



ENGLISH

EXCELLENCE STRATEGY

THREE PROPOSALS FOR RESEARCH CLUSTERS

The FSU's topics in the excellence competition

NUTRITION

WATER LENSES ARE NUTRITIOUS AND HEALTHY

An inconspicuous plant could make up for a poor diet

WAFFEN-SS

WHY NON- GERMANS SERVED IN THE FORCE

The motives of the roughly 500,000 volunteers from the whole of Europe

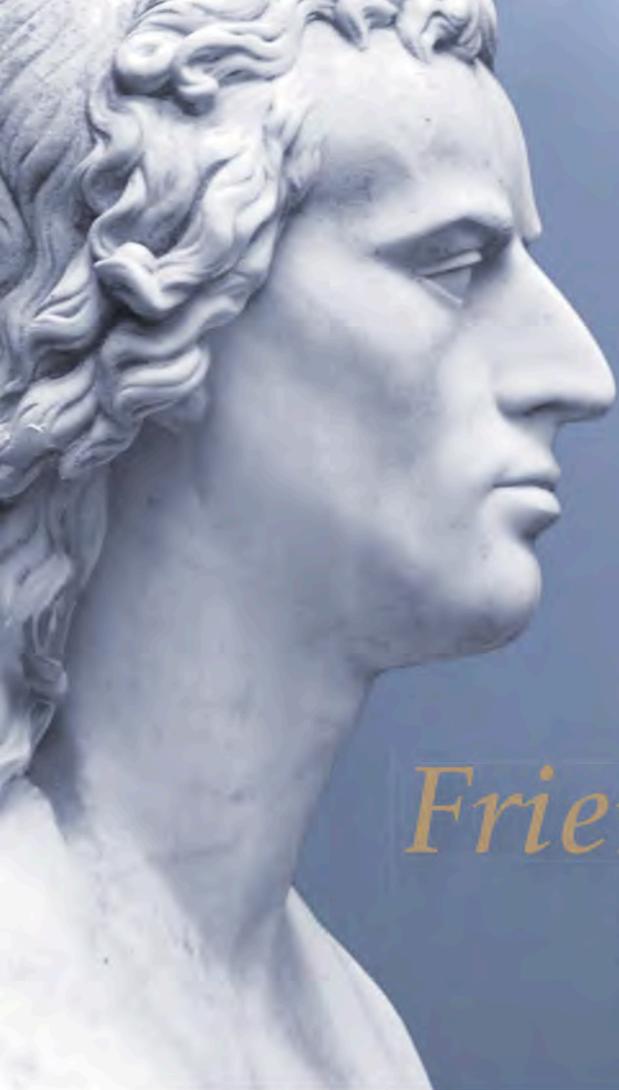


FEATURE

500 YEARS OF REFORMATION

When Martin Luther protested against the Church's sale of indulgences, he set a reform movement of epochal proportions in motion. The traces of it are visible to this day in Jena and Thuringia.





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Prof. Dr. Walter Rosenthal
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Visible, Sustainable and Globally Connected

2017 is a significant year for the Friedrich Schiller University Jena (FSU). It is exactly 500 years since the Reformation was set in motion in Wittenberg: a major European event that resulted in immense upheavals in many walks of life – and to which our university owes its foundation.

This issue of our research magazine LICHTGEDANKEN is therefore dedicated to the subject of the Reformation. It offers insights into the diverse research on Martin Luther and the Reformation conducted by FSU scientists in the last decade and in collaboration with numerous partners in Thuringia. The results of their research are available to the broad public – in publications and on the Internet (see p. 10 ff.).

However, 2017 is also the year in which the FSU, like many other universities in Germany, is again competing for funding as part of the »Excellence Strategy« pursued by the Federal and State governments. Success in the Excellence Strategy is an important step towards permanently sustaining the level hitherto attained in research and teaching. The FSU is participating in the Excellence Strategy with three proposals for research clusters (p. 8 – 9). One draft proposal with the title »Balance of the Microverse« builds on the successful graduate school »Jena School for Microbial Communication« and has been submitted by the FSU and its Jena partners. The second draft proposal, »Enlightening the Receptome: From Biophysics to Clinical

Applications«, originated in collaboration with the University of Würzburg. The planned cluster pools the special expertise on receptor research established at both universities. The third draft proposal, entitled »Dialectics of the Global«, was jointly submitted by the well-established university alliance of Halle – Jena – Leipzig. Collaborating across Federal States, the three universities have joined forces with further partners to conduct research on the processes of globalization. I would like to thank all scientists involved for their great commitment in preparing and completing the draft proposals.

Excellent research at the University of Jena is, however, not limited to the cluster proposals submitted. Scientists are working at the highest level in many – also small – areas, and connect with research partners all around the world. In this issue of LICHTGEDANKEN, we present some of the researchers with their latest research topics. I wish you a stimulating read. We will be happy to receive your suggestions or criticisms on the current issue. You can reach the editorial team by email at: presse@uni-jena.de

Jena, May 2017

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Scarcely anyone at the FSU has studied the events surrounding the Reformation as intensively in the last few years as the former Rector Klaus Dicke. A portrait.

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The Wartburg Festival was held 200 years ago. The signal for political awakening is one of the most multifaceted events in German history. But the event would never have taken place without Jena's students.



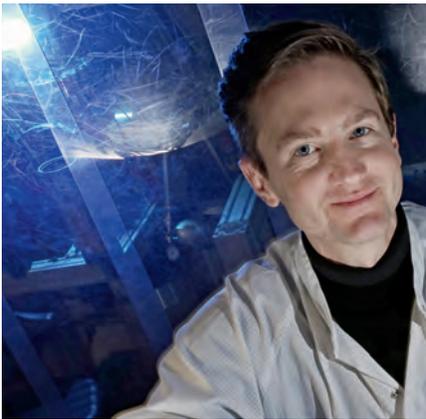
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To be found today in the museum: symbols of the political organisations of the East German State.

Comparing dictatorships

New Post Graduate Research Training Group examines European dictatorships after 1945

What social basis do dictatorships have? How do societies function under the conditions of a dictatorship? What modifications must people make, and in what way do they at the same time exploit the dictatorship for their own aims and interests? Questions such as these are being pursued in a new Post Graduate Research Training Group. The title of the

new training group, »The GDR and the European dictatorships after 1945« highlights its focus: »We want to direct the focus onto East and West Europe,« says PD Dr Jörg Ganze-müller who will run the group's business. Not only the reg-imes in the Soviet power block but also dictatorships similar to those in Spain, Portugal and Greece are to be compared. Twelve doctoral students will conduct the research in the Post Graduate Research Training Group. Ten posts will be funded through Thuringia's Ministry for Economic Affairs, Science and Digital Society, and the Ettersberg Foundation will sponsor two scholarships. A total of €1.5 million will be available to the Training Group. The Post Graduate Research Training Group took up its work in March; it has been set up initially for three years. sl

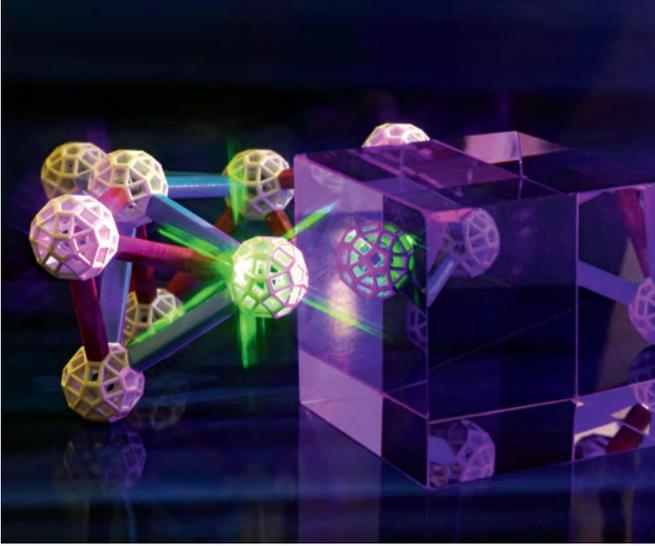
Healthy ageing

As part of the Pro Excellence Initiative, the Free State of Thuringia is funding a group of junior scientists with €3.9 million

When people get older, the outward effects are visible to everyone. Over the course of time, the first wrinkles are joined by grey or thinning hair, overall fitness declines and they struggle with age-related illnesses. The reasons for these changes lie primarily within the body. What happens in human cells during the ageing process is of great interest not only to scientists but also to the Thuringian Ministry for Economic Affairs, Science and Digital Society. The ministry is providing €3.9 million as part of the Pro Excellence Initiative in order to drive research into cellular ageing in three core subject areas until 2020. The research project carries the name »RegenerAging«. As part of this project, the group of junior scientists, »Epigenetics of Ageing«, headed by Dr Holger Bierhoff (photo), took up its work at the start of the year with initial funding for five years. »Epigenetics looks at the packaging of our genome and how as a result certain genome strands are activated or shut down. These mechanisms change with



age and can contribute to signs of ageing and age-related illnesses at a molecular level,« explains Holger Bierhoff. The 40 year-old would like to find out with his team how non-coding RNA molecules help to turn the gene switches for cell growth and cell passivity on and off, and the role they play in keeping retroviral DNA elements at bay. jd



Special glass block with special optical characteristics and a grid model on which the glass chemists with Prof. Wondraczek are conducting research.

Functional glass

The Friedrich Schiller University (FSU) is supporting Slovakian partners in Trenčín in setting up a European research centre for high-performance glass

»Centre for Functional and Surface-Functionalized Glasses«, or »FunGlass«, is the name given to a project worth €25 million which is to establish a centre of excellence in Trenčín in Slovakia to research new glass materials. Scientists at the FSU are playing a central role in setting up this centre. FunGlass is supported by the European Commission as part of its »Widening Participation« Initiative (TEAMING, Horizon 2020) with €15 million. The Slovakian government is providing a further €10 million.

With this funding measure, the EU is aiming to set up powerful research centres in member states with a weak scientific and technological base. Throughout the process, these countries are to be supported by excellent partners from the European centres with the strongest research activity. The FunGlass project team was able to prevail with its concept against stiff competition: A mere 10 centres across Europe are receiving funding in this pilot phase while there were applications from 169 consortia.

New functionalities enable new applications – in solar cells or medical engineering

Research is focusing on the functional characteristics of glass and its use in new applications. The new centre is primarily to conduct research into how glass characteristics change, for example, by varying its chemical composition, thereby enabling new functionalities to be created. Possible areas of application include solar power and medical engineering. Prof. Dr Lothar Wondraczek from the Chair of Glass Chemistry II – Laboratory of Glass Science is taking on the leading role in setting up the »Functional Glass« Department which, together with subjects such as Biomaterials, Material Processing and Coatings, forms one of the five departments at the centre.

AB

The value of the FSU

Independent study determines the significance of the university for the regional economy of the Free State of Thuringia

While private investors have scarcely any chance now of growing their wealth meaningfully, the State has things better. Universities generate €190 bn per year as demonstrated by the Donors' Association for the Promotion of the Sciences and Humanities in Germany in 2013. A study conducted by the consultancy company »DIW Econ« belonging to the German Institute for Economic Research in Berlin, has now proved the value the Friedrich Schiller University (FSU) has for Thuringia.

€1 becomes €2.50

Every euro of state funds invested by the Free State of Thuringia generates economic output in the region worth €2.50. This, in summary, is the result of extensive investigations. The university creates this additional economic output as an employer, trainer and investor. It is therefore an important economic factor in the region and contributes emphatically to a very good employment situation. In 2013, the FSU's direct and indirect value added effect and employment impact (excl. the hospital) totalled €274 million and 5,262 persons in employment in the Free State. Regional purchasing power also improved as a result with the result that there was greater demand for goods and services. This stimulated additional value added of €79.1 million via so-called »induced effects« which is associated with a further 1,770 persons in employment. The additional tax revenue in Thuringia alone that is due to the FSU, comes to a total of €46.5 million.

Central role in the innovation system

The important role of the FSU in the Free State, however, goes beyond the direct effects which are relatively easy to quantify in monetary terms. The FSU produces innovations and technological progress and – with its smart minds from all over the world – plays a central role in the innovation system in the Jena region. Here, it represents the internationally visible anchor point, the effect of which is to inspire the numerous non-university research institutes and companies and to promote spin-offs of innovative companies thanks to numerous patent applications. However, as the authors of the study underline, the effects of research and teaching activity at the University of Jena as part of the regional system of innovation, can only be quantified approximately.

AB



Petri dishes with fungal cultures. The »Jena School for Microbial Communication« (JSMC) has received funding in the Excellence Initiative since 2007.

Research clusters in the excellence competition

The FSU is entering three draft projects for research clusters in the current competition organized by the Excellence Strategy of the Federal and State governments. The draft proposals were submitted at the beginning of April. A decision will be reached by the autumn on which proposals may be developed to form full-blown applications. In the previous phase of the Excellence Initiative, the FSU received funding for its Graduate School for Microbial Communication (JSMC) – as the only project in Thuringia to qualify.

BY UTE SCHÖNFELDER

The universe of the tiniest

One application from the FSU builds on the Jena Excellence Graduate School for Microbial Communication which has been in existence since 2007, and it addresses scientific but at the same time socially pressing questions.

The tiniest organisms determine the biggest questions facing humanity. Whether it's a matter of combating dangerous infectious diseases, keeping the environment healthy, sustainable agriculture or a stable climate, microorganisms – bacteria, fungi or viruses – play a crucial role in all areas. The key to answering these questions lies in exact knowledge of the way in

which microorganisms cohabit and the interaction of microbes and their host organisms. These are the subjects being addressed by the consortium for the cluster application »Balance of the Microverse« in which numerous non-university research institutes in Jena are participating under the leadership of the FSU: the Leibniz Institute for Natural Product Research and Infection Biology – Hans Knöll Institute (HKI) –, the Fraunhofer Institute for Applied Optics and Precision Engineering, the Leibniz Institute of Photonic Technology, the Max Planck Institutes for Chemical Ecology, for Biogeochemistry and for the Science of Human History, the Helmholtz Institute Jena as well as the new DLR Institute for Data Science.

»Together with our partners, we are outstandingly well positioned to tackle these subjects comprehensively,« emphasizes the spokesperson for the consortium, Prof. Dr Axel Brakhage (photo), pointing out that the FSU has already proved its expertise in these matters by acquiring three collaborative research centres (Sonderforschungsbereich – SFB). »These SFBs have only recently arisen from the Excellence Graduate School which is testament to the incredible pace of research which we have developed here in Jena in the field of microbial communication,« says Brakhage. The holder of the Chair for Microbiology and Molecular Biology and Scientific Director of the HKI sees the application in the Strategy for Excellence programme in itself as a success: »Regardless of any possible funding, we have positioned ourselves clearly for the coming years in scientific terms.«



Molecular switchboards

The aim of the research alliance of the universities in Jena and Würzburg is to systematically decipher the »receptome«, the total of all receptor molecules in an organism, and exploit it for the treatment of diseases.

Receptors are »molecular switches«. They consist of protein and their job is to control metabolic processes within and between the cells of an organism. This occurs through interaction with other molecules. Receptors are therefore mainly to be found like tiny antennae on cell surfaces where they interact with the right neurotransmitters. The »receptome« – the sum of all receptor molecules of an organism – makes up more than five percent of its protein.

Due to their function, receptors are ideally suited as targets for a variety of therapeutic applications. The aim of the proposed research cluster »Enlightening the Receptome: From Biophysics to Clinical Applications« is to decipher the receptome in all its diversity and exploit it for the treatment of diseases. The cluster application has been submitted by the universities of Würzburg and Jena and their hospitals. Jena research groups from the Leibniz Institute on Aging – the Fritz Lipmann Institute (FLI) – and the Max Planck Institute for Chemical



Ecology (MPICE) are also involved. Prof. Dr Markus Sauer (University of Würzburg), Prof. Dr Klaus Benndorf (Photo, r.) and Prof. Dr Christian Hübner (l.), both from the Jena university hospital, are acting as spokespersons.

With the research cluster, the scientists want to further expand their successful collaboration from the collaborative research centre, »Receptor Light: High-end light microscopy elucidates membrane receptor function«. »In the last few years, both of our facilities have already established themselves as internationally recognized centres for high-resolution light microscopy,« Prof. Benndorf emphasizes.

Basic research is to be extended on this basis even to the stage of developing approaches for clinical applications. »Achieving a better understanding of how receptors work, will lead to new diagnostic and therapeutic methods, for example for tracing and combating tumour cells,« states Prof. Hübner with conviction.

Levels of the global community

Together with the University of Erfurt and further partners, the university alliance of Halle – Jena – Leipzig is submitting an application for a research cluster that analyzes the advancing intermeshing of cultures in the globalization process.

The research cluster applied for by the name of »Dialectics of the Global« is based on a paradox. While more and more people are included in the process of globalization, scepticism towards the globalized world is growing. »Technical progress is leading to an ever closer intermeshing and intertwining of cultures,« says Prof. Dr Stefan Matuschek (photo). »As a result, individual, culture-specific norms are more and more flagrantly confronted with other, external norms culminating in the juxtaposition and opposition of different concepts of the world and world order that we want to examine in the cluster,« states the literary scholar who acts as a spokesperson for the FSU.

The scientists want to explore the different cultural, legal, political and social levels of the global community. They will pool their expertise in European, American, East Asian, oriental and African cultures and languages to obtain a global



cultural perspective. Besides the universities in Jena, Halle, Leipzig and Erfurt, the Max Planck Institute for Social Anthropology (Halle), the Leibniz Institutes for Regional Geography and the History and Culture of Eastern Europe in Leipzig as well as the Simon Dubnow Institute at the University of Leipzig are also participating. Further spokespersons are Prof. Dr Matthias Middell (Leipzig) and Prof. Dr Yvonne Kleinmann (Halle). The consortium is building on the already existing »Forum for the Study of the Global Condition« organized by the university alliance of Halle – Jena – Leipzig. »The Strategy of Excellence is an additional catalyst for this process,« says Matuschek.

University founder Johann Friedrich I. in Jena's market-place. The Ernestinian was a staunch supporter of Luther's Reformation. Luther preached a sermon in the Church of St. Michael's, seen here in the background, in 1524. This is where the reformer's original gravestone is to be found.



FEATURE

Time of upheaval – 500 years of Reformation

On Luther's trail in Jena and Thuringia

When Martin Luther protested against the Church's sale of indulgences with his 95 Wittenberg Theses 500 years ago, he set a reform movement of epochal proportions in motion. The Reformation not only affected the Church and religion but also changed the whole of Europe. Significant sites of where Luther lived and worked are located in Thuringia, and numerous sources and documents in Thuringia's archives and libraries testify to this day to the far-reaching upheavals in culture, education, society and politics. Research on Luther and the Reformation enjoys a long tradition at the University of Jena, the founding of which was also a direct consequence of the Reformation, and it is highly regarded in international circles. »



Time of upheaval – time of awakening

Without Luther, no »Hohe Schule«, without the Reformation, no University of Jena. One can only speculate as to what would have become of this little town of farmers and winegrowers without its university. One thing is clear, namely that without the great upheavals of the Reformation which found committed supporters in the dynasty of the Ernestines, the town would look very different today. How the Reformation came to Jena, how ideas and dogmas spread, but also how testimonies and cultural assets from the time of the Reformation can be preserved and used for scientific purposes in the future – these are topics of current research at the FSU.

BY UTE SCHÖNFELDER

Photo above: View onto the interior courtyard of Collegium Jenense. The »Hohe Schule« was founded by the Elector Johann Friedrich I. in the former Dominican monastery in 1548, and ten years later it was declared a university.

Did he or didn't he? Martin Luther published his famous 95 Theses in Wittenberg on 31 October 1517 in which he denounced the Church's abuse of selling indulgences and which became the starting-point of the Reformation.

Whether – as is frequently maintained – he nailed his Theses to the door of Wittenberg's Schlosskirche or not, is still a matter of debate in academia. However, the trail left by Luther and other reformers throughout Europe is beyond doubt. Luther himself and

many of his pioneering ideas and deeds are rooted in Thuringia: he studied in Erfurt and joined the local Augustinian monastery, and he translated the Bible in Wartburg Castle near Eisenach.

And Luther was also a guest in Jena. He resided in the town several times between 1522 and 1537. He preached at the Church of St. Michael's and debated with the reformer and his former doctoral supervisor, Andreas Bodenstein, known as Karlstadt.

Martin Luther's gravestone in the Church of St. Michael's. Commissioned by Johann Friedrich I. after Luther's death, the bronze epitaph was intended for Luther's grave in Wittenberg's Schlosskirche, but it never arrived. Since 1871, the stone has been in the ownership of the university.

It was above all the consequences of the Reformation that were dramatic for the town and its development to this day. After Luther's death in 1546, Emperor Charles V waged war against the »Schmalkaldic League«, an alliance of local Protestant rulers, in order to push back against the Reformation and Protestantism in the country. Besides the Hessian Landgrave Philipp, Johann Friedrich I. from Saxony, was also at the head of the Schmalkaldic League.

In 1547, the alliance had to acknowledge defeat against the imperial troops, while Johann Friedrich I. – today affectionately known as Hanfried by the people of Jena – was taken prisoner and lost large parts of his lands. He also had to relinquish Wittenberg and his university. In 1548, the staunch supporter of the Lutheran Reformation therefore set up the »Hohe Schule« in his remaining dominions, or in the former Dominican monastery in Jena, to be more precise. Ten years later, it was raised to the status of a university. »The foundation of the university is probably the most visible consequence of the Reformation for Jena to this day,« Prof. Dr Christopher Spehr emphasizes. The Professor of Church History is the authorized representative of the FSU's Executive Committee for the anniversary of the Reformation (interview p. 20). »The University of Jena was intended to be the 'better Wittenberg' from the outset.«

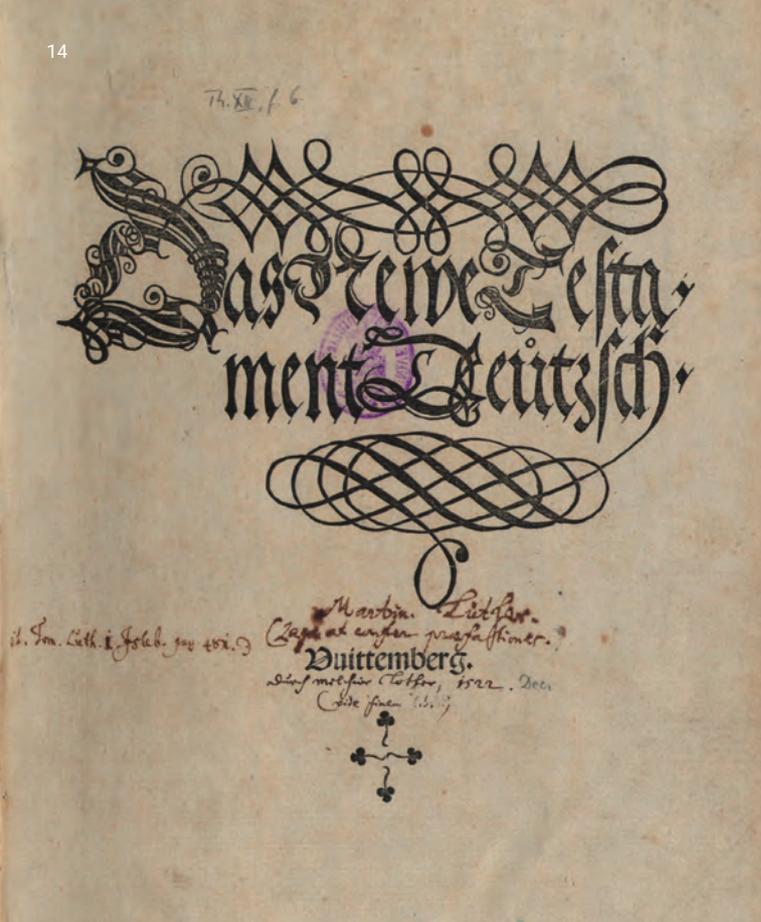
The royal house of the Ernestines to which Johann Friedrich I. belonged, supported the ideas of the Reformation and flew the flag for the Lutheran faith. The Ernestines had their archive of manuscripts and prints transported from Wittenberg to Weimar; the royal library – the Bibliotheca Electoralis – came to Jena and today it forms part

of the Thuringian State and University Library (ThULB). They include Luther's personal copies of the Old and New Testaments with hand-written annotations. Further collections of Protestant manuscripts and cultural assets were added in the course of the centuries; to preserve Luther's legacy, the Ernestine Dukes – in competition with the Wittenbergs – had a Jena edition of all Luther's writings published. A printing works was established in 1554 on the premises of Jena's Carmelite monastery on what is today Engelplatz. The first edition of the »Jena Luther Edition« was published there from 1555 to 1558.

Scientific networks established – contemporary witnesses made public

All this today forms the basis for numerous research projects which in the course of the past Luther decade have produced insights under the leadership of the FSU, contributed to the scientific debate on the Reformation with symposia, publications and ideas as well as establishing an active network between research facilities, archives and libraries. Above all, however, research into the Reformation in Jena has paved the way for making the unique documents from Luther's time available to a wider public and preserving them for scientific research for posterity: They are available for viewing by anybody in the »Digital Reformation Archive« (p. 16), and scientists at the FSU were also instrumental in designing the exhibition »Luther and the Germans« (p. 14) which can be seen in Wartburg Castle until November. These, and further research projects and their results are presented on the following pages.





Luther's September New Testament dated 1522 from the Thuringian State and University Library is displayed in the exhibition.



The Rector's chain of office from 1858 (above) and the seal of the university from the time of its foundation with an image of the Elector Johann Friedrich I. are also to be seen in Wartburg Castle.

Luther and the Germans

The special national exhibition »Luther and the Germans«, which can be seen in Wartburg Castle in Eisenach until 5 November, reflects the relationship of the Germans with the famous reformer over the course of 500 years. The University of Jena is providing the curators of the exhibition not only with objects but also its formidable scientific expertise.

BY JULIANE DÖLITZSCH

Luther is not just Luther – the image of the great reformer has instead been subject to regular revision in the last five centuries, changing from a prophet all the way to a separatist. The reasons for this fickle relationship are illuminated by the special national exhibition »Luther and the Germans« on view in Wartburg Castle. No fewer than four scientists from the FSU form part of the unit of scientific advisors for the exhibition. The historian of the Early Modern, Prof. Dr Georg Schmidt, the historian of the Reformation and Head of the University Archives Extraordinary Prof. Dr Joachim Bauer, the theologian Prof. Dr Christopher Spehr and the Germanist Prof. Dr Jens Haustein lent their support with insights into their particular fields during the preparations lasting several years. The exhibition is divided into three sections, dealing with Luther's time in Wartburg Castle, his services to religious, personal and family freedom and the German language as well as

the political instrumentalization of the reformer. The Thuringian State and University Library is contributing eleven prints to the exhibition, among them Luther's September New Testament from 1522 of which there are only a few original copies in existence. The University of Jena is principally donating pieces from the time of its foundation in the middle of the 16th century, e.g. the University seal and the seal of the Theological Faculty. A few further objects, such as the Rector's chain of office, date back to the 19th century when Luther was increasingly stylized as a »national German hero«. »The image of a hammer-wielding Martin Luther is a clear expression of this trend,« Joachim Bauer explains. »He was already venerated in the 16th century, and the 17th century saw his sacralisation with depictions of him with a halo, for example, or as an angel with an everlasting gospel to preach,« adds Christopher Spehr.

The Germans and their view of the world

The exhibition shows not only all facets of Martin Luther: »For the Germans, it was not necessarily a question of Luther's perspective but of fitting him into their current world view,« Bauer explains. It is of course true that Luther expressed ambivalent opinions on the Jews. But during the Third Reich, his highly negatively formulated judgments were very deliberately picked up for propaganda purposes in support of NS ideology, Spehr explains. And in this sense, the exhibition is not only a show about Luther but also quite literally about the Germans. Ultimately, they themselves and their history are reflected in Luther.



Flyer based on a template from the Cranach workshop: Martin Luther, coloured woodcut with text in type, Magdeburg 1546, Foundation Schloss Friedenstein Gotha



Flyer by Michael Ribestein: Elector Johann Friedrich I., Duke of Saxony, coloured woodcut with text in type, Berlin 1547, Foundation Schloss Friedenstein Gotha

Flying paper

They were the means of mass communication at the time of the Reformation. In the same way as photos, opinions and news are disseminated today via tweets and posts, people in the 16th century used the recently invented techniques of printing to distribute information in illustrated leaflets. The reformers also exploited this development to spread their ideas and dogmas.

BY UTE SCHÖNFELDER

The collection of one-page prints among the copperplate engravings of the Foundation Schloss Friedenstein Gotha is one of the most comprehensive of its kind. But the roughly 700 flyers illustrated with woodcuts from the 15th and 16th century slumbered unnoticed for decades. The unique collection that had grown over time had only been partially scientifically recorded and published, and scarcely anyone had a complete overview of the collection which mostly dates back to the Saxon Ernestinian electors.

But that is in the past: The »Project Group for the History of the Reformation«, formed in 2012 under the aegis of the University of Jena, has now conducted a comprehensive review of the entire collection which is to be found in a recently published catalogue (ISBN 978-3-89790-413-2).

The joint project work in which the university and research library of Erfurt/Gotha also participated besides the Univer-

sity of Jena and the Gotha Foundation, consisted in preserving the flyers, processing their content and fully digitizing them for the first time. »This has fulfilled a long-held desideratum of our research work,« explains the head of the project, Christopher Spehr. Now – 500 years after the start of the Reformation – the flyers offer a vivid illustration of Reformation times not just to scientists but also to any interested audience, according to Jena’s Church historian (interview p. 20).

After all: »The Reformation was a media event,« says Prof. Spehr. With the spread of book printing in the 15th and 16th centuries, print products of all kinds became increasingly important for communication processes. »The flyers, in particular, were an easily affordable alternative to books and they were especially successful in spreading.«

Renowned artists, among them Lucas Cranach the Elder and the Younger or Albrecht Dürer, produced the woodcuts for the single leaf prints.

The pages that were approx. 40 by 30 centimetres in size focus on the events of the time. »We find numerous portraits of secular and religious representatives, among them images of the reformers Luther and Melanchthon, but also Charles V or the founder of Jena’s university,« reports Ulrike Eydinger, a project staff member from the Schloss Friedenstein Foundation. We also find subjects from everyday life, political reports – for example on military conflicts – all the way to natural phenomena and sensationalist gossip.

»However, a very substantial part of Gotha’s collection of flyers is devoted to matters of religious denomination,« Eydinger states. She explains that polemical disputes with the Catholic faith and Reformation teachings were frequently the topic of such illustrated texts.



With this document, members of the Schmalkaldic League seal the extension of their contract to defend all attacks in matters of faith in 1536. The alliance of Protestant princes and towns founded in 1531 under the leadership of Elector Johann Friedrich I., had to acknowledge defeat, however, against the troops of Emperor Charles V. The document is in the possession of Thuringia's State Archive – Central State Archive of Weimar – and can be found as one of around 750 documents in the »Digital Archive of the Reformation«: www.reformationsportal.de.

Digital Archive

Pope Leo X threatened to excommunicate Martin Luther in 1520 if he did not recant his views within 60 days. Luther rejected this demand as we know today from the history books. But what form did such a threat of punishment – the so-called bull of excommunication – actually take? What form did indulgences take and what was Martin Luther's handwriting like? Scientists and amateur historians can find answers to these questions in the »Digital Archive of the Reformation« (www.reformationsportal.de).

BY UTE SCHÖNFELDER

The »Digital Archive of the Reformation (DigiRef)« on the Internet comprises around 750 written records from the time of the Reformation – from the bull of excommunication against Luther, via personal correspondence from the reformers all the way to the protocols of the inspectors who registered the situation in church communities in the country on behalf of local rulers. Planned in 2012 and implemented from 2013, the digitization of the State archives from Thuringia, Saxony-Anhalt and Hesse has been a joint project. Besides the State Archive of

Thuringia – Central State Archive of Weimar, the Thuringian State and University Library (ThULB) is also part of the project consortium and is primarily responsible for the technical implementation of the online portal. The ThULB also uses the multimedia platform UrMEL (Universal Multimedia Electronic Library) to link the Reformation portal to further Reformation-specific sources such as the collection of Luther's private secretary Georg Rörer.

The Reformation portal that is aimed equally at historians, theologians and the general public is divided into two areas. Contemporary witnesses of the events of the Reformation are presented in the exhibition module – the »showcase«. »All documents can be viewed as high-resolution images and the original texts have been transcribed and changed to modern German,« explains Dagmar Blaha, project coordinator from the Central State Archive of Weimar.

The second area of the portal contains a research module and is dedicated to the »visitation protocols« at the time of the Reformation (see also interview on p. 17). The protocols for the first visitation after the launch of the Reformation are documented for each territory inspected in the core States of Central Germany. 118 archive records from Central German territories have been selected for this purpose. This database allows a targeted search to be conducted for places and people. Members of the public interested in history, for example, can find out when the Reformation began in their own town and what kind of reaction it provoked.

A visit from the defenders of the faith

The Reformation was a time of unprecedented upheaval for people at the end of the middle ages: entrenched certainties began to topple, and the old order, cemented over the course of centuries, crumbled. Monasteries were refused their dues, and the authority of the clergy evaporated in many places. In this situation – exacerbated still further by the peasants' war of 1525 – the Elector Johann of Saxony (1468 – 1532) felt compelled to take the initiative. He despatched inspectors to towns and villages to ask the priests about their teachings and their circumstances. An interview with church historian Prof. Dr Christopher Spehr and head of the University archives, adjunct professor Dr Joachim Bauer.

BY STEPHAN LAUDIEN

Who were the inspectors, and what can be said about their work?

Bauer: The inspectors were mostly theologians and officials who were instructed by the Elector to review the situation on the ground. Probably the best-known »visitor« was Philipp Melanchthon.

Spehr: The Latin term »visitator« was used for visits by the bishop to his diocese in the Early Medieval Church. This duty of the bishops was transferred to the local ruler in the wake of the Reformation

What happened on these visits and how do we know about them today?

Bauer: The inspectors arrived in the towns and called the priests there together. »The Inspectors' Instructions« served as a guide and was de facto a Reformation manual. This book first appeared in 1528 in a print run of over 700 copies, and later it served in further regions to enforce the Reformation. The archives contain numerous visitation protocols which constitute valuable sources for us. We know, for example, that the first major inspection took place in 1527. The parishes in the Saale-Orla region were visited, beginning in Weida and continuing to Auma and Ziegenrück.

So the priests were accountable to the inspectors?

Spehr: The inspection was accompanied by a kind of inventory. The priests had to open their books and declare their

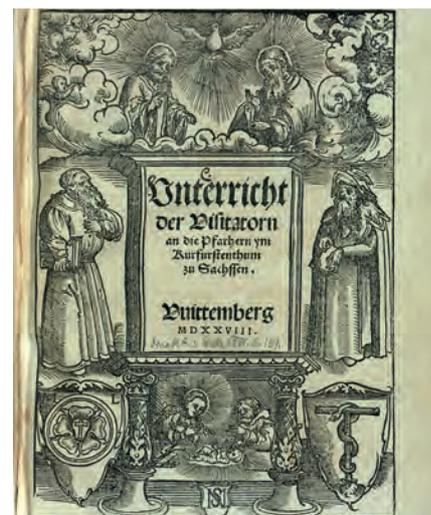
revenues and outlays. The central question, however, was that of their faith. What were the priests and preachers teaching their congregations? Were they clinging to the old faith, or had they become Protestants?

Did the priest lose his position if he refused to follow the new teaching?

Spehr: There were further inspections in the Electorate of Saxony after the 1530s. The reviews focused more closely on the extent to which the new teaching was being followed and whether the priests were financially provided for. If a priest refused to follow the orders of the local ruler, he might lose his position. But the Reformation did not make an immediate break with the old Church. Instead, the first few years saw wide-ranging transitions and compromises, and we can therefore assume that this was a phase of transformation. The most permanent impetus for establishing the Protestant Church in the Electorate of Saxony emanated from Martin Luther and his colleagues. Ultimately, the clergy was obliged to follow this teaching from Wittenberg.

What about ordinary people? Were the subjects forced to recognize the new teaching?

Spehr: In most cases, people adopted the new teaching as they were now able to understand much more than before. Services, for example, were now held in German. The liturgy and the sermon



Front cover of the »Inspectors' Instructions to the Priests in the Electorate of Saxony« by Philipp Melanchthon (1528).

could be understood and the hymns were catchy. Anyone who did not want to embrace the new faith could secretly stick to the old one or officially leave the area. Nevertheless, there was a lengthy transitional period during which the papal customs were still tolerated.

So the Reformation prevailed peacefully?

Bauer: By and large, yes. But there were some legal disputes. For example, the legal fight conducted by Jena's Dominican friars to keep their monastery continued well into the 16th century. They did not leave it voluntarily...

The Collegium Jenense

Bauer: Exactly. In the wake of the Reformation, Thuringia's monasteries were valued from 1526 and their finances and remaining occupants registered. Anyone wanting to leave the monastery could lead a civil life in the laity. The buildings vacated by Jena's Dominican monastery later housed the newly established »Hohe Schule«.

Two books have also been published on this subject: *Joachim Bauer, Stefan Michel (pub.): Der »Unterricht der Visitatoren« und die Durchsetzung der Reformation in Kursachsen (ISBN 978-3-374-04755-0) as well as Dagmar Blaha, Christopher Spehr (pub.): Reformation vor Ort. Zum Quellenwert von Visitationsprotokollen (ISBN 978-3-374-04162-6).*



Thuringia in the century of the Reformation

The Reformation is inseparably linked to the name of Martin Luther. But the focus on Luther blurs our vision of other reformers, as well as the process of the Reformation which began before Luther's appearance and extended far beyond him. »Outside Germany, people normally talk of the age of reforms rather than the Reformation«, says Dr Alexander Krünes. The historian is coordinating the research project »Thuringia in the Century of the Reformation« which will run to the end of 2017.

BY STEPHAN LAUDIEN

The project was initiated by Prof. Dr Werner Greiling as Chairperson of the Historical Commission for Thuringia and Professor of Modern History in Jena as well as Prof. Dr Uwe Schirmer who teaches Thuringian Regional History. Five research projects which junior scientists have been entrusted with form the centrepiece. Their focus is on the school system, poverty and means of combating it, the Elector Johann of Saxony, the Reformation in the country and universities in the age of the Reformation.

»We are researching the social history of the late 15th and early 16th century,« says Uwe Schirmer. In concrete terms, this means the far-reaching political, social, cultural and religious upheavals

triggered by the Protestant movement shaped by events in Wittenberg.

Core State of the Reformation

In geographical terms, the research can be confined to the Thuringian, central German area, and predominantly to Thuringia as the »core state of the Reformation«. The researchers wish to understand the far-reaching transformation processes which affected the Church and State, the judiciary and case law, towns and villages as well as schools and universities in the wake of the Reformation.

New insights are to be found in old sources. True to this principle, the five

doctoral students set out to search in archives, church registers and administrative records. Much of what was found portrays a new, more accurate image of everyday life at the time of the Reformation. »Some of the findings have never been presented and described in this fashion before,« Uwe Schirmer states. For example, Julia Mandry has discovered that building on the well-organized systems in place for the poor in pre-Reformation times, efforts were made to redesign welfare for the poor, both financially and structurally. So-called Common Boxes played a central role in this process. Revenues from the Church's possessions flowed into these municipal coffers. »The money from the Common Boxes was ulti-

Church in Thuringia. The hilltop church of St. Mary's in Schleiz (see also cover photo) dates back to the 12th century. After the launch of the Reformation, the first Protestant church service was held here on 8 June 1533. Jena historians are currently researching in minute detail how the »age of reforms« proceeded in concrete terms in Thuringia with the aid of numerous archives. The project »Thuringia in the Age of the Reformation« is receiving financial backing from the Free State of Thuringia, the Sparkassen Kulturstiftung Hessen-Thüringen and the Landesbank Hessen-Thüringen. Funding for the project that finishes at the end of 2017 is in excess of €560,000.

mately only partially used for looking after the poor,« says Mandry. As the ledgers prove, even before the Reformation, up to 3,000 needy people received free bread and money on some days in Weimar. The reasons for the high number of poor are diverse and hard to establish in detail. However, it is worth noting that attitudes towards the poor and poverty were changing. Whereas before the Reformation alms were seen as pleasing God, there was a gradual move towards something akin to a right of basic care. This was accompanied by administration for the needy and an attempt to reduce the number of freely roaming beggars. »It was part of Luther's basic world view that everyone should be able to feed themselves from the fruits of their own labour,« says Julia Mandry. Wishful thinking. Linked to this idea is the increasing stigmatization of the poor and beggars.

What was the policy pursued towards the Church by Johann of Saxony (1468 – 1532) like? Doreen von Oertzen-Becker has studied this question. She has identified the impetus provided by Johann – later Johann der Beständige – himself in the policy pursued towards the Church in the Electorate of Saxony. She notes in the process that Johann was for long unjustly in the shadow of his brother and co-regent Friedrich der Weise (1463 – 1525) in terms of public perception. She investigated how the sovereign maintained contact with personalities of the Reformation and how they influenced him and shaped his thinking. She also analyzed how religiously motivated conflicts were successfully solved.

»The Reformation was also a revolution of knowledge,« Schirmer notes. Thuringia and Central Germany were rightly to be viewed as »pioneering regions of scholarship,« he states. But the Reformation was by no means responsible for the boost in education according to Schirmer. Even in the decades before 1517, the region of Central Germany had a high density of schools. In addition,

the University of Erfurt blossomed around the year 1300. Later, when Erfurt was going through a crisis, the universities of Leipzig and Jena flourished.

»There was clearly a need for higher education,« says Andreas Dietmann who is studying Thuringia's education system in the 15th and 16th centuries. He notes a wide variety of different schools in the towns at the end of the Middle Ages: Latin parish schools, town council schools, German schools for literacy and numeracy as well as small, private independent schools. The town schools offered an education programme for villagers. This flourishing system encountered difficulties in the early stages of the Reformation as a result of anti-clerical influences, and it then collapsed. »In the years that followed, Luther made the case for school education through appeals to towns and citizens,« says Dietmann. This gave rise to a new school system, shaped by the Reformation, which in turn flourished impressively. It was closely linked to the new confession and it was adopted by church constitutions of the 16th century as part of the growing state Church. Andreas Dietmann assumes that the literacy rate in the region in the 1570s was at least 50 percent. Where did this obvious hunger for education come from? The high density of towns in Thuringia definitely played a part. The established professions in these towns demanded educated staff. Alexander Krünes also thinks it was the extremely fragmented nature of the area that led to competition in culture and education that was sustained into the 19th century.

The foundations laid at that time were to continue to have an impact for a long time to come. The fact that the ideas of the Enlightenment fell on particularly fertile ground in Thuringia, for example, can be interpreted as a direct consequence of this education offensive. Frequently it was the priests who acted as »popular educators« in imparting in-depth knowledge to the com-

mon men. Subjects such as horticulture and agriculture, medicine or cattle breeding were covered in print media (books, calendars, magazines). Later, the ordinary people experienced their own legal, morally religious, cultural and political enlightenment. »When the priests left the universities, they took with them an educational assignment, as it were, to the villages,« Alexander Krünes explains. From 1800, the character of Luther served as a role model for an enlightened citizen as the reformer had paved the way for the Enlightenment. The formula that applied ran as follows: no Enlightenment without Reformation. The way in which Luther and the Reformation were received is also the subject of research.

In his work, Martin Sladeczek refutes the theory of any special church-building style during the Reformation. Although various churches were converted after 1530, this was primarily due to the increase in the population. Only later is specifically Protestant church-building established. Its characteristics include the removal of the side altars and an altered system of images and inscriptions. »The Catholic saints disappear, classical motifs are scaled back and Protestant personalities such as Luther, Melanchthon and the local priests are portrayed as the teachers of the true faith,« Sladeczek states.

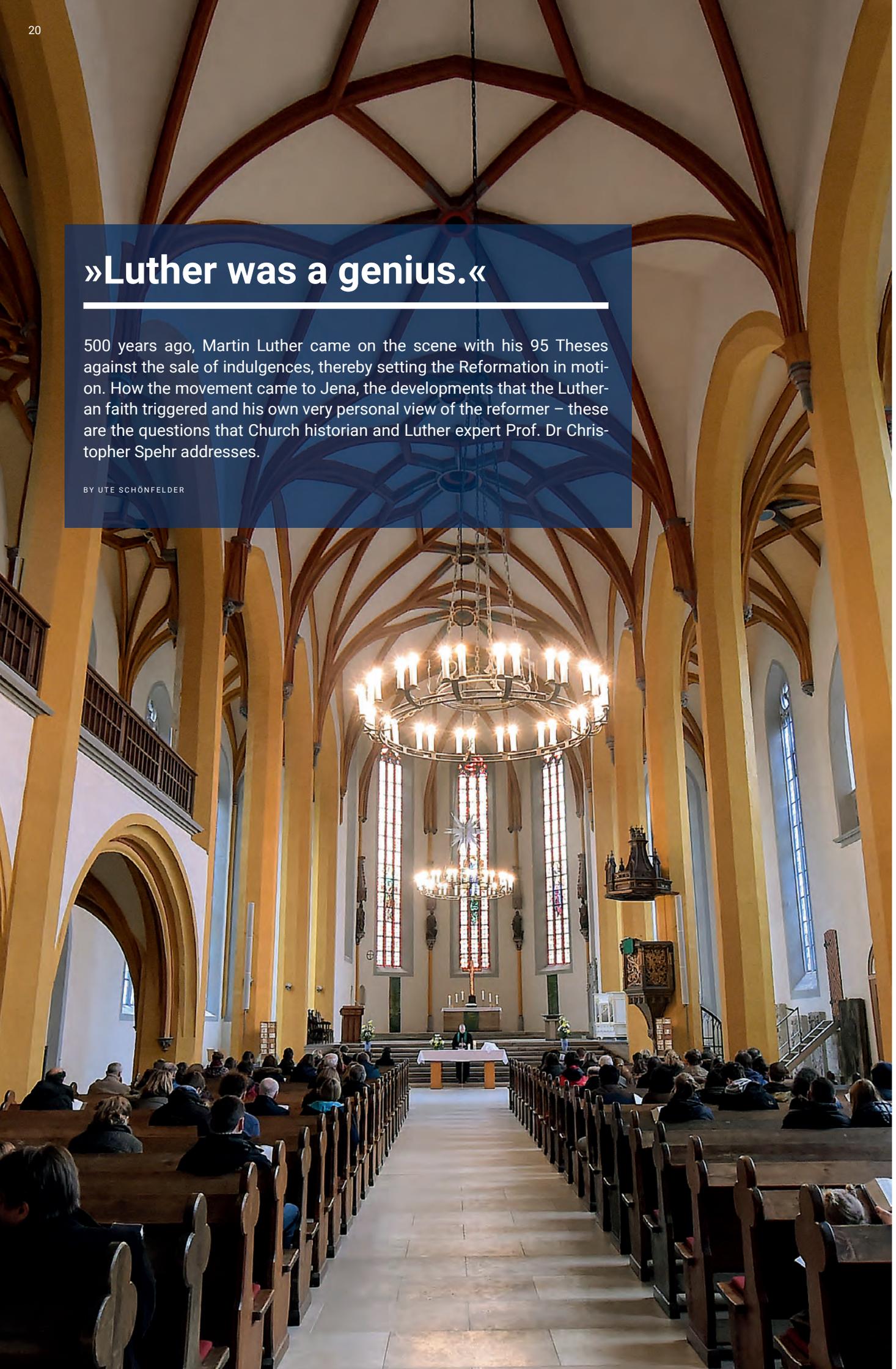
There is no way around Luther

The results of the research will be published in a separate series of publications. The historians are also on the road in Thuringia, presenting their research to the public. And the exciting thing about it is that their presentations focus on subjects of local Reformation history – coordinated to fit the particular location of the presentation. There is no way for the scientists to avoid the subject of Martin Luther. But the reformer is not the sole focus. The history of the Reformation in its »core state« is simply too varied for that.

»Luther was a genius.«

500 years ago, Martin Luther came on the scene with his 95 Theses against the sale of indulgences, thereby setting the Reformation in motion. How the movement came to Jena, the developments that the Lutheran faith triggered and his own very personal view of the reformer – these are the questions that Church historian and Luther expert Prof. Dr Christopher Spehr addresses.

BY UTE SCHÖNFELDER



We are now in the anniversary year of 2017. It is exactly 500 years since Martin Luther triggered the Reformation and with it wide-ranging and far-reaching processes of change. What was the deciding factor in your view?

Luther gave people direct access to God. Whereas in the late Middle Ages, priests acted as the intermediaries between God and the people, after Luther every individual stands directly before God. In 1522 he said the following. You are responsible for yourself in your hour of death. And nobody will be with you in this hour to carry you through death – only God can do that. With this insight, Luther was contributing to a concept of individuality that is commonplace for us today. The crucial factor for him is to proclaim the gospel that awakens the certainty of faith in a person and gives them confidence in their actions in the world.

How did that change the Church?

The doctrine of justification states that a person becomes righteous from grace alone in his belief in Jesus Christ. Although a person is a sinner, they are accepted by God, at no cost, without any deeds or accomplishments of his own. This insight has ramifications for the Church and the doctrine of the sacraments. Luther, for example, reduces the sacraments to baptism and the Lord's Supper. At the same time, Luther's realization impinges on ecclesiastical practice: the Protestant sermon, the service in German together with German hymns and the Lord's Supper in both guises – i.e. with bread and wine. The marriage of priests is introduced, the office of priesthood raised to one of preaching and ministry and the local congregation upgraded to a community of the faithful.

The most fundamental effect of this process of change is the differentiation of western Christianity. I deliberately do not talk of a schism within the Church but of differentiation into separate confessions. Besides the Roman Catholic Church, the Reformation spawned the Lutheran Evangelical as well as the Reformed Churches; the Baptists

and other groups who were thought of as dissenters in those days, must also not be forgotten.

How relevant are Luther's teachings today?

Luther certainly raises questions and concerns that stimulate and inspire us today. But I would like to state clearly that the Reformation of the 16th century is behind us! It was 500 years ago. I don't believe we can simply transpose Luther onto today's reality. The world then – and our worldly experience too – were different. We have to see Luther and the Reformation in their historical context, otherwise we cannot do them justice. From today's perspective, we have a larger horizon than Luther and his contemporaries. In Western Europe, we have experienced the Enlightenment, and have had to endure the dictatorships of the 20th century – those are experiences that have helped us to make progress intellectually. These experiences also apply to faith.

Nevertheless, there are certainly questions from the time of the Reformation that are still relevant for us today or have become so again.

If we focus on the individual, one question, for example, still relevant today is the following: What carries me through life and through death? And the answer provided by Luther and the reformers was: belief in God. And this is still valid today. But subjects such as the relationship between Church and State, formulated in Luther's so-called »two realms teaching«, are still topical. Or the commitment of the individual to their fellow human beings or society. For Luther, it went without saying to campaign against errors and injustice and denounce the sale of indulgences even if it put his own life in danger! In my opinion, it is also important for us today to raise our voices when we discover injustices.

Although Wittenberg is considered its starting point, the Reformation took place in many locations in Europe. What significance did the Reforma-

tion have for Jena and the university, and what role did Jena play for the Reformation?

Probably the most important result of the Reformation for Jena was the foundation of the university! Johann Friedrich I. founded the »Hohe Schule« in Jena from his prison cell in 1548. The »Salana« was set up because the Ernestinians had lost Wittenberg University to Moritz of Saxony after their defeat in the Schmalkaldic war, and Johann Friedrich I. needed a training centre for priests and officials. Here the »true spirit of Luther« was to be taught. One expression of this preservation of the »authentic Luther«, for example, was the Jena Luther Edition which competed with the Wittenberg Edition. Jena and especially the Church of St. Michael's evolved to become a place of memorial for the Reformation and at the same time a place where the Protestant theology and Lutheranism were nurtured and taught.

Luther himself only stayed in Jena a few times. Which people carried the Reformation in Jena in that case?

Jena was already open to new ideas in the early phase of the Reformation. Thomas Müntzer, for example, established contacts here in 1521. He conducted correspondence with Jena's councillors and town judge Michael Klausbeck. Müntzer even tried to win a position as a preacher in Jena but did not succeed. The most important Jena reformer until 1524 was Martin Reinhart who worked here from the autumn of 1521 or spring 1522. Reinhart who studied in Wittenberg with Karlstadt, developed independent teachings and emancipated himself from Luther. In 1523, Karlstadt moved to Orlamünde and reinforced the early reformational movement in Central Saale. Overall, Jena and its surroundings acted like a kind of laboratory for the Reformation in which many things were tested. In terms of substance, Reinhart and Karlstadt encouraged the priesthood for all believers and emphasized the independence of the parish to a greater degree than Luther. In 1524, Luther made a tour of inspection to Jena on the advice of the local ruler and criticized



Church historian Prof. Dr Christopher Spehr is the authorized representative of the Executive Committee of the FSU for the anniversary of the Reformation, and has just co-published the brochure »Sites of the Reformation – Jena« which illuminates the local traces and sites of the Reformation as well as the history of its impact (ISBN 978-3-374-04415-3). We agreed to meet in Jena's Church of St. Michael's for the photo shoot – »the most important location for the Reformation in Jena«, as he says (see also photo on p. 20).

these experiments. Reinhart and Karlstadt were banished from Saxony. Anton Musa was appointed to Jena in 1524 as a pastor and later superintendent. He kept the Reformation on an orderly, Lutheran track.

Where can the traces of the Reformation be seen in Jena today?

The most important site is the Church of St. Michael's with the pulpit from which Luther preached and the original gravestone. The second site is that of the »Schwarze Bär«, the inn where Luther argued with Karlstadt – in those days situated outside the gates of the town. Of central importance – for the university – is the Collegium Jenense, the former Dominican monastery in which Johann Friedrich I. had the »Hohe Schule« established. The town hall is also a site of the Reformation, as is the Carmelite monastery in which the Jena Luther Edition was printed and the remains of which can now be accessed again.

The Jena Luther Edition is currently on show in an exhibition of the ThULB. Also being presented is an edition of the New Testament from 1540, on the last page of which Luther's close associate Georg Rörer has left a handwritten note intended to document the nailing of the Theses in 1517. How do you think the publication of Luther's Theses actually happened? Did he really »nail« them to the door?

What is documented is that Luther sent a letter to Archbishop Albrecht of Brandenburg the day before the Feast of All Saints – namely on 31 October 1517 – in

which he challenged him to a public disputation on the sale of indulgences. He had his theses for this disputation printed in the form of a poster and we can assume that he also had them proclaimed in Wittenberg. But of course, he never had a hammer in his hand for this purpose! He had them attached to church doors by the beadle, the attendant from the university. This was usual practice in those days. The poster was not attached with nails, however, but with glue – the church doors would have never survived otherwise. But there are no eyewitness reports for the attachment of the Theses. Nevertheless, there are some clues, among them Georg Rörer's note although he was not present on 31 October 1517. The contemporary witness Melanchthon also reports that the Theses were attached to the door.

What do you personally think of Luther? Is he a hero in your eyes?

Luther was a genius. I regard the term hero as inappropriate, as it allows no differentiation. For all the sympathy one may have for Luther and admiration for his amazing talents, there are aspects of him which I find alienating and difficult to accept. For example, the oppressive, anti-Semitic polemics in his late writings on the Jews. Nevertheless, it is beyond doubt that he was a religious teacher who provided the Christian faith with significant impetus such as his translation of the Bible, his repertoire of hymns, the Small Catechism, the subject of freedom, etc. But he – doubtless like all great intellectuals – was a man with ambiguities and not just a shining light.

Is enough attention paid to this »dark« side of Luther – especially on the 500th anniversary of the Reformation?

Yes, undoubtedly. The subject of his writings on the Jews occupies the minds not only of historians and theologians but is also one of the main topics of the anniversary of the Reformation. It has by no means been swept under the carpet as has been suggested by some journalists. The subject is discussed not just in colour supplements but also critically debated in position papers by the Evangelical Church in Germany and the Evangelical Church in Central Germany.

What reforms would Luther advocate today, in your opinion?

He would have a serious heart-to-heart with the Church. He would ask: Where are you with the core message of Christianity? What are your concerns regarding faith and the people? What are you undertaking to pass on the relevance of the faith that supports us in life and death, to the next generation? Don't argue about trivialities! Develop visions for a living Church with a future!

To put it succinctly: He would initiate a reform of the Church. For him it would be about the truth, and so I think he would warn us to focus more on enquiring after the truth. And he also would not tire of preaching that faith and love belong together at an elemental level. If we took that to heart, many aspects of our society and environment could be designed to be more sustainable.

Reformer in a cellulose bath

»Außer Thesen allerhand gewesen« – this is the title of the current exhibition on the 500th anniversary of the Reformation that can be seen in the Thuringian State and University Library (ThULB) until December. Among the exhibits are books and manuscripts from the time of the Reformation from the ThULB's collection: early writings of Luther and other reformers, hand-written notes and valuable prints. But the exhibition organizers and restorers had their work cut out before the centuries-old volumes could be shown off in the display cases in the room for antique treasures, thereby bearing vibrant witness to their time of creation.

BY UTE SCHÖNFELDER

The Thuringian State and University Library (ThULB) is currently advertising its exhibition using the slogan »Treasures of the Reformation Age«. How could it be any different? We are in the year 2017 – THE anniversary year of the Reformation – so it's obvious that the largest library in the Free State chips in with an appropriate contribution to the 500th anniversary of the major upheavals in the Church and society. After all, Thuringia is one of the core states of the Reformation; for the last ten years, during the »Luther Decade«, intensive research has been carried out at the FSU and other research institutions, results published, collections in archives and libraries digitized and made available online and exhibitions prepared and staged.

Unlikely treasures

So, one morning in March, I follow Dr Joachim Ott in search of the local treasures of the Reformation. From the information counter of the ThULB, our search takes us to the room for antique treasures in which the exhibition »Außer Thesen allerhand gewesen« can be seen until December. The contrast could scarcely be more striking: from the glass-roofed, spacious foyer, flooded with spring light in spite of the scaffolded entrance area, we proceed to the small, darkened exhibition room. The poster announcing the treasures is emblazoned on the entrance door. It shows a man in a monk's habit with an oversized quill who – so it seems – is inscribing his frus-



View into the exhibition room in which the »Treasures of the Reformation Age« are to be seen until 14 December.

tration over the Church's sale of indulgences on a church door in large letters. With these scenes in my mind, I enter the exhibition expecting original documents testifying to that major movement. But at first glance, the open books presented here in twelve modestly lit display cases, hardly match my idea of »treasures«: These volumes, some of which are weighty tomes, have none of the pomp and splendour to offer that I expected, neither gold nor illustrations boasting lavish colours. Instead, there are thick, grey leather-bound volumes, and the

open pages are of solid paper in shades of yellow and brown. The few illustrations are woodcuts in the same colour as the printed letters.

This is hardly the stuff of treasures. As if sensing my silent reservations, Dr Ott explains: »All these books come either from Luther's direct environment, contain writings by him or were edited by him.« Ott runs the ThULB's Manuscripts and Special Collections Department, and he designed the exhibition and prepared it with his team.

So what the visitor sees here could also

be described as work materials: Luther and other reformers wrote the books or annotated the texts of others, adding endless notes between the printed lines and in the margins. Their handwriting – small and scarcely legible for the untrained eye of the viewer – makes the volumes before me unique specimens and true treasures.

World document: Luther's Mass

One small, outwardly nondescript volume, exhibited in the very first display case, is a true rarity. The book is open at the title page of the »German Mass« by Martin Luther. Printed in Wittenberg in 1526, the slim work has been part of UNESCO's World's Documentary Heritage since 2015. »This book is probably the only completely preserved copy of the second edition,« states Dr Ott, drawing my attention to the border on the frontispiece which originates from the workshop of Lucas Cranach the Elder. With the »German Mass and Order of Service«, to quote the full title, Luther offered the complete liturgy of the main service in German for the first time. While other reformers had been publishing orders of service in the German language since 1522, Luther continued to conduct mass in Latin until 29 October 1525. Only then did he also celebrate the service in German. The slim pamphlet around three millimetres thick is part of an anthology bound in vellum containing a total of 32 works by the reformers. But how does such a work come to be in the middle of a hotchpotch of other writings? »It was normal in those days to sell texts separately from bound books,« states Joachim Ott. »Readers collected what interested them and had it bound in their own individual arrangement.«

In the display case directly opposite lies what is probably the weightiest work of the exhibition: the twelve major, leather-bound folio volumes of the Jena Luther Edition – the entire reformer's

writings – eight in German, four in the Latin language. The collection was printed in the Carmelite monastery on today's Engelplatz that had been converted to a printing works and that has been open to the public for several weeks following extensive restoration work. Published between 1555 and 1558, the edition is the most important testament to Jena's book-printing history. »The edition was commissioned by the Ernestinian Dukes as competition for the Wittenberg edition, as at that time Wittenberg was no longer under Ernestinian rule,« says Ott. Luther's close confidante Georg Rörer gave personal instructions relating to the edition and its printing. His handwritten and printed specifications are also displayed.

The first volume of the Jena Luther Edition lies open in its own showcase. The massive book block weighs an estimated four to five kilos. The other volumes are a match for it in terms of pages and size and are lined up behind it. The title page of the book »Erster Teil aller Bücher vnd Schrifften des thewren seligen Mans Doct. Mart. Lutheri« [First Part of all Books and Writings of the beloved, blessed Doctor Martin Luther] is decorated by a woodcut showing the founder of the university of Jena (»Hanfried«) beside Luther, both in prayer before Christ on the Cross. The text is printed in large ornate letters in black and red. Two brass clasps are attached to the front of the volume and are used to close the book.

Even if the centuries have left their mark on these magnificent examples of early modern artisanship – they definitely do not look their age of almost 500 years. »The books – as you see them here – are largely in their original condition,« Dr Ott emphasizes. And returns my astonished look by adding: »Paper and binding from those days are very robust.« No comparison with books from the 19th or 20th century which can only be preserved today with difficulty. In addition, the books are kept in a special sto-

Photo right: The »German Mass« by Martin Luther from the year 1526 has been part of UNESCO's World's Documentary Heritage since 2015 and can be seen in the exhibition.

rer room in the basement of the ThULB when they are not being exhibited. At a constant 19 degrees and relative humidity of 50 percent, they will certainly survive the next few centuries as well, as he explains with a grin. And he adds that it is exhibitions like these that are more likely to damage these valuable treasures. How come? »When the heavy volumes are left open for weeks and months, and also at an angle, when they are exposed to light for longer periods – that affects the material.«

This must be avoided, of course, he adds, and prevented from occurring from the outset. That is the task of the restorers at the ThULB. They continually inspect the huge stocks of books and manuscripts – the ThULB has around 27,000 titles from the 16th century alone – look after them, restore them and prepare them for exhibitions.

A glimpse into the restoration workshop

Restorer Frank Schieferdecker and his team – Annett Blumenthal, Susanne Kull and Ulrike Sachße – work one floor below the exhibition room. Their workshop is a large bright room looking onto the Frommanscher Garten. Large work desks are lined along the window front with pots, brushes and paper, and there are further work surfaces in the middle of the room with beside them huge alligator shears with blades one metre in length, mobile pedestals and cupboards with endless rows of drawers. And above all: books. Books of very different sizes, colours and ages on trolleys, waiting to be digitized, books separated into single leaves on shelves, freshly bound copies held down in screw clamps on a large work surface.

»Treasures from the time of the Reformation« are also being worked on this morning. In front of Susanne Kull lies a large-format book with texts and songs from the 16th century that was used in church services. The restorer inspects the fresh binding of bright leather, opens



Deutsche
Messe vnd ord-
nung Gottes
diensts,

Martinus Luther.
Ordnung der messen

Wittemberg.
Von S. Augustini Schrifften



the thick book containing a good three hundred pages, and checks the adhesion again as well as the freshly engraved capital letter. All this has been created manually using the same tools and techniques as in Luther's time.

The restoration log beside her records every single step of the process that has restored the book in its yellowed condition with holes and mould spots to its former splendour in the last few days. The aim of restoring books, however, is not to re-establish as perfect an appearance as possible.

»The books are to be restored to their original condition as far as possible,« Susanne Kull says. And for that reason, the weighty hymnbook is still to undergo a further restoration step. The original leather used for the binding is glued onto the new binding – irrespective of any damaged areas on the edges or the spine. »We try to stabilize such areas,« says the restorer who has been looking after the books of the ThULB for more than 25 years. Finally, the two clasps and the labels on the spine are reattached, and the book goes back to the special storeroom.

Kull's colleague Annett Blumenthal is also working on a

book from the time of the Reformation. She sits hunched over a stack of loose leaves lying on her desk. Right at the top is the title page with a likeness of Luther. »But we have our work cut out here,« she says, talking about the damage to the almost 500-year-old, thick, yellowish paper. »The edges are frayed, and in some cases the holes in the signatures are so large that the glue was no longer holding.« Dark grey mould stains are appearing around the image of the reformer.

The brittle pages come from an anthology of Luther's sermons containing a total of 17 individual pamphlets. I am now familiar with the common practice in Reformation times of having various texts bound to form a separate book. Whoever did this with Luther's sermons, we are no longer able to view the original binding from the 16th century. »It has not survived,« says Workshop Manager Frank Schieferdecker regretfully, looking at the very unattractive grey library soft cover in which the printed matter from 1523 has so far been kept. »The binding was



In the restoration workshop of the ThULB: Workshop Manager Frank Schieferdecker and member of staff Susanne Kull look after and preserve the extensive stocks of books in the largest library in Thuringia. From the 16th century alone – the time of the Reformation – the collection comprises around 27,000 titles.



Before restoration: The title page of the anthology of Martin Luther's sermons from 1523 is showing major signs of damage. The holes in the paper have now been repaired and the book has been returned freshly stitched to the ThULB's special storeroom.

probably changed around 1900,« Schieferdecker estimates. That was the last time the book was repaired, he says. Nobody knows now where the volume originally came from or how it ended up in the ThULB.

Separated into separate folios, the damaged paper is now ready to be repaired by bonding fibres. »We can repair small areas by hand,« Annett Blumenthal explains. But that would be much too complicated for large-scale damage such as on this Luther book. It is quicker to repair the holes mechanically.

Mechanized papermaking

The fibre bonding unit is basically no more than a bath measuring almost 2

square metres with a sieve in the middle. By raising and lowering the water level, large-format sheets of paper can be »made«. Or, as Frank Schieferdecker explains, new fibres can be added to damaged sheets. »For this we use cellulose fibres which most closely approximate to the colour tone of the original.« In the present case, the restorer chooses a slightly brownish fibre. Practised in the art, Schieferdecker counts the quantity needed to fill the gaps in the original by hand. The cellulose is then mixed with water in a large blender and chopped up into small pieces.

In the meantime, Annett Blumenthal has carefully laid the damaged sheets on the sieve in the fibre bonding bath. She adds the pulp from the blender and starts a pump. With a deafening roar, the water now rushes through a rubber

hose with a sprinkler head at the end of it, and fills the bath, in the process of which the paper fibres spread finely over the whole bath. The noise is reminiscent of a laundrette when three washing machines drain simultaneously. About one minute later, the bath is full. Switch off. Silence.

I try to imagine how at this moment the fine fibres snuggle up to the centuries-old paper sheet and fill up every hole, however tiny. There is nothing to be seen of the process in the milky, cloudy liquid. A few moments later, the excess pulp is siphoned off, and Annett Blumenthal takes the sheets of the book out – now free of holes again and with a frame of new paper – and lays them on a vacuum table, still gleaming moistly. Another switch is pressed. If the noise before was like a washing machine, it

Photo above: Restorer Annett Blumenthal prepares the historical folios for the fibre bonding process. Cellulose fibres are washed into the bonding bath (photo center) and fill in the gaps in the paper. Photo below: The restored pages are then dried, freshly cut and stitched.

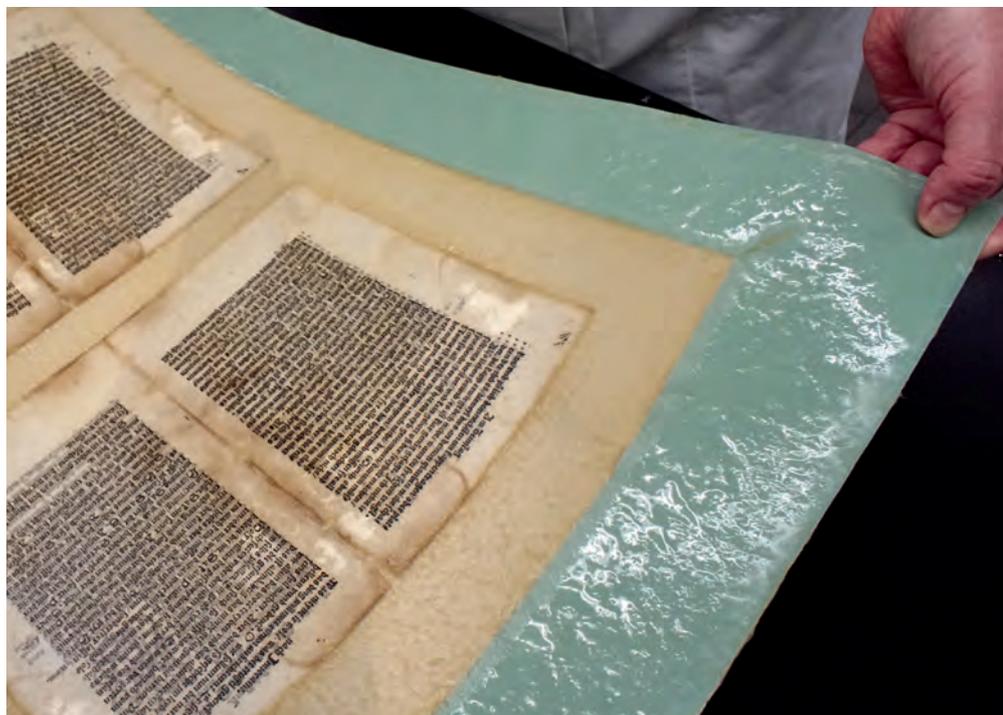


now reminds you of the loud blast of air from a hairdryer. Air is now sucked through the bonded paper and the majority of the moisture removed. Finally, the entire paper is coated with starch paste to fix the fibres and protect them from further decay. The entire procedure of converting the tattered, brittle printed sheet back into a sturdy sheet of paper, has barely taken ten minutes. »The final steps are to dry press the paper and cut off the excess fibres at the edges of the original paper,« Annett Blumenthal explains as we leave the workshop again. I already know the steps that come later from Susanne Kull: pressing, stitching, binding and the Luther volume can be returned to the storeroom.

Reformation anniversaries from former times

On the way outside, I make a detour back to the exhibition. On our tour, Joachim Ott had drawn my attention to one display case in which specimens of a much more recent date are shown. These are anniversary writings composed for earlier major anniversaries of the Reformation. Even in 1617, the university and Church in Jena celebrated a six-day festival to commemorate 100 years of the Reformation. The occasion of the major European upheaval was also marked in 1717, 1817 and 1917.

What will be presented here in 100 years, on the 600th anniversary of the nailing of Luther's Theses? Who knows. But one thing seems to me to be certain: The books from Luther's pen and bearing his signature, stored and preserved here in the ThULB, will still be in good condition – thanks to the work of the restorers, skilled craftsmanship and the latest technology.





»Sometimes it's a help, sometimes a hindrance«

Scarcely anyone – outside of the Theological Faculty and the Historical Institute – has studied the events surrounding the Reformation at the University of Jena in the last few years as assiduously as the former Rector Klaus Dicke. He has played a major role in ensuring that besides the festivities, science, too, has not been short-changed during the Luther decade. But where does the political scientist and practising Catholic draw his passion for this of all subjects?

BY SEBASTIAN HOLLSTEIN

If you ask Klaus Dicke what he intends to do after the anniversary of the Reformation is over, he does not have to ponder long: »On All Souls Day, the first thing I'll do is enjoy a morning-after breakfast for the mind.« After all, in the last ten years, Luther and related items have occupied no small amount of time in the diary of the former Rector of the Friedrich Schiller University. Since leaving the management of the university in 2014, he has given many presentations, attended conferences, written ar-

ticles and explained his view of things in discussions. And all such work naturally has to be prepared, researched and organized. »A decade like this is a pretty long time,« says Dicke betraying a degree of exhaustion.

But where does this extraordinary commitment to the anniversary of the Reformation actually come from? Why is Klaus Dicke so preoccupied with the events surrounding the schism within the Church 500 years ago? The answer

may lie in a fruitful blend of profession and confession, as Dicke is a political scientist and a Catholic. Born near Koblenz, he grew up in the Rhineland of the 1950s and 1960s. Catholicism was omnipresent here and a part of the public sphere that was taken for granted. »Altar boy, processions, sacristan duties – I also experienced the full gamut,« says the 63-year-old. »The Church supplied a framework for the course of the whole year.« He left his familiar faith environment when he went to universi-

Photo left: Installation on the market square of Wittenberg. Martin Luther (1483–1546) set the Reformation in motion from here. The monument to the reformer in front of the town hall can be seen in the background.

ty. Neither Marburg nor Tübingen were considered bastions of Catholicism. He saw the subject of Catholic Theology which he read besides Political Science and History, more as a good option for becoming a teacher than as a path to self-discovery. Nevertheless, he expanded his view of his own faith here. The Catholic theological seminary in Marburg only boasted two professors, and for that reason the course was dominated by Protestants. His time in Tübingen was primarily shaped by the dispute with Hans Küng who as a professor was levelling explicit criticism at the Catholic Church and thereby encouraging a process of self-reflection. But does a degree in Theology do anything for one's own faith? »Sometimes it's a genuine help and sometimes a hindrance,« Dicke says today. »Sometimes you can derive greater benefit from doubting, searching thinkers in this field such as Imre Kertész than from many theological tracts, but on the other hand, it is also very enriching to be able to follow the practices of faith over many centuries. Theology is a highly interesting science.«

One of the first priorities for the student Klaus Dicke in any new town was to contact the student congregation. In Marburg and Tübingen, these are organized along ecumenical lines – a subject that has stayed with him to this day. Not least because he becomes further and further removed from his Catholic heartland in the course of his university career. First it takes him as a junior lecturer to the Protestant north, to the University of Kiel. »That was diaspora in itself. The Catholic community there is very modest. You know each other from Sundays. That naturally leaves its mark and creates bonds,« the man from the Rhineland recalls. Finally, he has a similar experience when he moves to the FSU in Jena in 1995. The almost secularized east seems to present another new challenge. However, the research

environment and working conditions are of much greater importance to the political scientist than the homeland of his faith. »I have never chosen where to work or live on the basis of my faith,« he says. Conversely, however, faith did once have its say. »I was in first place among the list of applicants for a Catholic university in south Germany, but I was not appointed because my first marriage had ended in divorce,« Dicke recounts.

The Reformation offered a »rich tapestry of opportunities«

In any case, with Jena he has arrived in the heartland of the Reformation. Time and again, his research priorities touch on the Early Modern – »and if you study this epoch, you won't be able to avoid the movements of reform.« And altogether, Dicke is at pains to stress that the events were not restricted to 1517. »If you look at the theological landscape around 1500, you will find a plethora of options; there was a rich tapestry of opportunities and Luther seized one of them.« Reading Martin Luther's writings constitutes for Dicke the starting point for an intensive analysis of the Reformation. The political dimension fascinates him above all else. »If you read Luther's work on authority, you can see the great extent to which the events around 1517 also emanated from robust political pragmatism,« the political scientist explains. »Generally speaking, the divisions that we have created today between politics and religion did not exist in those days. Everything was much more closely interwoven – and that is precisely what makes the constellation of forces so exciting.« And one political consequence of the Reformation is also the University of Jena which was initiated by a Protestant prince imprisoned by Catholics (p. 12 f.).

Dicke was determined, therefore, that



Prof. Dr. Klaus Dicke. The political scientist was Rector of Friedrich Schiller University from 2004 to 2014. The 63-year-old has been interested in Luther and the Reformation for longer than the last ten years of the Luther decade.



Luther as a toy figure in front of the door of Wittenberg's Schlosskirche. Klaus Dicke sees the event character of the anniversary of the Reformation with scepticism.

his university had to be part of any Luther decade when it became evident during his time as Rector that the anniversary of the Reformation was to be very elaborately celebrated. »I saw in this an opportunity to link theological research at the Friedrich Schiller University more closely to the State. The objective, after all, was to exploit the potential of the anniversary – and with it the decade – not only for celebration but also for science.« He therefore set up the initiative »Science and Church« and helped to found the »Reformation Research Network«. He explains that they are both working very well to this day and have established themselves as an information forum and communication platform between numerous institutions in Thuringia.

Too much Luther – too much »hero worship«

»The anniversary has led to an increase in knowledge in many areas. Whether the same applies to insight remains to be seen,« Klaus Dicke says. For him there is slightly too much Luther, slightly too much hero worship in the current celebrations. »Luther is only one of a whole series of reformers,« he says. »Of course, his translation of the New Testament was a huge achievement, but translating the Old Testament constituted admirable teamwork with a result that was no less valuable.« This entire focus on one strong man and the cultivation of the myth of the nailing of the Theses to the church door, sometimes encourage overly nationalistic traits, he states, which are

inappropriate when commemorating an event that affected half of Europe. He also views the event character of the anniversary, which has now gained the upper hand, with great scepticism. Nevertheless, Dicke is delighted by much of what has been set in movement. »Many construction projects have been realized as part of the decade, and a wide variety of subjects surrounding the Reformation have attracted a much larger audience than would otherwise have been the case – for example, a film about Luther's wife Katharina von Bora, which also discusses the role of women in those times.« In general, the Church had generated greater attention, he says, especially in states such as Thuringia and Saxony-Anhalt. This is due in no small measure to his own efforts. Since he left the office of rector, especially, he regularly receives requests for presentations thanks to which he has to immerse himself time and again in all the ramifications of the entire subject. »When I was completing my Abitur, I would never have expected that one day I would concern myself so intensively with Protestant theology – and in the process become more curious every time,« says Klaus Dicke by way of an interim conclusion. »The questions in my head have certainly not grown fewer.« He sees the fact of embarking on a search for the answers as a major personal enrichment. After all, he states, for all the differences, the important thing every time is to discover what the two confessions have in common.

One winner to emerge from the decade has already been decided as far as

the former Rector is concerned: ecumenism. Of all days, the day commemorating the anniversary of the »schism« has contributed to creating closer ties between the two confessions, he says. »The way in which we have all accepted an understanding of the Reformation and tried in the process to see things from each other's perspective, gives me confidence for the future,« reasons the Catholic. »There were and are a whole series of joint events and church services which focus on what we have in common.« In spite of all thoughts of reconciliation, »as a Catholic you cannot help but view an anniversary of this nature with a tinge of sadness,« Dicke admits. »The Reformation was without doubt absolutely necessary in the circumstances of those times, but I am not so sure that the Church had to split over it.«

Klaus Dicke himself still has a lot of miles to cover this year. The next presentations have already been written. The anniversary Church Convention in Jena and Weimar is coming up in May. He hasn't decided yet, he says, how he is going to spend 31 October – the anniversary of Reformation Day. Probably with friends in the town of Oettern where he lives. There he is the only Catholic and an accepted member of the community. However, the way in which he came to be accepted was unusual, as he recounts. »Shortly after we moved there, my wife – who is Protestant – asked me to take a role in an Easter play as they were short of an actor. It was the role of D. Martin Luther, of all people – and I seem to have played him very convincingly.«

Calendar: 200 years of the Wartburg Festival

The Wartburg Festival as a signal of political awakening is one of the most multifaceted events in German history. But without Jena students, the event at the castle which once offered Martin Luther a refuge, would never have taken place in this fashion 200 years ago.

BY JULIANE DÖLITZSCH



Procession of the students to Wartburg Castle on 18.10.1817, Heinrich Hose, copper engraving, not dated

fraternities during the two days. It was principally the – definitely politically intended – burning of aristocratic symbols and book dummies on the periphery of the event that in the end triggered the ensuing denigration and persecution of the members of the fraternity,« explains Dr Stefan Gerber from the research office for the Recent Regional History of Thuringia.

It is undisputed today that the Wartburg Festival represented a minor milestone on the path to the formation of the German nation. The ban on fraternities after 1819, in particular, reinforced them in their collective identity and advanced the struggle for a nation state until the German Reich was founded in 1871. One of the political symbols of democracy was also born 200 years ago: »The flag of the Jena students made in 1816 by Jena's 'women and maidens', consisted of the colours black, red and gold. And as the students from Jena had issued the invitations to Wartburg, their flag led the procession. Since the Hambach Festival of 1832 and above all during the revolution in 1848, black, red and gold now prevailed on a national level as a political symbol,« Bauer recounts.

The reasons for the Wartburg Festival were as complex as its subsequent interpretation. The three-day conference in Wartburg Castle from 11 to 13 October of this year is evidence that the interpretation of the Wartburg Festival has still not been completed after 200 years. Historians from all over Germany will ponder »The Wartburg Festival in 1817 as a European Event« – and perhaps once again hit on completely new patterns of meaning.

It goes without saying that the Wartburg Festival in 1817 is inseparably associated with Thuringia due to Wartburg's location in Eisenach. Less well known is the fact that the original student fraternity from Jena issued invitations, thereby starting the ball rolling for the joint festival. After receiving an application from the students, the Weimar government of Grand Duke Karl August determined the site of the meeting. The students were eyeing three occasions for the festival: the 300th anniversary of the Reformation, a memorial to the Battle of the Nations near Leipzig in 1813 and the staging of a national meeting of students.

»Loosely formulated, you could also call the celebrations a 'students party'. The whole event only became highly politically charged as a result of the subsequent public debate and the quickly ensuing slanders,« states Prof. Dr Joachim Bauer from the University Archives with conviction. On the one hand,

there were speeches at the event against parochialism and in favour of a national state, and from 1814 it became a ritualized celebration in the sense of a peace festival in which along with 500 students from 13 universities, the residents of Eisenach also took part. Even professors from the alma mater Jenensis and government officials were present.

Students as a compensating element

On the other hand, central, internal student concerns such as the foundation of a binding »fraternity« at all German universities, were discussed. This is also reflected in the course of the festival: October 18 was primarily dedicated to the memory of Martin Luther and the Battle of the Nations near Leipzig in 1813, while exclusively student themes were addressed on 19 October. »The Jena students often acted as a compensating element between more radical



BIOINFORMATICS

Mathematics in vegetable oil

Bioinformatics specialists and botanists have made an interesting discovery. The number of theoretically possible fatty acids with the same chain length but of different structure can be determined by means of the famous Fibonacci sequence, and therefore follows the »Golden Mean«. This finding can be used in the chemical analysis of fatty acids – so-called lipidomics – to name but one example.

BY UTE SCHÖNFELDER

Mild in taste and of great nutritional value, the bright yellow vegetable oil pressed from sunflower seeds has many different uses and is extremely healthy as it contains a large proportion of unsaturated fatty acids. This is the term for fatty acids whose hydrocarbon chains contain one or more double bonds. »As the double bonds can occur in different places in the molecule, fatty acids can occur with the same chain length but different structures,« Prof. Dr Stefan Schuster explains. The Professor of Bioinformatics and his team are driven by the question of whether and how the number of all structural formulas of fatty acids can be calculated for a given chain length so as to be able to use this variable for analytical procedures.



Prof. Dr Stefan Schuster is on the trail of the Fibonacci sequence in nature and has now struck lucky with natural fatty acids.

And in the process, the Jena-based researchers have recently made an interesting discovery. Not only have they been able to prove that the number of fatty acids occurring in nature with rising chain lengths can be elegantly forecast. They also show in an article in »Scientific Reports« that this number obeys the famous Fibonacci sequence. With this sequence, named after the Italian mathematician Fibonacci (around 1170 to 1240), every number is the sum of the two preceding numbers: 1, 1, 2, 3, 5, 8, 13, 21 etc. »In the case of fatty acids, this means that the number of possible fatty acid structures increases with every carbon atom by a factor of roughly 1.618...,« Schuster explains. The longer the chain, the closer the sequence approaches this factor. While

only one structure is possible in each case for chain lengths of one or two carbon atoms, the number grows to two, three, five, etc. for three and more carbon atoms. »With six carbon atoms, we already have eight possible structures, with seven, thirteen and so on.«

The Golden Mean in nature

The factor 1.618... describes a ratio known in nature but also in art as the »Golden Mean«. It is to be found in architectural masterpieces such as the old town hall in Leipzig but also in flowers, snail shells and even in the human body. If the ratio of parts of a building or the proportions of plants or bodies correspond to a figure of roughly 1.618, the human eye perceives them as being especially well-balanced and »harmonious«.

»Even the leaves of many plants or the seeds of the sunflower are arranged in accordance with this rule,« Prof. Dr Severin Sasso from the Institute of General Botany and Plant Physiology explains. The Junior Professor for Molecular Botany is one of the authors of the publication along with doctoral student Maximilian Fichtner. »It is interesting that even certain constituent parts of the sunflower – the fatty acids – follow this principle,« says Dr Sasso. However, not all possible fatty acids occur in sunflower oil by a long way. It consists largely of fatty acids with a chain length of 16 or 18 carbon atoms. According to the calculations made by the Jena bioinformatics researchers, there could be almost 1,000 and over 2,500 different versions of them respectively. »Similar correlations apply to certain classes of amino acids,« Maximilian Fichtner adds.



The results relating to the Fibonacci sequence in fatty acids can be applied primarily in the area of lipidomics – the comprehensive analysis of all fats in a cell or organism. »An exact knowledge of what substances can theoretically occur is essential for this work,« Prof. Schuster emphasizes. The metabolic processes and interactions with other cellular substances involving fats and their constituent parts are examined with the aid of lipidomics.

The arrangement of the seeds of marguerites, daisies or sunflowers, but also the structure of romanesco broccoli (photo left), follows the Fibonacci sequence: the ratio of two successive numbers approaches ever closer to the ratio of the »Golden Mean«. The resulting »golden angle« of 137.5 degrees forms the optimum angle between successive leaves or florets.



Original Publication

Schuster S et al. Use of Fibonacci numbers in lipidomics – enumerating various classes of fatty acids. *Scientific Reports* 7 (2017) 39821, DOI: 10.1038/srep39821

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NUTRITION

From the pond to the pot

The little floating plants are popularly known as »duckweed«. But contrary to what this term implies, water lenses are not just a delicacy for fish or waterfowl. The green protein bombs are also ideal for human diets, whether as a smoothie or in an omelette.

BY STEPHAN LAUDIEN AND UTE SCHÖNFELDER

Wolffia globosa, a small rootless water lens, clearly has the potential to make it big. Working with professional colleagues in Kerala (India) and Germany, scientists from Jena have examined the potential of various water lenses for human nutrition. The results are promising. They have been published in the specialist journal »Food Chemistry«.

»Water lenses could certainly serve as a source of protein for human diets,« says Prof. Dr Gerhard Jahreis. It is no coincidence that water lenses are called »green machines«, the nutritionist adds. Jahreis says the water lenses are comparable in their protein content to lupins, rapeseed or peas. The protein yield is around 30 percent of its dry weight, he says. He explains that the little water plants are definitely to be rated as valuable from the perspective of nutrition physiology, particularly with respect to the composition of the amino acids – the components from which proteins are built. »All amino acids are present at the levels recommended by the World Health Organization,« Jahreis emphasizes. The tiny plants also contained valuable omega-3 fatty acids, he continued, such as stearic acid and alpha linolenic acid.

The proportion of starch is comparatively low in water plants. Only 4 to 10 percent of their dry weight consists of starch although the proportion depends largely on their conditions for growth, he states. That also makes the green water vegetable interesting as a food that is particularly low in calories, according to Jahreis.

Fast reproduction with no additional fields

»The water lenses reproduce very quickly but do not need any additional cultivation space,« says PD Dr Klaus Appenroth. He adds that this represents an enormous advantage compared with soya, for example, in view of the decli-

ning space for cultivation. Water lenses had been on the menu for millennia in Asian countries such as Thailand, Cambodia and Laos, he continued. In particular, he points to the species *Wolffia globosa* which in Asia is served as a soup, vegetable side-dish or omelette.

In the current tests conducted by the research group, *Wolffia microscopica* proved the most promising. For the present study, the researchers examined six different species of water lenses: *Spirodela polyrhiza* from the USA, *Landoltia punctata*, *Wolffiella hyalina* and *Wolffia microscopica* from India, *Lemna minor* from Germany and *Lemna gibba* from Italy.

First, the plants are cultivated for 14 days in an Erlenmeyer flask in a culture medium, as can be seen in the photo (p. 36). During this period, a thick, floating lawn sprouts from a few plants sown. Subsequently, the green biomass can be harvested and freeze dried for chemical analysis.

First pilot plants for producing duckweed on a grand scale

»So far, the duckweed has not been cultivated for larger applications but simply 'harvested' from bodies of water,« says Klaus Appenroth. The plant physiologist has devoted almost his entire career as a researcher to these tiny plants and among other things, built an extensive collection of Lemnaceae (English: duckweed). Nevertheless, he says, the first pilot plants have been set up in Israel and the Netherlands in which water lenses are produced on an industrial scale – primarily for biomass production.

Another factor in favour of using the plants for human consumption in the future is that, according to the authors of the study presented, water lenses can easily absorb trace elements dissolved in the water. In this way, diet-related deficiencies could be compensated with little effort.



Klaus Appenroth (r.) and Gerhard Jahreis inspect the extensive collection of water lens plants in their laboratory. Water lenses are already consumed today, primarily in Asia, and that is where the requirement is greatest, they say. The diet in India, in particular, with its high population, is heavily biased towards starch due to their consumption of rice, while proteins and trace elements are often missing in the food. The addition of water lenses rich in valuable protein and trace elements, could provide a remedy, according to the conviction of the researchers from Jena. The climatic conditions in the Indian subcontinent are also ideal for cultivating water lenses. The »snack from the pond« still has to establish itself in European cuisine. Water lens smoothies are conceivable or biscuits produced free of gluten.

The smallest flowering plants in the world

The family of water lens plants (*Lemnaceae*) has 5 genera with 37 species worldwide. In Central Europe, for example, the lesser duckweed (*Lemna minor*), the gibbous duckweed (*Lemna gibba*) as well as the star duckweed (*Lemna triscula*) are all native species. The greater duckweed (*Spirodela polyrhiza*) is also frequently found in these parts on stagnant or slowly flowing waters.

There is also the so-called rootless spotless watermeal (*Wolffia*) which is primarily indigenous to warm and tropical latitudes and therefore relatively rare in Germany. **They are considered to be the smallest flowering plants in the world.** Members of the Asian watermeal species *Wolffia globosa* are only 0.7 to 1.5 millimetres in size, spherical in shape and they grow without roots floating on the water. They reproduce vegetatively – by means of asexual cell division – and they do so at such a rate that they are able to cover entire water surfaces within the shortest space of time. Water lenses are the fastest growing flowering plants that exist: Up to six tons of biomass grow from one gram within three weeks under ideal conditions.

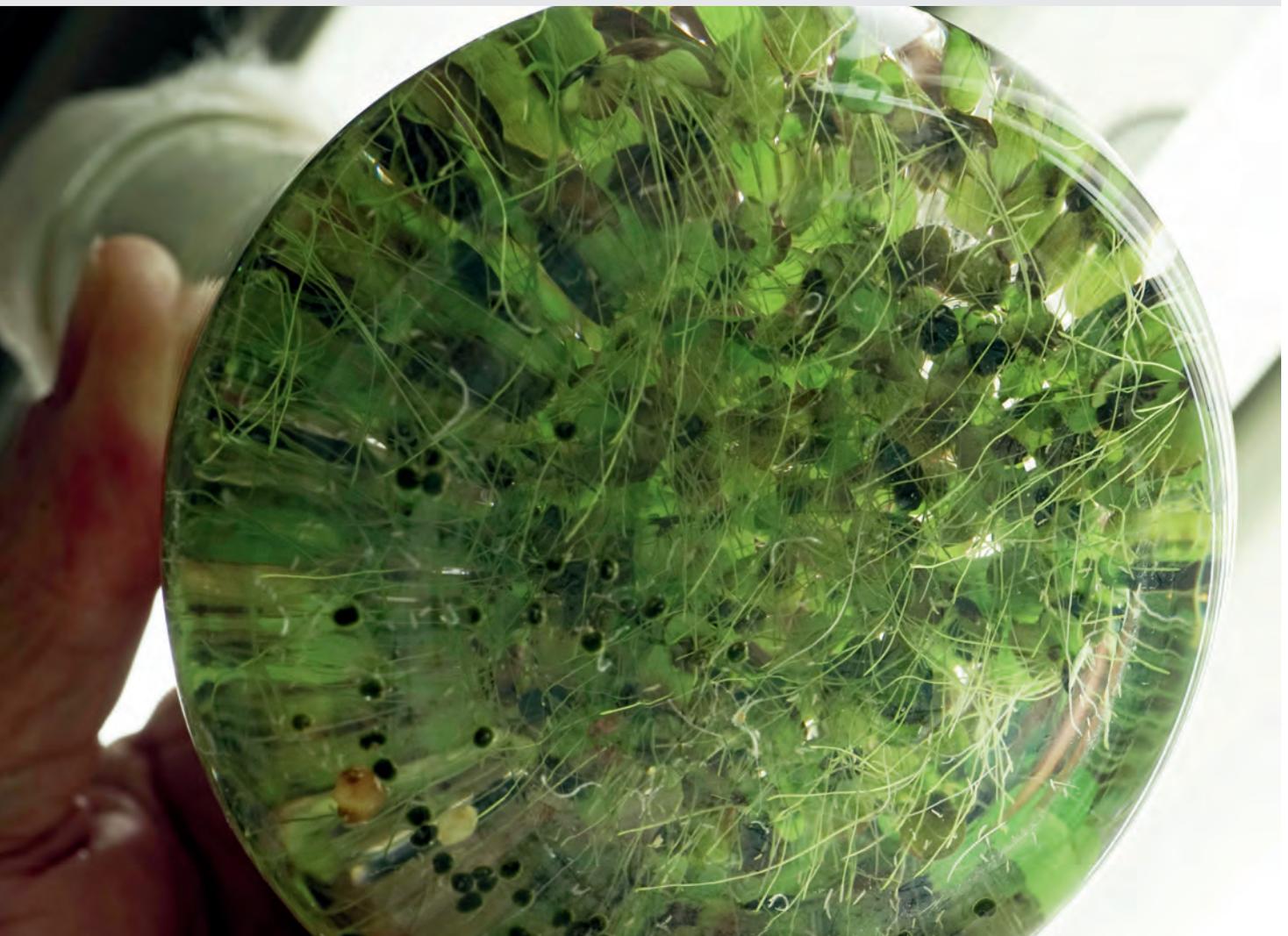
However: For such turbo growth, the tiny green plants need consistently warm temperatures. For any production of water lenses on a major scale, subtropical or tropical areas are much better suited than Germany or Europe.

In nature, water lenses are an **important staple** for many fish and waterfowl. But they are also already playing a role in human nutrition. For example, water lenses

have been eaten for many generations in East Asia (Thailand, Myanmar, Laos), and are standard products in the form of »water eggs« (khai-nam). Water lenses were also a traditional item on the menu of the Mayans in Guatemala where they were known as »water corn« (Xim Ha). Due to their high protein content, ideal amino acid composition and low fat content, water lenses are particularly valuable from the perspective of nutrition physiology.

To be consumed, water lenses must grow in clean water as they quickly absorb substances in the water – pollutants, for example – in large quantities and store them. On the other hand, this circumstance is also exploited, and water lenses are used specifically in order to biologically cleanse polluted waters and waste water. In **water treatment plants**, water lenses can reliably remove nitrogen and phosphorous compounds from the water as well as heavy metals, pesticides or dioxins.

The tiny plants also offer further interesting deployment options thanks to their huge propensity to reproduce, for example as raw material for the **bio-fuel ethanol**. This is because water lenses produce on average around five times more biomass than maize per hectare per year. And they require no land for cultivating food or fodder and can be more easily harvested than algae, for example, which are already being used today in the production of biofuel.



PD Dr Klaus Appenroth

Plant physiologist and specialist for water lenses

What hurdles must water lenses overcome to establish themselves as food in Europe?

As no members of the water lens family have been used for generations as food in any country in the European Union, they were classified as a »novel food«. That means they would have to be tested in accordance with the »Novel Food Directive« before being officially sold and used as food. The fact that these plants have been eaten in Asian countries since time immemorial, plays no part.

Through our analyses, we are making an important contribution towards creating the necessary preconditions and we are continuing our work. Colleagues in the Netherlands and Israel are also striving to clarify the legal side of the procedures required. There is of course also a need for a company that produces the plants in suitable volumes. This cannot be the task of a university.

The areas where water lenses can be deployed are already varied (see box on p. 38). Where do you see their greatest potential – as well as their use as food?

Firstly, in the cleansing of waste water as water lenses absorb all possible substances from the water. Of course, that only works all year round in warmer countries, e.g. in India.

Secondly, in the use of biomass to extract starch. Sugar can be easily derived from starch and can be fermented to form bioalcohols (ethanol or butanol) and used to generate energy.



PD Dr Klaus Appenroth has devoted almost his entire career as a researcher to water lenses. He manages the international committee on water lens research which is lobbying worldwide for more intensive use and application of duckweed.

Colleagues from China, in particular, are working in this direction. It is naturally a good idea to combine these two applications. When waters rich in nutrients are used, the plants absorb and store these nutrients, and so the biomass can also be used as green manure, e.g. to recycle phosphates. And thirdly and finally, water lenses are of course also suitable as animal feed. A calculation is required as to

whether cultivation is financially covered by the produce.

Can you reveal your »ultimate« water lens recipe?

I like water lens curry best: For this, you fry some onions and black mustard seeds. Add cumin, chili peppers and ground ginger. Then add the water lenses – preferably *Wolffia* – fry briefly and add salt and lemon to taste. Done. It goes well with rice.



Original Publication

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Seeing through fish

The delicate structures of two Indo-Pacific flounders are shown in transparent form in a new special exhibition in the Phyletisches Museum. The subject of the INSIGHTFISH exhibition which runs until 8 October 2017, is »Seeing through Fish« made possible by modern techniques. Fascinating specimens and large-scale photos with transmitted light give visitors a unique insight into the beauty and structure of fish.





Photo left: Section of the cover of the publication »The Waffen-SS A European History«.

HISTORY

Not just men of conviction

During the Second World War, around half a million men from countries occupied by Germany served in the Waffen-SS. Historians have analysed and published a book on what moved them to join this feared force.

BY STEPHAN LAUDIEN

During the Second World War, the Waffen-SS left a trail of death and destruction across Europe. The units in this elite force were feared and hated. Nevertheless, many people in countries occupied by Germany volunteered to fight in the ranks of the Waffen-SS. A further substantial number of foreign recruits were conscripted. An international team of researchers with Dr Jochen Böhler from the Imre-Kertész Kolleg and Prof. Dr Robert Gerwarth from the School of History at University College Dublin have spent four years investigating the background to the deployment of foreign SS soldiers in fighting units and as guards

in the concentration and extermination camps. The research group has now published its first results.

Financial emergency or anti-communism

»There were many different reasons for joining the Waffen-SS, and at the same time those that did so had much in common,« says Dr Jochen Böhler. The main motives included providing financially for themselves and their families as well as agreement with the German war aims. »For many men in the occupied territories, the Waffen-SS offered the

only way of surviving the war,« says Jochen Böhler. For example, recruitment focused on so-called Trawniki men, largely in prisoner-of-war camps in which there was an extremely high death rate. Refusing to serve under German command would therefore have meant almost certain death. Added to these were volunteers, for example in the Ukraine, whose countries no longer existed and who believed they could get along in a greater German empire after the war. In countries such as Norway, Holland or France, the idea of fighting with the Germans against Bolshevism was one of the main reasons for joining the Waffen-SS. It was usually these staunch anti-communists who clung to their convictions to the end. Nevertheless – and this is also one of the conclusions of the research project, »Non-Germans in the Waffen-SS: A Cultural History« – it was by no means the case that all members of the Waffen-SS of non-German origin were criminals, according to Böhler. »There were rebellions, desertion and resistance in the ranks of the auxiliary troops,« he says.

Over 25 scientists in nearly every country from which the SS men came, are involved in the project. Together they have written the English book, »The Waffen-SS. A European History«, published by Prof. Gerwarth with Dr Böhler. In the process, geographical regions such as Northern Europe or South-East Europe were viewed as belonging together.

»It is striking that the racially motivated classification of people of different origins is seamlessly maintained under arms,« says Jochen Böhler. In specific terms, this meant that anyone who

BACKGROUND

The Imre-Kertész Kolleg at the Friedrich Schiller University Jena is a place of interdisciplinary, transnational historical research on historical events of the 20th century in East-Central and South-East Europe.

The project, »Non-Germans in the Waffen-SS: A Cultural History« has been running since 2013 and will be continued until 2018, and further publications are planned. The research is supported by the Gerda Henkel Foundation in Düsseldorf which has contributed almost €240,000.

was far down the ladder in the Nazis' racial classification, such as Russians or Ukrainians, had far less chance of promotion than the French or Norwegians, for example.

Altogether, there were around half a million non-Germans who wore the uniform with the skull and crossbones and SS runes. Whatever their motivation was in joining the Waffen-SS, they mostly shared the same fate after the war. »Collaborating with the enemy was taboo in most countries,« says Jochen Böhler. In France, for example, the fact that Alsations – i.e. French people of German origin – were involved in the massacre of Oradour in 1944, was seen as traumatic. They were termed »malgré-nous« (against our will) and they became tragic figures. In the Baltic countries, on the other hand, former members of the SS were widely venerated as heroes after the end of the Cold War and as pioneers in the fight against Bolshevism. It is to the credit of the new book that it offers a nuanced, scientifically justified picture to offset the well-known stereotypes.



Dr Jochen Böhler on the steps of Prinzessinnenschlösschen in Griesbachgarten in which the Imre-Kertész Kolleg is based. The Jena historian and his professional colleague, Prof. Dr Robert Gerwarth from the School of History of University College Dublin, have spent four years investigating the background to the deployment of foreign SS soldiers in fighting units and as guards in the concentration and extermination camps.

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Prof. Dr Adrian Pfeiffer in his element: In the laboratory of the Institute of Optics and Quantum Electronics, he devotes himself to laser experiments with an uncertain outcome.

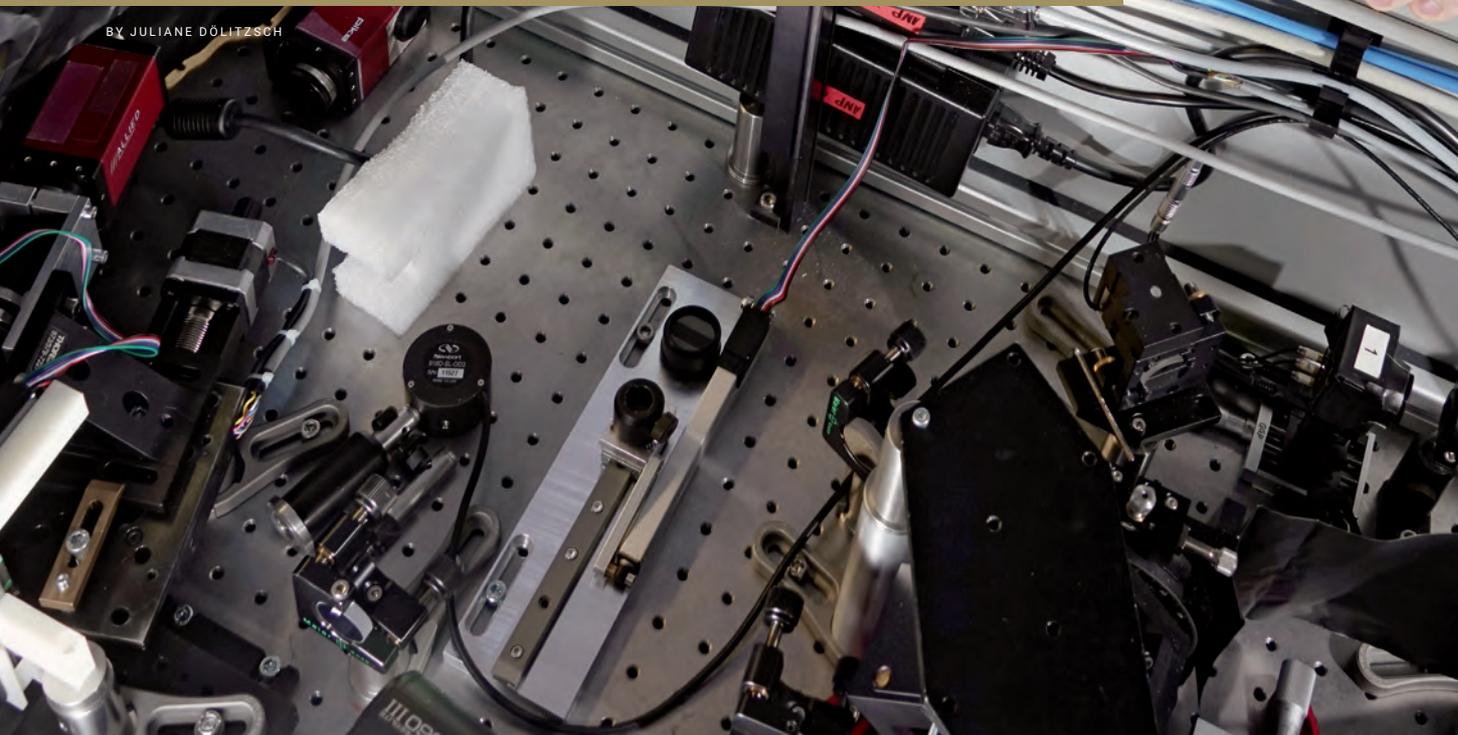


PORTRAIT

Science roller-coaster

Prof. Dr Adrian Pfeiffer researches physical processes down to attosecond precision. In the process, experimental physics sometimes requires bold research ideas, radical rethinking – and no fear of failure.

BY JULIANE DÖLITZSCH



THE BOLD EXPERIMENT

Pfeiffer's latest project that the funding initiative »Experiment!« by the Volkswagen Foundation is supporting with €100,000, focuses on »subcycle precision non-linear spectroscopy« and, as he explains, it requires a radical change in thinking. Specifically, he is investigating how long a group of light pulses requires to travel from their point of origin, a material sample, until they strike a detector. The problem with the experiment lies in the inaccuracy of the measurement, as all the optics involved which the light pulses pass on their way to their target, bring with them certain surface characteristics. »Even with precision optics, you have to expect variances of around 60 nanometres.

As at the speed of light, this shifts the time of the pulse by several hundred attoseconds, it is impossible to find out anything about the dynamics in the sample with attosecond precision,« the young physicist explains. Nevertheless, he shows his ingenuity and still makes an attempt – by motorizing all the optics between the sample and the detector. By repeating the experiment multiple times, Pfeiffer assumes that the average determined in the time taken for the light pulses to strike reflects actual timing differences in different material samples. For example, he would like to find out how quickly electrons react to intense light in different materials such as thin glass or crystals.

»The ratio of two attoseconds to one second corresponds to that of one second to the age of the universe.« What Prof. Dr Adrian Pfeiffer describes with this image is a time span so short as to be scarcely imaginable: one attosecond is the billionth part of a billionth of a second. It almost goes without saying that experiments conducted in such a short timeframe are not always predictable. Nevertheless – or perhaps because of this very fact – the 37 year-old is expanding his research on attoseconds. He has recently received two prestigious scholarships for his work: €40,000 from the Daimler and Benz Foundation and €100,000 from the Volkswagen Foundation. The latter supports daring research ideas with an uncertain outcome through its funding initiative »Experiment!« – failure is an accepted result, he states, when explaining the reasons for obstacles.

Modifications are part of the research process

But who wants to contemplate failure when they have a new idea for research? »Every scientist in physics today is exploring frontiers whether in optics or solid-state physics. It's always a matter of extremes: ever smaller, faster, bigger. As long as it's terra incognita. That's what makes experimental physics so exciting,« Pfeiffer explains. And that also implies the possibility of failure, it's important not to fear failure, he states. No experiment works the very first time, says the Junior Professor for Attosecond Laser Physics from experience. But nobody interprets the

modifying of an experiment as failure, he explains: »That is simply the process of research. It's much more usual for it not to work than for it to work.«

There can be three reasons for this in the natural sciences according to Pfeiffer. Faulty materials or technology, human error on all levels, from setting up to evaluating the experiment or simply a research idea that doesn't work. »Unfortunately, you never know the real reason. It's easy to start doubting yourself.« Water off a duck's back, that's not his style: »In that regard, I'm no wiser now, and I'm still an optimist. And I can still get very angry when things don't work.« From such phases, he can also clearly deduce where the term »absent-minded professor« comes from. He is then so immersed in his own thoughts and preoccupied with the problem because he would like to find out where the sticking point lies in the experiment, he continues.

Once he had a crazy idea, he says. It could have very quickly brought powerful new insights to the field of spectroscopy. But the experiment simply refused to work, and sooner or later he gave up. The sketch of the idea is still in his desk, but it probably won't ever leave his drawer again. »I still don't know what the problem was. And that still peeves me.« The physicist likes to quote the A-Team TV series: »I love it when a plan comes together.« But in the end, the constant ups and downs constitute for him everyday working life in science. »Research is like a roller-coaster ride,« the attosecond expert opines. Adrian Pfeiffer has made his hobby his

job. What keeps him going? Coffee in the morning. And the excitement and the striving to find something new. That could be compared to someone who has a model railway, he says: »It's not always much fun setting everything up but you do it anyway because you want to see it running one of these days.« Pfeiffer, who comes from Baden-Württemberg, also likes to be adventurous in his free time. He enjoys skiing, climbing and sailing, but often he can't find time for them. After his lab work and teaching assignments, he is more likely to be found in the bouldering centre in Jena or on his mountain-bike.

Constant progress required

His research into attoseconds to which the native of Tübingen has dedicated himself since starting his dissertation, took him initially to Zurich in 2007 and to the Lawrence Berkeley National Laboratory in California for three years. He has been a Junior Professor in Jena since 2013. A normal career path in science, says Adrian Pfeiffer. Constant progress and mobility are a must. That fits well with what the passionate physicist whenever somebody asks him a critical question about the deeper meaning and benefit: »It's the engine for development in general. Just take lasers in medicine or computer technology – if you're in favour of progress, you can't be against experimental physics.« And as far as the big picture is concerned, he naturally likes to stick with his daring research ideas.



Dr Norman Henniges views the map collection in the German National Library in Leipzig.

ter around 1850, there was a genuine hype surrounding school wall maps,« Dr Andreas Christoph explains. »They were not just used from a geographical standpoint but also to illustrate economic or social relationships. They expressed the prevailing world view of their time and helped to shape it,« the science historian from Ernst-Haeckel-Haus continues.

As this resource offers an incredible well of insights currently rolled up in the archives collecting dust, Dr Andreas Christoph and the science historian Dr Norman Henniges in collaboration with the German Museum of Books and Writings of the German National Library (DNB), have conceived the CANVAS project to free the school wall map from its life in the shadows. The German Federal Ministry of Education and Research is putting €80,000 into the project.

Creating standards for digitization

The scientists are focusing first on digitizing all the copies and drawing up a concept. »What we need to do first is define standards for our further work,« Henniges reports. From a technical point of view, for example, he says it is not possible to scan the maps some of which are up to three by three metres in size. »That is why they are photographed – with a resolution of 100 megapixels. This ensures that even the minutest details are not lost.«

The coming months will concentrate predominantly on school wall maps from the period between 1913 and 1950. In future, they will be made available on the DNB's own portal. »The aim, of course, is to enable all scientists to use them, and in the long term to open them up via Open Access to anyone interested,« Project Manager Christoph explains.

The whole world at a glance

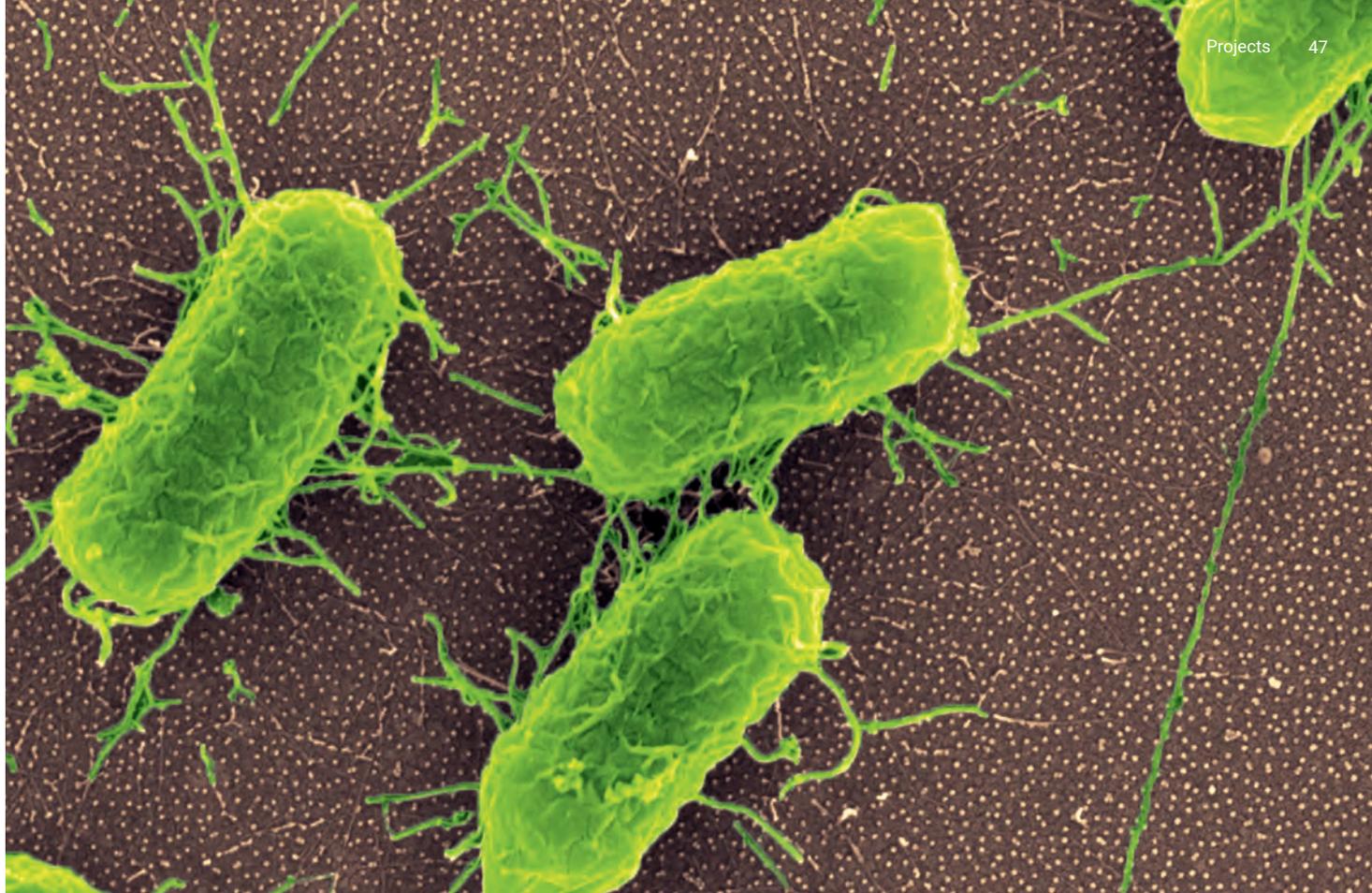
Still relevant even in the age of Google Maps: science historians plan to digitize around 4,000 school wall maps.

BY JULIANE DÖLITZSCH

Anyone recalling their geography lessons can see large maps in their mind's eye. Germany, Europe, the whole world: they all graced the classrooms and their job was to contribute to the extension of topographic knowledge. Not infrequently, the information displayed on them became obsolete before school days were over, as in Central Europe

alone, national borders shifted drastically in the 20th century as a result of two World Wars and the division of Germany – not to mention the rest of the world.

This inevitably leads to an enormous number of school wall maps which are long since out of date but of great value from an historical perspective. »Af-



Bacteria as they occur on the surfaces of materials in hospitals – e.g. on door handles – but also in other public buildings.

Germ on the wing

FSU is coordinating a major project for collaborative research and development on the way in which we deal with pathogens in aviation.

BY AXEL BURCHARDT

A cough here, a sniff there: Waiting rooms in medical practices are among the places with a high density of germs. Wherever people congregate and spend time together, there is a risk of infection from pathogens. Railway stations and airports are also places where the risk of infection lurks.

A current research and development project coordinated by the FSU as part of the InfectControl 2020 consortium is looking at the risk potential of airports and air travel. The partners from the worlds of science and business want to develop effective strategies within three years for controlling the ways for pathogens to spread on flights. Within the InfectControl 2020 consortium, which is funded by the Federal Ministry of Education and Research, the project known as HyFly receives €2.6 million of funds.

In airports and airplanes, not only do healthy people encounter sick individuals, but pathogens from all parts of the globe are also to be found there and are carried to other locations by the passengers.

Interrupting infection chains

HyFly now aims to provide active prevention and help to interrupt the infection chains on flights. »Prevention is the aim,« Prof. Dr Klaus D. Jandt explains. The materials scientist is the coordinator of the alliance and he adds: »Thanks to our partners from various sectors of industry, there won't just be a White Paper at the end of the process to neutralize the impact of aspects relevant to the spread of infections at airports from a construction and process

planning perspective. There will also be model solutions for new materials, e.g. with significantly lower germ adhesion, and these are later to be launched on the market.«

Materials scientist Jandt and his team will investigate the role played by materials and their surfaces in the spread of infections in air travel. One particular challenge lies in the fact that such surfaces are subject to frequent and intensive cleaning and disinfection. Over the course of time, this changes the properties of the materials surface. The project is to examine the effect of such changes on the tendency for microbial contamination. As an alternative to chemical disinfection methods, the researchers want to examine treating surfaces with light such as UV radiation, especially the efficacy of UV LEDs.



Electromobility where you live

Computer scientists are developing a comprehensive concept for using regenerative energy for residences. The first apartment block is currently being refurbished and fitted out in Chemnitz in Saxony.

BY JULIANE DÖLITZSCH



Computer scientist Steffen Späthe is managing a sub-project in the »WINNER« consortium.

Illustration above: Solar modules on the roof, electric car outside the door – this is the objective of the project which intends to bring electromobility directly to residential quarters.

More and more people in the 21st century are giving thought to how they can take the burden off our planet. Besides the use of public transport, electric cars today offer an opportunity to avoid excessive pollution of the environment caused by the emission of harmful substances. Relying on renewable energy to generate electricity has long become the hallmark of a sustainable way of life that looks after our natural resources. The research project WINNER (»Wohnungswirtschaftlich integrierte netz-neutrale Elektromobilität in Quartier und Region«) which is being funded by the German Federal Ministry for Economic Affairs and Energy to the tune of €2.5 million over three years, combines both approaches. The FSU is realizing the project together with six partners from Central Germany. »We want to bring electromobility directly to residential quarters by providing tenants with charging stations for electric cars,« reports Steffen Späthe, Manager of the sub-project »WINNER Potential«, which is established at the Chair for Software Technology. This is precisely

what is now being tested – and by no means just theoretically.

An apartment block is currently undergoing a total refurbishment in Chemnitz in Saxony, and in future it is to serve as a »demonstrator« for the WINNER model. »A photovoltaic system is being installed on the roof, and four charging stations for electric vehicles are being set up in the car parks,« Späthe states. Added to this are two electric cars which the residents will be able to share – environmentally-conscious carsharing with neighbours. The electricity generated via the roof can also power heating pumps, illuminate staircases or outdoor systems or else be used to supply power for the tenants.

Identifying potential for saving energy

Above all, it is fascinating for the team to draw up an energy balance sheet and identify the potential for savings in the use of energy. »Measuring the energy consumption of a building with 32 tenants over a longer period of time offers promising insights for us as the central data unit in the project. This helps us to understand the times when consumption is particularly high or low, and control when power is taken from the grid and when from the roof,« Späthe explains. The electricity from the external energy supplier is less expensive at night, but on the other hand, the local, solar-generated power could be fed in during more expensive periods, he comments.



Video recordings of their own lessons are to give student teachers feedback on their teaching during their school internship.

Taking a camera into class

The government is funding two digitization projects in university education with around €840,000. The objectives are to achieve a higher quality of examinations and video feedback for beginning teacher candidates.

BY JULIANE DÖLITZSCH

Digital media are conquering the world – and they do not stop short of German universities. As part of the funding programme »Research into digital university education«, the Federal Ministry of Education and Research (BMBF) will fund two FSU projects in the coming three years, both of which are established at the Institute of Educational Science.

Reflection instead of cramming facts

With KAT-HS (»Kriteriumsorientiertes adaptives Testen in der Hochschule«), Prof. Dr Andreas Frey and Dr Christian Spoden are aiming to make written University exams more meaningful. »Exams are incredibly relevant for students and the marks often count towards their degree, but the psychometric quality of the exams often fails to do justice to their importance,« Frey explains. For example, lecturers would like to encourage students to think for themselves but instead they only test their knowledge of facts – or vice versa.

The purpose of the KAT-HS project, which is enjoying funding of almost €450,000, is to redress this discrepancy. »The aim of our project is to develop and test a concept for precise, criterion-referenced, computer-based exams that can be used across universities and faculties,« Frey explains. The exams of the future are also to adapt to each individual examinee: »In the case of adaptive tests, the follow-up questions are based on the answers given before. Anyone, for example, who answers a lot of questions correctly, will be given more difficult ones,« Frey reports.

Video documents teaching experience

Prof. Dr Alexander Gröschner is also bringing new media into play. His research project OVID-PRAX (»Online-based Video Feedback in practicum«) enjoys funding of around €390,000 from the BMBF, and takes as its starting point the support given to student teachers in their school internship. This is taken in the third year of study and for the tea-

cher candidates it usually means actually standing in front of a class for the first time. Gröschner and his team want to find out whether feedback on video recordings of the lesson generates greater added value for the student teachers. Hitherto it has frequently been the case, he explains, that they describe their experience of taking lessons in final project reports.

There are hardly any video-based reflections or feedback from peers or lecturers. As well as the video group, there will also be a text-based group for comparison in the OVID-PRAX project and one containing no reflection on their experience, either by video or in writing. A test both before and after their practicum deployment is intended to show who has achieved the greatest gain in knowledge and feedback competence. The BMBF's funding programme »Research on digital University Education« focuses on the universities' current e-learning practice and looks into opportunities to apply new technical developments from other spheres of society.



The hunt for the fireball

Researchers obtain their objects of scientific study in many different ways: some cultivate bacteria or plants, others survey test subjects and others still operate measuring equipment or collect water and soil samples. And some researchers are helped by pure chance.

BY UTE SCHÖNFELDER



Dr Dennis Harries from the Institute of Geosciences had one of his research objects literally fall at his feet. Admittedly, there was a fair hike involved as well. Even a pretty long hike, totalling more than 150 kilometres. But one thing at a time.

It is 6 March 2016, a late Sunday evening when a glowing fireball enters the earth's atmosphere between Salzburg and Passau and traces a bright trail across the sky. The police receive numerous emergency calls from anxious residents. At 22.37hrs, the light apparition is also captured by several automatic cameras belonging to the »European Fireball Network« before it fades away not far from the borough of Stubenberg in Lower Bavaria. »That was the typical signature of a meteorite fall,« says Den-

Photos left: The Jena piece of the Stubenberg meteorite (»Stubenberg M6«). The stone made of common chondrite weighed around 35 grams from which one piece was sawn off and provided for analysis. The light grey, slightly gleaming rock is surrounded by a deep black fusion crust – traces of its scorchingly hot passage through the earth's atmosphere. Originally, it comes from the asteroid belt between Mars and Jupiter.

**Top left: Location of the find in a piece of woodland;
Bottom left: The remaining piece of the meteorite with cut surface.**

Photo right: Dr Agnese Fazio and Dr Dennis Harries. When they're not off hunting meteorites, the mineralogists analyse rock samples as here with a Raman microscope.



nis Harries who works at the Chair of Analytical Mineralogy of Micro- and Nanostructures, and among activities, conducts research on meteorites. Based on the photographs and data on the weather situation that evening, it was possible to narrow the area in which the cosmic rock must have struck the ground very precisely. When the first pieces of the Stubenberg meteorite were found a few days later, Harries could not wait any longer in Jena. Together with his Italian colleague, Dr Agnese Fazio, he sets out for Bavaria.

»The calculated scatter field comprised several square kilometres of farmland and woods,« Harries recalls. On the very day of their arrival, the 35 year-old discovers a tiny fragment of the meteorite. »It was then that the thrill of the chase gripped me.« There followed a day-long hike. Metre for metre, Dennis Harries and Agnese Fazio combed the area along with dozens of other researchers and amateur meteorite hunters – often watched sceptically by the farmers who were waiting to be able to plough their fields at long last.

»According to calculations, the rock must have been around 600 kilograms

in weight with a diameter of 70 cm before entering the earth's atmosphere,« Agnese Fazio recounts. »Much larger pieces must have hit the ground than what had been found so far,« says the 29 year-old junior scientist with experience of hunting meteorites. In 2012, she was with a team from Pisa University on an expedition to the Antarctic. The researchers there had discovered more than 100 meteorites in the space of 2 months.

Meteorite hunt with a happy end

After three days, Fazio returns to Jena. Harries continues to search. His frustration mounts, and his feet are hurting. He has now left the farmers' fields where searchers had a clear view, and was now combing through brambles in the dense wood. Still he finds nothing. But this would not be a good story if it did not have a happy ending: On 3 April, ten days after starting his search, Dennis Harries notices an unusual-looking black rock on the side of a path, about the size of a ping-pong ball. »I knew immediately it was at least something

unusual,« Harries recalls. As a precautionary measure, he photographs the site of the find before carefully lifting the stone out of the soft soil lined with pine needles and small twigs. When he has the stone in his hand, he knows that he has found a piece of the Stubenberg meteorite.

What followed after the happy end, is part of everyday scientific life: the meteorite was measured, sectioned and subjected to mineralogical analysis. »The stone is a common chondrite,« says Dr Harries. As a meteorite, the »Stubenberg« is pretty unspectacular, he goes on. »Over 80 percent of all meteorites found on earth are made of this material.« Nevertheless, these stones, that are not found on earth (except as meteorites), afford a glimpse into the deep past of our solar system. The meteorites come from the asteroid belt between Mars and Jupiter and they were created from the cloud of gas surrounding the sun in the early ages of the solar system, more than 4.5 billion years ago. They therefore consist largely of unchanged original matter from our solar system.



PSYCHOLOGY

Troublemakers stick in the memory

»I'll make a note of that face!« That's what often goes through our minds when a colleague at work jumps the queue in the canteen, a football player repeatedly fouls his opponent or even when a neighbour you don't know pinches your parking space. Psychologists have found out that this is no empty threat and that our memory is indeed very good at storing such people – at least if they belong to our own group.

BY SEBASTIAN HOLLSTEIN AND UTE SCHÖNFELDER

Photo above: Small car – big space. Anyone parking like that in the company car park is likely to be remembered by their colleagues.

Building the pyramids in Ancient Egypt, landing space probes on Mars or mastering the current global crises in politics and business – if people want to achieve a goal together, a high degree of cooperation is required. And that applies not just to mammoth undertakings such as the ones mentioned above. Different people also cooperate in a small personal setting, their family, circle of friends or at work, pool their resources and skills, and by doing so, they are able to benefit from each other – as a social group.

But it only works if things are done fairly. »A shared group membership increases people's willingness to cooperate. If individual group members take advantage of these high levels of cooperation, by not contributing, they put the group functioning at risk,« says Dr Stefanie Hechler.

To maintain their ingroup cooperation, group members benefit from recogni-

zing and remembering unfair behaviour or deceit in order to penalize it or avoid it in the future, the psychologist explains.

Together with her colleagues, Prof. Dr Thomas Kessler and Prof. Dr Franz Neyer, Stefanie Hechler is investigating these recognition and memory mechanisms. »If we observe people who misbehave beyond the norm – show deceit, for example – we remember them particularly well as they acted differently to what we expected,« Hechler explains.

The person memory investigated addressed two kinds of information: »That means we not only remember their faces, but also behaviour that was previously associated with them,« Hechler continues. After all, she explains, when you next meet them, it is better not only to remember that you have already seen them but also that they acted uncooperatively. As the



Fair play or foul? Whether in a team sport or another walk of life: anyone behaving unfairly does rather more than simply create a negative impression. For members of their own social group, the troublemaker becomes a potential danger and is remembered as such.

team of psychologists from Jena has now been able to demonstrate for the first time by means of two independent studies, we remember such troublemakers particularly well if they belong to our own social group.

Acting fairly or selfishly

For their study, the psychologists recruited a total of 130 participants and split them into two groups. Although each participant acted on their own behalf, it was clear to all those involved to which group they belonged. They were also able to clearly identify whether the other participants belonged to their own group or the other one as they wore either a blue or yellow T-shirt.

In the first part of the experiment, participants shared 100 imagined monetary units with alleged group members.

»In our culture we most often perceive an equal share as fair,« Dr Hechler explains. »Especially as the test subjects were able to observe the decisions of other participants.«

In the next phase of the experiment, the test subjects were asked if they could remember other participants, and if so, if they also remembered how they had behaved. What the participants did not suspect, however, was that the other persons were not participating in the study but merely acting out certain kinds of behaviour. They either shared their money fairly or only gave a small part of it – in other words, they clearly behaved unfairly.

The result was clear. Players in the blue group mainly remembered those in the blue group who only gave a small amount of money – and in the yellow group, it was the other way round. The test subjects remembered unfair behaviour by members of their

own group most often. However, there was no difference in the recognition of faces. The explanation given by the psychologists is that the participants in the study perceived themselves as part of the group (self-categorization). At the same time, participants evaluated their own group better than the outgroup. »If I share a group membership with a person, I suppose that they have certain characteristics and that they behave in a certain way that is conform with my image of the group,« says Hechler. We usually have a more positive image of ourselves and members of our own group than of members of similar groups which we are not a member of. The impact is all the greater if a member of our own group turns out to be a cheat. Because in social groups, people perceive themselves as a community pursuing a common goal or at least the same situation. »We believe that the other members of the group are similar to ourselves. Because

we would cooperate within our group, we expect them to do the same,« says Dr Hechler. If group members violate norm, they are perceived as a danger to the group and our alarm bells ring, she explains.

Non-conformists may be a danger to the whole group

»Our results show that even such basic psychological processes as person memory, which we most often do not control consciously, are affected by self-categorization,« says Stefanie Hechler. »A norm violation, such as non-cooperation within the group, is perceived as a threat to the group and thus, we remember the person responsible and their behaviour especially well.«

The psychologists were able to confirm these results in a second study. It was designed in a similar way to the first one. However, this time the other people taking part in the experiment did not just behave either fairly or unfairly but in some cases also inconspicuously or neutrally.

Once again, the participants mainly remembered the uncooperative members of their own group – identified this time by a scarf of a certain colour. They were noticed, especially by comparison with those whose behaviour was neutral. And they were recognized as troublemakers significantly more frequently than members of the other group whose behaviour was equally uncooperative. A further interesting result of the Jena study:



The psychologist Dr Stefanie Hechler has discovered together with colleagues that we have particularly good recall of persons who show misbehaviour removed from the norm.

»Although uncooperative behaviour in our own group is remembered more often, participants' guessing behaviour indicated that they expect such behaviour rather from outgroup members,« Hechler states. »This implicates, that we heuristically think that our group members behave more cooperatively than outgroup members.«

The present results also raise new research questions for the psychologists which they want to pursue in their further research work, for example on how stable the positive image of one's own group is. How long and to what extent is uncooperative behaviour tolerated within one's own group until group members distance themselves from it? And what role do processes of perception and memory play? »We are wondering whether this memory bias for uncooperative group members can be extended to any norm-violation, even if it does not have actual negative consequences,« Dr Hechler says. The researchers also want to look more closely at the psychological basis for the different powers of recollection. Is it the unfair action itself that strengthens the memory or is it the associated exploitation of the other members of the group who themselves are behaving fairly?

The research results presented have come about as part of the project »Cooperation in social groups: cheater perception and memory in intergroup contexts«, which forms part of the FSU's Research Group »Person Perception« funded by the German Research Foundation.



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Enrichment or threat

Students investigate the climate of opinion about refugees

Masters students on a course of »Public Communication« start researching during their studies: On the course entitled »Analysis from the perspective of Communication Psychology«, for example, they are required to independently design, carry out and evaluate a research project of their own.

»I'm not right-wing but...«

Stephanie Wohlt, Tarek Barkouni, Anika Czichy, Kirsten Richter, Kristin Silge and Anna Welzel examined attitudes towards refugees in their project »I'm not right-wing but ...«. »This statement implies that – contrary to the image that people have of themselves and that others are supposed to have of them – they do indeed sympathize with one or two views. We wanted to take a closer look at this,« says Kirsten Richter. »Our aim on the one hand was to record the current climate of opinion on refugees. In addition, we wanted to find out whether there was a difference between implicit and explicit attitudes,« Richter explains. Implicit attitudes are deeply embedded in the personality, often sub-consciously. Conscious, expressed attitudes are often described as explicit. »With regard to the 144 participants of whom most were students and between the age of 20 and 35, we are able to confirm a climate of opinion towards refugees that is more positive than negative. Nevertheless, it is revealing that the implicit test in which positive and negative associations in the test subjects both with refugees and with Germans were surveyed,



How do German citizens perceive refugees who seek shelter here? One result of this research project conducted by students is that anyone who sees themselves primarily as German or as part of Germany, tends to experience strangers as a threat – and their view of them is one of rejection.

actually turned out to be more negative than the explicit test for which there were specific questions,« Stephanie Wohlt reports. »From this it could be concluded that the answers given in the explicit section were more positive because the respondents wanted to portray themselves as more open or in order to obtain greater social approval. However, it is not possible to say whether this occurred consciously or subconsciously,« says Richter in explaining one possibility for the discrepancy. The non-representative study of the group also shows that feelings of threat triggered by refugees are connected to negative attitudes towards them. Anyone who regards refugees as a risk, has a more critical attitude towards them; anyone who tends to see them more as a source of enrichment, has a more positive stance towards them. jd

A problem shared is a problem doubled

How consumers perceive mistakes in service

The train is late, the food is cold or the breakfast buffet in the hotel has already been cleared away when you enter the breakfast room – mistakes can frequently occur in the service sector. A team working for marketing expert Prof. Dr Gianfranco Walsh has succeeded in showing that one and the same service problem is perceived very differently, depending on whether customers are affected on their own or as a group. According to this study, service mistakes affecting a group lead to far greater annoyance with the supplier than mistakes affecting individuals, as researchers report in the »Journal of Service Research«. The reason they give for this is the consensus effect which states that people tend to suspect the cause of an event to be beyond their own sphere of influence if other people are also affected. US



Poor service? There is a big difference for disappointed customers whether they alone are affected by poor service or as a group, according to the results of the study. After a service mistake is made which affects a group, customers are more inclined to talk negatively about the provider in front of acquaintances and to register a complaint.



Above: Walnuts and other nuts offer protection from cancer. Below: Part of a facsimile of the »Human Family Tree« by Ernst Haeckel.



Hard shell – healthy kernel

Nutritionists have good news for anyone who enjoys eating nuts. Nuts, as the results of current studies show, can reduce the growth of cancer cells in the gut.

Roasted and salted, ground into biscuits or freshly cracked from the shell – nuts are healthy. »We have known for a long time that nuts are full of substances that are good for the cardiovascular system and that protect against obesity or diabetes,« says Dr Wiebke Schlörmann. The effect they have in protecting against bowel cancer has also already been indicated in numerous studies, the nutritionists continue. »What we did not yet know in detail, was the basis for the protective effect of nuts.« Dr Schlörmann and her colleagues from the Department of Nutritional Toxicology are now able to give concrete answers to this question. In a study published in the magazine »Molecular Carcinogenesis«, they present results which illuminate the molecular mechanisms of this protective effect (DOI: 10.1002/mc.22606).

According to this study, the health-promoting effect of nuts is based among other things on the fact that the body's own defence for detoxifying reactive oxygen species is activated. Such substances which are created, for example, by ultraviolet radiation or various chemicals, can cause damage to cells that can trigger cancer. »But the body possesses a whole series of protective mechanisms which render reactive oxygen species harmless,« explains Dr Schlörmann. These mechanisms are mobilized by nuts and their ingredients. The researchers examined the effect of macadamia nuts, hazelnuts, walnuts as well as almonds and pistachios. To do so, the nuts were artificially digested, and the products of the digestive process were subsequently examined for their effect on cell lines. US

Trees of life rooted in Jena

Science historians and biology didacticians Prof. Dr Uwe Hoßfeld and Dr Georgy S. Levit recall the birth of scientific family trees 150 years ago in the renowned special interest magazine »Nature«.

How do you visualize diversity? Biologists in the 19th century found themselves facing this question when they became aware not only of the diversity of plant and animal species but also that they are interconnected. The answer was supplied by Ernst Haeckel: Starting from Darwin's theory of evolution 150 years ago, the famous scholar created the first Darwinian phylogenetic family tree of organisms and published it in his paper »General Morphology of Organisms«. In the special interest magazine »Nature«, the science historians and

biology didacticians Prof. Dr Uwe Hoßfeld and Dr Georgy S. Levit recalled the birth of the »Tree of Life« as it is usually referred to (DOI: 10.1038/540038a). Haeckel was influenced not only by Darwin when inventing trees of life. A colleague and friend in Jena from the field of linguistics also inspired him. »The linguist August Schleicher had already created the first tree of life in 1863 in order to illustrate the development of Indo-Germanic languages,« says Hoßfeld. »Ernst Haeckel then took up this method of visualization.« sh

Under the microscope

Psychologists question young people on their relationship with Europe and the EU

Long before the British took their Brexit decision, it was already clear that Europe is facing a crisis. The financial crisis in many euro countries, rising numbers of refugees and growing right-wing populism are presenting the European Union with major challenges. »And the thing is that the EU itself currently has a poor standing with many Europeans,« says Prof. Dr Peter Noack. However, according to the holder of the Chair of Pedagogy Psychology, it is striking that attitudes to Europe and the EU also appear to be a question of age. While it was primarily the older generation in Great Britain that voted for Brexit, young people tended to see their future in the EU, he reported.

Youth identifies with Europe

Against this background, a team in Jena with Prof. Noack is working in collaboration with researchers from Sweden, Great Britain, Estonia, Czech Republic, Portugal, Italy and Greece to study the attitudes of adolescents and young adults towards Europe. A preliminary study in which 1,300 young people from eight different countries took part, has provided the first interesting results. Adolescents and young adults from all eight countries mainly identified with Europe. This applies, for example, to around three quarters of the persons surveyed in Germany. »However, the fact that the majority of young Greeks also professed a European identity, surprised us in view of the current situation,« says Noack, Head of the Jena working group. He adds: »It does, however, apply to them least of all by comparison with other countries, and equally to young Italians – which was unexpected.« Young people in Greece reveal themselves to be the most anxious in their attitudes to Europe. This is least true of 16 to 30 year-olds in Germany and Great Britain. US



Damaged flag as a symbol for the future of the EU? It is obvious that the community is mired in crisis. But the majority of young people in Europe identify with it, as psychologists have found out in a study.

Optimal solutions

Computer scientists develop an algorithm that solves abstract problems efficiently and precisely and present it at one of the most prestigious international conferences on the subject of Artificial Intelligence in the USA

Whether for automatic picture recognition or self-driving cars: algorithms can solve abstract problems. But many of these problems are so complex that optimal solutions can never be calculated or only with an enormous commitment of time. That is why heuristics play a major role here – techniques by which you can find a solution to a problem with a limited investment of time and without complete knowledge. The disadvantage is that heuristics only ever supply an approximation of the best possible solution. Dr Christian Komusiewicz, researcher at the Chair of Theoretical Computer Science, and Masters student Maximilian Katzmann are now able to announce a successful development in this field: Together, they have developed an algorithm that solves abstract problems efficiently and precisely. This is done, as in the past too, with the aid of a network consisting of

individual nodes. Katzmann gives an example of a complex problem: »I would like to fit in as many meetings as possible one after the other within a given amount of time, with each meeting having a certain, specified timeframe.« Every node then stands for a meeting; a connection between the nodes stands for overlapping meetings. The aim, therefore, is to obtain as many separate nodes as possible. Hitherto, »local search heuristics« have been used to find a good solution to such problems. Here the algorithm first calculates a simple solution. Then it gradually swaps up to three nodes in the network between the solution and the remaining nodes provided this leads to a better solution. The new algorithm developed by the computer scientists in Jena represents a refinement of these »local search heuristics« in networks. »Our program not only calculates an approximation, but frequently the optimal solution to a problem,« Komusiewicz says. AB

What is growing in the savanna?

Satellite and terrestrial data reveal information on the biomass in the Kruger National Park in South Africa

Savannas form one of the largest habitats on earth. »In addition, they play a crucial role in the global carbon cycle,« says Victor Odipo (photo below). According to the doctoral student from the Chair of Earth Observation, the volume of plant biomass above ground is decisive in determining the savannas' ability to store CO₂. Odipo and colleagues from the universities in Jena and Oxford as well as the Federal Institute for Geosciences and Natural Resources have established a method by which the biomass of the savannas can be very precisely measured. To do so, researchers use both radar data recorded by satellites and laser scanning data surveyed from the ground. They have published their results in the specialist magazine »Forests«. US



Dry rot as chemist

How bacteria switch on the synthesis of certain natural substances in pillar-fungi

Old buildings often suffer from dry rot. This fungus (photo above) attacks wood, thereby endangering the stability of construction materials containing wood. The dry rot fungus *Serpula lacrymans* is also a good »chemist«, however: various types of bacteria are able to trigger the formation of dyes in it. New results from Prof. Dr Dirk Hoffmeister and his team are now casting light on the complex molecular interrelations between fungus and bacteria. As the researchers together with their colleagues working with Prof. Dr Axel Brakhage from the Leibniz Institute for Natural Product Research and Infection Biology write in the magazine »Environmental Microbiology«, they have been able to prove that the bacteria switch on certain fungus genes responsible for colour in the fungus. This »communication« between fungi and bacteria can even be seen with the naked eye: Fungal mycelium and substrate turn bright yellow. MR

Insights into the atom

Physicists present new mechanism for examining atomic nuclei

It is not easy to view the smallest components of matter. While the outlines of atoms can be revealed with scanning tunneling microscopes, direct close-ups of atomic nuclei have so far been totally impossible to achieve: just as distant planets are often shrouded in a thick atmosphere, a cloud of electrons circling the atomic nucleus obscure the view into the inside of an atom. Researchers have to resort to ingenious methods in order to gain direct access to atomic nuclei. And that is precisely what Prof. Dr Stephan Fritzsche and his colleagues from the Institute of Theoretical Physics at the university and the Helmholtz Institute in Jena have done. In the specialist

magazine »Physical Review Letters«, they present a method by which they are able to lift the veil provided by the cloud of electrons and directly excite the atomic nuclei. The examination method is based on so-called two-photon emission spectroscopy. The method consists in directing an electromagnetic beam into a sample of the element to be examined. The electrons in the atomic shell are excited and move into a higher energy state from where they fall back again into their original state. In the process, every atom excited in this way gives off its energy in the form of two light particles (photons). »However, one of these photons is absorbed by the atomic nucleus which is then itself excited,« says lead author PD Dr Andrey Volotka. This excitement of the atomic nucleus – like that of the remaining second photon – can be spectroscopically recorded. The signals observable in the photon spectra give researchers insights into the structure of the atomic nucleus and the way in which it interacts with the electrons. US

In pass. Joh. Baum. Ein wenig ist
vans für gedruckte selben / oder vnd
vans ins dinsten solt

413
Ende

Register.

Epistel 2. Corinth. 4. C. Wir haben aber / End. An vn
sern leibe offenbar werde. Euange. Luce. xxij. f. Es erhob
sich auch / End. Geschlechte / Israel etc.

An S. Mattheus tag.

Epistel /j. Corinth. xij. B. Es sind mancherley gaben /
End. Nach dem er wil. Euang. Matth. ix. B. Vnd da Jhe
sus von dannen gieng / End. Vnd nicht die fromen

An S. Michaels tag.

Epistel Apoca. xij. Vnd es erhob sich ein streit. Euang.
Matth. xvij. Zur selbigen stunde

Am tage Simonis vnd Jude.

Epistel. j. Pet. j. B. Gelobet sey Gott / End. Der See
len seligkeit. Euange Johan. xv. E. Das gebiete ich euch /
Ende. Der mich gesand hat.

Anno domini 1517 in profesto omnium Sanctorum, p
Wittenberge in valuis templorum proposita sunt
de Indulgentiis, a D. Mart. Luth.

Anno
1518

Gedrückt zu Wit-

temberg durch

Hans Luft.

M. D. XL.

A note on fixing the ›95 Theses‹ by Georg Rörer

Held by the Thuringian State and University Library (ThULB), the edition of the New Testament published in 1540 also contains a handwritten note by Luther's confidant Georg Rörer (1492–1557) on the posting of the Theses in 1517: *Anno domini 1517 in profesto omnium Sanctorum, pr<...> Wittenberge in valuis templorum proposita sunt pro<positiones> de Indulgentiis, a Doctore Martino Lutero.* To rephrase it in English: ›In the year of the Lord 1517, on the eve of All Saints' Day, [...] Dr Martin Luther presented his theses on disputation of indulgences by fixing them on the door of churches in Wittenberg.‹

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