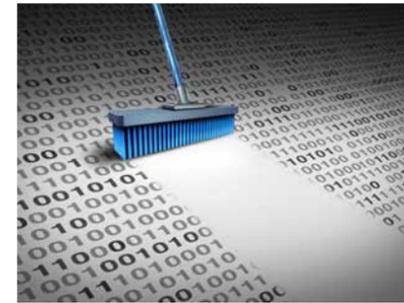




Cover: Shutterstock
The magic of Latin American sounds – played in a shopping street in Armenia, Colombia. Engineering and cultural scientists collaborate on the digital documentation and automated analyses of guitar music in a new way.

Music Informatics: AI for Colombian Sounds | Annual Meeting 2022: Where War is Being Waged, it is Impossible to Conduct Research | Documentation: Speech “Research and War” | Climate Change: A Rapid Climate Test for Coral | History of Theology: Christianity and the Spirit of the Age | Digital Hoarding at Work: Dare to Delete More



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“Where War is Being Waged, it is Impossible to Conduct Research”

As the first in-person event after two years of the pandemic, the DFG's Annual Meeting at the end of June in Freiburg im Breisgau was already a particularly special occasion. In addition to this, the festive ceremony also established the sense of a bond with Ukraine 2,000 kilometres away. And geopolitical issues were indeed the overall focus of the three-day meeting.

Hundreds of guests gathered on the Tuesday evening at Bürgerhaus Seepark for the official function, which was once again to be the worthy highlight of the DFG's Annual Meeting this year. And while many colourful lanterns were already bathing the mild summer night in atmospheric light on the lakeside grounds, DFG President Professor Dr. Katja Becker was holding her welcoming speech inside – and she got right to the heart of what made the three-day meeting in Freiburg im Breisgau such a special occasion: “It’s an enormous pleasure to be able to welcome you all after more than two years of the pandemic!”

The mood could have been exuberant and light-hearted – had it not been for the war in Ukraine, which naturally overshadowed this event as well. Consequently, the President’s speech went on to deal with the subject of “Research and War”. But didn’t the war seem light years away on that summer night in Freiburg? Was it conceivable to speak appropriately about something that seemed abstract, at least to most of those present?

Well, that evening Katja Becker certainly succeeded in giving a

speech that left a lasting impression in its description of the effects of war on science. After all: “where war is being waged, it is impossible to conduct research.”

The many accounts of how the Russian war of aggression was impacting on science in Ukraine could easily have remained merely descriptive. But then the speaker said this one sentence before briefly falling silent: “And what has been irretrievably lost is the life of the Ukrainian researchers who interrupted their research work to fight for their freedom – and indeed that of all of us.” The war came very close to the assembled guests at that moment – the impact was brief, yet profound. And this is exactly how we should remember this moment: a powerfully emotional sense of a bond with people in Ukraine – even though the tranquil city of Freiburg is 2,000 kilometres away from Kyiv.

Just beforehand, the Federal Minister of Education and Research, Bettina Stark-Watzinger, and the Bavarian Minister of State for Science and the Arts, Markus Blume, had given welcoming speeches in which they talked about the relationship between politics and science. Policymakers much appreciate

the benefits of the German science system, they said. As Stark-Watzinger noted: “The basic funding of the science organisations is firmly in place – with a guaranteed annual increase.” She also highlighted the Excellence Strategy as an important building block that was to be further developed.

But the focus here again was on “geostrategic challenges”. Blume referred back to the notion of a “turn of the times”, saying that a similar change in direction was required in research funding. Science policy was enormously important in terms of Europe’s sovereignty, he said. In turn, Stark-Watzinger stressed the “simultaneous nature of the disruptions” – in addition to war, there was the fight against climate change and the digital transformation as well as issues of future energy supply and global health. Both Stark-Watzinger and Blume said that, whatever the issue, solidarity between science and policymaking had never been as important as it was now.

But it was not just at the official function that the geopolitical challenges were such key considerations: both at the committee meetings that took place earlier and at the General Assembly the following



Hosts and guests at the official function (from left to right): Kerstin Krieglstein, Rector of the University of Freiburg, Martin Horn, Mayor of the City of Freiburg, Bettina Stark-Watzinger, Federal Minister of Education and Research, DFG President Katja Becker, Markus Blume, Minister of State for Science and the Arts of the Free State of Bavaria, and Heide Ahrens, DFG Secretary General.

day, DFG President Becker likewise emphasised the importance and necessity of a decisive response on the part of the DFG – as well as the entire scientific community and society at large in Germany – to the Russian war of aggression against Ukraine. She said the war violated all the fundamental values not only of civilisation and Europe, but also of science and its bridge-building ideals. In response, the DFG has suspended all research projects that it was funding with its Russian partner organisations at the institutional level at the beginning of March.

As Becker reported, the support measures for Ukrainian academics that were set in motion at the

same time were now to be further expanded. In addition to the assistance offered to those who have fled Ukraine, funding was currently being considered for researchers who were unable or unwilling to leave their country in spite of the war. For example, they could be temporarily integrated in existing or even newly founded German-Ukrainian research consortia: this would not just give them material security but also ensure they were connected to the international academic community. From the DFG’s perspective, these measures and others like them are crucial in the long term, too. “Strengthening Ukraine as a research base and maintaining it in

the medium term is the responsibility of civil society and one that the DFG is happy to take on,” said Becker.

She also went into detail about the challenges of science cooperation with China, which was recently the subject of extensive media research and reporting. The DFG expressly welcomes the discussion this has triggered on the applicable guidelines and rules, for example with regard to dual-use projects and good research practice, and has sought to encourage this debate itself. “Nonetheless, we currently see no reason to impose fundamental restrictions





Venue of the official function in Freiburg: Bürgerhaus Seepark.

on our cooperation activities with China, let alone put a stop to them,” Becker clearly stated. However, said Becker, when it came to academic cooperation with China, the DFG and the Alliance of Science Organisations in Germany as well as the universities and researchers themselves had to do a better job of handling the fundamental contradiction between the desire to engage in cooperation and achieve academic excellence while at the same time being subject to political control and China’s pursuit of its own national interests.

“China is already a technological leader in some areas and a key partner when it comes to tackling global challenges such as climate and health issues. At the same time, German science must become more aware of the fact that China has to be seen as a competitor and a strategic rival, too,” said the DFG President. Against this backdrop, the DFG was expanding its cooperation

with other Asian partners such as Thailand, South Korea and Taiwan, said Becker, and also deepening its contacts with partner organisations in Japan, South Korea and India.

Despite the current crises, Becker also said there were encouraging signs of solidarity and effective bridge-building within the international scientific community. As examples, she cited the DFG’s trusting collaboration with its Polish partner organisations and also the annual meeting of the worldwide association of research funding organisations – the Global Research Council (GRC) – which Becker chaired in Panama at the end of May.

At the General Assembly, the DFG also presented its Annual Report 2021, which contains all the key facts and figures on its funding activities. Last year, for example, the DFG – the largest research funding organisation in Germany – funded 31,625 projects with a total of around €3.65 billion.

In their report on funding activities since the last General Assembly in July 2021, Becker and Secretary General Dr. Heide Ahrens initially highlighted the activities dedicated to further research into the coronavirus and the multiple dimensions of the coronavirus pandemic. The interdisciplinary Commission for Pandemic Research, which was established in 2020 and has now been extended until the end of 2023, has a central role to play here. Another focus was the measures developed for universities of applied sciences, most of which have already been implemented: here the DFG is seeking to do more to tap into the research potential offered by these institutions. Last but not least, the DFG is also focusing on the issue of sustainability and embedding this notion more firmly in its institutional activities, having already established a Presidential Commission to this effect.

Other topics discussed at the Annual Meeting in Freiburg include a position paper issued by the DFG Executive Committee on the role and perspectives of the DFG in the German science system (see article on p. 6–7), additional initiatives aiming to promote equality and diversity in science, elections to the Executive Committee and Senate, and also current funding decisions, which included the approval of Research Units in the field of artificial intelligence.

In addition to all these decisions and strategic considerations, it will be the official function that will be remembered by those present – not only because of the emotional

impact of the President’s speech. That summer evening by the lake had a distinctive quality to it, perfectly capturing what had been lacking during two years of the pandemic: person-to-person dialogue and also real-life experience – as offered by the Big Band of the Freiburg University of Music. The young musicians gave a rousing performance on a stage directly on the water, making no small contribution to the very special evening atmosphere.

Indeed, the words spoken by Freiburg’s mayor Martin Horn in his welcome at the start by no means proved to be exaggerated: “Freiburg is a university city, Freiburg is a city of science, Freiburg has the popula-

tion with the youngest average age in Germany – ladies and gentlemen, you have chosen the right place to hold your Annual Meeting!” And so at the end of it all, Becker was able to look back very positively on her first in-person Annual Meeting since being elected DFG President in 2019: the DFG had dedicated three very intense days to research and research funding in Freiburg and had set the course for the future, she said.

Benedikt Bastong

is a Press and Public Relations Officer for the DFG.

The full text of the speech “Research and War” by DFG President Professor Dr. Katja Becker is included as an insert in the middle of this issue.

Copernicus Awards 2022 and 2020

Two pairs of winners honoured in Warsaw for outstanding German-Polish cooperation

On the last occasion, two years ago, it was only possible to hold this event virtually due to the pandemic; this year, the Copernicus Award presented by the DFG and the Foundation for Polish Science (FNP) for outstanding German-Polish cooperation in research and science was once again handed over at an in-person event. Krystyna Radziszewska of the University of Łódź and Sascha Feuchert of the University of Giessen (3rd and 4th from left in our photo) were honoured in early June in Warsaw by DFG

President Katja Becker and FNP President Maciej Żylicz (2nd and 1st from left) for their joint re-



search accomplishments in the field of Holocaust studies. The ceremony also included recognition of 2020 winners Stefan Dziembowski of the University

of Warsaw and Sebastian Faust of the Darmstadt University of Technology (1st and 2nd from right) once again – this time in person – for their collaboration in the field of theoretical cryptography.

In addition to paying tribute to this award-winning research, the DFG President, her Polish counterpart and also the German Ambassador to Poland, Arndt Freytag von Loringhoven, emphasised in their speeches the outstanding importance attached to German-Polish cooperation in science, especially given the current political situation in Europe.

Promote, Access, Shape

Position Paper on Role and Perspectives of the DFG in the German Research System / Executive Committee describes central tasks, operating principles and strategic options

What does the largest research organisation and central self-governing body for science and the humanities in Germany see as its own role in the research system? What tasks does this give rise to, and what are the most important topics and challenges in the various fields of activity? What prospects does this involve for the future?

The DFG Executive Committee has now presented a position paper exploring these fundamental issues. In it, the body responsible for strategic and conceptual orientation sets out central tasks and

operating principles. After first being presented to the Senate and the Joint Committee, the paper was finally submitted to the General Assembly by the end of June which was held as part of the DFG Annual Meeting 2022 in Freiburg im Breisgau. This document builds on the previous position paper “On the Future of the German Research System” published by the DFG in 2013.

“Our aim in putting out this position paper is to provide an overview of our own positioning and the strategic orientation that

the DFG will seek to pursue in the coming years. It is aimed at DFG members and all those involved with it, as well as all other actors in the German research system and the interested public,” underlined President Professor Dr. Katja Becker.

The paper starts by describing the most important characteristics of the German research system, whose strength and independence derive primarily from the work done by the researchers and academic institutions involved, as well as being able to rely on the sustainable sci-

ence policy support provided for the system as a whole and its individual organisations, which is in turn based on the planning security of the globally unique Pact for Research and Innovation. Institutional differentiation according to the various functions of research – ranging from basic research and topic-specific investigation motivated by current societal concerns through to applied and experimental research – is a constitutional feature of the system, as is its across-the-board research strength and breadth based on a large network of efficient, regionally distributed institutions and centres in which the higher education institutions have a key role to play.

Within this functionally distributed system, the DFG regards itself as bearing particular responsibility for promoting knowledge-driven research, as President Becker was keen to underline: “The DFG is particularly active in those areas where research itself finds its own topics and follows the dynamic of scientific knowledge processes. Through its funding across the entire breadth of science in Germany, the DFG also has a particular responsibility for the further development of the research system.”

From the DFG’s point of view, this results in three operating principles in terms of its activities: these are set out in the paper as a three-pronged approach – namely “promote, access, shape”. The most important of these is “promote”, i.e.

Left: The DFG Head Office in the Bonn Kennedyallee.



suggestions for expanding collaborative ventures. Challenging examples of this type of “strategic funding action” include the DFG’s AI initiative, the Clinician Scientist Programme, the current measures for universities of applied sciences and the expansion of funding for science communication, as well as targeted international activities and the commitment to a cross-disciplinary science diplomacy strategy.

The third operation principle, “shape”, involves the DFG developing and shaping the appropriate framework conditions and standards required to boost knowledge-driven research of the highest quality. Central topics and fields of action here include

the task of supporting independent and non-prescriptive scientific knowledge processes by organising fair, science-led competition in the selection and funding of incoming research proposals. There are a number of current and future challenges in this area, including the following: continuous adaptation of the funding portfolio to the changing needs of science, optimisation of the review process, issues of academic career support, reform of the publication system and implementation of the second phase of the Excellence Strategy.

The second operating principle “access” has somewhat lesser emphasis and involves providing support for strategic funding initiatives to respond to impulses from the academic community in tapping into or actively fostering specific research fields, to meet acute research needs or to take up

the freedom and independence of research, good research practice, equality and diversity, sustainability, and also the digital transformation and research infrastructures.

“Taken together, the operating principles ‘promote, access, shape’ map out a broad spectrum of possibilities for ensuring excellent research and the advancement of the research system,” said DFG President Katja Becker in conclusion: “Following these principles and with an awareness of its specific impact potential and systemic responsibility, the DFG will continue to fulfil its mandate to shape Germany as a research base and its overall science system.”

www.dfg.de/en/service/press/press_releases/2022/press_release_no_22

The paper can be downloaded under (in German only): www.dfg.de/positionspapier_rolle_entwicklung_dfg



Illustration: DFG/Lichtenscheidt

Christian R. Woolstra

A Rapid Climate Test for Coral

Mitigating ecological collapse: climate change has destroyed almost half of all corals in recent years, and coral bleaching continues to spread. A standardized rapid mobile test promises to identify particularly resilient species and habitats to improve their long-term survival.

Beauty under threat: more and more coral reefs are suffering from so-called coral bleaching as a result of climate change; here a reef at the Farasan Banks, located north of the Farasan Islands in the Red Sea.

September 2021: after a year of no travel due to the COVID pandemic, the research team from Konstanz is diving in the Red Sea again for the first time. Finally! It is the end of summer and therefore the warmest time of the year. The water here currently reaches temperatures of up to 33°C. As in previous years, the team from Germany has discovered corals that have turned white. The dreaded coral bleaching is setting in.

What was considered a marginal phenomenon in the scientific community only a few decades ago has become a bitter everyday reality: annually recurring coral bleaching, which – driven by the increasing warming of the oceans – destroys coral reefs over wide areas and with them a large part of marine biodiversity. The third global coral bleaching event from 2015 to 2018 affected no less than 90 percent of coral reefs worldwide and left about 30 percent of corals dead. The projected horror

scenario is the almost complete global loss of coral reefs, even in the case of only moderate warming of the water by 1 to 2°C – an assessment shared by politicians and scientists alike.

But what are corals anyway? Why are they so sensitive to their prevailing temperature regimes? And what can be done about it? Corals are sessile animals that are considered architects of the coral reef ecosystem. Through their calcium carbonate skeletons, corals create a three-dimensional structure which in turn creates habitat for thousands, if not millions, of species. Coral reefs are therefore rightly called the “rainforests of the seas”. They are of key importance both ecologically and economically and ensure the livelihoods of around a billion people around the globe. There are about 1,000 different identified coral species which all have one thing in common, regardless of the variety of their colours and growth

forms: they are masters of teamwork (symbiosis).

Darwin himself described coral reefs as “oases in the desert of the ocean” and wondered where the energy comes from that sustains them. Today we know that it comes from the symbiotic interaction of corals with intracellular, photosynthetic algae, to which they also owe their bright colours. A coral is essentially an animal that has “learned” to live like a plant. While the coral animal host supplies its algae with CO₂ and nutrients, the algae in return release sugars and other metabolites from photosynthesis to their host, which provides the energy to grow and build skeletons that provide the framework structure of the reef ecosystem.

This symbiosis is so efficient that it meets almost all of the corals’ energy needs. It also explains their sensitivity to temperature: corals are evolutionary “racehorses”, ideally adapted to their environment and water temperature. Yet this is

also their Achilles’ heel as climate change progresses, because even small increases in temperature lead to symbiotic imbalance – or dysbiosis. The algae are expelled, the corals bleach, and eventually starve.

However, not all corals and reef ecosystems are affected equally by the impacts of climate change. Firstly, there are regions such as the Red Sea and the Persian Gulf where corals live and survive despite extreme environmental conditions. Secondly, during many coral bleaching events, colonies can be observed that do not bleach and seem less affected by temperature stress. Clearly: if we want to effectively protect coral reefs as habitats, we need to find out why certain corals and reef sites are more resilient and have a greater chance of survival.

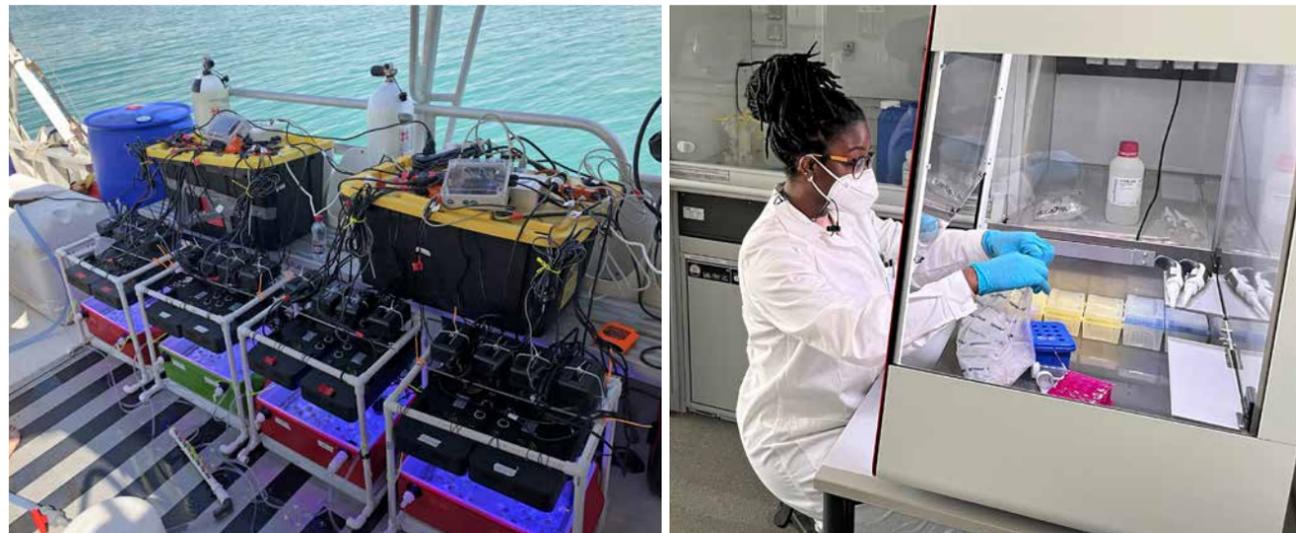
For this purpose, the Konstanz research team led by Christian R. Voolstra and collaborators developed a rapid climate test to assess

the heat tolerance of corals. The “Coral Bleaching Automated Stress System” (CBASS) enables the thermal tolerance of corals to be tested directly on site using a test box and within a single day – rather than having to spend several weeks running laboratory-based experiments as before. The test system is easily transportable and simple to handle: the corals collected during the dive are placed directly into test boxes where a heat test takes place at different temperatures – a kind of stress test for corals. A standardised procedure is used to model their stress performance, which allows a direct comparison between corals, species, and reef sites. The strength of the test procedure lies in its standardisation, which allows identification of resilient corals and reef ecosystems for conservation and further study globally. In order to support the broadest possible dissemination and employment, all assembly instructions, datasets and analytical routines are freely available.

It can be compared to the familiar concept of an ECG, where the heart condition of a patient is determined under stress. Based on a comparative analysis using thousands of other ECGs, robust conclusions can be drawn about a patient’s health without the need for invasive examination. The same principle applies to the stress test for corals: the standardised procedure provides a snapshot of the condition of the corals tested, thereby enabling an assessment of their stress tolerance without the need for costly laboratory evaluation. Based on downstream analyses, it is then possible to further decipher molecular mechanisms underlying stress tolerance and identify diagnostic markers that can be used to detect heat-resilient corals.

Initial results are described in a current research study being carried out with DFG funding. Here, researchers used CBASS assays to determine the heat tolerance of smooth cauliflower corals

Left: Rapid climate test for corals. The “Coral Bleaching Automated Stress System” (CBASS) assesses the thermal tolerance of corals within 18 hours. This is achieved through a standardized testing procedure comprised of four distinct heat stress runs (the photograph shows the four boxes holding coral nubbins and the controller units) and subsequent modelling of their stress performance. Right: A staff member prepares samples for DNA extraction in the laboratory.



Illustrations: Christian R. Voolstra

Striking differences in the heat tolerance of corals: fragments from coral colonies tested for their resilience in the CBASS climate stress test. Some colonies have retained their natural brown colouration while others paled, leading to visible “coral bleaching”.

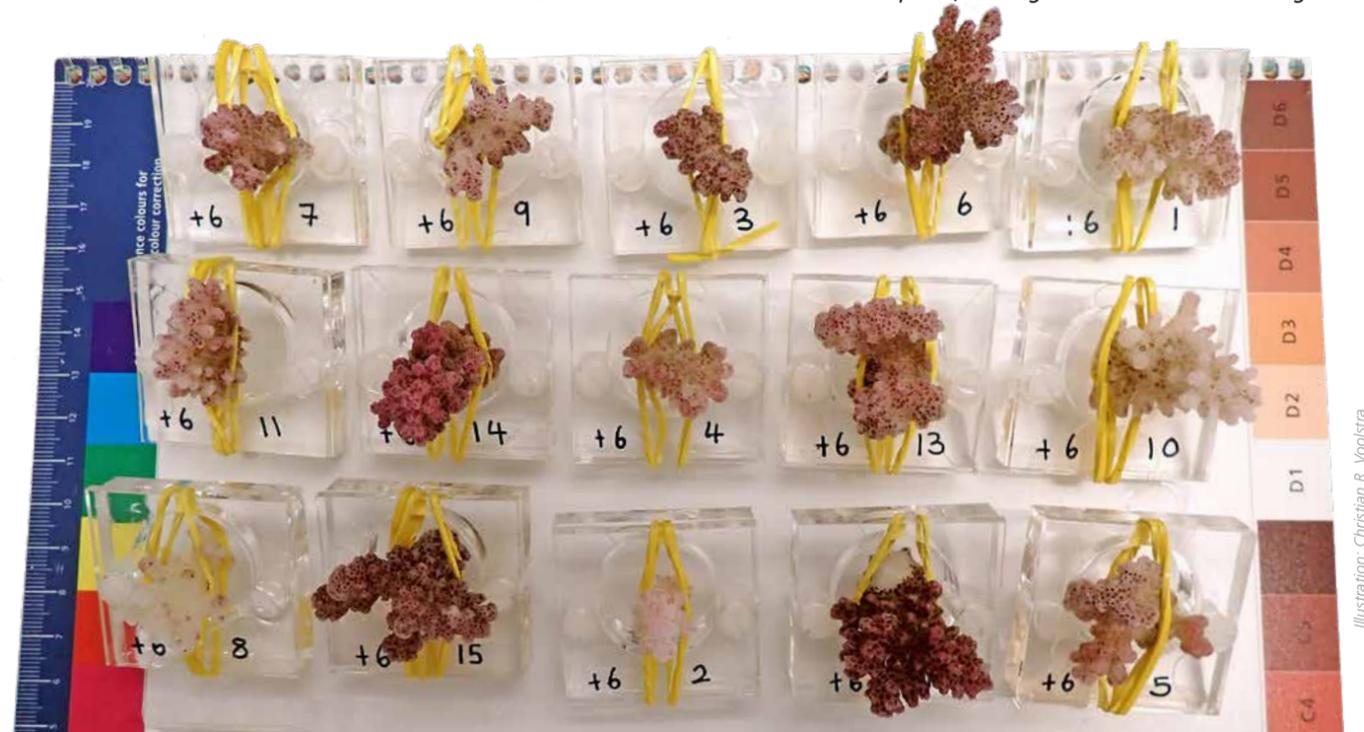


Illustration: Christian R. Voolstra

(*Stylophora pistillata*) from different regions in the Red Sea. The results indicate that smooth cauliflower corals from the Gulf of Aqaba – the northernmost part of the Red Sea – have a high relative heat tolerance that is comparable to conspecific corals from the central part of the Red Sea. However, the absolute heat tolerance of corals from the central Red Sea is up to 3°C higher. This suggests different tolerance mechanisms.

In order to test this hypothesis, the research team conducted further molecular analyses on the heat tolerance of corals from different locations. Genetic studies

show that corals and their associated algae from the Gulf of Aqaba exhibit strongly altered gene expression in response to heat stress, such as the increased production of certain stress proteins. At the same time, the composition of the coral-associated bacterial communities changed. Besides algae, bacteria also have an important role to play in the health and resilience of corals. For example, certain bacteria can increase a coral's heat tolerance by scavenging oxygen radicals. By contrast, smooth cauliflower corals from the central Red Sea did not undergo any of these profound changes during heat stress. In-

stead, both the corals and their algae showed a high, constitutive expression of stress genes regardless of temperature: they already had ramped up a stress response that no longer needed to be induced, also known as front-loading in the scientific literature.

These results support the idea of different mechanisms of heat tolerance in smooth cauliflower corals. The notion is that corals from the Gulf of Aqaba constitute a resilient population that reacts proportionally to the intensity of the temperature increase and can also recover quickly after the stress

The Farasan Banks are home to hundreds of coral reef sites and associated marine biota. This “paradise”, known to divers all over the world, is also suffering the consequences of climate change in the world's oceans.



Illustration: Anna Rokk



Illustration: Pete West

Scientific diving under the Tara Pacific Coral Expedition includes sampling off the uninhabited Ducie Island, the southernmost atoll on Earth. Researchers are interested to determine to what extent the (environmental) impact of humans is detectable in reefs that have not suffered any direct anthropogenic exposure so far.

has subsided. This is an interpretation that was confirmed based on a downstream time series analysis. By contrast, the static and mute response of corals from the central Red Sea indicates resistance to high water temperatures manifested by the constitutive expression of certain stress genes. This permanent “alert state” seems sensible in the extremely high water temperatures in the central part of the Red Sea, but it does not allow for a flexible response if temperatures continue to rise – this is the current conclusion drawn from the available data.

To date, it is not clear which of the two mechanisms protect corals better from the global rise in ocean temperatures due to climate change. However, a smaller number of coral bleaching events have indeed been observed in the Gulf of

Aqaba in recent decades. Research was planned to be continued in the Persian Gulf in the summer of 2022. Based on these data, it will be possible to determine if other tolerance mechanisms exist, or which mechanisms and genes are responsible for the increased stress tolerance of corals from the Persian Gulf. The notion that mechanisms of resilience and resistance can be distinguished in the world's oceans using molecular methods arguably holds important implications for the screening of coral reefs and the identification of particularly heat-tolerant corals. One thing is certain: not all corals and reefs can be saved. This makes it all the more important for researchers and conservationists alike to focus their efforts on those reefs and corals that have the greatest chance of

climate change survival. The newly developed test procedure is poised to make a key contribution here.



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gepris.dfg.de/gepris/projekt/433042944?language=en



Jörg Lauster and Marieluise Clotz

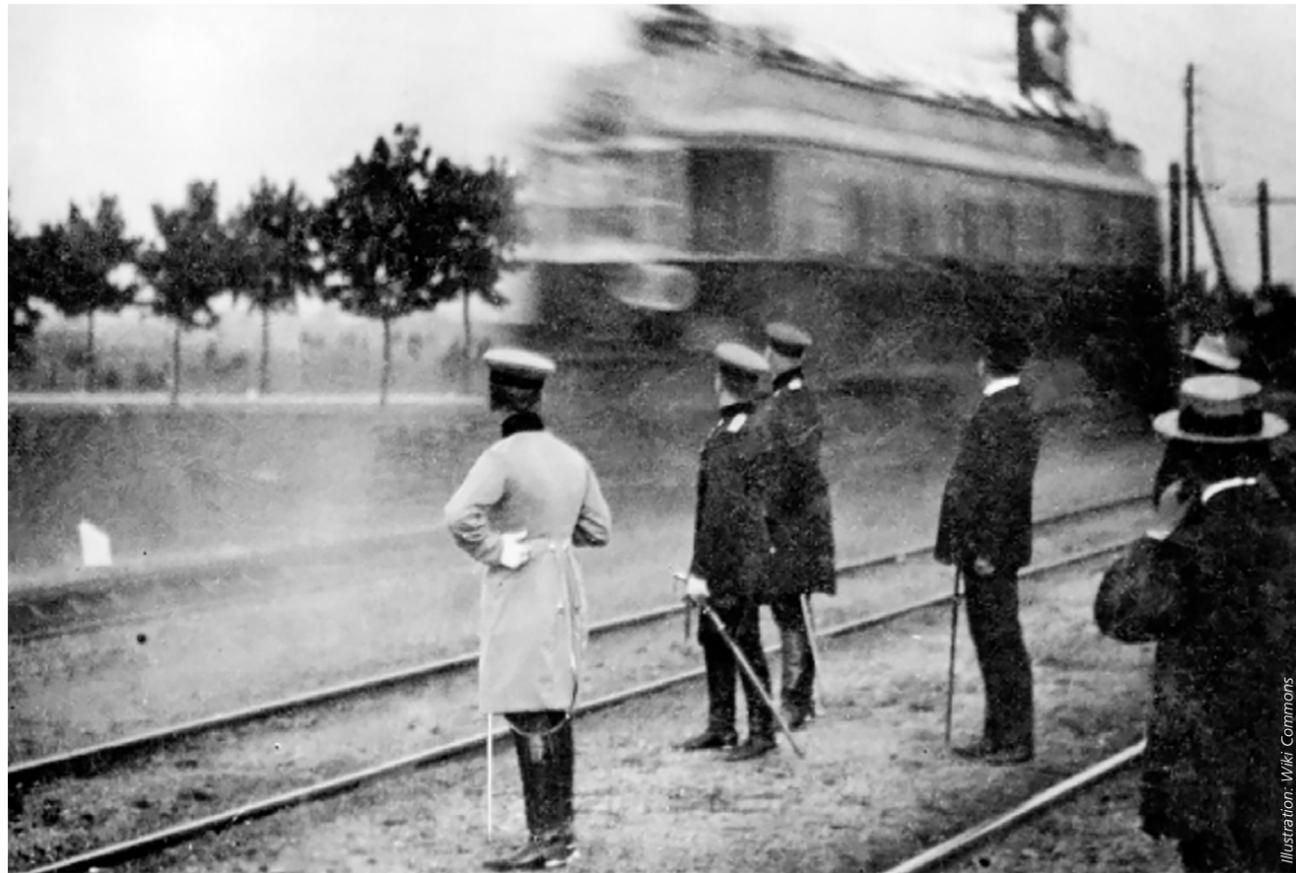


Illustration: Wiki Commons

Christianity and the Spirit of the Age

Around 1900, the journal *Christliche Welt* was one of the most important publication organs of German-speaking Protestantism. Its digitisation provides an entirely new form of access to what is still an outstanding source of the history of theology with its multifaceted relevance to the present.

It is always crucial to ask the right question. “What is a gentleman?” was the title of a short article in the “Miscellaneous” section of the magazine *Christliche Welt* (*ChW*). The author Paul Jaeger (1869–1963) – a Protestant theologian who styled himself P. J. – points to the English origins of the ideal and, following

an Anglican bishop, applies it as the model for a Christian way of life. A gentleman moves through life oriented towards human goodness and with a serene nobility of soul, just as Paul the Apostle recommended to the Corinthians. “This is the ‘Christian gentleman’ – he does not need an ornate ritual code, nor

is he ‘insular’ in character: he belongs – thank God! – to the great international community of Christians” (*ChW* 11 (1897), 335). So far, so revealing.

This brief article perfectly captures the appeal of the *ChW*. From 1886 onwards, under the leadership of liberal theologian Martin

Left: The immense acceleration of technical and social life preoccupied people around 1900, including the contributors to the journal “*Christliche Welt*”. The picture shows a high-speed rail car that reached a record-breaking 210 kilometres per hour on a Berlin test track in 1903.

Rade (1857–1940), it brought together Protestant authors and opinion to publicly discuss the relevance of Christianity in that era. Firstly, this required a keen eye for contemporary concerns. With a sure instinct, the author surmises that the notion of the ‘gentleman’ is not just about etiquette but offers an ideal that is appropriate to the times: to cast this in genuinely Christian terms is to reconcile the spirit of the era with Christianity.

Secondly, it was important to be able to take a broader view: in 1897 the author looks across to England – a country that was in fact in geopolitical competition with the German Empire at the time. The author does not dwell on this latter point, however, instead adopting what would have been a global perspective by his standards by invoking an international Christian community that is in search of what unites Christians all over the world.

Thirdly and finally, access is not reserved for an exclusive circle of readers: there has to be an impact on a broad public. There was no medium better suited to this in the German Empire than the emerging magazines.

The research project *Zeitgeist und Christentum* (‘Zeitgeist and Christianity’) is dedicated to the study of *ChW*, which is considered one of the most important journals of German-speaking Protestantism in the modern era. It appeared

from 1886/87 to 1941, so its period of publication covers the epoch of major upheavals in German history, thereby allowing insights into how the events were interpreted by the Church and dealt with from a religious point of view.

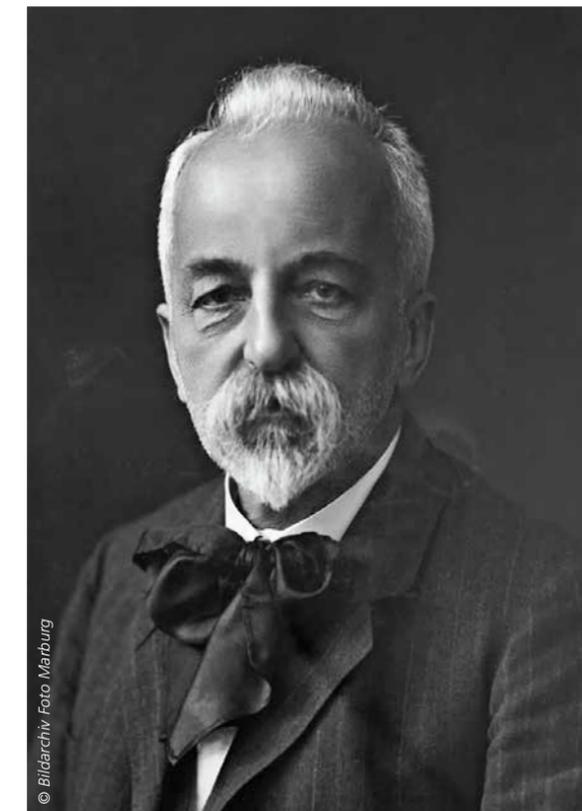
This makes the *ChW* an outstanding source of theological, intellectual and cultural history of the late 19th and early 20th centuries. The distinctive feature of its programme was to bring contemporary trends and Christianity into dialogue with each other – a product of the mindset usually referred to as “cultural Protestantism”. Contemporaries referred to the *ChW* as the “journalistic flagship of cultural Protestantism”. The salient features of the journal under the editorial leadership of Martin Rade were its openness to divergent opinions and its interest in exploring theological positions through joint discourse.

The influential theological debates that were pursued in the *ChW* have already been the subject of research in the history of theology. Almost everyone of any standing within Protestant theology published in the journal, but from a particular perspective: the medium and the target group required writers to step down from their academic ivory tower of theology and put forward their arguments in a way that was widely accessible. This can never be achieved by means of a “translation” of course – as if complexity could simply be conveyed in straightforward language. Such simplification always involves some kind of selective in-

Right: Portrait of Protestant theologian and left-wing liberal politician Martin Rade (1857–1940), initiator and editor of the journal.

terpretation, and in the case of the journal and its articles this was a selective self-interpretation. It offered authors – and especially female authors – the opportunity to explain themselves, which is what makes the journal such a remarkable source for understanding their theology.

This simplification also had a particular objective: most of the articles strive to be relevant to the present. The sheer variety of articles, not only by well-known theologians but also by many lesser-known authors, make the journal a seismograph that records both minor movements and major earthquakes that occurred when contemporary developments came up against Christian tradition. From the foundation of the journal up until 1913, the focus was on the integration of the Christian faith



© Bildarchiv Foto Marburg

Thomas Martin and Thomas Engler

Tooth for Tooth

Insectivorous, frugivorous or omnivorous: Modern imaging techniques and 3D technologies enable palaeontologists to make mammals chew again – virtually – even though they have been extinct for many millions of years.

This provides fresh insights into the feeding habits of the first mammal communities after the extinction of the dinosaurs.



Found on Earth about 150 million years ago: a Jurassic dryolestidan. Early mammals fed mainly on insects, which can be seen from their pointed molars.

Teeth are the hardest and most resistant structures of the mammalian body, making them preferred objects of study in palaeontology, the science of prehistoric life: even after many millions of years, when soft tissues such as muscles and internal organs, as well as hair, nails and horns and even bones have long since passed away, fossil teeth appear intact with shiny enamel.

This is due to the high degree of mineralisation of the enamel, which consists of the mineral apatite, a calcium phosphate, and contains only about 2 percent organic material. For this reason, teeth do not even have to “fossilise” to become fossils: they are already fully mineralised during the lifetime of their owner. However, the hardness of the enamel comes at the cost of the fact that damage to the teeth cannot

be repaired by the body – something we are painfully reminded of when we go to the dentist.

Teeth are the most important source of information for palaeontology, even more so than bones. Members of a species can be clearly identified by their teeth – they are rather like an identity card. Mammals grind their food by chewing thoroughly, which requires a precise fit of the rows of teeth in the upper and lower jaws. For this reason, the shape of the teeth within a species may only vary very slightly, because otherwise this accuracy of fit would be lacking. So each mammalian species has its own tooth pattern and can be reliably determined from a single molar.

In addition to relationships, teeth also provide information about the food and diet of their owners. It is in

the mouth that food is prepared for digestion. The “invention” of chewing with a precise fit of the teeth for efficient grinding of food was one of the key innovations on the way to the great evolutionary success of mammals. While reptiles such as lizards, snakes and crocodiles swallow their prey without chewing it – with their simple cone-shaped teeth, chewing would not even be possible – mammals process their food into a homogeneous paste while it is still in their mouths. This paste can be digested much more quickly and efficiently than an unchewed chunk of food. For this reason, the energy yield is significantly higher, which enables a constant body temperature. These adaptations gave mammals a key advantage in the course of evolution.

The shape of the teeth provides direct indication of a mammal’s diet.

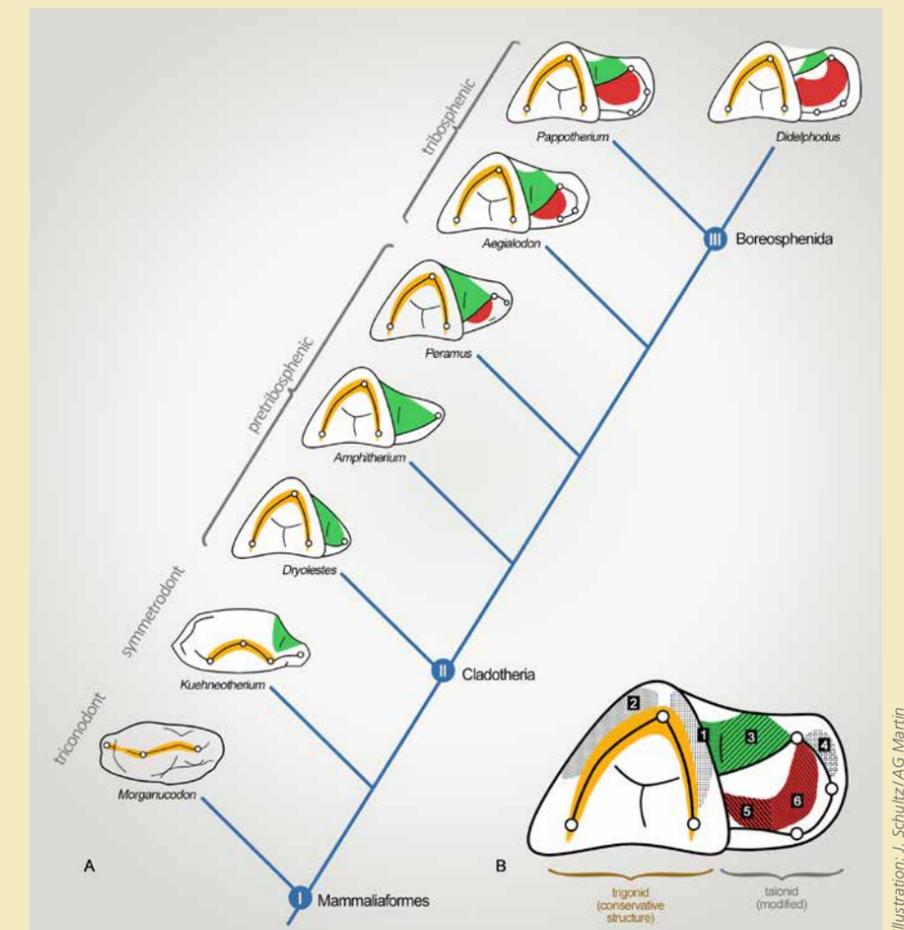
For example, carnivores have what are known as carnassials – a blade-shaped pair of cheek teeth that they can use to break open prey and cut the flesh. Herbivores such as horses and cattle, on the other hand, have flat and broad molars with multiple tortuous enamel edges suitable for grinding tough grass. Meanwhile insectivores such as shrews and moles have molars with many sharp points that enable them to perforate and cut insect carapaces.

The great variety of shapes of the teeth seen in today’s mammals – from the tiny shrew tooth to the elephant grinder tooth – goes back to a basic pattern with three tooth cusps. These were originally arranged in a row and later in the form of isosceles triangles. The triangles of the upper and lower teeth were arranged in opposite directions so that they interlocked in a zig-zag pattern when biting. This type of tooth, which originated about 180 million years ago in the Lower Jurassic, allowed a pierce-and-cut function and was suitable for crushing insects and other invertebrates, but not tough plant food. A squeeze-friction function of the teeth did not emerge until an innovation occurred about 150 million years ago, when a basin-shaped structure – the so-called talonid – was added behind the pierce-and-cut triangle of the lower molars.

A newly developed cusp on the triangles of the upper cheek teeth reached into this talonid when biting down. This is called a protocone and it functioned like a pestle in a mortar (= talonid). In this way, the pierce-and-cut function of the protocone/talonid. This key innovation was a



Top: X-ray images are generated in the microcomputer tomograph, allowing high-precision 3D models of even very small fossils to be created. Bottom: View of the evolution of the tribosphenic molar, which was the starting point for the great diversity of today’s mammalian dentitions.



Right mandible of a 60-million-year-old primate precursor (Plesiadapis) from the Palaeocene of Walbeck. According to palaeontologists, the animal was about the size of a rabbit.



Graphic/Illustration: G. Oleschinski/AG Martin

Illustration: G. Oleschinski

Illustration: J. Schultz/AG Martin

first step towards tapping new food sources, because the tribosphenic molars (from the Greek *tribein* = to grind and *sphen* = wedge) enabled efficient grinding of plant food, too, thereby making it digestible.

The research project focuses on the functional development of mammalian dentitions after the evolution of the tribosphenic molar. Up until the mass extinction at the Cretaceous-Palaeogene boundary 66 million years ago, mammals maintained the basic tribosphenic pattern just described, largely unchanged. But change did occur after the disappearance of the dinosaurs, when mammals began to find new food sources. The three main cusps of the upper molars were joined by additional cusps that widened the chewing surface and provided an additional squeezing function. This apparently occurred several times independently in the course of

evolution in groups that are not closely related, which indicates the high pressure of selection towards a broadening of the chewing surface.

With the help of the software Occlusal Fingerprint Analyser (OFA) developed in DFG Research Unit 771 “Function and Performance Enhancement in the Mammalian Dentition – Phylogenetic and Ontogenetic Impact on the Masticatory Apparatus”, it has been possible to have the dentitions of mammals chew again virtually, even though the creatures themselves have been extinct for many millions of years. For this purpose, the so-called wear facets are utilised – brightly polished areas on the enamel surface of the teeth which are created by contact between the tooth and food during the chewing movement. Fine scratches (striations) on these polished facets, produced by individual hard food particles, indicate the

relative movement of the teeth during chewing.

Using OFA, 3D models of the teeth only a few millimetres in size and generated in the microcomputer tomograph can be brought into occlusion on the screen; the chewing movement can then be virtually reconstructed from the orientation of chewing facets and striations. By quantifying the contact surfaces of upper and lower teeth, it is possible to determine the efficiency of the different molar shapes.

One outcome of these complex investigations: the multicuspid molars have larger contact surfaces and shallower inclined facets, so the squeezing-friction function is significantly increased as compared to the basic three-cusp tribosphenic pattern. As such, these molars were better suited to handling tough food – a first step towards many mammals such as example horses, cattle and elephants later specialising in fibrous plant food.

In addition, the research team has been able to carry out various analyses of tooth surfaces (dental topographic analyses, DTA). These are methods that describe the surface structure of the teeth, such as the so-called relief index. This can be used to determine the complexity of the tooth crown relief. High RFI

The impressive chewing surface of a molar tooth of an ice-age bison. The multiple twisted enamel edges helped grind grass.



Illustration: G. Oleschinski/AG Martin

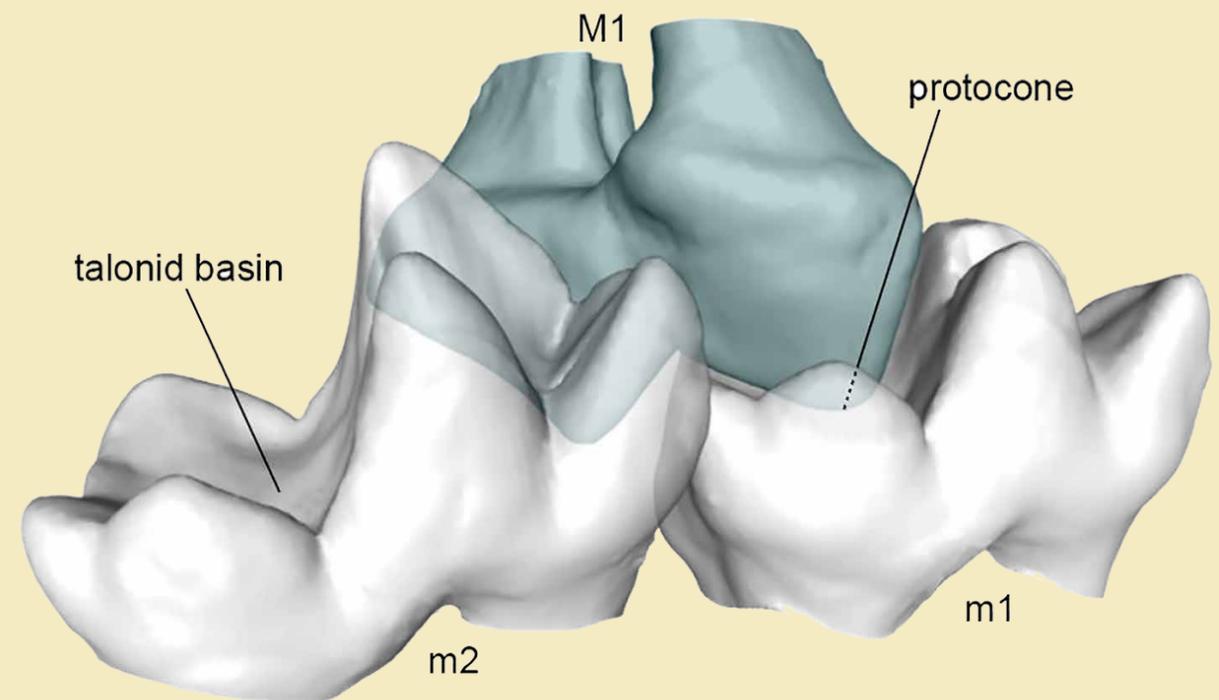


Illustration: J. Brinkkötter/AG Martin

Virtual reconstruction of biting in an opossum (Didelphis) with tribosphenic molars.

values are typical of insectivores and folivores, while low RFI values indicate frugivorous adaptation. It was possible to draw on the excellently preserved fossil material from the Walbeck site near Helmstedt in Saxony-Anhalt, where a rich mammal fauna existed 60 million years ago, shortly after the mass extinction at the Cretaceous-Palaeogene boundary. A total of about 5,000 individual teeth and several dozen complete rows of teeth were available for investigation. Many of the teeth are so well preserved that they still show the tiny details of the chewing facets and striations.

The results of the project show that the mammals of Walbeck pursued different feeding strategies. Some groups with conservative dentition ate insects like their Mesozoic predecessors, while others, such as early precursors of primates

(*Plesiadapidae*), fed on fruits or were omnivorous, which is still true of many primates – including humans – today. These different dietary preferences helped reduce competition for resources among emergent mammals. Based on a functional analysis of the dentitions, the team was able to determine the ecological role of mammals in a Paleocene ecosystem immediately after the extinction of the dinosaurs (with the exception of birds).

The mammals from Walbeck are an outstanding example of how modern imaging and 3D analysis techniques – which have revolutionised palaeontology in the last 15 years – can be used to obtain unexpected palaeobiological information even from long-known museum material (the Walbeck site was discovered in the summer of 1939, shortly before the outbreak of the Second World War). This once again

underlines the importance of collections as indispensable sources of information, today and in the future, also in terms of new questions that might arise for future generations of researchers.



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Further information on the research topic (open access): <https://pfeil-verlag.de/publikationen/mammalian-teeth-form-and-function>



Christian Kehling, Sascha Grollmisch, Estefanía Cano Cerón and Karlheinz Brandenburg



Illustration: Shutterstock

Artificial Intelligence for Colombian Sounds

Automated music transcription and analysis: using machine learning techniques and neural networks, engineers and musicologists are seeking to optimise the retrieval of music information and the data-driven management of digital music archives.

Music is as diverse as the cultures in which it originates. Across the globe, there is a wide range of styles and musical genres – from electropop, rock, hip-hop, country and jazz to neoclassical music. The characteristics of individual pieces of music in terms

of rhythm, tonality, mood and instrumentation are as versatile and multi-faceted as musical genres are diverse.

Basic research on the perception of music has a broad spectrum, ranging from physics with its description of sound pressure and

wavelengths to digital representation and semantic musical analysis. Here, musicologists draw on their resources to investigate the effect of music on people. If you combine this research with novel technologies for automatic data analysis, you enter a field of research that

Left: High spirits and a way of passing the time – men playing their guitars in a shopping street in the central Colombian town of Armenia.

experts refer to as Music Information Retrieval (MIR).

MIR analyses music based on its measurable parameters, thereby attempting to automatically derive conclusions about the properties of higher semantic levels. The starting point is the pure audio signal with its qualities such as volume and frequency distribution. From this, more complex information can be obtained such as time signature, key, genre and the instruments that feature in a recording. This allows the audio material to be assigned to categories in an automated way. Such information is indispensable for large databases in order to enable efficient sorting and searching.

It enables radio and television broadcasters to identify times and slots in the programme where music subject to licensing is to be played without having to sift through or document the tracks by hand after production. Also, streaming services can automatically find suitable music that matches listeners' tastes. Musicians also benefit from MIR by playing their own or other people's works to the computer, which then converts the recorded audio snippet into musical notation. This process is called "automatic transcription" – a longstanding research topic that is comparable to automatic speech recognition.

In recent years, enormous progress has been made in image recognition and speech analysis using the methods of artificial intelligence (AI). In addition to improved hardware, large data sets also have

a key role to play here. Similar progress can be observed in automatic music analysis. Due to the data situation, the research work focuses mainly on western classical and pop music, while regional and traditional types of music receive little attention. Data sets for these are available only sparsely, if at all, or in poor quality. Current research trends therefore focus on approaches that operate with a limited number of examples or are able to draw on prior knowledge that has already been learned or is learnable from related fields. This also applies to the DFG project with the acronym ACMus: it aims to provide an exemplary framework by improving MIR algorithms for the analysis of traditional Colombian music.

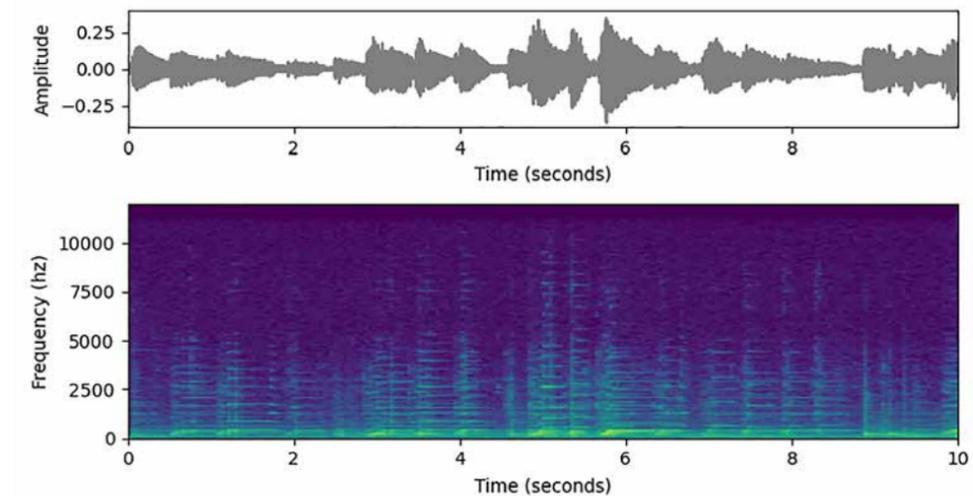
Advanced Computational Musicology, ACMus for short, focuses on the semantic analysis of traditional music from the Colombian Andean region. The project team drew on the intelligent tools and possibilities of machine learning and initially developed AI

tools with the aim of recognising rhythm, language and instrumentation. Eventually, it was possible to use this data pool for the existing databases for the purpose of archiving and searching.

The project involves international collaboration between several institutes and universities. In addition to the Ilmenau University of Technology and the Fraunhofer Institute for Digital Media Technology, also located in Ilmenau, the University of Antioquia and the Pontifical Bolivarian University in Colombia are also involved. Not unexpectedly, it emerged that the expertise that Colombian musicians and musicologists are able to contribute plays a crucial role when it comes to the culturally accurate annotation of sample data. In turn, German team members provide their expertise and knowledge in fields such as signal processing, AI and MIR.

For the purpose of conducting automatic analyses, the research team used neural networks with spectrograms as the input, i.e. a time-frequency representation of

A revealing spectrogram produced by the ACMus project that illustrates the temporal progression of an audio signal's frequency spectrum.



Graphic: AG Kehling

the audio data. This input information is passed on via numerous networked neurons and continuously re-weighted and summarised. At the end of a neural network, the probability of the presence of the learned categories is predicted based on the flow of information. These predictions are then compared to previously compiled expectations, and an error is calculated from the deviations. Based on this error information, network neurons can be aligned so that future predictions can be made with even greater accuracy. Training neural networks is an iterative process and is usually repeated until the calculated error can no longer be reduced.

Such data-based methods require large amounts of suitable sample data in order to be able to make accurate predictions. Unfortunately, there are few existing data records of Colombian folk music, and certainly not in acceptable digital quality. In addition, the annotation of the data is carried out manually, which requires a great deal of time and expertise, so it is very expensive. Since the annotated data pool is fundamental

to the training of neural networks, one of the research team's biggest challenges was to develop new methods that require less training material.

With this goal in mind, the researchers focused on two approaches: transfer learning and semi-supervised learning. The former describes the principle of the adaptation of pre-trained networks to new tasks. To put it simply: A neural network is trained for a task based on a broad database, and this learned model is then adapted to the specific task in question. For example, to learn which audio recordings contain speech, models are pre-trained using large data sets of Western speech and music. These are then adapted to traditional Colombian music and language with the addition of far fewer examples. This is important so as to ensure that indigenous chants are not erroneously classified as language, for example.

The second approach, semi-supervised learning, extends fully supervised learning by integrating non-annotated data: this means

that the entire archive can be used for training so as to help improve predictions when it comes to music recognition – not just the small part of audio recordings marked by experts. It should be noted that errors in unknown data are not amplified by erroneous predictions, so they do not have a negative effect on the overall result. For this procedure, a number of different approaches – including that of image recognition – were systematically investigated and adapted to music data.

The project involved the gradual development of a dataset, and the methods presented were developed and evaluated. After completion of the project, the dataset continues to be freely available to the academic community and includes several subtasks. One part focuses on recognising rhythms in *bambuco* (a musical genre from the Andean region of Colombia that is played in either six-eight or three-four time). Another aspect of the analysis aims to automatically recognise the number of instruments used in pieces of music. This is a challenging task, considering that Colombian music is played on poly-



Nimble-fingered: an indigenous guitar player on the central square of Armenia in Colombia. Researchers have found a new way to digitally document and analyse the sounds of a guitar.

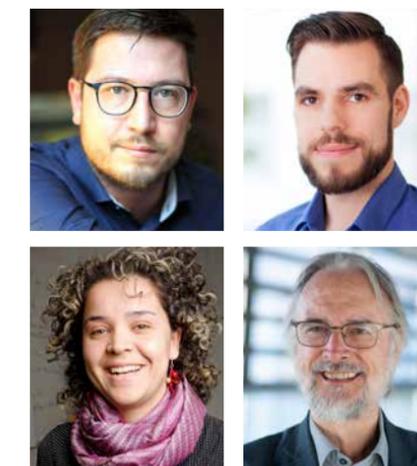
phonic stringed instruments such as classical guitars, *tiples* (so-called necked box lutes) and *bandolas*, which can play either the melody or the accompaniment or indeed both at the same time. Interesting audio samples and all publications are provided on the ACMus website (see QR code at the end of the article). The website also provides free access to the pre-trained models for distinguishing speech from music and for recognising instruments. This was an essential aspect of ACMus.

All in all, the project was able to contribute to directing the interest of MIR basic research towards Colombian music. The musical cultural heritage of the Colombian Andean region is worth documenting and preserving in the long term, not only from the point of view of the project par-

ticipants. In addition, the intercultural and interdisciplinary dimensions of the project have helped reveal some new and interesting aspects. For example, the time signatures of some of the pieces are perceived very differently by the individual musicians. The starting point for the study here was provided by ambiguous results in the automatic determination of beat types based on existing MIR algorithms.

The AI tools available so far still appear to be far too complex to be used by non-experts. In future, it will be important to enable those without technical expertise – such as musicians or music researchers – to use such tools intuitively. In addition to robust, previously trained models, this also requires easy-to-use interfaces and visualisations that are capable of clearly depicting the results.

In view of the world's cultural and musical diversity, flexibility is clearly necessary in creating learning models that are able to respond equally to different characteristics without necessarily having to fall back on existing categories. Adaptive models can help here, i.e. those that are capable of learning. Much remains to be done in data-driven transcription and analysis to develop and use large digital music archives that allow flexible searches and therefore deep semantic analyses. There will be no lack of interested users.



Dipl.-Ing. Christian Kehling and Dr.-Ing. Estefania Cano Cerón, both Electronic Media Technology Group, TU Ilmenau, and **Dipl.-Ing. Sascha Grollmisch**, Fraunhofer Institute for Digital Media Technology in Ilmenau, were involved as collaborators in the DFG project.

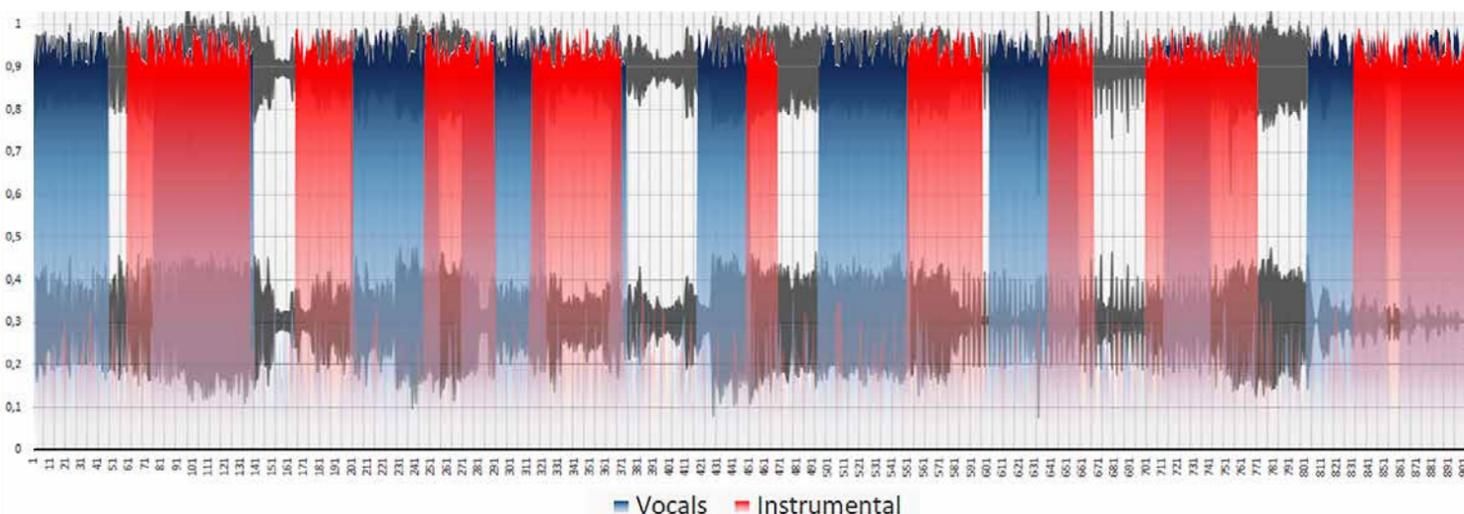
Professor Dr.-Ing. Dr. rer. nat. h.c. mult. Karlheinz Brandenburg was the project leader; he is a Senior Professor of Electronic Media Technology at TU Ilmenau – and gained fame as the co-inventor of the MP3 standard for audio data compression.

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Project website with audio samples: <https://acmus-mir.github.io>

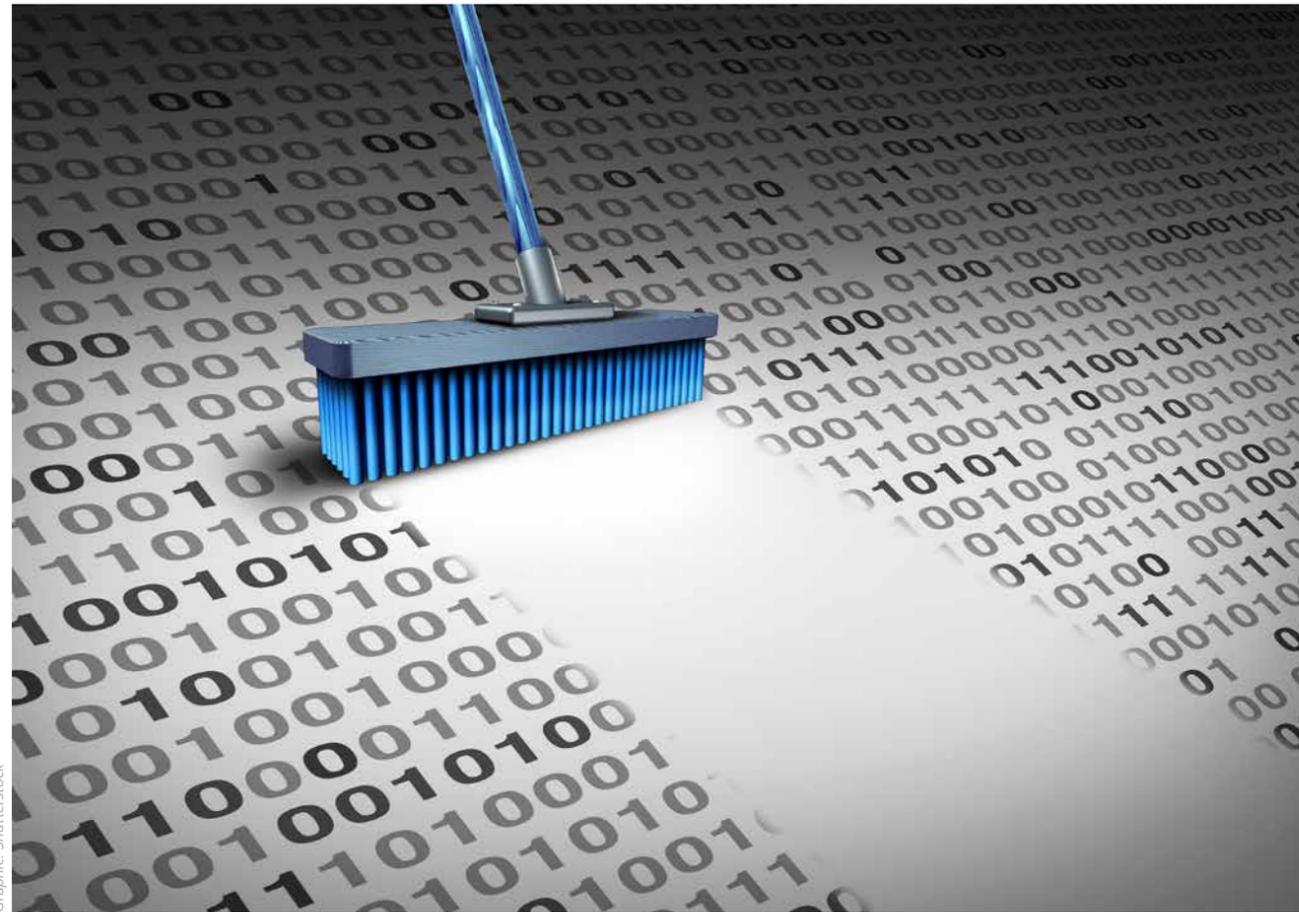


When it comes to analysing pieces of music, it is important to distinguish between music and speech elements. This figure shows a typical waveform with the layered probabilities for vocals (blue) and instruments (red) for each analysed frame.



Graphic: AG Kehling

Ute Schmid and Cornelia Niessen



Graphic: Shutterstock

Dare to Delete More

Cleaning out digital clutter from screens and hard drives: an interactive-learning assistance system has been created to help people take leave of irrelevant files at the workplace. This can be emotionally relieving, too. Computer scientists and psychologists use artificial intelligence for this purpose, thereby putting this technology to use in a day-to-day application.

We all know the problem – all those boxes in the attic that should have been sorted out long ago, or the wardrobe with old clothes that haven't been worn in years. This is an enormous burden for many people – and we often feel better if we're able to stay on top of things and know exactly what can be found where. But clearing out and keeping order are cognitively

and emotionally demanding tasks that often entail a sense of insecurity. Do I really never want to wear this coat again? Surely I might be able to use these empty jam jars some time in the future? Everyone has problems with systematic decluttering to some extent. Those who are incapable of making such decisions suffer from a compulsive hoarding disorder.

In recent years, a comparable phenomenon has been observed in the digital world – “digital hoarding”, i.e. the accumulation of digital items such as e-mails, files and photographs. As with material things, people can have problems deleting their digital “belongings”. The decision to delete or not to delete can involve the fear of making a wrong decision that is irreversible. Initial

empirical evidence suggests that how we deal with digital objects often depends on whether it is in the private sphere or the work context.

The assumption that especially conscientious and anxious people have problems deleting digital objects in the work context has not been consistently confirmed. An experience sampling study conducted in everyday work settings was able to show that the avoidance of deleting irrelevant files is due to cognitive ability rather than personality traits. People who are less distracted by irrelevant information due to their cognitive abilities often see no need to delete irrelevant files at all because they are not bothered by them.

The consequences of digital hoarding are manifold: for some workers, accumulating digital objects can cause them to lose track of what they have – either perceived or in actual fact – even though search functions and filters offer increasingly powerful ways of finding files. Rather like an untidy desk, digital clutter can contribute to people being less able to focus on specific tasks. Initial findings on this have been collected in the field psychology by means of critical incident studies.

For companies, excessive digital hoarding can become an enormous cost factor. Increasingly, data storage is no longer taken care of on an in-house basis but via a cloud service provider. This means unnecessarily stored data generates unnecessary costs. The assumption is that cloud computing consumes

Digital hoarding can become a problem in day-to-day office routine. It can also place psychological strain on people at the workplace.

huge amounts of power – not least according to a Greenpeace report on the energy consumption of server parks; permanent cooling is required here, too.

So it is high time for companies to turn their attention to reducing storage of irrelevant digital objects. The DFG project “Dare2Del” is dedicated to developing an intelligent assistance system to help employees with the cognitively demanding and emotionally stressful task of deciding which digital objects are irrelevant and can be deleted. In terms of computer science, this project has specifically opted for a partnership approach in which humans and artificial intelligence (AI) are to work together and learn from each other.

According to research, a pure assistance system that presents information but leaves the intelligence to the user would not offer sufficient support. The other extreme – an AI system that decides autonomously – would be neither desirable nor feasible in this application

context: it would not be desirable because the decision as to whether a digital object will really never be relevant again ultimately has to be controlled and answered for by a human being; it would not be feasible because the scope of application is too complex and dynamic to reach an entirely certain result at a fixed point in time.

The decision as to whether a digital object is irrelevant is based in part on clearly definable specifications derived from laws as well as company-wide regulations. On the one hand, these can be modelled as rules, e.g. contracts must never be deleted or customer data has to be deleted after a certain period of time. On the other hand, most companies will have departments with specific policies and practices; what is more, employees have their own preferences that are not to be overridden. More often than not, it is difficult or impossible to describe such aspects comprehensively.

The fact that such “tacit knowledge” is relevant to decision-making



Illustrations: Shutterstock / Collage: Hering

in many areas but is not accessible to explicit knowledge representation has, since the 1990s, increasingly shifted the focus of AI research away from knowledge-based methods and expert systems towards data-driven machine learning methods that draw on the “knowledge engineering bottleneck”. The enormous success of deep neural networks achieved in recent years, especially in the field of image data classification, has led to significant interest in the topic of AI in general.

Many methods are extremely data-intensive, however. In order to obtain reliable models in complex applications, the latter have to be trained using hundreds of thousands of data that has been pre-classified or annotated by experts. Once learned, such models cannot adapt to new circumstances. In addition, the data

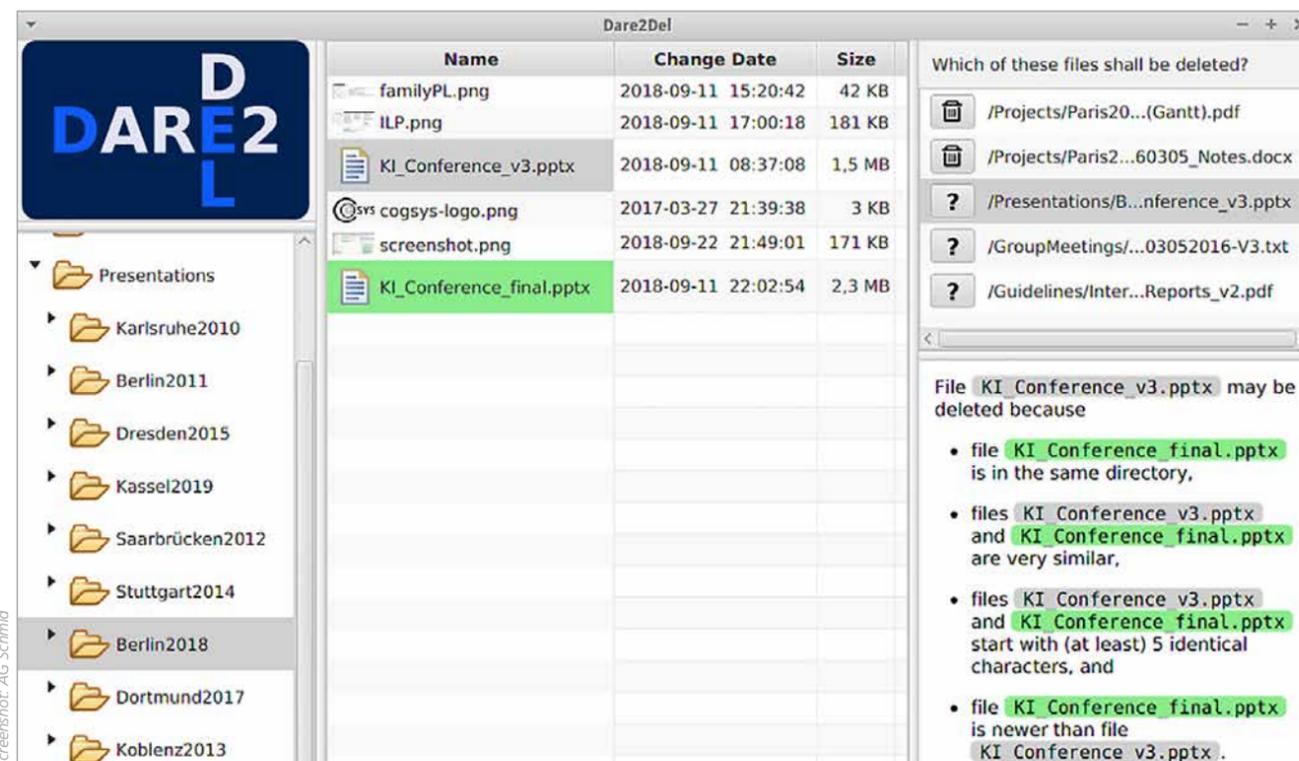
is calculated in such a complex way that even the AI experts cannot understand how a decision is arrived at.

For many practical applications, three requirements for machine learning approaches have emerged as being most important: explainability, interactivity and the possibility of combination with knowledge-based approaches. Dare2Del takes all three aspects into account: in this project, a classic machine learning approach is used as a starting point – namely inductive logic programming (ILP for short). ILP is based on the Prolog logical programming language and allows explicitly provided knowledge, training data and learned models all to be represented in the same format. Legal requirements and regulations can therefore be explicitly introduced into the

system as knowledge. In addition, general knowledge – for example regarding time-based dependencies and directory structures – can be defined and used in the course of the learning process. With most machine learning methods, everything has to be induced from data – even what is actually known. This is why so much data is required. But with ILP it is possible to make most of the idea of “what I already know, I don’t have to learn”. This means that existing prior knowledge reduces the amount of data necessary for learning.

Dare2Del is extending ILP – firstly to enable interactive learning and secondly to generate linguistic explanations. Interactive learning means that users can correct the system decision – in this case whether or not a digital object is irrelevant.

Dare2Del is based on an approach that draws on explanatory interactive learning. The particular feature here is that users can check and correct not only the system’s decisions but its explanations.



Cloud storage often incurs high costs for companies as well as consuming large amounts of energy for power supply and cooling.

Unlike existing approaches, the possibility of interaction is extended to include explanations. Users can also correct explanations, and these corrections are then fed into the ongoing learning process. This allows the model to adapt more quickly and more selectively.

This method of explanation generation is based on an approach developed by American computer scientist William J. Clancey back in the days of expert systems research. His method is expanded on in the Dare2Del project to enable explanations with differing degrees of detail. Currently, the computer scientists involved in the project are working on a variant of explanations based on so-called “near misses”. Users are shown what minimal changes in properties in a digital object would be required in order for it not to have been classified as irrelevant by the current model.

The researchers working on the project assume that by providing explanations in different variants as well as by actively involving users in the decision-making process, it will be possible to achieve a positive cognitive and emotional effect. By actively engaging with Dare2Del, users are supported in specifying their decision-making criteria for deleting digital objects and in becoming aware of these criteria. Active correction also aims to ensure that users feel they can rely on the system’s decisions but at the same time do not develop blind trust in the system and simply rubber-stamp its decisions.

The Dare2Del project is one of eight interdisciplinary tandem projects being pursued under Priority Programme 1921 “Intentional Forgetting in Organisations” (www.spp1921.de). The aim is to tap into mechanisms of human forgetting for

use in technical and organisational contexts and develop information systems that enable organisations to forget information of many kinds – data and processes, knowledge and habits – that has become irrelevant or obstructive.



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www.uni-bamberg.de/en/cogsys/research/projects/dfg-project-dare2del



The Deutsche Forschungsgemeinschaft

The Deutsche Forschungsgemeinschaft (DFG, German Research Foundation), a registered association, is the largest research funding organisation and the central self-governing organisation for research in Germany. Its mission, as defined in its statutes, is to promote “all branches of science and the humanities”.

With an annual budget of around €3.65 billion, the DFG funds and coordinates more than 31,000 research projects in its various programmes. These projects are carried out by both individual researchers and groups of researchers based at universities and non-university research institutions. The focus in all disciplines is on basic research.

Researchers at universities and research institutions in Germany are eligible to apply for DFG funding. Research proposals are evaluated by reviewers in line with the criteria of scientific quality and originality, and then assessed by review boards, which are elected for a four-year period by the German research community.

For more information, visit www.dfg.de/en

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The DFG currently has 97 member organisations, primarily comprised of universities, non-university research organisations such as the Max Planck Society, the Leibniz Association and the Fraunhofer-Gesellschaft, the Helmholtz Association of German Research Centres, and academies of sciences and humanities. The majority of the DFG's budget is provided by the federal and state governments, and it also receives funds from the Stifterverband.

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Dark and bright moments in the international world of science and scientific cooperation: in April, the DFG had to close its office in Moscow at the behest of the Russian authorities – further collateral damage following the Russian invasion of Ukraine, to which the DFG previously responded in early March by suspending all German-Russian research cooperation funded at the institutional level with its Russian partner organisations. These and other effects of the war – along with the currently much-cited geostrategic challenges facing science – are topics that come up frequently in this issue of our DFG magazine. Meanwhile a completely different picture emerges on the American West Coast at almost exactly the same time: in April, the DFG opened its Office North America in San Francisco – the third after Washington, DC and New York. It forms part of the German Centre for Research and Innovation (DWIH), which has also been newly established there. From the DFG's perspective, the Bay Area is one of the most important and dynamic innovation centres in the world, where there is a very intense dovetailing between basic and applied research and entrepreneurship. As Secretary General Heide Ahrens said at the festive opening, this also has the potential to provide valuable stimuli for the DFG, which itself increasingly promotes knowledge transfer.