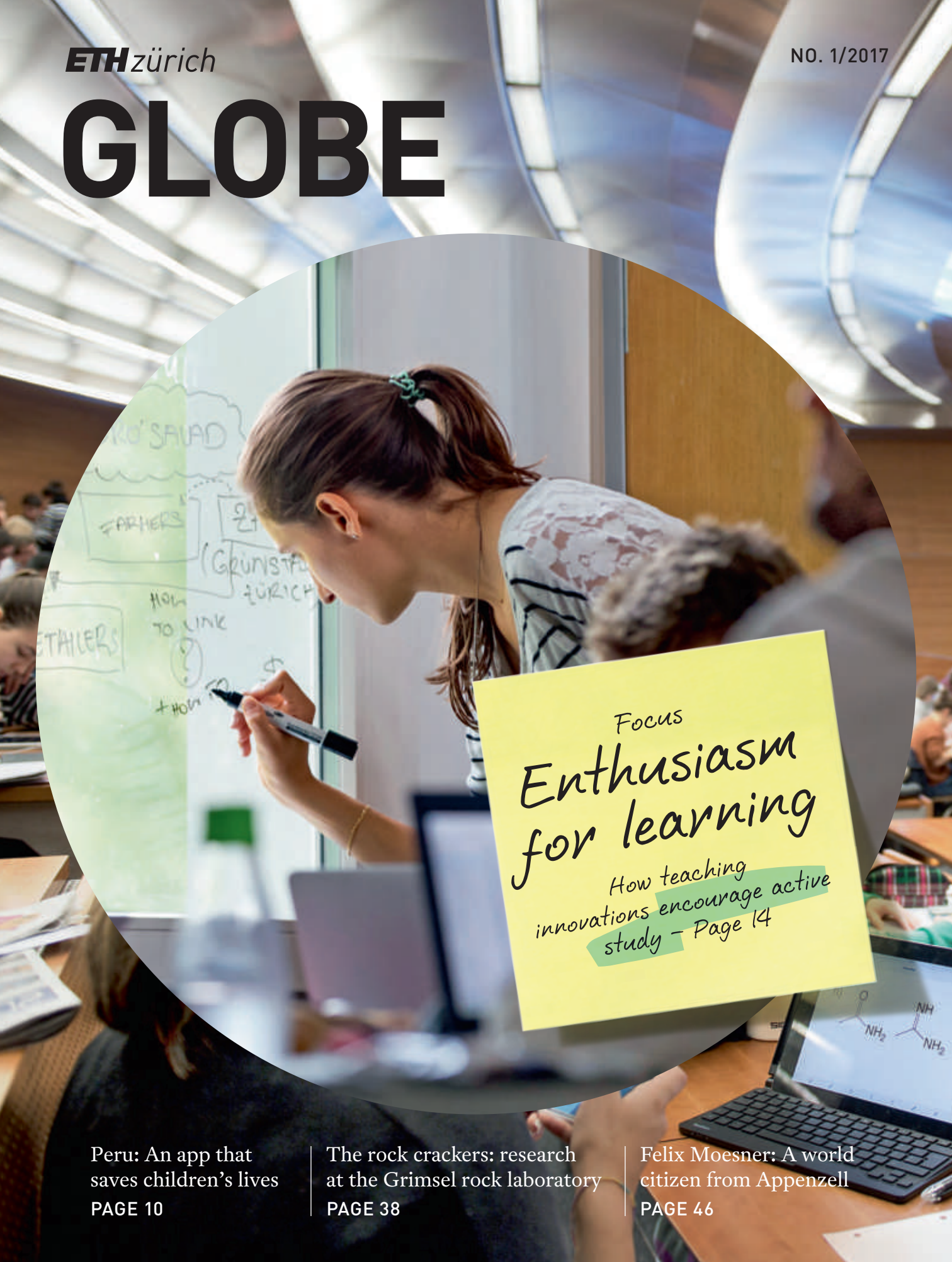
ETH zürich

NO. 1/2017

GLOBE



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CHANGING KNOWLEDGE

Lino Guzzella, President of ETH Zurich

Today we find ourselves in a world that changes more quickly than ever before. In this digitally connected age, we can access news and information every second of the day. With just the touch of a screen, we can find the answers to questions in even the most exotic fields of knowledge. Yet at the same time, we are learning that in the flood of available information, it is becoming ever more challenging to sort the wheat from the chaff.

What can we learn from this? The memorisation of factual information loses its value in the digital age of learning. Instead, learning to critically assess information, determine its significance, and put it into its proper context is becoming more and more important. If we want to help shape change, rather than letting it simply wash over us, we must empower young people to be creative, critical and agile in their thinking, and responsible in their actions. While the value of knowledge as a personal asset is diminishing, critical thinking is becoming more valued.

The foundation of an ETH education rests on rock-solid methodological expertise in mathematics and the natural sciences. Nevertheless, as a university we must also continue to develop our teaching. It is an exciting time to try new things – to dare to experiment. ETH Week, the Student Project House, project-oriented teaching in a variety of courses – all of these give our students the chance to test themselves in projects of their own and grow in interdisciplinary teams. Digital tools increase the opportunities for interaction between students and lecturers, and innovative teaching formats like flipped classrooms allow students to determine how they learn. Find out more in this issue of *Globe*.

You can read how the Rector would like to develop teaching at ETH Zurich from page 16 onwards.

Lino Guzzella, President of ETH Zurich

Cover image: Alessandro Della Bella; Simon Tanner Editorial: Giulia Marthaler

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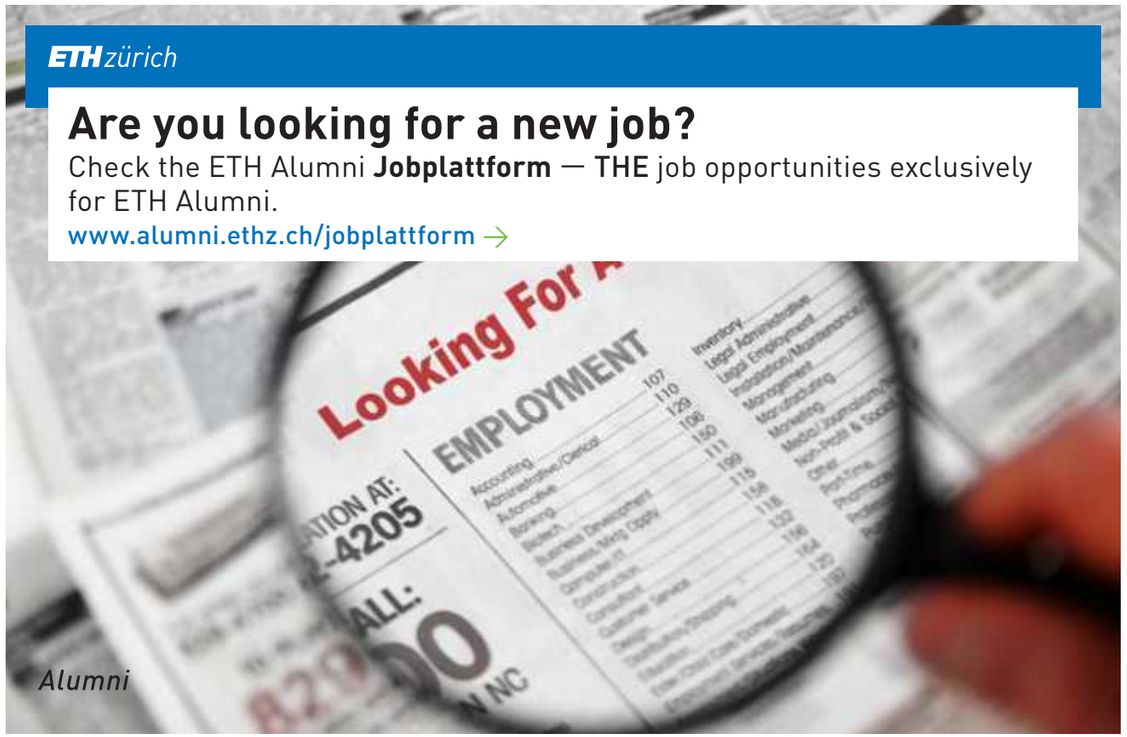
Image: Walter Karlen; Daniel Winkler; Jesse Burke



Alumni

NEW AND NOTED

Network-based structural colours can also be found in nature, for example in the South American plum-throated cotinga (Cotinga maynana).

Material research

NETWORKED COLOURS

An international team including ETH scientists has developed a new material that can be used to produce coloured coatings for metals. It consists of a very thin oxide layer placed on top of a metallic network perforated by tiny cavities. Different colours are created by varying the thickness of the oxide layer. These newly developed network-based structural colours are easy to apply over large areas, and their intense luminosity and extreme resistance to scratches ensures that they retain their colour even when the coating is damaged.

Analysis

ULTRAFAST PROCESSES

In nature, some processes occur so quickly that the blink of an eye is very slow in comparison. For example, many basic physical, chemical and biological reactions take place on the ultrafast time scale of a few femtoseconds (10^{-15} s) or even attoseconds (10^{-18} s). Tracking such processes in real time with atomic resolution is one of the main reasons for developing new large-scale research facilities such as SwissFEL, the Swiss free-electron laser.

For the first time, ETH researchers from the ultrafast spectroscopy group, together with colleagues from the University of Geneva, have successfully analysed such quick reactions using a compact laboratory X-ray source. Using the new device, they were able to demonstrate how a chemical reaction can change two highly fluorin- ated molecules within a few quadrillionths of a second.

The researchers first needed to refine an X-ray-based measuring technology, known as X-ray absorption spectroscopy, to achieve a time resolution of 20 femtoseconds. They then added a femtosecond laser beam in such a way as to produce a coherent, soft X-ray beam with a "white" spectrum that can be used to obtain precise structural information. The new device can, for example, be used to analyse the distribution of electrons within a molecule or the distances between atomic nuclei.

Medical technology

PRECISE MEASUREMENT

Researchers from the ETH Institute for Biomedical Engineering have used a new sensor to successfully measure tiny changes in strong magnetic fields with unprecedented precision. The new sensor is so sensitive that it can even be used to measure mechanical processes in the body, such as the contraction phase of a heartbeat. The researchers hope to obtain information on heart diseases using this new, non-invasive approach.

Image: Flickr/Gregory Smith; Peter Rüegg

NEW AND NOTED

Big adventure

AROUND THE ANTARCTIC

Shortly before Christmas, the Russian icebreaker Akademik Tryoshnikov set out from Cape Town, loaded with people and equipment, on the Swiss Polar Institute's international Antarctic Circumnavigation Expedition (ACE). The expedition, which will come to an end again in Cape Town this month, comprises a three-month-long complete circumnavigation of the South Pole.

During the expedition, 55 scientists from 30 countries are researching numerous aspects of the Antarctic in 22 interdisciplinary projects – sometimes under hazardous conditions, such as here while making the crossing to La Possession, an island in the Crozet archipelago.

One of the projects is by ETH Professor Heini Wernli, whose research group wants to conduct a detailed investigation of the hydrological cycle of the Antarctic Ocean. Further ETH researchers belong to the group led by Derek Vance. They are studying diatoms (a type of algae) in the Antarctic Ocean and their influence on the nutrients in other oceans.

→ www.spi-ace-expedition.ch

Image: Florian Bruckner

Mobile health

An app that saves children's lives

In remote villages in Peru, pneumonia is one of the most common causes of death in children. Now researchers from ETH Zurich are in the process of developing an app to help identify the illness early on.

Each morning, at 6 a.m., the same scene plays out in the small town of San Marcos in northern Peru as seven research assistants climb onto their motorcycles and set off over steep, unsurfaced roads. Their daily task: to survey the tiny villages that lie scattered around San Marco at altitudes of between 2,300 and 3,900 metres, visiting families with children who are currently taking part in a study.

The study is being conducted by researchers from ETH along with the Swiss Tropical and Public Health Institute (Swiss TPH) and Universidad Peruana Cayetano Heredia. "Our goal is to improve the living conditions and healthcare for children in this area," says Walter Karlen, Assistant Professor and Head of ETH's Mobile Health Systems Lab. To achieve this, Karlen is turning to mobile health technology and developing an app designed to provide a faster and more reliable way of diagnosing pneumonia in children.

A research assistant from the Environment-Health-Development-Platform in San Marcos examines a little patient with a pulse oximeter connected to a tablet.

Lack of early identification

Alongside diarrhoea, pneumonia is the most common illness in small children in the Cajamarca region. Many people here live in extreme poverty. The floors of the houses are made of compacted clay, kitchens have no running water and most people still cook over an open fire. "The smoke and poor hygienic conditions help respiratory illnesses take hold," says Daniel Mäusezahl, epidemiologist at the Swiss TPH. For years now, he has led multiple studies focusing on environmental health in the region. These aim to improve children's health through the installation of enclosed stoves and instruction in hand washing and kitchen hygiene – and thereby to avoid illnesses, and pneumonia in particular, in the first place. According to the World Health Organisation (WHO), almost two million children worldwide die of pneumonia every year – more than malaria, AIDS and measles combined. "Often the illness is not detected early enough," says Karlen, who is heading up the study along with Mäusezahl. The reason for this is the lack of early warning systems as well as lack of medical care. The only hospital in the region is in San Marcos – which is more than 50 kilometres away from some of the villages. There are around 25 small health centres in the catchment area, but these have no doctors and are staffed exclusively by nurses. Because it is difficult for the nurses to differentiate pneumonia from ordinary bronchitis, children are often taken to hospital only when their condition is critical. "By then, sometimes it is already too late," says Karlen.

A new app aims to prevent cases like this by assisting medical staff as they diagnose pneumonia. An initial version is already being used as part of the study by the local research assistants, whom he trained himself. Each week, the research assistants visit each of the 300 or so families involved in the study, asking parents about the health of their children, who are all two years old or younger. They also measure the children's breathing rate using the app. "This is an important diagnostic marker for identifying pneumonia," says Karlen. In small children, a normal breathing rate is between 20 and 40 breaths a minute. This is usually measured by observing how many times the child's chest rises and falls in the space of a minute. "However, people often lose count," says Karlen, potentially leading to an inaccurate value.

More diagnostic certainty

The app eliminates this problem by taking care of the counting. All the user needs to do is tap the screen each time they see the child breathe. If there is any break in the pattern, the app counts it as an accidentally missed measurement point and has the user keep tapping until the app can determine a reliable average value. It is also possible to store the results on various days and compare them at a later date. "This provides the person taking the measurement with added certainty and supports them in making a diagnosis," says Karlen. Previous studies have already indicated that the app is faster and just as reliable as the conventional counting technique.

However, the use of the app as a diagnostic tool is just one part of the study, and the priority is now on expanding the app functions. As Karlen points out: "The more indicators we can collect in addition to the breathing rate, the more reliable the diagnosis." One of these indicators is the oxygen saturation in the blood. If this value is extremely low, it is a good indicator of severe pneumonia. For this reason, each time the research assistants also take a measurement with an instrument known as a pulse oximeter, a standard piece of medical kit in these parts. A sensor attached to the finger uses infrared light to measure the levels of oxygen in the blood.

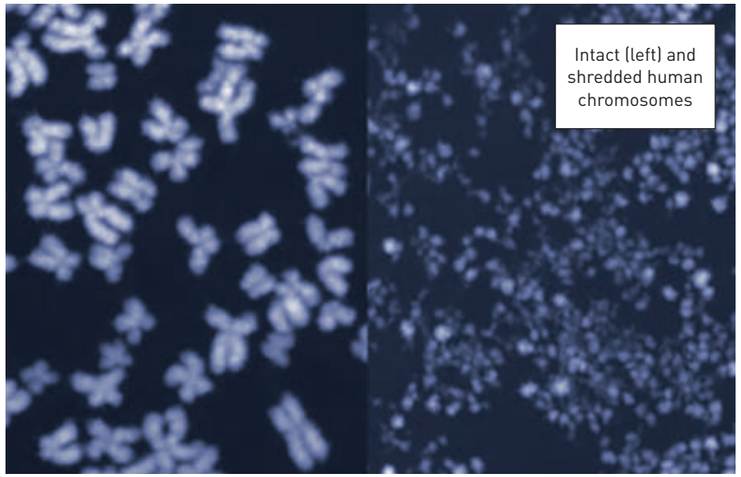
The study is intended to demonstrate whether or not blood oxygenation is also suitable for use as a diagnostic criterion within the app. To do this, the researchers have already developed a mathematical model that factors in the oxygen levels of the air at a given altitude. It then correlates this with blood oxygen levels, which allows it to determine the probability of severe pneumonia in the patient. However, there are still a few hurdles to overcome before this becomes a viable method. One is that blood oxygen levels vary widely from individual to individual, even in healthy people. There is also the fact that oxygen levels vary with altitude: as the air becomes thinner, blood oxygen levels decline. This makes it difficult to determine standard values, particularly in the case of children living high in the Andes. For the moment, the researchers want to collect as much data as possible from a range of altitudes so that they can validate their model. Since the research assistants also note each child's state of health on each visit, it is also possible to compare values from healthy and sick children.

If the results are promising, the researchers intend to create a new, expanded app. This could then be rolled out to the local health centres in collaboration with local health staff, and tested for everyday practicability. "Apps have enormous potential to improve healthcare in places lacking medical equipment and expertise," says Karlen. After all, these days smartphones and tablets are cheap and commonly found even in low and middle income countries. Karlen hopes that his app will be one of those helping to save children's lives in the future. — Claudia Hoffmann

Local research assistants discuss using the app during a training session.

Information about the project:
→ www.ethz.ch/pneumonia-diagnosis

Image: Environment-Health-Development Platform, Peru, (UPCH – SwissTPH), Walter Karlen, Daniel Mäusezahl



Cancer therapy

WHEN SCISSORS TURN INTO SHREDDERS

Enzyme MUS81 might have an obscure name, but it plays a central role in our cells – for example, in emergencies where cells are unable to replicate because the DNA-replication machinery gets tangled up in strands of DNA. MUS81 then works like a pair of genetic scissors to help clear the jam: the enzyme cuts the DNA molecule near the site of stalled replication, thus enabling replication to restart and the genome to be entirely copied before cell division. However, the function of this important enzyme must be precisely regulated, so that it severs the DNA only when this helps the cells.

Researchers from the Institute of Biochemistry at ETH Zurich have now worked out in detail how the control mechanism functions. Their research is also encouraging for clinical trials of a cancer drug that targets the regulation of MUS81. Originally developed by Japanese scientists, the drug is currently undergoing clinical trials to examine its effectiveness for treating different types of cancer.

The drug disables a control protein that regulates the cell cycle. This causes MUS81 to spin out of control and break up chromosomes relentlessly, shredding the entire chromosome set and thus killing the cells. The new findings could help to shed light on the results of the ongoing clinical trials and explain, for example, why the cancer drug works better for some patients than for others.

Agriculture

PIGEON PEAS IMPROVE SOIL FERTILITY

Maize is Malawi's most important food crop and is widely grown by subsistence farmers. But crop yields tend to be mediocre in many regions. A lack of phosphorous – and often nitrogen – in the soil is a common problem. After a major fertilizer programme failed to yield long-term results, an ETH doctoral student has now come up with an alternative solution. She showed how a mixed crop of maize and pigeon peas could improve soil structure, which in turn has a beneficial effect on soil fertility. This could increase maize yield in the medium term.

Microbiology

A SIMPLE WAY TO COMPLEXITY

It is one of the most complex known naturally occurring peptides: a cytotoxic nanotube used by sea sponges living in the Pacific to defend themselves against other creatures. The agent is produced by bacteria that live in symbiosis with the sponges. ETH microbiologists showed how nature creates this peptide in a staggeringly simple way. This was the starting point for them to work on how to use biotechnology to create this compound – which is also of interest to cancer research – extremely simply.

Image: Jiradet Gloggnitzer

Geophysics

DRAMA ON THE ALETSCH GLACIER

The Moosfluh, the slope that borders the Aletsch glacier, has been moving for many years. But now, the whole slope, which covers an expanse of about a square kilometer, is moving downhill at an unprecedented pace. The temporary closure of the Moosfluh cable car operations last autumn – despite its mountain station's movable foundation – shows just how dramatic the situation is. Geoscientists at ETH Zurich can now show that the instability of this slope is connected directly to the retreat of glacier ice and thus to climate change.

For their analysis, the researchers relied on a unique dataset that was collected using various measuring instruments and systems, including airborne and terrestrial laser scanners, as well as radar and GPS measurements. They also analysed satellite and historical measurement data on glacier dimensions, and topographical maps.

The data shows that the situation deteriorated rapidly after glacier shrinkage reached a critical threshold in the mid-1990s. Ever since, the glacier ice has been receding at a faster rate than before. This, in turn, has accelerated the slope movement, albeit with a time lag of nine years.

The fact that glacier shrinkage causes slopes to move is nothing new for geologists. However, until now they assumed this would be a slow, barely perceptible process. That is why they are so surprised at how quickly the Moosfluh slope is moving.

An increasing number of rockfalls have occurred at the foot of the Moosfluh slope.

Image: Andrew Kos

Climate research

PROFITABLE GOALS

At the end of 2015, the international community met in Paris and agreed to limit global warming to under 2 degrees Celsius. A research team including ETH scientists has used global fishing as an example of how this could benefit humanity. Comprehensive model calculations reveal that the fishing industry stands to profit enormously if average global warming does not exceed 2 degrees. This is particularly true in tropical areas, where excessive warming would lead to drastic losses of up to 47 percent.

Biotechnology

AGAINST DIABETES

ETH researchers from the Department of Biosystems Science and Engineering have used an engineering approach to produce artificial beta cells. These cells can do everything that natural pancreatic cells do: they measure the glucose concentration in the blood and produce enough insulin to effectively lower the blood sugar level. The new beta cells have proven to be extremely effective in animal tests conducted so far. They worked better and for longer than any other solution in the world.

Find out more about this and other ETH Zurich research at:
→ www.ethz.ch/news-en

Being creative also means occasionally taking an unusual position: students working on a project for ETH Week

1ST PRIORITY: ACTIVE LEARNING

"THERE IS NO SUCH THING AS THE IDEAL TUTORIAL SESSION."

Guillaume Schiltz – P. 25

"In future, problems will become more complex, and multidisciplinary teams more important." – P. 16

Sarah M. Springman

The amount of information available today is approaching infinity, while the half-life of knowledge is getting shorter. Critical thinking is becoming increasingly important. Taking independent action, working in teams, taking a creative view of the big picture – these skills, coupled with solid expertise, will be key to shaping the future. *Globe* shows how ETH Zurich is using innovative teaching to get its students fit for the future.

Image: Alessandro Della Bella

Ready for the future

Rector Sarah Springman explains how ETH Zurich prepares its students for the job market and what opportunities new teaching formats have to offer.

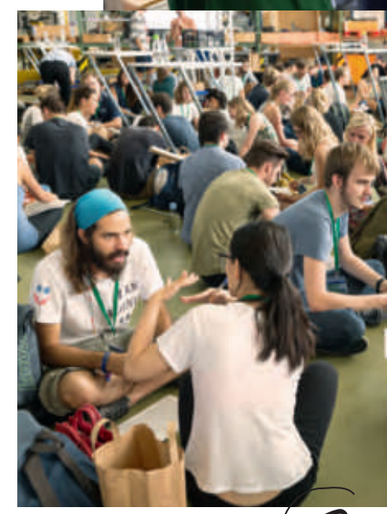
INTERVIEW Florian Meyer and Roland Baumann

Sarah M. Springman
A UK native, she has been a Full Professor of Geotechnical Engineering at ETH Zurich since 1997 and Rector of the University since January 2015. Sarah Springman is responsible for all matters related to teaching and for the organisation and quality assurance of study-related matters, including the examination process.

Where is teaching at ETH Zurich heading?
Active learning will gain in importance, which will be manifest by more use of flipped classroom techniques, combined with independent and group working. Our students will still have to have a basic understanding of the fundamentals and relevant technical and scientific knowledge, and they should also be able to analyse a problem independently and recognise which concepts and principles should contribute to the solution. Moreover, these problems will grow more and more complex over time. It will become increasingly important to flesh out project-related solutions in multidisciplinary teams, a skill that will permit our graduates to stand out on the job market.

Is that also one of the reasons why ETH created the KITE Award, which honours the most innovative teaching concept? It was bestowed last year for the first time, going to a project-based course.
Yes, Mirko Meboldt's course is a good example of what I'm talking about. It requires first-year students to work in teams of five or six to develop and test a product under competition conditions. Teamwork is a focus of ETH Week, too: based on a cross-disciplinary topic, such as nutrition or water. Students learn to work in multidisciplinary groups to research, present and debate concepts through "design thinking" and to develop creative and critical solutions to complex problems.

Image: Markus Bertschi



1. ETH organised the second ETH Week in September 2016. Students looked for sustainable solutions to issues concerning water as a resource.

2. More than 180 students from 20 countries and all 16 departments participated.

3. The students learned to develop their ideas in interdisciplinary teams and communicate them to others.

And in the Student Project House?
Students from various disciplines work together either alone or in teams in the Student Project House. The focus is not only on the result of their extracurricular project work, but to an equal extent on entrepreneurial learning and discovery processes, so that students can try out their own ideas in a well-equipped and safe space. If something doesn't work straightaway, there are other students and coaches on hand to provide support; students are encouraged to examine critically what worked well and what they would do differently next time. Students who conduct projects that permit them to activate their own ideas may well carry these memories with them for the rest of their lives.

"We want to create more space."
Sarah M. Springman

How are these efforts related to the Critical Thinking Initiative that ETH launched in 2014?
We need technical experts who weigh up the pros and cons of a solution as a matter of course, and who can convince others of the value of their approach through their arguments. We want to create more space in the crowded curricula to promote critical thinking and to allow time for active learning and reflection. ›

Image: Alessandro Della Bella (3)

How will you create this space?
Some degree programmes already include such space, others are planning changes. We held a retreat in 2015 with around 100 participants, all of them individuals who shape education at ETH, including the Directors of Studies, who are responsible for curricula, as well as administrative staff who support teaching delivery.

"Students learn very differently today than they did 20 years ago."
Sarah M. Springman

When we talk about "new learning", we inevitably think of online courses. What role do these play at ETH?
We have a modern e-infrastructure with smartphones, computers and internet. Digitalisation permits us to exploit the strengths of the various media and to offer our students a range of choices of how to learn, independent of time or location. If they can understand a topic more easily through an animation or film, then they should take advantage of those online offerings. Our students are digital natives, and they expect this from us. For me, "blended learning" is the future. ETH has been active in this area over the past nearly 20 years.

Do digital learning methods impact the way students learn?
Absolutely. Students learn very differently today than they did 20 years ago, not least because they have more options. They can almost customise their education programme. However, this also means that students have to figure out for themselves what works best for them. Our Student Services provide advice if asked.

And it doesn't necessarily have to be a digital format?
Students can acquire the knowledge they need through independent study, by attending classes, doing exercises and labs or by talking to experienced students and lecturers. After all, everyone learns in their own way. Some appreciate lectures, while others prefer to watch video podcasts; some like to learn in groups, others do so alone. Project-based learning, too, isn't everyone's cup of tea. How an individual learns is a personal decision.

How is the relationship between lecturers and students changing?
New teaching methods can lead to more intense and more personal interaction, but this doesn't fundamentally change the central role of the relationship between lecturers and students. This is an important characteristic at ETH. In the UK, students are increasingly viewed as customers because they pay high tuition fees. I don't agree with this perception because there is an experience gap between professors and students. Feedback from students is very important, whereas professors are responsible for determining what content is relevant to a course and what will be tested. This ensures the quality of the education. ›

Image: Simon Tanner (3)

1. New learning methods, such as the flipped biology classroom shown here, enable more intense interaction between lecturers and students.

2. In this model, sitting passively in a lecture is a thing of the past. Students work in small groups on interactive online tasks.

3. Because students can prepare the material on their own, there is a lot of time for discussion and individual support in the lectures.

Private funding for innovation in teaching

Donations from forward-thinking sponsors drive many of ETH Zurich's pioneering teaching projects. Donors such as the Ernst Göhner Foundation, the Baugarten Foundation, the Schwyzer Winiker Foundation and Plastic Omnium have made the Student Project House possible, while the Avina Foundation and the Wegweiser Foundation are behind ETH Week, part of the Critical Thinking Initiative. Individual donors have also made a significant contribution to promoting teaching: ETH Zurich alumnus Adrian Weiss established the Rector's Impulse Fund at the ETH Zurich Foundation, which provides annual funding for the implementation of innovative ideas.

→ www.ethz-foundation.ch/en/education

Digital learning methods allow students to learn anytime, anywhere.

Image: Alessandro Della Bella

Hannes and Luca are fired with enthusiasm about their Velopranger project.

In the Student Project House, students can implement their own ideas and projects. Here, sudents are developing an app for cyclists.

So, a range of choices for learning methods, but no picking and choosing course content?
ETH is unlikely to offer a completely freely configurable Bachelor's or Master's programme. The degree programmes have to form a coherent whole. As a university, we make every effort to support our students according to their preferences, but they have to fulfil the ETH requirements in order to pass. We don't make any concessions on quality. A degree from ETH will never come cheaply – that is, without any great effort. In return, our successful graduates are highly regarded in industry.

So fulfilling requirements means passing exams. What kind of latitude does digitalisation afford here?
One innovation is the highly original Safe Exam Browser, or SEB, which we developed here at ETH and have released to a Consortium as open source software. It not only enables integration of a wide variety of application software, but also facilitates access to selected websites in a protected environment. This makes it possible to test the skills and proficiencies students will need later in industry in an exam environment: they have to possess the factual knowledge and understand it, and be able to explain it in their own words and apply it to examples. For instance, SEB allows computer science students to program in their exam, which reveals a lot more than when they answer multiple choice questions. Incidentally, this service puts the University among the best in the world in online exam delivery.

What basic skills and core competencies should students acquire at ETH?
Basic knowledge of mathematics and physics remains the foundation of our curriculum, even in the age of digitalisation, followed by specialised subject-oriented knowledge. Our alumni continually pick up the latest technologies through their work – or they attend continuing education courses at ETH. Teamwork and the ability to understand others and win them over is becoming more important.

On the topic of "fit for industry": How important is it to have professors and lecturers who also work in industry?
Not all of them have to come from industry, but diversity is very important for students. Nothing can replace people's real-life experience in projects, and some of the best lectures I know are given by teachers who are able to make theoretical principles comprehensible by sharing their own experiences.

ETH supports innovation in teaching through the Innovedum fund. How much demand is there for that?
We disbursed almost all of the available 2.1 million Swiss francs for the first time in 2016. Private donations also help us to promote innovative teaching.

Image: Simon Tanner (2)

How important is the Educational Development and Technology (LET) department?
LET is very important. Our experts in teaching innovation and technology are involved in many of the projects I mentioned. They assist us in evaluating Innovedum projects and boost awareness of new technologies amongst the teaching staff. They help lecturers with implementation and give didactic courses and training seminars on modern approaches. The Safe Exam Browser, for instance, is a LET product.

In closing: What is the goal of all these innovations in teaching?
We help students to become the future experts in their fields. This is our educational mandate. It isn't purely about conveying content; it's just as much about developing personalities – in other words, it's about education and development. Tan Chorh Chuan, the president of our partner university in Singapore, speaks of "future-ready graduates". I like this term a lot; it expresses very nicely what I want us to achieve as Rector. ○

"It's also about developing personalities."
Sarah M. Springman

Experts for teaching, learning and innovations

Studies at ETH provide an excellent education. ETH Zurich continuously refines its curricula and teaching methods to ensure that this remains true. In addition, the University boasts an Educational Development and Technology (LET) department that reports to the Rector. LET supports teaching through services and innovations in teaching. For instance, it offers continuing education programmes relating to teacher training for ETH lecturers and other individuals who teach, and trains students to coach and supervise groups. Further, LET helps departments develop and refine their curricula. LET is also responsible for student course evaluations and for the online exams service (e.g. the Safe Exam Browser). The various LET events (Refresh Teaching, Innovedum Events) serve to give lecturers inspiration and allow them to talk about their practical experiences with others. They receive advice in all matters relating to teaching development, such as developing educational objectives, designing courses and exams, deploying learning technology, and evaluating and planning projects through the Innovedum fund. What's more, LET developed the EduApp mobile app, which helps students efficiently manage day-to-day life at university. Lecturers use EduApp in their courses, too, and they also receive support when they implement online courses, all of which – with the exception of the MOOCs – are available on the Moodle learning platform offered by LET.

→ www.ethz.ch/let-en

Learning from real-world problems

Our world is becoming more and more complex, and less and less predictable. Gone are the days of one-size-fits-all solutions. What's needed now is creative collaboration – and our students are learning this and much more in specific, real-world projects.

TEXT Martina Märki

It's Wednesday morning at the Arch_Tec_Lab. The open hall is full of students frantically tapping away at their laptops, staring intently at screens and talking with one another in quiet but urgent tones. There is that pre-premiere feeling of excitement. Standing by the projection screen at the front of the hall, Michael and his partner Thomas are getting ready to be the first team to present their new energy concept for the ML building on the ETH Zentrum campus – one of the project assignments within the "Integrated Design Studio". Before signing up for this course, which is offered by the Department of Architecture, Michael studied mechanical engineering, and Thomas architecture.

It is a sort of dress rehearsal. Today the two students present to a jury of their peers and student assistants. But in two weeks' time, they and all the rest of the students will be pitching their ideas at a final presentation that will include external experts. Michael is nervous: "We just found out yesterday that the chimneys of the old district heating power plant are still in use, so we had to change our whole concept at the last minute."

Arno Schlüter
Arno Schlüter is Professor of Architecture and Building Systems at the ETH Zurich Institute of Technology in Architecture, a professorship funded by Siemens Building Technologies. As part of a new Master's programme, he teaches students using real-world, interdisciplinary projects.

Just like in real life

For Arno Schlüter, Professor of Architecture and Building Systems and the course's coordinator, this is no disaster. "People learn best when they are confronted with real-world problems," he says confidently. This includes discovering that sometimes it can be difficult to obtain all of the relevant information. "I've always wanted to run a course that brings together buildings and energy, and one that allows students to work on real-world problems," says Schlüter. He has fulfilled that ambition with the Integrated Design Studio, which has now run twice. It is offered as part of the new Master's programme in Integrated Building Systems, hosted by the Department of Architecture but interdisciplinary in scope.

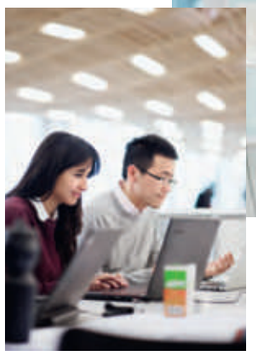
The programme aims to teach mechanical engineers, structural engineers, electrical engineers, architects and economists how to use new technologies to build as energy-efficiently as possible within an increasingly complex construction sector. It goes beyond theory, offering a semester in the Integrated Design Studio to learn through real-world projects. This time, the 18 participating students have been given the assignment of developing a proposal for improving the university district in Zurich's centre from an energy perspective. This requires them to tackle a complex problem from multiple angles, from how the city and district will develop in the future and the implications that this will have on traffic and energy requirements, to the specific technical solutions required in individual buildings.

It is entirely expected and intended that the differing approaches of engineers and architects will clash from time to time. "It's certainly something they will have to deal with later on in their careers," says Schlüter unperturbed. Michael and his colleague Thomas have succeeded admirably in ironing out their differences over the course of the project: "Of course it was hard at times. We spent whole nights battling it out, but it's fair to say I've never learned as much as I have on this project," says Michael.

Image: Provided by Arno Schlüter

Whether it's in the innovation project in mechanical engineering right at the beginning of your studies (right), or in the Master's programme at the Department of Architecture (below), projects call for absolute commitment.

> "It's not about being the best, but about learning together."
>
> *Mirko Meboldt*



500 on the hunt for treasure

Take 1 professor, 4 assistants, 18 students and a challenging assignment: "The intensity you get when you work together on a problem for an extended period does wonderful things for teaching and learning, even if it is a challenge for all involved," Schlüter enthuses. But is it possible on a larger scale? Absolutely, says Mirko Meboldt, Professor of Product Development and Engineering Design. Since 2013, he has been running project-based courses involving more than 450 students – in their first year of study. Instead of learning passively about mechatronics systems, students learn firsthand in small project teams as part of an "innovation project" run by the Department of Mechanical Engineering. When Meboldt first suggested the idea, people thought he was mad. Project-based learning on this scale, and so early in the course? Nobody was offering anything like it. But it works.

Students are divided into 90 teams of 5 to 6 students apiece, and given one semester to develop a mechatronics system from the initial proposal to the finished and tested product. Last year's innovation project involved ›

Image: Florian Bachmann; Annick Ramp (2)

Mirko Meboldt
Mirko Meboldt studied mechanical engineering at the University of Karlsruhe. He worked for Hilti AG before coming to ETH Zurich in 2012. As a professor at the Institute of Design, Materials and Fabrication within the Department of Mechanical and Process Engineering, he was responsible for implementing the innovation project for students in their first year of study.

designing a system that would search for treasure on the seabed; this semester, Meboldt is issuing his students a similar assignment for the surface of Mars. Teams are supported by some 30 tutors drawn from later semesters, who train for their role in an accompanying coaching course. This allows them to learn the basics of leadership and coaching, and put it straight into practice.

More than specialist knowledge
The students who lead the project groups as coaches are critical to the quality of the course. "This is something we underestimated at the beginning," admits Meboldt. It's not the specialist knowledge that is so important, he says, but rather the coaches' ability to lead a team. "In a system in which the requirements are left open," he says, "I can't know what specialist knowledge will be required. Do I need a team coach who is great at mechanics – or perhaps at electronics? I'm better off looking for leadership."

From his own experience, Meboldt knows that industry needs people who can work together to turn knowledge into value in a complex environment. It's a skill he wants his students to learn early on. At the end of the semester, the students will go head to head in a competition to put their systems to the test. Of course things become competitive – but in fact students' marks are not affected by who wins or loses. "The innovation project is not about being the best, but about learning together," says Meboldt. This includes realising that the task is so complex that the team has to define a realistic goal for itself. Or seeing that effective teamwork is key to success. ○

In recognition of his teaching, Mirko Meboldt has received the KITE Award.

KITE Award

In 2016, ETH presented its inaugural KITE Award for innovative teaching concepts. The prize went to **Mirko Meboldt** for his Innovation Project and Leading Engineering Projects and Coaching Design Teams courses. The other finalists were **Gisbert Schneider** and **Renate Schubert**. At the Institute of Pharmaceutical Sciences, Schneider offers a range of interdisciplinary courses on the topic of "Computer-Assisted Drug Design". Students undertake a practical block during which they form virtual firms tasked with developing a molecule with a specific function. Schubert has reimagined the Economics course offered by the Department of Humanities, Social and Political Sciences and taken by up to 500 students. Students can study independently drawing on lecture notes, interactive exercises and media reports. They work in small groups to work through economic arguments with specific examples of their application, and are free to choose from a range of learning elements.

For information about the KITE Award, please visit:
→ www.ethz.ch/kite

Image: Giulia Marthaler; Oliver Bartenschlager

One size does not fit all

Tutorials are an unavoidable part of every ETH degree course. But at least students attending physics lectures are free to choose the format in which they practice the principles of their subject.

TEXT Isabel Nägele, Florian Meyer

For students of physics, there's no getting away from the fact that they will have to practice the principles they learn in lectures until they have fully understood them. This process also equips them with skills that extend far beyond theoretical knowledge and remain valuable long after their studies: they learn to quickly grasp a problem and solve it systematically. Especially in the first few semesters, this calls for highly personalised teaching and learning formats – no easy task when there are thousands of Bachelor's students at ETH needing to learn the basics of physics. "There's no one perfect tutorial for all students," says Guillaume Schiltz, the Department of Physics educational developer, "but we do take our students' learning needs seriously."

Since 2013, students in the foundation phase of their degrees have been able to choose a tutorial format that best fits their learning preferences. The "tutorial marketplace", as the model is known, offers four formats that correspond to four common learning preferences.

More personalised learning
In the "Micro teaching" format, students are taken through the most important points from the lecture, offering the opportunity to clear up any outstanding questions. This format is designed primarily for students who are still unsure about the material. "Scaffolding" represents the conventional tutorial: Students solve problems with the help of hints and pointers, and discuss their results together. The "Coaching" format offers students support according to their needs, with assistants helping them to develop personalised problem-solving approaches. Then, for those students who have already mastered the material, there is the "Masterclass" format with additional exercises for advanced students.

Tutorials take place in small groups of around 20 students, with the focus on personal interaction. All the tutorial formats emphasise feedback among lecturers, tutorial assistants and students, as this allows lecturers to ascertain where students are currently experiencing difficulty and adjust their teaching accordingly.

By giving the students the freedom to choose the tutorial format that suits them best, the tutorial marketplace encourages them to take responsibility for their learning. "Since students have little in the way of choice during their first few semesters, giving them an option is extremely motivating," explains Schiltz. Before, students were assigned their seats on a moving train that stopped only at the exam. Now, students can at least choose the compartment that appeals to them. Even so, everyone has to solve the same problems, and is given sufficient time to do so whatever the format.

Scaffolding is the most popular format, with an average of 60 percent of students opting for this traditional tutorial format. Another 30 percent choose the coaching model, while 10 percent go for micro teaching or the masterclass. The feedback is encouraging: four out of five students would like to see the model applied to other lectures. ○

Teaching concepts in the Department of Physics:
→ www.eduphys.ethz.ch/elearning

Guillaume Schiltz
Guillaume Schiltz is an educational developer within ETH Zurich's Department of Physics. The humanities scholar has worked in teaching methods for 30 years now. ETH has its own network of teaching specialists who support lecturers in their teaching activities.

Image: Heidi Hostettler

In tune with the students

Online modules have long been used by traditional universities, too. They enable professors to engage more closely with their students.

TEXT Roland Baumann

VSETH President Lukas Möller (left) congratulates John Lygeros on his CS Award for Best Teaching.

The first time he heard about TORQUEs and flipped classrooms, John Lygeros admits he was sceptical: "How could it make sense to leave out the most fascinating part of a lecture?" says the ETH Professor of Control and Computation, recalling his preference for presenting the core material in a classroom setting. His lectures involved a combination of PowerPoint slides and a blackboard, which he felt was a tried-and-tested concept: "I used slides to maintain the pace of the lecture, and the blackboard to slow the lesson down to make it easier for the students to follow my explanations."

Promoting online courses

But an ETH initiative to promote online courses was about to turn his method of classroom instruction on its head. The initiative was launched by the Educational Development and Technology (LET) unit some five years ago with substantial funding from ETH alumnus Emil Halter. The basic idea behind the new concept is that the students review instructional material in the form of videos at home and take online quizzes to assess what they have learned. That leaves more time in the classroom to delve deeper into the subject.

These ETH online courses are known as TORQUEs – Tiny, Open with Restrictions courses focused on QUality and Effectiveness – and they are produced specially for individual classes. This instructional strategy is typically referred to as the flipped classroom. Lygeros was under no pressure to adapt his teaching methods and produce a TORQUE; in fact, he had already won two Golden Owl teaching awards for his traditional classroom teaching in 2009 and 2012. Golden Owls are awarded annually by the VSETH student association to one faculty member from each department in appreciation of their outstanding teaching.

Nevertheless, Lygeros decided to take up the challenge and adapt his fourth semester Signal and System Theory II course to the new format. It proved to be a great success: Lygeros was awarded yet another Golden Owl in 2014, the year in which he made his TORQUE, and in 2016 he received the Credit Suisse Award for Best Teaching, which is bestowed upon just one ETH professor a year. "These awards go to show that the students really appreciate the effort we put into our teaching," Lygeros says happily; he has always invested significant amounts of time in improving his lessons in collaboration with his team. But what actually prompted him to totally restructure the way he taught that particular class, despite his initial reservations about TORQUEs? "I knew that our students were enjoying the class and learning a lot, but I was intrigued by the idea that we could do even better with a different format," he explains.

Closer engagement with students

Even with full support from LET and the Multimedia Services team, producing the teaching videos and preparing the new lessons was still a major undertaking. But in hindsight it was a worthwhile investment. "I have a much clearer idea as to what point the students have reached, so I can better address their needs," Lygeros says.

For example, he can gauge how well prepared his class is for a lesson by checking how many students have completed the online quiz. And since most of the students look through the material in advance, he has more time in the classroom to find out whether they have understood the course content. One of the methods he employs is multiple choice questions that the students answer during the lecture using an ETH smartphone application called EduApp. The questions and answers can then be briefly discussed in a plenum. Anyone who is still struggling with the material can watch the videos again. At the end of the day, however, videos, quizzes and online interaction are simply another way of helping students find their way through the course material. "The more options we offer our students, the more likely it is that every single one of them will find a good way to gain access to the content," says Lygeros. TORQUEs do have some snags, though. The contents of a course change over time, so the videos become outdated. If Lygeros wants to update something, he can't simply replace a slide; he has to produce a whole new video module. And that takes time. Two years after adapting his Signal and System Theory II course to the TORQUE format, he decided to add a new chapter. He is currently tackling this with his traditional combination of blackboard and slides until he finds the time and money to make new videos. Could he also imagine producing a MOOC (massive open online course) and making it available to the whole world? "MOOCs are fantastic. They open up learning to people who may otherwise not have the opportunity or the means to attend a university," Lygeros argues. Nevertheless, he currently has no plans to transform his course into a MOOC. Instead he is focusing on producing tailor-made courses for his subject area. Even though MOOCs raise educators' international profiles, he doesn't really feel the need to remotely address an extra 1,000 people on top of the 150 students he already has. And when you recall his enthusiasm for engaging more closely with his students, that actually makes perfect sense. ○

> "I can better address the students' needs."
> John Lygeros

John Lygeros
Greek-born John Lygeros has been Professor of Control and Computation at the Department of Information Technology and Electrical Engineering (D-ITET) at ETH Zurich since 2006. As well as taking over the Signal and System Theory II course, he also introduced two Master's courses in the department. His tool of choice for these latter two courses is the blackboard. "That's because the course content is highly complex and mathematical and requires meticulous explanations," he notes. As Lygeros is currently serving as Head of Department at D-ITET, these courses have been taken over by other colleagues.

Image: Giulia Marthaler (2)

Students get closer to nature on a field trip to the forest in the Ticino.

Let us out!

A focus on breadth rather than depth: the new field trips offered for environmental scientists deal intensively with the topic of biodiversity rather than with identifying flora. This is more application-oriented and central to many subject fields.

TEXT Corinne Johannssen

Explaining how his students fought to save the field trips, Urs Brändle, educational developer at the Department of Environmental Systems Science, can't conceal a note of pride: "It's a good example of student participation in our department." The bone of contention in the new, revised curriculum was the systematic field trips. In the first draft, they were envisaged only for specific specialisations. "There's an enormous amount of organisational work involved," Brändle says in defence of the decision. But the students weren't prepared to take no for an answer. "They campaigned hard to be able to continue to study in the field," he remembers. Today, the field trips are still part of the programme – albeit with a different objective.

In the past, the field trips aimed at deepening systematic knowledge. The students spent their time in the field identifying a wide range of plant species. Now the focus is on biodiversity. "This is a hugely important topic for environmental scientists," Brändle says. "And not only for those who go on to work in an environmental agency." From insects and waterfowl to grasses and lichen: by using different groups of organisms to bring biodiversity to life, the field trips aim to sharpen students' awareness of their natural surroundings.

Andrea Funk, who also studied environmental sciences at ETH and now coordinates the field trips, points out: "While knowledge of species is certainly important, we have decided to pursue an exemplary approach to the subject." That's why students only need to be familiar with one to two dozen species in each group of organisms – of course, bearing in mind that this is only a very small part. "Anyone wishing to look into the subject in more depth will find a broad range of courses on offer in subsequent semesters," she says.

Into the field well-prepared

The field trips take place in the form of half-day modules. From the 14 different options on offer, the Bachelor's students select 6. In the first week of the semester, experts and the some 140 students meet for an introductory session. As well as hearing lectures on biodiversity monitoring, they practise mobile data capture using their own smartphones. But before they get to go out into the field, the students must first pass an online test about the species relevant to the module they've selected, which they can prepare for with the help of images and videos.

The field trip begins with a review of the species. "In practice, the reality is quite different from doing exercises on the computer," Funk says. "There, all you have to do is press a button and the bird sings, but it doesn't work like that in nature." Flora and fauna also look far more individual in the field than the textbook example on a photo. Once they have a firm grasp of the subject matter, the students start to look for and record the species in the field. Depending on the module, they cover a particular route and chart or count the population of flora, lichen, birdcalls or spider webs, for example. They determine their position with the help of their smartphones. Finally, the students and experts evaluate the first data in situ.

In the plenary evaluation session held at the end of the semester it's not just about biodiversity, however. "For me, a critical appraisal of the quality of the data is just as important as the environmental question," Brändle points out, and gives an example. In the arachnids module, with the help of the webs the students are also tasked with determining the species. And since it's easy to make mistakes, the experts discuss with the students how many data sets they need so that the identification errors become inconsequential. "In the age of big data, the data aspect goes far beyond the boundaries of ecology," Funk adds.

More minds, more expertise

That this field trip involves a lot of effort comes as no surprise. Brändle is therefore pleased that the burden of organising the field trips is now distributed among a number of chairs and institutes. The 46 half-day field trips are mentored by a dozen experts and additional student employees. This broadens the scope of subjects and offers greater choice. However, it also means more coordination work and increased initial effort for first-time preparation and implementation: apart from the online materials for student preparation and data capture, the algorithm for assigning the students to the half-day field trips was also redeveloped from scratch. In order to manage this task, Brändle launched an Innovedum project, which provided funding for two part-time positions for a period of one year. "This is extremely valuable," Brändle says. "Innovedum makes it possible to finance extracurricular activities, such as establishing these field trips," he adds. Following the successful pilot trips last year, he is now looking forward to finally starting the new course proper. ○

Urs Brändle
Urs Brändle studied biochemistry at ETH Zurich and did his doctorate in agricultural sciences. He previously worked in IT training and as a grammar school teacher before joining the Department of Environmental Systems Science as an educational developer in 2008.

"In practice, the reality is quite different from doing exercises on the computer."
Urs Brändle

Image: Urs Brändle

Image: Susi Lindig / © DUSYS

Creative, interdisciplinary, sensory

What ETH students love about their university.

COMPILED BY Corinne Johannssen

"If I don't understand something when I'm preparing for a lecture, I can just rewind the video and listen again."

Bigna Härdi, 5th semester, Bachelor's degree in electrical engineering and information technology, talking about TORQUEs

"It's exciting to interact with different subject areas, and everyone works in a very purposeful manner. I also really enjoyed the lectures."

Xingong Xu, 1st semester, Bachelor's degree in computer science, talking about ETH Week

"In lectures you learn about other people's ideas. In the Student Project House, I can explore ideas I've come up with myself."

Luca Naterop, 5th semester, Bachelor's degree in civil engineering, talking about the Student Project House

"In contrast to the traditional lecture format, the flipped classroom allows me to organise my learning more flexibly."

Gleb Ebert, 1st semester, Bachelor's degree in biology, talking about the flipped classroom

"It's a completely different way of learning: We develop an idea, toss it out, and then come up with something new and we're free to find our own solution."

Théophile-Messin Roizard, 3rd semester, Bachelor's degree in mechanical engineering, talking about ETH Week

"What's exceptional is being able to develop your own solutions and work on a real-world, multifaceted project as part of an interdisciplinary team."

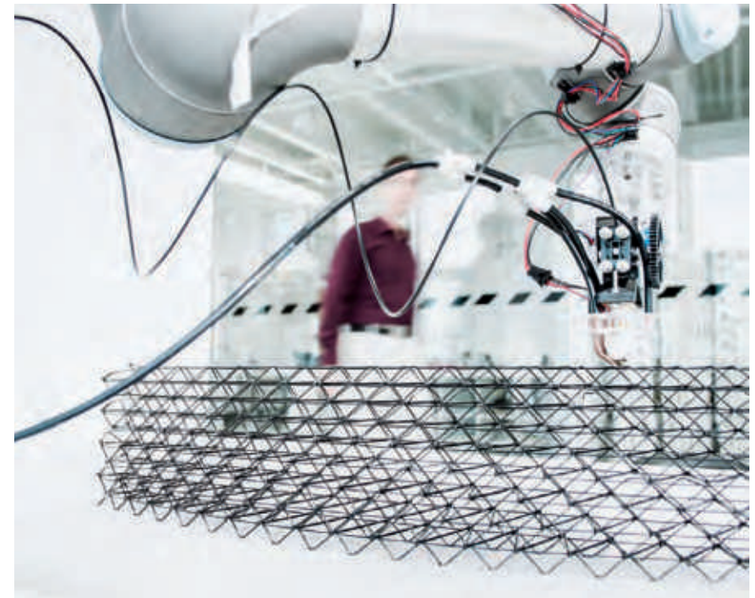
Thomas Wüthrich, 3rd semester, Master's degree in integrated building systems, talking about project-based learning

"For me the field trips are the highlight of the semester because they speak to multiple senses at once. You just don't get that in a lecture theatre."

Joanna Reim, 3rd semester, Bachelor's degree in environmental science, talking about field trips

"The group work helps me to identify my weaknesses and to fill in the gaps in my knowledge."

Leonie Seefeldt, 1st semester, Bachelor's degree in biology, talking about the flipped classroom



The in situ fabricator robot in action

Swiss Technology Award

AWARD FOR CONSTRUCTION ROBOT

Mesh mould technology has won the Swiss Technology Award 2016. This technology allows for the manufacture of any shape of concrete structure without formwork, with a robot using a computer model to create a steel wire grid that is then filled with concrete. The project is led by Norman Hack of NCCR Digital Fabrication, a doctoral student within the group headed by architecture professors Fabio Gramazio and Matthias Kohler. The group initiated the project at the Future Cities Laboratory at the Singapore-ETH Centre, and this year the technology will be implemented for the first time in the NEST building of EMPA in Dübendorf.

Media technology

MEDIA TECH CENTER

Driven by digitalisation, the media industry currently finds itself in an era of fundamental change. ETH Zurich, already home to many data science experts, now intends to establish a dedicated programme of research and teaching about the digital media transformation. As part of its media technology initiative, ETH Zurich is creating a new chair as well as a media technology center.

"Our aim is to harness the advances in data technology for the media in Switzerland," says ETH President Lino Guzzella. The new chair will train the next generation of specialists for a changing marketplace. It is part of the Department of Computer Science and will cement the connection with other data science specialists, both within ETH and beyond.

The NZZ Media Group, Ringier, SRG and Tamedia, Switzerland's biggest private media companies, have already been brought on board with ETH Zurich's initiative. Ringier, SRG and Tamedia are the main sponsors and will be providing 3 million Swiss francs each to the initiative over the coming decade. The NZZ Media Group will be contributing 1.5 million Swiss francs. Intensive collaboration is underway with the industry partners to determine the most pressing topics for research and application.

The ETH Zurich Foundation is currently looking for additional sponsors of the media technology initiative.

ETH Zurich Foundation

NEW PARTNERSHIPS

Business and society rely on the safety and reliability of IT systems, as well as on adequate data protection – and Swiss Post is no exception, which is why it is joining SIX Group as a funding partner of the Zurich Information Security and Privacy Center (ZISC) at ETH Zurich.

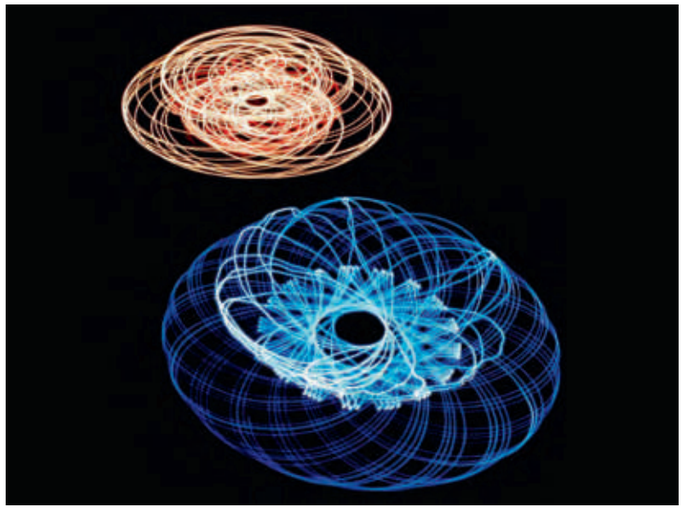
The BASF Switzerland Research Foundation is providing 1.2 million Swiss francs of funding to ETH Zurich's Pioneer Fellowship Programme. This donation will support researchers and pioneering projects in specialist areas of chemistry, particularly innovations for sustainable construction.

Image: NCCR Digital Fabrication

150th anniversary of the Graphische Sammlung ETH Zürich

Opening a treasure chest

The University's collection of prints and drawings has made a strong start to its anniversary year. With collections ranging from the fifteenth century to the present, it hopes to attract new visitors and inspire interdisciplinary collaboration.



Peter Fischli (b. 1952), David Weiss (1946 – 2012): Surrli, *from a series of 28 colour photographs, 1989 (left) and Albrecht Dürer (1471 – 1528):* Adam and Eve, *copperplate engraving, 1504 (right)*

From Rembrandt, Goya and Picasso to Warhol and Fischli/Weiss, the Graphische Sammlung ETH Zürich brings together a broad range of prominent artists, and this year marks its 150th anniversary. It was established in 1867 by Gottfried Kinkel, Professor of Archaeology and Art History, with the backing of the directors of the Polytechnikum, which had been founded just 12 years earlier. His goal was to create a "collection of artworks on paper". Enthusiasm for assembling scientific collections was at its peak around that time, and indeed most of the scientific collections held by the University of Zurich and ETH – which at that time shared the main building that today houses ETH Zurich – stem from that period.

Original and digital

It didn't take long for Kinkel to start building up his collection, but the most valuable addition came with the banker Heinrich Schulthess-von Meiss's remarkable 1894 bequest of more than 12,000 copperplate engravings, etchings and woodcuts. Today the collection comprises more than 160,000 single leaves and groups of works, making it the biggest of its kind in Switzerland after that of the Kunstmuseum Basel. Its reputation extends far beyond the country's borders, especially among experts in the field of prints and drawings. In addition to the old masters, the collection's acquisition policy focuses in particular on Swiss graphic art and works created over the last three decades.

Visitors can admire portions of the collection in the four short-term exhibitions that are held each year. Free guided tours are also available, and single leaf prints may be browsed in the study room upon prior request. Due to their fragile nature, the originals can be displayed only for brief periods before being returned to the special acid-free boxes in which they are kept. An increasing number of the works are now also offered in a digital format, though a work of art displayed on a screen can obviously never replace the original. Nevertheless, these digitised versions provide a handy overview of what the collection contains. The Graphische Sammlung ETH Zürich strives to provide all its works with high-quality metadata, keenly aware that this is a vital part of offering added value to researchers. And the collection is certainly ripe for research, with many of its treasures probably yet to be unearthed.

Strong ties to the teaching and research communities are a key goal for Linda Schädler, who has been in charge of the Graphische Sammlung ETH Zürich since May 2016. Her primary focus is to encourage interactions with the disciplines of architecture and art history, though she is also keen to collaborate with science departments. One example that Schädler finds particularly interesting is the idea of working with biologists to explore the theme of reproduction, which also plays such a central role in graphic art.

Gaining a wider public

One of Schädler's major objectives as the head of the collection is to open it up to a broader public. She sees the anniversary year as a good opportunity to raise awareness both within ETH and among a wider audience, and to motivate new visitors to engage with this field of art. "It's mostly just experts in this field who are familiar with the treasures we have here, and that's something we want to change," Schädler says.

Changing perspectives is the motto for the collection's anniversary year, and cooperation is high on the agenda. The Eternal Present exhib- ition due to open in February is a co-production with the Helmhaus art museum in Zurich and will be spread over both sites. This will be followed by a joint project in May with the Institute for the History and Theory of Architecture (gta), which is also holding events this year to celebrate its own 50th anniversary. The third exhibition starts in August and will focus on young Swiss artists, while the fourth and final exhibition of the anniversary year will be co-curated by students from the University of Zurich and ETH Zurich. The exhibitions will be accompanied by a series of critical discussions aimed at forging links with other disciplines.

Impetus for future success

Another of the reasons for opening up the collection to a wider public is to dispel people's misconceptions. "If you have only a sketchy knowledge of the Graphische Sammlung ETH Zürich, then it's easy to make the mistake of thinking there is nothing more to it than our undeniably superb collection of graphic prints by old masters. What many people don't know is that we also focus on contemporary art on paper and are constantly incorporating emerging trends," says Schädler.

The collection, which forms part of the ETH library, also fulfils an important strategic objective with the idea of opening the works up to a wider public. The national tasks explicitly assigned to ETH Zurich include not only protecting and preserving the country's cultural heritage, but also boosting the use of the University's collections and archives in the realms of scientific communication and public dialogue. If there's one thing the team behind the Graphische Sammlung ETH Zürich is wishing for to mark this important anniversary, it is for this process of gaining a wider public for the collection to prove a resounding success that continues well beyond the anniversary year. — Isabelle Herold

Find out more about the events being held to mark the anniversary of the Graphische Sammlung ETH Zürich:
→ www.gs.ethz.ch

Spin-offs

SUCCESSES IN 2016

Eight of the 25 spin-offs from ETH Zurich founded in 2016 are in the information and communication technology sector. Six companies operate in the mechanical engineering sector and in aerospace, four in biotechnology and pharma. And two of the companies offer products focusing on timber construction. This is no coincidence, since the recent start-up Swiss Timber Solutions originated from the House of Natural Resources project. This unique building at ETH Zurich tests technologies and new parts made out of Swiss hardwood. Swiss Timber Solutions focuses on fire protection, support design, and the preservation of wood structures. The Swiss Wood Solutions spin-off develops and markets premium wood products worldwide.

30 UNDER 30

The founders of ETH spin-off Wingtra have made it onto the Forbes Europe "30 under 30" list for 2017 in the Industry category. The list is a showcase of the best young innovators and entrepreneurs. Wingtra is a fast-growing spin-off of ETH Zurich's Autonomous Systems Lab, and develops drones for civil applications.
→ www.wingtra.com

Image: Graphische Sammlung ETH Zürich (2)

ETH Alumni

FROM THE EXECUTIVE BOARD

ETH alumna Brigitte Manz-Brunner has been newly elected to the executive board of the ETH Alumni Association. The deputy managing director of Senarclens, Leu + Partner will be responsible for Communication & Marketing. Meanwhile, alumnus Werner Keller of the Baden alumni branch has been appointed an honorary member.

Brigitte Manz-Brunner is looking forward to her new role.

Hönggerberg campus

GREEN LIGHT

The Hönggerberg campus is central to ETH Zurich's growth, and there are plans to build further on the campus. Now the Zurich city council has approved ETH's "Campus Hönggerberg 2040" master plan. This plan builds on the existing master plan and lays the groundwork for the future development of the Hönggerberg campus.

Graphic of the consolidated campus

In 2009, Nenad Ban received the Rössler Prize for his outstanding research and teaching.

Nenad Ban has been awarded one of Europe's most highly paid prizes in the field of medicine.

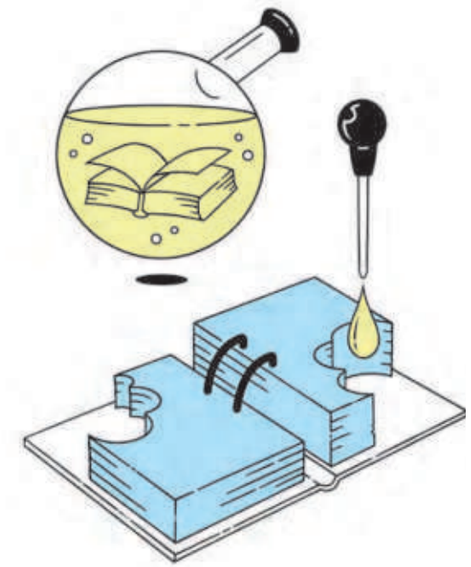
Ernst Jung Prize

PRESTIGIOUS MEDICAL AWARD

With prize money of 300,000 euros, the Ernst Jung Prize for Medicine is one of the richest medical prizes in Europe. This year, the honour was shared between ETH structural biologist Nenad Ban and the Göttingen neuroscientist Tobias Moser. Since 2000, Nenad Ban has been Professor at ETH Zurich's Institute for Molecular Biology and Biophysics. He was the first scientist to describe the atomic structure of ribosomes in the cells of higher organisms (eukaryotic cells). Ribosomes use genetic code to build proteins in living cells. They are one of the biggest and most complex molecular machines to be found in cells. The ETH professor and his team were also successful in uncovering the structure of ribosomes in the mitochondria of mammalian cells. Mitochondria are the cell's powerplants: special structures that provide cells with energy. Mitochondria have their own genome and a different type of ribosome.

Because of ribosomes' fundamental importance in a range of cellular processes, any dysfunction can be devastating, extending to illnesses such as cancer or metabolic disorders. Ban's work on protein biosynthesis in healthy cells is vital to understanding how this fundamental process is altered in the cells of diseased patients.

Images: Provided by Brigitte Manz-Brunner; EM2N; Peter Rüegg



Column

An existential question

Research is fundamentally a state of mind involving continual re-examination of doctrines and axioms upon which current thought and action are based. It is therefore critical of existing practices.

Theobald Smith, *American Journal of the Medical Sciences*, 178, 740 (1929)

If we take this renowned pathologist's definition as the basis of our day-to-day work in the lab, the statement quickly confronts us with an existential question much like the one Gretchen posed to Faust – How do you view religion? – while sitting in Martha's garden. Ultimately, he gives an evasive answer: "Names are but sound and smoke."

Science faces a question of similar existential gravity – How do you view criticism? – which brings with it a dilemma. If research itself is meant to continually criticise prevailing practice, then the commonly accepted standard for good research today is wrong. Present evaluation systems reward having many publications in the same (or closely related) fields, and with little contextual variation, carried out by the same working group or individual. It is difficult, by comparison, to get courageous and radical ideas published through the "standard machinery". The papers that are successful in this system tend not to be works that challenge the existing axioms and doctrines. Furthermore, Max Planck's witticism that "truth never triumphs – its opponents just die out" implies that it can take a long time before "truths" get published – too long for a science career, which currently plays out in a bit less than a decade.

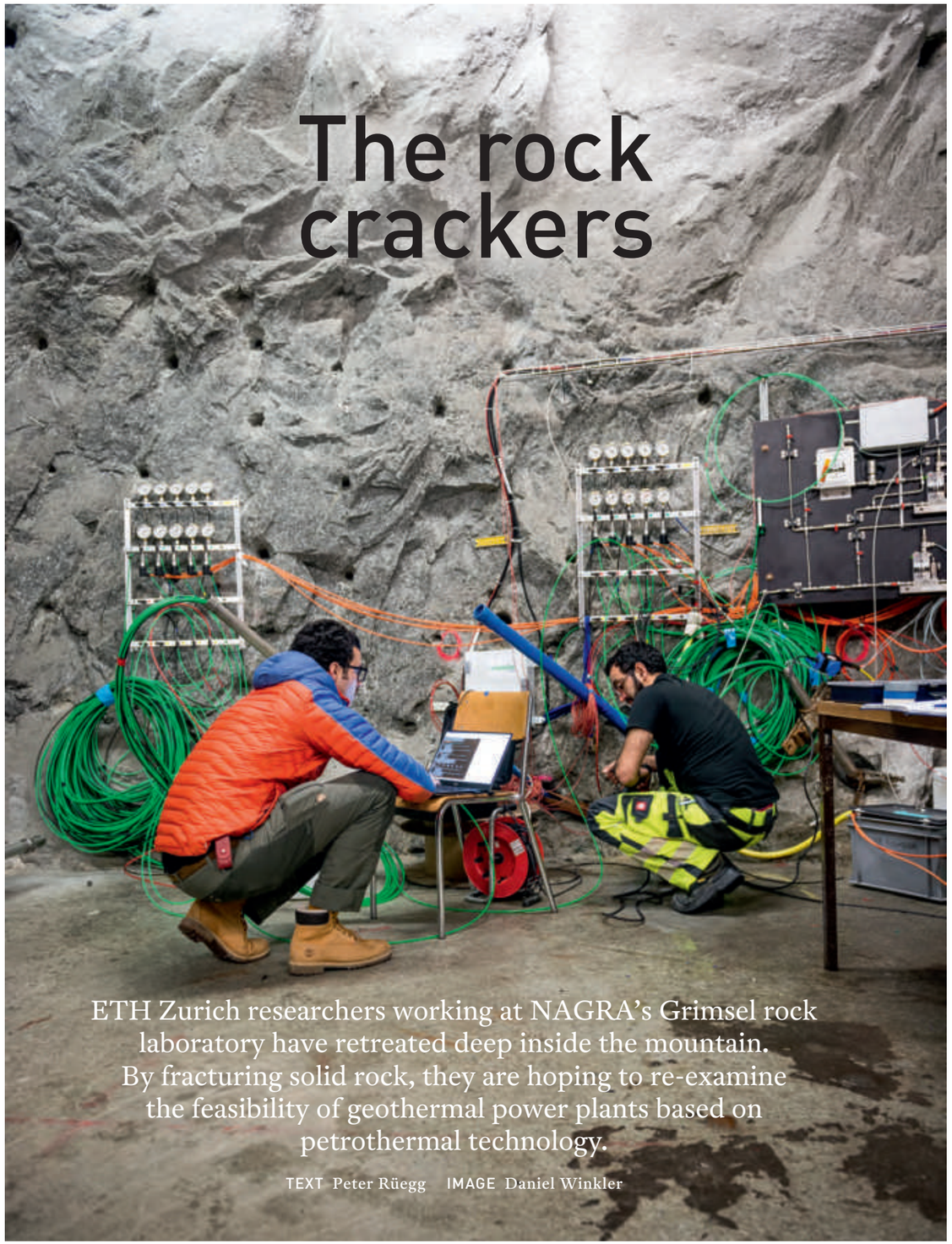
There are various ways to counter this: a peer review system that uses sound judgement and a penchant for risk could be set up, based on anonymity rather than ideology. Publishers' incentives need to reward quality rather than quantity. And last but not least, we should mentor young scientists newly embarking on their careers, rather than simply ticking off items on a checklist to determine appointments. Presumably we will soon be using artificial intelligence for this process anyway, as well as for writing, evaluating, editing and publishing manuscripts. This needn't be a bad thing though, as it would free up time for us to spend engaged in critical thinking.

PS: Does anyone have experience with social bots that boost the h-index?

Gerd Folkers* heads the ETH Critical Thinking Initiative. He is also President of the Swiss Science and Innovation Council. Prior to that, he spent many years as President of the Collegium Helveticum.

*I would like to thank everyone who I couldn't condense into a "Bourbaki experiment": Tine Bratrich, Anita Buchli, Hansjürg Büchi, Jürg Brunnschweiler and Margrit Leuthold. More on this in the next column.

Illustration: Benedikt Rugar; Image: Giulia Marthaler



The rock crackers

ETH Zurich researchers working at NAGRA's Grimsel rock laboratory have retreated deep inside the mountain. By fracturing solid rock, they are hoping to re-examine the feasibility of geothermal power plants based on petrothermal technology.

TEXT Peter Rüegg IMAGE Daniel Winkler

It's an icy-cold early December day at the Grimsel Test Site, nestled at the foot of the dam that holds back the Räterichsbodensee reservoir. Water has frozen into bizarrely shaped ice streams on the huge slabs of rock. We take one last glimpse out of the window before the VW minibus plunges into a tunnel leading into the mountain beneath the dam wall.

After driving a good kilometre, the minibus stops next to a niche in the rock. Bicycles are propped against the wall to the right of a greenish-blue steel door. An illuminated sign spells out "Welcome to the NAGRA Rock Laboratory", marking the entrance to the research facility's centre of operations. It's not as cold here: deep inside the Juchlistock mountain, with 450 metres of solid granite over our heads, the temperature stays at a steady 13 degrees. Engineering geologist Florian Amann covers the last few hundred metres to the laboratory on foot, advancing further down the tunnel that was carved out by the energy supply company Kraftwerke Oberhasli AG when it built the hydroelectric power plant.

Amann swings open a metal door and heads down a concrete staircase that leads to a large cavern. A researcher is crouched on the floor staring transfixed at his laptop, which is propped up in front of him on a chair. One of his colleagues in bright yellow work trousers is monitoring a dozen pressure sensors, and a tangle of green hoses is lashed to a rack on the wall. No daylight enters the cavern, and apart from the murmurs of the scientists there's not a sound to be heard.

This underground cavern is the setting for a one-of-a-kind experiment that aims to pave the way for deep geothermal energy in Switzerland: the In-situ Stimulation and Circulation experiment, known for short as ISC.

Project manager Florian Amann. One turn is all it takes to adjust the water pressure in a borehole.

The scientists working on this experiment are hoping to discover how to crack solid rock in order to create and maintain an efficient heat exchanger – a key component in producing electricity in geothermal power plants (see page 41).

> "Once we start the experiment nobody will be able to walk around down here."
> Florian Amann

To fracture solid rock, researchers "stimulate" it by pumping water into boreholes under high pressure. This causes the rock to rupture, after which water can be heated up by pumping it through the resulting system of cracks. The researchers hope to discover whether this system of cracks can be maintained over a longer period of time and whether the water circulation is sufficient to make operation of the heat exchanger economically viable.

The experiment is also designed to show which method of fracturing rock is the most practical. Rock can be fractured in two different ways, and the scientists here are using both. The first method is hydraulic fracturing, where the scientists steadily increase the water pressure in a borehole until the solid rock cracks. The second method is hydraulic shearing, where the geoengineers apply targeted increases in water pressure to existing cracks in the rock. That causes the crack walls to dislocate, making the cracks bigger.

Political pressure

The scientists are particularly keen to find ways of minimising the number and intensity of earthquakes that occur during stimulation. This issue was one of the key reasons behind the failure of the deep geothermal energy projects in Basel and St. Gallen. At both sites, local inhabitants felt the earthquakes that were triggered when the bedrock was pressurised. Both projects were terminated, marking a setback for geothermal energy.

"Current experience of petrothermal systems amassed around the world indicates that there is a way ›

to do this without causing detectable earthquakes," says Amann, "and that's what we want to achieve, too." The researchers have also been spurred on by recent political events: in its Energy Strategy 2050, the Swiss Federal Council included the goal of using geothermal power plants to generate 7 percent of Switzerland's energy requirements, amounting to 4.4 terawatt hours, or one and a half times the output of the Beznau I nuclear power plant. To achieve this goal, a total of 25 geothermal power plants, each generating 20 megawatts, will need to be commissioned over the next 30 years.

Two years of preparation

Amann and his team have spent two years carefully preparing every last aspect of the experiment. Everything has to be in place the day he finally presses the "red button": "We only get one shot at cracking the rock," says the engineering geologist, noting that the rock can't be patched up again once it's been fractured. "If something goes wrong, we would have to develop a whole new fresh body of rock, and we simply don't have the time or the money for that."

To prepare the experiment, the researchers conducted a detailed analysis of the rock at the test site to familiarise themselves with every last centimetre of the rocky mass. That puts them in a position to compare the condition of the rock before and after the water is injected.

They also drilled 15 boreholes into the rock ranging from 18 to 50 metres deep and up to 15 centimetres in diameter and equipped these with highly sensitive measuring instruments.

The researchers need three of the boreholes to conduct strain and temperature measurements, four for seismic measurements, and four for pressure and strain monitoring. They need to capture every last detail of any dislocation, deformation or change of pressure in the rock. Highly sensitive micro seismometers are also positioned outside the boreholes to record any vibrations that occur before, during and after the water stimulation.

Amann leaves the cavern and enters a circular tunnel drilled by a tunnel boring machine. Cables run along the walls and water from the rock trickles along the floor. After 30 metres, he stops in front of an inconspicuous little box mounted on the rocky floor of the tunnel. He stoops down to briefly check that it's intact. "This is a tiltmeter," he explains, "which measures the inclination of the granite tunnel floor to detect any deformation caused by changes in the rock." The tiltmeter can even detect the tiny inclination of the floor that occurs when somebody walks past the sensor. "Once we start the experiment nobody will be able to walk around down here," emphasises the project manager, "as this would distort the readings and we would have to remove that interference from the data afterwards."

Team member Reza Jalali carefully feeds a fibre-optic cable into a borehole.

ISC-EXPERIMENT

The ISC experiment falls under the remit of the Swiss Competence Center for Energy Research – Supply of Electricity (SCCER-SoE). It involves six professors from ETH Zurich and one from the University of Neuchâtel. The experiment is led by Florian Amann from SCCER-SoE. The ISC experiment is funded by the Swiss National Science Foundation, the Swiss Federal Office of Energy and industrial partners including Shell and EKZ.
→ www.sccer-soe.ch/research/geo-energy

Underground shop talk: Florian Amann (left) chats to rock lab director Ingo Blechschmidt.

Real-time modelling

Data is central to this experiment, and so is data management. Seismic monitoring alone generates terabytes of data. The researchers have continuous access to this data from ETH Zurich thanks to the cavern's direct internet connection.

"A lot of computing power comes into play during stimulation," says Amann. The data is transmitted in real time to enable a simulation to instantly predict the next few minutes of the experiment.

Analysing all the data will take two to three years. "We're producing enough data for generations of doctoral students," notes the project manager. A full overview of the ISC experiment is not due to be completed until 2020, though industrial partners won't have to wait that long for the key findings. "Industry is very interested in our results. We'll be providing them with valuable data from an early stage," Amann says.

Nonetheless, the researchers (and the electricity industry) are still very much at the start of a long journey. The ISC experiment is "only" a pilot project and is on a much smaller scale than a "proper" geothermal power plant. So why bother with this kind of experiment? "The method we're using to crack the rock can't be tested in a borehole that's 5,000 metres deep," says Amann. As well as the prohibitive costs this would entail, it would also be virtually impossible to equip such a deep geothermal borehole with this type of sophisticated measuring equipment. That's why the researchers have to reproduce this kind of system on a small scale and then use a computer model to scale it up. "The work we're doing here is a key part of minimising and perhaps even eliminating the risks posed by this technology," Amann adds.

Convinced of its feasibility

Time underground passes at a sluggish pace. The fluorescent lights cast a steady glow that gives no clue as to how much of the day has already passed. Occasionally the sound of an engine penetrates as far as the cavern. The men's stomachs start to rumble. It's midday, time to get a bite to eat with the other researchers back at the rock laboratory's centre of operations.

Amann heads up the stairs, followed by his colleagues. He opens the greenish-blue steel door, enters the dimly lit main tunnel and makes his way back to the main offices on foot.

Originally the researchers had wanted to fracture the rock in early December, but problems with the delivery of certain measuring instruments upset their plans. Amann doesn't see that as a bad omen, though. He is confident that the experiment will generate valuable data and mark an important step forward for deep geothermal energy.

His faith in this method of power generation is equally unshakeable: "I'm convinced that geothermal power plants will meet some of our energy needs in the future. And what we're doing here will provide the basis for Switzerland to exploit this low-CO_2 energy source." ○

DEEP GEOTHERMAL ENERGY

Temperatures at depths of 4,000 to 6,000 metres lie between 150 and 200 degrees Celsius. This geothermal energy can be used to generate electricity. Hydrothermal systems (e.g. St. Gallen) work by tapping into aquifers. The hot water is piped to the surface and used to produce electricity. Deep hot-water aquifers are hard to find, however, and they are rare in Switzerland. That's why a more realistic option for this particular country is to exploit petrothermal systems (e.g. Basel). That involves drilling down into the 200-degree-Celsius crystalline bedrock. Injecting water under high pressure creates a system of cracks through which the water circulates. This makes the water hotter, so it can be used to drive turbines and generate electricity once it returns to the surface. ETH Zurich launched a research initiative in the area of geothermal energy four years ago, supported by funding from the Werner Siemens Foundation.

CONNECTED

ETH Professor Margarita Chli tries her hand at the magic "Cubli" cube.

1 *ETH at WEF*

A VISIT TO GRAUBÜNDEN

ETH Zurich attended the World Economic Forum (WEF) Annual Meeting 2017 in Davos, giving guests an insight into its activities as an innovative research institution focusing on both local and global issues. Alongside the official ETH presentations in the closed WEF meetings and workshops, ETH showcased its latest research results in the fields of game development and robotics in a public exhibition (top).

In addition to a meeting with prominent delegates from the Canton of Graubünden (bottom right), the programme also included gatherings with representatives from various top universities, international associations and industry. Then-US Ambassador Suzi LeVine was among those who came to get a first-hand report on ETH research (bottom left).

2 *SwissFEL inauguration*

BRILLIANCE FOR CUTTING-EDGE RESEARCH

In early December, the Paul Scherrer Institute (PSI) inaugurated its new large-scale research facility, SwissFEL, with a ceremony attended by Johann Schneider-Ammann, President of the Swiss Confederation. The Swiss X-ray free-electron laser is expected to deliver important research findings relating to energy, the environment, information technology and health. In the photo, Schneider-Ammann (right) and PSI Director Joël Mesot press the red button, putting the facility into operation.

1 *ETH at WEF*

2 *SwissFEL inauguration*

3 *Global Talent Summit*

4 *ETH Alumni Focus Event*

5 *Press conference*

Image: Andreas Eggenberger (3); Paul Scherrer Institute / Markus Fischer

Image: Andreas Eggenberger (2); Martina Ghiringhelli Buesen; KEYSTONE/Ennio Leanza

3 *Global Talent Summit*

LIVING IN A WORLD WITHOUT WORK

Artificial intelligence, the internet of things and adaptive robots will fundamentally change the employment world in the coming years. At this year's Global Talent Summit, high-calibre experts discussed what this development will mean for our society, especially for people in less-skilled occupations. Organised by ETH Zurich in conjunction with *Diplomatic Courier* magazine, the event also offered opportunities to put new ETH technologies to the test.

4 *ETH Alumni Focus Event*

DEALING WITH RISK

Do we fear the right things? This was the question asked at the Focus Event on risk. ETH alumni discussed it with speakers Walter Rüegg, former head physicist of the Swiss Armed Forces, and Stefan Brem from the Swiss Federal Office for Civil Protection, based on a variety of concrete examples.

5 *Press conference*

MID-TERM ASSESSMENT

Halfway through its first term, ETH Zurich's Executive Board held its first public press conference, in which it took stock of its work to date. Among other things, the team explained to the journalists in attendance why ETH will begin offering a Bachelor's degree in medicine, when the next Cybathlon will be held, and why private third-party funding plays a key role in the University's success.

Agenda

CONCERTS

9/10 April 2017
Spring concerts
This year's spring concert features the Alumni Symphony Orchestra of Zurich conducted by Johannes Schlaefli, performing works by Edward Elgar and Amy Beach.
Casino Frauenfeld, 9 April 2017, 5 p. m.
Tonhalle Zürich, 10 April 2017, 7.30 p. m.
→ www.alumniorchester.ch

EXHIBITIONS

Francesca Gabbiani,
The Night of the Hunter II, *2008*

Until 17 April 2017
Eternal present
Art of the last 20 years from the Graphische Sammlung ETH Zürich is the focus of a collaboration with Helmhaus Zürich. This joint exhibition, held at both institutions, showcases the work of some 40 contemporary artists, as well as 10 themed reference pieces from the 15th to 18th centuries.
Graphische Sammlung, ETH Zurich, Main Building
Helmhaus, Limmatquai 31, Zurich
→ www.gs.ethz.ch

Arch_Tec_Lab, the world's biggest robot fabrication laboratory, will also be opening its doors.

Treffpunkt Science City

THE FUTURE OF WORK

12 March – 2 April 2017: The world of work is changing at a breathtaking pace as the fourth industrial revolution opens up whole new horizons. What will a factory look like in the future? What new professions can we expect to evolve? How should students be taught? Is Switzerland becoming the Silicon Valley of the future? What about the impact on the careers of researchers, architects and doctors? Will we still be working full time until the age of 65 in 20 years' time? Treffpunkt Science City's spring programme, "Work in the World 4.0 – How the working world is being turned on its head", responds to these questions and more as it looks at the digital revolution in the world of work.

Programme and registration (events are held in German):
→ www.ethz.ch/treffpunkt-en

BrainFair 2017

THE MARVEL OF THE MIND

13 – 18 March 2017: The brain is probably the most complex organ in the human body – and also the most fascinating. It contains around 100 billion nerve cells that ensure the proper functioning of the body and mind. The 20th "Brain Week" delves into this exciting topic, offering discussion forums, talks, and an open day. Visitors can learn about brain research firsthand and find out more about this fascinating organ.

Information (in German only):
→ www.brainfair-zurich.ch

Image: Graphische Sammlung ETH Zürich; Nicola Pitaro

EVENTS

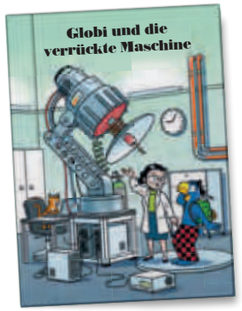
30 March – 2 April 2017
Challenge 2017
The 26th annual winter sports competition between EPFL and ETH Zurich is upon us. Over 200 students and 50 doctoral students and professors will be taking part in the event, which is organised by students from the two universities. It is a unique opportunity to share ideas in a relaxed setting and to make new contacts.
→ www.challenge17.ch

19 May 2017
Prizewinning *Matura* projects
School-leaving projects in mathematics, computer science, the natural sciences and technology will be on display to the general public in ETH Zurich's main hall. Prizes will be awarded for the best projects in computer science before the exhibition opens.
Prize ceremony at 1.45 p. m.
Exhibition opening at 2.30 p. m.
ETH Main Building
→ www.ethz.ch/maturaarbeiten

16 March 2017
A rendezvous with time
The ETH Alumni Association is offering a new day-long seminar on time management, given by Gerhard Grieb. The seminar focuses on how we can better use and manage our time. Based on an analysis of their own current situations, participants learn about tools they can apply to improve their work and time management. Seminar is given in German; registration required.
ETH Zurich, Zentrum campus
→ www.alumni.ethz.ch/events

28 March 2017 / 6.15–7.15 p.m.
Explore, zoom, navigate
Visitors taking the evening tour at the ETH Bibliothek have the chance to explore a selection of historical maps in digital form. Tour is given in German.
ETH Bibliothek, ETH Zurich Main Building
→ www.tours.ethz.ch

4 April 2017 / 6.15–7.15 p.m.
Learn more about the railway
Rail enthusiasts big and small have the chance to visit the Institute for Transport Planning and Systems' railway operations laboratory, which will be opening its doors for a tour and introduction to signal box technology. Registration required; tour is given in German.
ETH Zurich, Hönggerberg campus
→ www.tours.ethz.ch



Recommended reading

GLOBI UND DIE VERRÜCKTE MASCHINE

(GLOBI AND THE MAD MACHINE)

The latest in this series of popular Swiss children's books is set at ETH Zurich. Globi wants to go on a trip to the mountains when he sees a lady drop her purse. Globi quickly retrieves it and hurries after the lady onto the Polybahn. The thankful lady reveals that she is a professor at ETH and, in gratitude, invites Globi to her laboratory to show him her newest discovery. Unfortunately, the machine proves their undoing as it reduces them to the size of peas, leaving them desperately trying to attract someone's attention. This plunges them into one adventure after another on a journey that takes them through various ETH facilities and laboratories – even all the way to the ETH location in Singapore! As ever, overcoming obstacles is the aim of the game, along with a good dose of fun. An enjoyable peek inside ETH for readers big and small. In German.

Globi Verlag
ISBN 978-3-85703-100-7
100 pages
CHF 22.90; CHF 20.00 in the ETH Store

Image: Curdin Wüthrich; Oliver Bartenschlager; Globi Verlag

ABOUT

Felix Moesner

Felix Moesner studied electrical engineering at ETH Zurich from 1987 to 1993 and obtained his doctorate at the Institute of Robotics in 1996. Following his postdoctoral research at ETH, he switched to industry as a consultant and IT specialist. In 2003 he became the Science and Technology Counsellor at the Swiss embassy in Tokyo, where his achievements included setting up various academic networks. Now he heads swissnex Boston, the Swiss science consulate, where he was appointed CEO in 2012.

A world citizen from Appenzell

Felix Moesner, an ETH alumnus and current CEO of swissnex Boston, has often felt drawn to far-flung places, but he has always maintained close ties with Switzerland.

TEXT Felix Würsten IMAGE Jesse Burke

Felix Moesner is brimming with enthusiasm as he leads us through the light-filled building with the Swiss cross above the entrance: "Here on the ground floor we have plenty of space for our many events, as well as work stations for visitors; upstairs we have the offices where we prepare our activities." As CEO of swissnex Boston here on Broadway in Cambridge (Massachusetts, USA), he heads the world's first science consulate. The global swissnex network has seen continuous growth in recent years, but the Boston node – conveniently located between two world-class universities, MIT and Harvard – is an important Swiss hub for cultivating contacts in science, given the region's status as one of the world's most important centres of academia.

Moesner has spent the past four years at the helm of this consulate, which was expanded in 2013 to include an outpost in Manhattan. "One of our tasks is to establish connections between Swiss and American educational institutions," he explains, adding: "swissnex facilitates contact between scientists, supports young Swiss startups that want to gain a foothold in the US, and organises events to highlight Swiss research activities." As one of the world's leading institutes of technology, ETH certainly makes frequent appearances here, but swissnex itself represents all Swiss universities. ETH Rector Sarah Springman, for instance, recently paid a visit, and former ETH President Olaf Kübler also dropped in briefly not too long ago. He actually still remembered the current Consul, much to Moesner's surprise, from a meeting years ago. Said Moesner: "When I was a student in the mid-1990s, I wanted to write my thesis in Japan, which was still very unusual at that time. That's how I first met Olaf Kübler: he was the department head and I had to visit him in person to obtain a permit. When I went there, he asked me if I had a supervisor and said he would be happy to step in if I didn't."

International character

A native of Appenzell, Moesner came into contact with foreign cultures early on in his life. His home town has a magnificent view of the neighbouring countries, his father was Austrian and his mother a dual citizen of Norway and France, and at school Moesner met children from Africa and Asia who grew up as orphans at the Pestalozzi Children's Village in Trogen. Nevertheless, it was rather by chance that he later wound up in Japan as a young researcher. Following four semesters of electrical engineering at ETH, he wanted to finally find out what practical use his knowledge could be put to. Moesner accepted an offer from the Far East: at Toshiba, a technology corporation that at the time was still developing industrial robots, he worked on a two-armed robot with intelligence. The technology was used later for the gripper arm of the International Space Station (ISS). Recalling his time there, he says: "Just next door, incidentally, a group was working on a robot that was slated for use in the event of an accident in a nuclear power station. Tragically, that project was shelved after I left." ›

"We absolutely have to keep the dual education system a priority in Switzerland."

"I dreaded the thought of becoming a bureaucrat."

Japan – again and again
Back in Switzerland, he decided to obtain a doctorate at the ETH Institute of Robotics, but he couldn't shake his wanderlust. He convinced his doctoral supervisor to let him conduct his practical research at the University of Tokyo and then write his dissertation at ETH. "It was a very productive time: in under three years, I was able to submit my work to ETH, publish a dozen papers and even apply for four patents besides," he says. After that, he accepted a postdoc position in nanotechnology at ETH. "I realised then that academia wasn't the path for me, so I went into industry and became a consultant at Synpulse, a management consulting firm." After another three years Moesner returned to Asia working for Credit Suisse, which at the time had just acquired Winterthur Insurance. The bank sent him to Tokyo, where he was to head the IT department for the life insurance division. Moesner recalls: "I was 35 years old then and suddenly I was supposed to manage a team of 50 Japanese staff. That was an extremely interesting challenge for me."

A year later, when the Swiss embassy wanted to hire someone with a science and technology background, Moesner decided to change jobs again. Although he was practically a perfect match with the job profile, he initially hesitated to accept their offer: "I dreaded the thought of becoming a bureaucrat." He tackled new ideas right from the start, even if his colleagues at the embassy didn't always appreciate his fresh approach. Even today, at swissnex, having entrepreneurial scope and being able to implement his own ideas are very important to him.

During his time at the embassy, Moesner also experienced the Fukushima catastrophe at first hand, and recalls that "the earthquake that led to the accident was severe even by Japanese standards." The massive tsunami and the subsequent nuclear disaster engendered great uncertainty that also left embassy staff at a loss. Even today, Moesner is visibly moved when he recalls those turbulent days: "I'm very grateful that I received so much support back then, particularly from Switzerland."

Inspiring setting
Five years ago, Moesner moved on to swissnex Boston. After ten years in the hectic metropolis of Tokyo, he and his family have now found a new home in a quiet suburb of Boston – much to the dismay of his teenage children. Even if the neighbourhood of the swissnex headquarters seems quiet, Moesner thinks it is simply fantastic to be working in such a privileged intellectual environment. "There are 300 colleges, universities and research institutions within a 90-minute drive. That creates a very inspiring atmosphere."

ETH, as he repeatedly notices from his conversations, enjoys an excellent reputation on the US East Coast. Moesner believes that Switzerland truly does deliver outstanding performance: "We owe it to our dual education system that we were able to achieve such an exceptional position in innovation. We absolutely have to keep this system a priority." Switzerland could, however, stand to learn from the American error culture: "In Switzerland and Japan, people are anxious to not make any mistakes if at all possible. It's completely different here. At swissnex Boston, too, we make many decisions within a very short time, and sometimes we also spontaneously try new things. If it doesn't work, we say: okay, we learned something from it."

Moesner will soon be packing his suitcase again: the next big move is planned for summer, this time within swissnex. In a sort of castling manoeuvre, the world traveller will then head swissnex China in Shanghai. He looks forward to returning to Asia: "I enjoy that part of the world," he says, "and I get to learn another new language there." His knowledge of Japanese will serve him well. As he explains, "Chinese and Japanese have many similar characters, so it shouldn't be too difficult to get off to a good start in the new location." His credo, however, will remain the same there: "I want to give something back to Switzerland through my work, so I advocate for my native country from abroad." ○

SWISSNEX
Switzerland has been operating science centres – known as swissnex – in selected locations since the year 2000. Each swissnex is responsible for establishing an extensive network of contacts at universities, research institutions and high-tech companies in the host region and making this network available to interested Swiss institutions and individuals. The first swissnex was opened in Boston in 2000. swissnex Boston works closely with swissnex San Francisco and Switzerland's science advisers in Washington DC and Ottawa. Since 2013, it has run the swissnex New York outpost whose primary activity is promoting start-ups and education.

5 QUESTIONS

Sabine Werner loves the challenge of big research projects, but she feels that the frequent evaluations are excessive: *"Less would be more!"*

1 *What do you enjoy about this field of research?*

I enjoy the opportunity to investigate the molecular and cellular mechanisms underlying human diseases. I am particularly interested in the mechanisms that are responsible for the repair of injured or damaged tissues. This area of research provides a perfect opportunity to link basic research to medically relevant issues. It also allows me to collaborate with colleagues from a broad range of disciplines and thus to exploit the amazing opportunities that are on offer at ETH Zurich and in Zurich as a whole.

2 *Which figures have really inspired you?*

My doctoral advisor in Munich and my postdoc advisor in San Francisco both promoted my excitement for basic medical research. They gave me significant academic freedom already at an early stage of my career and put their trust in me. That also gave me the self-confidence required for my future scientific work. At the same time, they passed on their scientific expertise and set a great example of how to run a large international laboratory.

Sabine Werner, Professor of Cell Biology at the Institute of Molecular Health Sciences and Chair of SKINTEGRITY, a flagship project that forms part of the University Medicine Zurich network.
→ www.ethz.ch/skintegrity

3 *How would you characterise a "modern" scientist?*

Someone who has the ability to look beyond her/his own area of specialisation and collaborates with colleagues from a wide range of disciplines. I believe that many important innovations result from interdisciplinary research and such collaborations make research more exciting and varied. The era of ground-breaking discoveries by individuals is largely over, and new findings are more likely to come from teamwork. I also believe that a modern scientist is someone who gives her/his co-workers the chance to develop their own ideas at an early stage of their careers.

4 *What would you change about today's world of academic research if you had the chance?*

I would significantly cut down on the frequent evaluations that eat up so much time. Obviously it's essential to evaluate research – especially since most of it is publicly funded – but the number of evaluations we have nowadays means that the best researchers have to spend a considerable amount of their time evaluating others. In many cases, one could reduce the frequency of the evaluations, especially for individuals or workgroups that have enjoyed many years of success. This is one case where less would be more. It would save everyone involved an enormous amount of time (and money).

5 *If you could swap jobs with someone for one week, who would you choose?*

An astrophysicist. I've always been fascinated by the idea of studying the universe and I would love to get more insight into this area of research.

— Interview conducted by Martina Märki

Image: Provided by Sabine Werner

ETH zürich

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ETH Zürich
23. January on 07:19

ETH study shows that climate change, glacier shrinkage and landslides are directly connected. With the help of a unique dataset, researchers documented a chronicle of a catastrophic landslide at the Aletsch glacier in Switzerland.

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Despite the success of the internet, Sir Tim Berners-Lee, father of the World Wide Web, is anything but satisfied with today’s situation.

“We need a decentralisation of the internet”
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ETH Zurich @ETH_en · Jan 19

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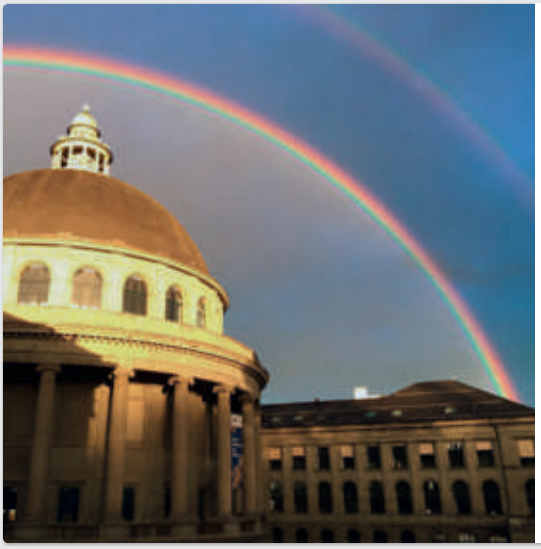

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ethzurich A double rainbow greeted us this morning right above the ETH Dome! Did you snap a picture as well? We’d love to see them, so make sure to tag with #RainbowAtETH!

#ethzürich #ethzurich #rainbow

dwiawd lovely!!!!

modern_wooden_architecture Amazing !