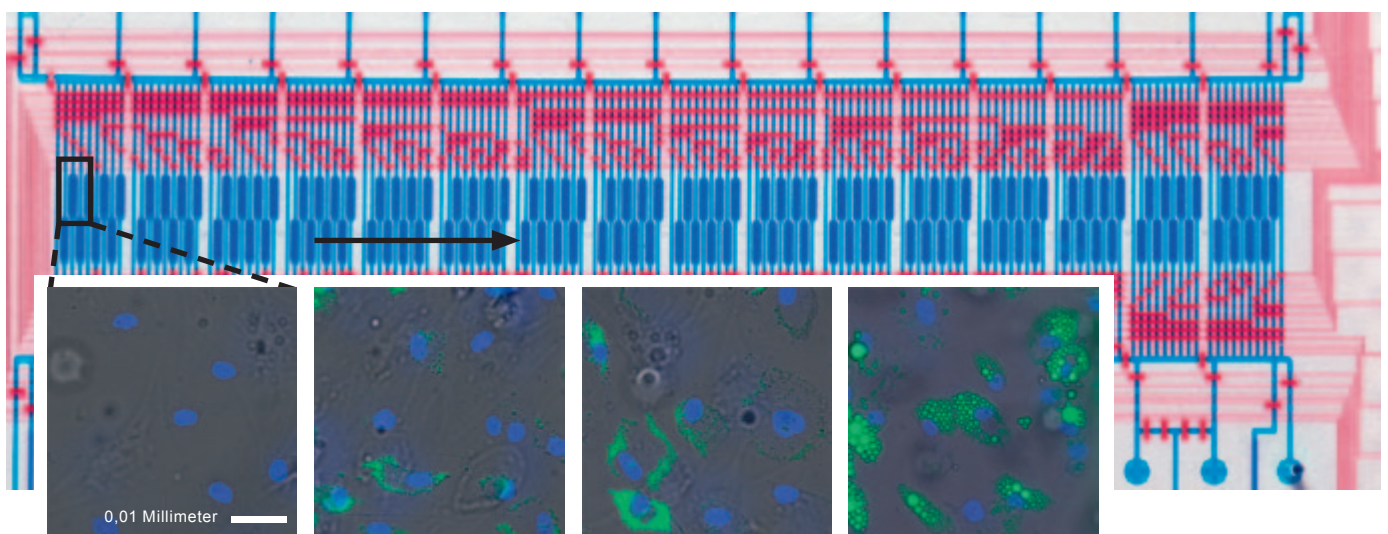
## "The long-term goal is to develop a cell replacement therapy for diabetes."

Meier and his team have optimized this technology and the procedures it involves for their research on adult stem cells from fatty tissue. Under uniform environmental conditions, the cells develop in a period of three weeks. Adult stem cells have the potential to develop into various differentiated cell types. For example, stem cells from the fatty tissue of an adult human can become brown or white adipocytes. Most of the fat in the human body and its fatty tissue is white fat, which is the body's main store of energy. "However, fatty tissue also consists of a lot of

colorful cells," explains Meier. "Brown adipocytes, for instance, are capable of breaking down white fat through heat production." If the scientists were to succeed in increasing the proportion of brown fat, it could offer a possibility for fighting obesity. "We are thus interested in the following questions: Can I create brown adipocytes or similar brown fat cells under certain environmental influences? Which cell types develop under which environmental conditions?" Now that Meier and his team have finished developing the method, they want to find answers.

### Making Biological Processes Measurable

Meier's research group aims to develop applications for making biological processes measurable: "We are building tools and using them to engage in quantitative biology. This means we are developing methods we can use to count proteins and ribonucleic acids at the molecular level." For example, the team has integrated a program for automated protein analysis in the microfluidic chips. "The idea is to understand the cells' world of signals and find out when a particular protein is activated as part of a signaling network." The signaling strength also plays a role as an information carrier, much as with a



*Microfluidic chip for the cultivation of adult stem cells from fatty tissue: The blue-colored microchannels are flow channels in which the nutrient media is delivered to the cell chambers. The red-colored microchannels are part of the control network for regulating flow on the chip. The magnified images show one of the 128 cell culture chambers on the chip. The series of images depicts the biochemically triggered differentiation of adult stem cells into mature fat cells after 0, 2, 5, and 10 days on the chip (respectively, from left). The increase in fat droplets in the cells during the maturation process is shown in green. Source: Matthias Meier*





*What influence does a calorie-rich diet have on fat cells? Microfluidic platforms can be used to study this and other questions. Photo: volfff/Fotolia*

telephone call in a mobile phone network: If the reception is poor and the network weak, less information is transmitted – one hears only snatches or individual syllables of what the person on the other end of the line is saying.

In their first studies on stem cells and adipocytes on the chip platform, the scientists observed the proteins of the mTOR signaling pathway. “We obtained new findings demonstrating that only a certain part of this signaling pathway is involved in the maturation process of the stem cells into differentiated fat cells, not the entire pathway, as previously thought,” says Meier. “We also showed that the signaling pathway is inhibited when the stem cells do not receive enough nutrients and get hungry.” In addition, the researchers succeeded in confirming their hypothesis: Stem cells store more lipids – fat molecules – and thus become larger while they are developing into adipocytes, when they are “fed” more frequently and their calorie intake is higher.

### From Sender to Receiver

Meier and his team are currently refining the microfluidic chip technology, because when they are finished studying the fat cells that receive insulin, they want to study the cells that produce insulin: beta cells from the pancreas. These cells produce the hormone insulin in healthy bodies when the glucose level rises, thus sending a signal to the fat cells. Insulin lowers the blood sugar level and influences the adipocytes: “When the fat cell receives insulin, it knows that there is glucose in the body and stores this sugar.” Defects in the signal transmission chain between the cells that send and receive insulin are a molecular cause of diabetes mellitus. Treatment involves increasing the amount of beta cells in the pancreas.

However, there are only relatively few adult stem cells in the pancreas. When researchers want to produce beta cells, they thus use so-called reprogrammed stem cells created from other types of cells, such as skin cells. “The big challenge in this project is that the natural tissue environment plays an important role in the maturation of beta

cells in addition to environmental conditions,” Meier explains. “We are thus developing artificial three-dimensional cell cultures and optical analytic methods on the microfluidic chip to study the maturation of the cells under controlled environmental conditions. Microfluidic approaches have previously been limited to 2D cell cultures, so-called monolayer cultures. “We are now working on producing 3D cell cultures in a chip in order to also recreate mechanical influences and cell junctions similar to those found in natural tissue.” Here too, the scientists are concentrating their efforts primarily on investigating and measuring signaling pathways that are active during the phase of cell development. “The long-term goal is to develop a cell replacement therapy for diabetes that can be tailored precisely to specific patients.” To do so, the scientists aim to cultivate beta cells on a chip that can later be implanted in a patient.

[www.mibioeng.com](http://www.mibioeng.com)



**Dr. Matthias Meier**

*studied biochemistry at the University of Regensburg. In 2006 he earned his PhD in biophysics at the University of Basel, Switzerland. He then conducted postdoctoral research at the University of Chicago and Stanford University, USA. Since 2012 he has served as leader of the “Microfluidic and Biological Engineering” research group, MiBioEng for short, at the Laboratory for MEMS Applications at the University of Freiburg’s Department of Microsystems Engineering (IMTEK). Meier is an associated member of the Freiburg Cluster of Excellence BIOSS Centre for Biological Signaling Studies. The MiBioEng research group is receiving funding from the German Research Foundation within the context of the Emmy Noether Program. Photo: private*

### Further Reading

Wu, X./Schneider, N./Platen, A., et al. (2016): In situ characterization of the mTORC1 during adipogenesis of human adult stem cells on chip. In: PNAS 113/29, S. E4143–E4150. doi: 10.1073/pnas.1601207113

Blazek, M./Zengerle, R./Meier, M. (2015): Analysis of fast phosphorylation kinetics in single cells on a microfluidic chip. In: Lab on a Chip 15/3, pp. 726–734. doi: 10.1039/c4lc00797b

Blazek, M./Betz, C./Hall, M. N., et al. (2013): Proximity ligation assay for high-content profiling of cell signaling pathways on a microfluidic chip. In: Molecular & Cellular Proteomics 12/12, pp. 3898–3907. doi: 10.1074/mcp.M113.032821

*A statue in Cordoba, Spain, commemorates Averroes. Freiburg researchers have demonstrated on the basis of his writings that the legal theorist was open to the ideas of his supposed rivals.*

*Photo: sophie\_tea/Can Stock Photo*




# Thinkers and Debates

Writings from medieval Arabic culture afford insight into an open and diverse Islam

by Anita Rüffer





Visitors to the office of junior professor Dr. Nadja Germann at the University of Freiburg's Department of Philosophy feel like they have been transported to the world of the Arabian Nights: The bright shelves are filled with books whose spines are decorated with mysterious golden letters that combine to form an ornamental whole. The optical magic of the Arabic-Islamic book culture is no accident, says the researcher, but an expression of the high regard in which language and writing were held in Arabic culture – and this leads directly to the topic Germann and her team are investigating in their junior research group: the philosophy of language in Arabic culture between 800 and 1200 AD.

The researchers are thus immersing themselves in an intellectual world that is light years away from the image of this world the so-called Islamic State tries to project today. "It's such a shame how ISIS is distorting the rich tradition of this culture and turning it into something horribly negative," says Germann. She is afraid these images will remain dominant in people's heads for a long time to come. "And yet there are completely different images."

Is everything written in the Koran, the foundational text of Islamic culture, supposed to be taken literally? Does the god who reveals himself in this book really want us to chop off the hand of every thief? "That should not necessarily be understood as an actual command but was often interpreted by Arabic thinkers as a metaphor illustrating that theft is something bad." Likewise, modern liberal reformist theologians like Mouhanad Khorchide, Islamic studies professor at the University of Münster, argue against reading the Koran and all it teaches about the relationship between God and humans as historical facts.

#### **Flexibility in Interpreting the Koran**

This conflict is by no means new: According to Germann, thinkers racked their brains about

what God's commandments should be taken to mean in real life even in the Middle Ages. The views ranged from strict literal interpretations of the text to very free interpretations. Written records of such theological debates go all the way back to the 8th century, only one hundred years after Islam came into being when Muhammad proclaimed his faith in Allah, the one god. Opinions as to how this god should be seen have always differed. Already in the Middle Ages, the flexibility in interpreting the Koran allowed for different currents of opinion. Some elements in the sacred book of Islam are also present in similar form in the Christian Bible and the Jewish Torah. What, for example, does it mean when the Koran speaks of the "throne of God" or the "hand of God"? Should we understand the god who reveals himself here as a person with a body and a voice? "A majority of Muslims," says Germann, "understand this in a figurative sense."

**"Arabic was as important then as English is today."**

Her research focuses on issues like this, which she studies on the basis of a broad spectrum of philosophical, linguistic, legal, and theological texts from medieval Arabia. One of the things that interests her about these texts is the influence of ancient Greek philosophers. Their writings were already known in the continuously expanding 10<sup>th</sup> century Arabic-Islamic world. Syrian Christians translated ancient authors into Syrian at this time, for instance, most notably Aristotle and his commentators. These texts were then translated into Arabic. Finally, in the 12<sup>th</sup> century Aristotle was translated from Arabic into Latin, allowing him to be read in medieval Europe. "The Arabs were the connecting link for his reception. Arabic was as important then as English is today." That's quite a roundabout path to fame for this revolutionary ancient thinker, who was already

**“All philosophers since Aristotle have been fascinated by the relationship between words, thoughts, and things.”**

reflecting fundamentally in the year 300 BC on how humans acquire knowledge and what part language plays in the process. “All philosophers since Aristotle have been fascinated by the relationship between words, thoughts, and things,” says Germann. For her tastes, however, the role of language in this relationship did not quite get the attention it deserved from Aristotle and his Greek commentators or from his later Arabic-speaking followers – with one “remarkable” exception: the philosopher Al-Farabi, who hailed from the Turkish or Persian cultural area and died in the modern Syrian capital Damascus.

### **The Origin of Language**

For Germann, Al-Farabi was the first philosopher in the Islamic world to develop a fundamental philosophy of language “at an incredibly high level.” His work *Kitab al-Huruf* (“Book of Letters”) inquires into the origin of language: Is there a natural classification of words to objects, or is the link between them based on an arbitrary system, as discussed by ancient Greek authors? Did God create language, or was it made by humans, as

Islamic theologians ask? Al-Farabi knows both traditions and does not see them as contradictory but combines them in a creative synthesis: Humans have a natural inclination to communicate. They need to find sounds that correspond to their thoughts. They receive the gift for doing so from nature – or, as a theologian would say, from God. Hence, Al-Farabi sees language as made by humans but not arbitrary, because it follows an ideal norm. Language thus springs from an intuition that was implanted in humans.

What Germann also finds striking is that this early Arabic philosopher interlinks his texts and the topics they treat with disciplines ranging far beyond his own field that were already engaged at the time in a lively discussion on language, its meaning, and its use: legal and literary theory, theology, and linguistics. “As a citizen of the Islamic world, he made use of the perspectives and the instruments of his time and his culture.” He therefore provides insight into an Islam whose consciousness was not hermetically sealed but intentionally permeable for centuries and open for creative discoveries beyond the boundaries of individual disciplines.

This universe is precisely what German and her colleagues are focusing on in their research group. The researchers are astounded at several of the findings their interdisciplinary perspective on philosophy of language has yielded so far. One of them concerns the 12<sup>th</sup>-century legal theorist Averroes, who made a name for himself beyond the borders of the Islamic world with his side job as an Aristotle commentator. Although Averroes was actually a member of the Maliki school of jurisprudence, which had more traditional orthodox leanings, the Freiburg researchers have identified many elements in his writings on legal theory – such as his taxonomy of language – that go back to positions originally advocated by opposing schools: an indication that he was open to the ideas of his supposed rivals. Moreover, the tendency of linguists like Ibn Jinni in the 10<sup>th</sup> century to treat language separately from the question of its origin as an abstract compound consisting of phonetic information on the one hand and its content and meanings on the other soon proved to be a helpful methodological tool for theologians and legal theorists in the interpretation of the divine revelation and the hermeneutics of religious law.

*Optical magic: Extravagantly decorated books and ornate letters testify to the high regard for language and writing in Arabic culture.*

*Photo: meen\_na/Fotolia*





*A statue of Al-Farabi in Turkistan, Kazakhstan: For Nadja Germann, he was the first philosopher in the Islamic world to develop a fundamental philosophy of language at a high level.*

*Photo: sophie\_tea/Can Stock Photo*



#### **Juniorprofessorin**

#### **Dr. Nadja Germann**

*studied philosophy, history, medieval literature, and Islamic studies at the Universities of Constance and Tübingen and earned her PhD in philosophy at the latter institution in 2005. Searching for opportunities to combine her philosophical research with her interest in other cultures, she hit upon Arabic-Islamic thinking. She has since focused on investigating the “archaeology of thinking” from a comparative perspective. After earning her PhD, she researched and taught in Leuven, Freiburg, Boston, Yale, Baltimore, and Geneva. Her areas of specialization are epistemology and philosophy of science, philosophy of language, and the relationship between language, thought, and reality.*

*Photo: Thomas Kunz*

To investigate these aspects in more detail, Germann has assembled a team including researchers from countries like Lebanon, Egypt, Puerto Rico, Tunisia, and Iran with expertise in various disciplines. They read and discuss texts from these disciplines together to acquire the necessary historical foundations and methodological tools for their subprojects. Obtaining the old manuscripts is “not always easy,” says Germann, “but we have good contacts and were quickly able to build up a library.”

[www.arabische-philosophie.uni-freiburg.de](http://www.arabische-philosophie.uni-freiburg.de)

#### **Further Reading**

Germann, N. (2016): Al-Farabi's philosophy of society and religion. In: Zalta, E. N. (Ed.) (2016): Stanford Encyclopedia of Philosophy, Summer 2016 Edition. <http://plato.stanford.edu/archives/sum2016/entries/al-farabi-soc-rel>

Germann, N. (2016): Learning by oneself: Ḥayy ibn Yaqzān, autodidacticism, and the autonomy of reason. In: Speer, A. / Jeschke, T. (Eds.) (2016): Schüler und Meister. Berlin / New York, pp. 613–637. (= Miscellanea Mediaevalia 39).

Germann, N. (2015): Imitation – ambiguity – discourse: some remarks on al-Fārābī's philosophy of language. In: Mélanges de l'Université Saint-Joseph 66 (in press).

# Flexible Training for Museum Work

“MuseOn” is Europe’s first continuing education program for museum personnel

by Stephanie Streif



*How can museum visits be made even more interesting and exciting? This is just one of many questions treated by the University of Freiburg's new continuing education program.*

*Source: Museum für Neue Kunst – Städtische Museen Freiburg, Erlebnis Museum, Photo: Theis und Partner*





A museum is so much more than just a collection and an exhibition space. A museum is also a place of learning. Museums of course have display cabinets presenting objects like flint arrowheads from the Middle Bronze Age or fish preserved in alcohol, but it is not enough to just show things. These objects also need to be explained, experienced, and organized, and that involves a lot of specialized knowledge as well as curatorial and organizational know-how. As a means of providing in-service training for museum personnel, the University of Freiburg has developed the continuing education program “museOn.” Most of the program is held on the internet, and students are free to select topics according to their personal interests. MuseOn is a project organized by the Freiburg Academy of Museum, Exhibition, and Collection Studies, FRAMAS for short – one of many examples of continuing education at the University of Freiburg.

The program of museOn includes eight subject areas with five sub-modules each. The first of a total of 30 sub-modules – including “Object and Knowledge,” “Museum Ethics,” and “Finance and Budget” – have already been online since the start of the 2016 summer semester and are currently being tested for suitability by selected professionals with practical experience in the respective fields. The continuing education program will be open for regular students starting in 2018 – an ambitious plan, when one considers that each sub-module first needs to be developed, then tested, and if necessary adapted.

Dr. Christian Wacker, the academic director of museOn, has been working with his team since November 2014 to design the program – or more precisely to plan it from the ground up, because according to Wacker there is no other program like it in Europe. To tailor museOn to the needs of museum personnel, the team began by asking practitioners systematically about their expectations.

**“The interactivity is very important to us.”**

What they learned is that museum workers are less interested in earning another degree than in gaining further professional qualifications and that they need flexible courses that are easy to sign up for and can be completed alongside a full-time job. The team also asked about content. The results served as the basis for the aforementioned subject areas and sub-modules, which were developed by experts at the university and in museums. One of the goals of museOn is to improve the communication between the university and museums and bridge the supposed gaps between research and practice.

#### **Scripts, Presentations, Films**

All it takes is two or three clicks for museOn students to get to the virtual lecture hall, where they receive further training as needed. The learning material available online is interactive and includes scripts, presentations, and short films.



*The Archaeological Collection of the University of Freiburg is a close cooperation partner of the Freiburg Academy of Museum, Exhibition, and Collection Studies (FRAMAS). Photo: Manfred Zahn*

Many of the lessons are prepared by the media instructors and producers from the project group themselves. “The interactivity is very important to us, because it is much easier to learn when one communicates with others,” says Wacker. The sub-modules therefore include a lot of online meetings, discussion forums, and Etherpads –

**“Around 80 percent of the instruction in museOn is digital.”**

that is, web-based editors that allow texts to be edited simultaneously by several authors. Moreover, there are entertaining online guessing games for activating prior knowledge. To ensure that the students don’t lose themselves in the great variety of material, each sub-module comes with a guide describing the most important learning goals and explaining step by step how

the participants should study and complete the online content. This teaching strategy is known as blended learning.

“Around 80 percent of the instruction in museOn is digital,” says Wacker. “Analog teaching is only used when there’s a benefit for the participants.” This is the case for the introductory course as well as for units taught in real exhibition halls. However, even courses like these are often discussed in depth and reviewed afterwards on the internet. The participants in the “Scenography and Space” course, for example, get together online after a museum excursion to reflect on and discuss their experience: “Cultivated disorder,” writes one participant of the Historical Museum in Basel, Switzerland. Another asserts of the Vitra Design Museum in Weil am Rhein: “The objects don’t need to be put in any special arrangement; they speak for themselves.” Impressions, opinions, and content are shifted back and forth again and





again on the learning platform, and everything the students do online naturally also goes into their grade.

### Certificate or Diploma

Speaking of grades: It is possible to earn two types of qualification with museOn – for the small version, the Certificate of Advanced Studies (CAS), students have to complete ten sub-modules in two subject areas, while the large version, the Diploma of Advanced Studies (DAS), encompasses 30 sub-modules in six subject areas. It takes one semester to complete the short version, two to three to complete the large version.

Why is a concept like museOn needed? “There aren’t any in-service training structures for work in museums at German higher education institutions,” responds Wacker. In other words, most people working at museums actually majored in

a specific academic field, like archaeology, ethnology, or art history, and then wound up working at a museum after completing a traineeship in the field. Another way to qualify for work at museums is by studying museology or museum studies, but Wacker points out that these fields are only offered as undergraduate programs. There is thus a lack of continuing education programs for people already working at museums.

The University of Freiburg and the City of Freiburg founded FRAMAS to ensure that this does not remain the case. FRAMAS cooperates closely with the university’s Department of Classical Archaeology, the Archaeological Collection, the Department of Art History, and other departments at the Faculty of Humanities. Other cooperation partners include museums and professional associations in the region and further afield – above all Freiburg’s municipal museums, Fondation Beyeler in Riehen, Switzerland, and the Baden-Württemberg State Museum Association. In addition, the German Federal Ministry of Education and Research is providing 1.2 million euros in funding for museOn within the context of the program “Advancement through Education: Open Higher Education Institutions” – initially for a period of three and a half years.

But Wacker and his team are already thinking beyond the end of the current funding period: “We hope to receive an extension, because we’re planning on expanding the program to include a master’s in advanced studies, and we also want to internationalize it.”

[www.museon.uni-freiburg.de](http://www.museon.uni-freiburg.de)



**Dr. Christian Wacker**

*is a classicist and a sports historian. He earned his PhD at the University of Würzburg in 1996 with a dissertation on the gymnasium in Olympia. Before assuming the post of director at the Deutsches Sport & Olympia Museum in Cologne in 2005, Wacker worked as a copyeditor, as a marketing representative at a scientific publishing house, and as an organizer of exhibitions for the Olympic Ski Stadium in Garmisch-Partenkirchen. In addition, he worked as a cultural and sales manager for the Munich audio guide developer audioguidance GmbH. After his time in Cologne, he set up the new Sports Museum in Doha, Qatar. He has served as project manager for the Freiburg Academy of Museum, Exhibition, and Collection Studies (FRAMAS) since November 2014.*

*Photo: Thomas Kunz*

### Further Reading

Lord, G. D. / Blankenberg, N. (2015): Cities, museums and soft power. Washington, D.C.

MacDonald, S. (Ed.) (2011): A companion to museum studies. Chichester et al. (= Blackwell Companions in Cultural Studies 12).

Korff, G. (2007<sup>2</sup>): Museumsdinge: deponieren – exponieren. Cologne/Weimar/Vienna.



*Treating patients as equals:  
Films show students what it's like  
to work at a palliative care unit.*

# Teaching with Films

Videos illustrate the daily life and personal experiences of patients in palliative care units

*by Petra Völzing*



**“The patients are the experts on their experience, the doctor the novice.”**

**B**orderline situations are an everyday occurrence in the Department of Palliative Care at the University of Freiburg Medical Center. Even though two-thirds of the patients in palliative care units are eventually released, the professionals caring for them need to be versed in topics like the finitude of life, anxieties, and uncertainties. Easing patients' physical pain is only a part of their job; they also need to tend to their psychosocial and spiritual needs.

The task of getting students to appreciate these special circumstances presents educators with a host of challenges. For one thing, there are logistic limits: “We have ten beds and about 350 students,” says Prof. Dr. Gerhild Becker, medical director of the Department of Palliative Care. This statistic alone already illustrates the limits of bedside teaching. In addition, there are scheduling constraints: “The people are very sick, so it is always difficult to foresee when a patient will be capable of speaking with students.” Consideration for the patients is always top priority at palliative care units, but the tight schedules of medical students leave no room for on-call patient visits.

### **Tour through the Unit**

Gerhild Becker and the educational scientist Bettina Couné developed a teaching approach in the 2015/16 winter semester with an eye to remedying this difficult situation. It combines lectures and seminars with e-learning modules designed to replace some of the traditional on-campus learning. The online module features film sequences including interviews with patients, doctors, and other professionals engaged in palliative care. In the introductory film a student takes a guided tour of the palliative care unit with assistant medical director Dr. Karin Jaroslawski. The student asks questions that are important for her – and by extension also for the viewer of the film – and the assistant medical director answers them. Another film shows a team meeting involving discussions about each and every patient. Discussions like these are a critical part of work

in palliative care units, where doctors, physical therapists, psychologists, and ministers all need to work together to achieve the best for the patients. The only way to do so is by communicating with each other. The films give the students important insight into work procedures at the Department of Palliative Care.

Films featuring patients talking about their experiences play a special role in the program. “The patients are the experts on their experience, the doctor the novice,” says Becker. On account of their illness, only few patients are capable of describing this experience, and even those who are cannot usually do so upon request while students are visiting the unit. These films are thus a valuable resource for the students.

### **Passing On Valuable Information**

In one film, a patient with amyotrophic lateral sclerosis (ALS), a disease of the nervous system, describes her personal experience. Her speech faculties were already greatly compromised at the time of filming. It therefore took a lot of time to record the film – time students do not have during bedside teaching sessions. And yet it is precisely these patients who can pass on valuable information to the students. What the ALS patient found worst was the experience of not being understood. “It is a profound feeling of incapacitation,” explains Becker. This is painful for many patients, for instance because people start doing things for them that they are actually still capable of doing on their own. “In this case we were lucky to find a patient for the film who was capable of communicating this experience in an easily understandable way for the students,” stresses Becker. That is not always the case with bedside teaching.

Another film treats a further important aspect of daily work in palliative care units: doctor's rounds. The film shows how important it is for palliative caregivers to treat patients as equals and as individuals. The doctor sits down at the



*This patient was admitted to the palliative care unit with a severe neuromuscular disorder. She speaks in the instructional film about her experiences with the healthcare system and about the things that help her regain her strength.*



*Team meeting (top), tour of the unit with assistant medical director Karin Jaroslawski (left), patient visit (right). The films give students important insight into work procedures at the Department of Palliative Care. Photos: Medical Center – University of Freiburg, Department of Palliative Care*



patient's bedside and listens to him. The head physician does not simply burst into the room with her entourage and speak about the patient. She speaks with the patient.

### Learning How to Endure Slowness

Medical students are required to take two units of palliative medicine, one in their first semester and the other in their fifth semester of study. The program begins with an introductory lecture course, followed by the e-learning module and an on-campus seminar. The videos are part of the e-learning module. "The films give the students a chance to learn at several different levels," says Becker. They learn on the basis of a model, working on a concrete topic and at the same time learning about the importance of their own inner attitude when talking with people suffering from a severe illness. Gerhild Becker

also cites other advantages: "Today's students are used to interacting at a much faster pace due to modern media. The ALS patient gives them a feel for how much time things can take. They need to learn how to endure slowness."

This form of learning can be a strain for students, because it forces them to confront the topics of suffering and death, while they are interested above all in helping and healing. "Some of the students told us they found it difficult to work through all this on their own," says Couné. That is a good thing in a sense, because the students need to find out whether they are up to the task of providing palliative care. All of the students have to take a multiple-choice test at the end of the online module. "This is important, because we need to check whether the students have acquired the necessary knowledge for the seminar," says Couné.



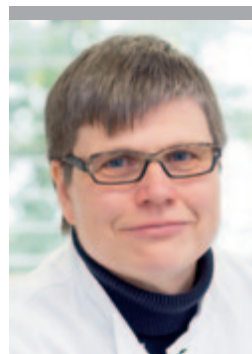
## Reporting from Daily Work Experience

“On the whole, it is of course important to not leave the students alone with what they learn watching the films,” sums up the educational scientist. The seminar the students take upon completing the e-learning module thus gives the students a chance to reflect on and sort out what they have learned through self-study. Karin Jaroslawski attends the seminar too. “You might say she reports directly from daily work experience,” says Becker. The experienced doctor responds to burning issues raised by the films and gives students the opportunity to come into direct contact with patients.

**“The films basically get right to the core of an issue.”**

The films are produced by a small team led by the media technologist Matthias Weis. “We try to keep the technology as unobtrusive as we can,” says Becker, the idea being to place the patients under as little additional strain as possible. This means putting up with minor technical shortcomings like background noise that cannot be edited out even through careful editing. The team usually films a lot more footage than can ultimately be integrated into the online modules. “The films basically get right to the core of an issue the students spend a lot of time thinking about,” says Becker. Another positive effect of the films is that the patients find it beneficial to talk about their situation and thus to contribute to the education of aspiring young doctors.

[www.palliativecare.uni-freiburg.de](http://www.palliativecare.uni-freiburg.de)



**Prof. Dr. Gerhild Becker**  
studied medicine, Protestant theology, Catholic welfare studies, medical ethics, and palliative care. In 1997 she earned her doctorate in medicine and in 2007 her habilitation at the University of Freiburg. In 2012 she was appointed as Baden-Württemberg's first professor of palliative care and as medical director of the Department of Palliative Care at the Medical Center – University of Freiburg. Since 2013 she has also served as an honorary minister for the Evangelical Regional Church in Baden. Becker's research group focuses on healthcare research, symptom control, pain therapy, patient autonomy, dealing with dying and death, mourning, spirituality, and quality of life and outcome research.

*Photos: Medical Center – University of Freiburg*



**Bettina Couné**  
studied educational science and German linguistics at the University of Freiburg. She is a research assistant specializing in teaching and learning for initial training and continuing education at the Department of Palliative Medicine. As degree program coordinator, she is responsible for organizing and developing the master's program in palliative care, which has been offered since 2010 as an in-service blended learning program. In addition, she develops pedagogical and media-learning concepts for various continuing education courses as well as undergraduate courses.

## Further Reading

Gaupp, R./Körner, M./Fabry, G. (2016): Effects of a case-based interactive e-learning course on knowledge and attitudes about patient safety: a quasi-experimental study with third-year medical students. In: BMC Medical Education 16, pp. 172. doi: 10.1186/s12909-016-0691-4

Meffert, C./Stößel, U./Körner, M., et al. (2015): Perceptions of a good death among German medical students. In: Death Studies 9/5, pp. 307–315. doi: 10.1080/07481187.2014.951496

Periyakoil, V. S./Basaviah, P. (2013): The flipped classroom paradigm for teaching palliative care skills. In: Virtual Mentor 15/12, pp. 1034–1037. doi: 10.1001/virtualmentor.2013.15.12.medu1-1312



*How are stock prices developing?  
What risks need to be considered?  
The mathematics of finance provides  
models for answering such questions.*

*Photo: Deutsche Börse AG*

# Finance from a Practical Perspective

Master's students work out solutions for financial institutions and investment consultants in a seminar

by Verena Adt

Economics meets mathematics, or more precisely: financial market experts working hand in hand with financial mathematicians. Financial market researchers rely on mathematical models when they want to analyze the development of financial markets, observe market trends, or calculate risks. Particularly useful are stochastic methods, which involve chance and probabilities and enable precise predictions that defy the uncertainties of chance.

Yet despite the thematic parallels between economics and mathematics, it is unusual that two University of Freiburg professors who teach and conduct research at the interface between these two fields have gotten together to teach an interdisciplinary research seminar for master's students. "There has never been a course like this

before," explain Prof. Eva-Maria Lütkebohmert-Holtz, an expert in quantitative financial market research at the Institute of Economic Research, and Prof. Thorsten Schmidt, a specialist in mathematical stochastics at the Institute of Mathematics.

## Mixed Teams

What's new about the seminar is that economics and mathematics majors spend four months working together in mixed teams to find solutions to problems from corporate finance. Also new is the fact that the topics are not set by the professors but by banks, insurance companies, and financial consultants. "Our students often complained that their courses lacked practical relevance, even when we based our case studies directly on real-life examples," says Lütkebohmert-Holtz, and Schmidt



adds that mathematics of finance is taught from a theoretical perspective even though it is practical in nature. Their seminar “Finance from a Practical Perspective,” by contrast, is purely practical. Offered for the first time in the 2016 summer semester, the course treats issues that financial institutions and investment consultants deal with every day: how to test the credit worthiness of bank clients as precisely as possible, how to put together an investment portfolio that provides security over the course of decades, how to identify and remove design flaws in listed investment funds. The partners of the seminar from the financial industry have a real need for the solutions suggested by the students.

### Regular Progress Reports

The fixed timeframe also conforms to typical practices in the financial world. The students spend at least 10 to 15 hours per week on their project, and they meet for weekly work sessions. The teams submit regular progress reports to the industry partners. At the end of the seminar they hold a detailed final presentation at the partner institution. “We demand that the students put in a lot of effort,” explains Schmidt. The concept also requires for the students to be closely supervised. Besides receiving support from the two professors, the student teams are supervised by two PhD students from the participating departments, and the partner companies send employees to provide practical guidance to the project groups.

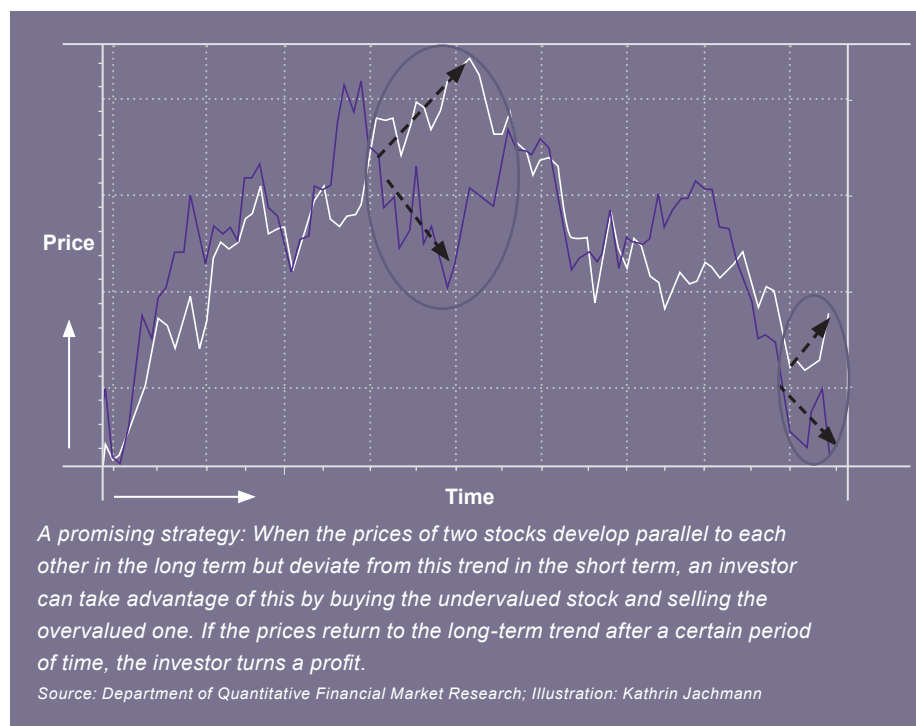
The opportunity to cooperate closely with industry partners had a strong motivational effect on the students, as Lütkebohmert-Holtz and Schmidt ascertained during the first seminar. Only one of the 20 students who signed up for the course dropped out. All the others showed great commitment in completing their project. The economics and mathematics students had to overcome a “steep learning curve,” says Schmidt. The first thing they had to learn was to communicate with the students from the other discipline. Then they had to familiarize themselves with what it takes to prepare and hold a well-designed presentation for a company – a key skill for their future professional lives. Finally, they had to practice voicing constructive criticism in a team. “This was quite difficult for them at the start,” says Schmidt, “but they managed to cope with the steep learning curve here too.”

The seminar began with four teams and four projects from three partner companies from the financial industry. One of the teams studied various tests banks use to determine the probability of clients defaulting on their loans. Stricter equity requirements imposed in 2006 forced banks to improve their internal rating methods, which are ultimately the deciding factor in calculating their equity capital reserves. The students began by testing four common methods and identifying their weaknesses. They determined that the existing rating methods consider loan defaults as isolated cases, although in reality it is quite possible for

**“We demand that the students put in a lot of effort.”**

them to be connected to each other, for example when the defaults are caused by an economic downturn. Then the team developed suggestions for a rating method that is not hampered by any of the weaknesses found in the four common models.

Another group developed a trading strategy involving pairs of stocks, triplets of stocks, and listed investment funds, so-called exchange-traded funds (ETF). The strategy is based on co-integrated



stocks, meaning stocks that exhibit long-term statistical relationships. The student team developed an algorithm that searches for such relationships in a large number of different stocks and takes the results as a basis for suggesting pairs of stocks that are suitable for a trading strategy aimed at taking advantage of price distortions in stock trading. When two stock prices develop parallel to each other in the long term but deviate from this trend in the short term, for example, investors can take advantage of this by buying the undervalued stock and selling the overvalued one. If the prices return to the long-term trend after a certain period of time, the investor turns a profit. To test their model, the team used a back-testing method that determines whether a trading strategy was profitable in the past and is therefore an promising option for the future.

The master's students enjoyed considerable freedom in conducting their research. As participants in a seminar, they were less dependent on the industry partners than they would have been as interns at the same companies, says Schmidt. The successfully completed project also led to initial contact with a potential employer for a number of the participants. All of them gained concrete practical experience in their future profession through the practical teamwork.

Lütkebohmert-Holtz and Schmidt are "very pleased" with the results achieved by their students. They plan to offer the seminar again in the 2017/18 winter semester. The professors already received the University of Freiburg's Instructional Development Award (IDA) for "Finance from a Practical Perspective" while planning the course in summer 2015. Recipients of the award are free to use the 70,000 euros as they wish, for instance to hire student assistants or to pay for teaching substitutes to gain more time to supervise the course.

[www.pr.uni-freiburg.de/go/finance](http://www.pr.uni-freiburg.de/go/finance)



**Key skill for students:**  
A participant holds a presentation at the partner company at the end of the seminar.

Photo: contrastwerkstatt/Fotolia



**Prof. Dr. Eva-Maria Lütkebohmert-Holtz** studied mathematics at the Universities of Bonn and Toronto and earned her PhD in 2004 in Bonn. In 2005 she was hired by the German Federal Bank as a research analyst. In 2006 she was appointed as a junior professor at the University of Bonn, and in 2009 she moved to the Faculty of Economics and Behavioral Sciences of the University of Freiburg, taking over the junior research group "Financial Mathematics: Pricing of Risks in Incomplete Markets." In 2013 she was appointed as professor of quantitative financial market research at the University of Freiburg. Her research focuses on modeling credit and liquidity risk, assessing and hedging financial derivatives, and quantifying model risks.

Photos: Klaus Polkowski



**Prof. Dr. Thorsten Schmidt** studied mathematics at the University of Gießen, where he became interested in the young field of mathematics of finance early on. After completing internships at banks in Frankfurt and London, he completed his PhD in Gießen in 2003 and was then appointed to a junior professorship at the University of Leipzig. In 2008 he moved to the Technical University of Chemnitz, where he developed a new research focus in electricity and gas markets. In 2015 he was appointed to the Chair of Mathematical Stochastics at the University of Freiburg, where he has concentrated particularly on model risks and fundamental issues of mathematics of finance.

### Further Reading

Liang, G./Lütkebohmert, E./Xiao, Y. (2014): A multi period bank run model for liquidity risk. In: Review of Finance 18/2, pp. 803–842. doi: 10.1093/rof/rft016

Schmidt, T. (2014): Catastrophe insurance modelled with shot-noise processes. In: Risks 2/1, pp. 3–24. doi: 10.3390/risks2010003



## Masthead

uni'wissen, the research magazine of the University of Freiburg, is published twice a year.

### **Publisher**

Albert-Ludwigs-Universität Freiburg,  
Rector, Prof. Dr. Hans-Jochen Schiewer

### **Responsible for Content**

Rudolf-Werner Dreier,  
Director of the Office of Public Relations

### **Expert Advisory Board**

Prof. Dr. Jürgen Bausch, Forest Science  
Prof. Dr. Ralf von den Hoff, Archaeology  
Prof. Dr. Gunther Neuhaus, Vice President  
for Research, Biology  
Prof. Dr. Sabine Rospert, Medicine  
Prof. Dr. Margit Zacharias, Vice President for Innovation  
and Technology Transfer, Microsystems Engineering

### **Editorial Staff**

Nicolas Scherger (Head Editor),  
Rimma Gerenstein, Yvonne Troll

### **Address of Editorial Staff**

Presse- und Öffentlichkeitsarbeit  
Albert-Ludwigs-Universität  
Fahnenbergplatz, 79085 Freiburg  
Telefon 0761/203-4301  
Fax 0761/203-4278  
E-Mail [uniwissen@pr.uni-freiburg.de](mailto:uniwissen@pr.uni-freiburg.de)

### **Print Run**

9,000 copies

### **English Translation**

Dr. David Heyde

### **Design, Layout**

Kathrin Jachmann

### **Cover Photos**

Hans Peter/Warner Bros. Records, Patrick Seeger,  
Maksym Yemelyanov, keki, 12ee12 (all fotolia)

### **Advertisements**

Gregor Kroschel  
Telefon 0761/203-4986  
[gregor.kroschel@zv.uni-freiburg.de](mailto:gregor.kroschel@zv.uni-freiburg.de)

### **Printing and Production**

Hofmann Druck, Emmendingen

### **Distribution**

Office of Public Relations

### **Yearly Subscription Price**

6 euros  
uni'wissen is available free of charge  
for members of the university.

ISSN 2194-8054

© Albert-Ludwigs-Universität Freiburg. All rights reserved.  
Reproduction, also of excerpts, is only authorized with permission from the editors. Articles indicating the author's name do not necessarily reflect the opinions of the publisher or the editors. The editors reserve the right to edit or abridge articles sent in by external contributors.

uni'wissen is available online  
at [www.wissen.uni-freiburg.de](http://www.wissen.uni-freiburg.de)



Presse- und Öffentlichkeitsarbeit  
Albert-Ludwigs-Universität  
Fahnenbergplatz, 79098 Freiburg  
Telefon 0761/203-4301  
Fax 0761/203-4278  
E-Mail [uniwissen@pr.uni-freiburg.de](mailto:uniwissen@pr.uni-freiburg.de)  
[www.wissen.uni-freiburg.de](http://www.wissen.uni-freiburg.de)