ETH zürich

NO. 1/2016

GLOBE

CONNECTED TO THE WORLD

Top-level research in the global village

PAGE 14

Space for critical thinking

PAGE 34

ScopeM: the perfect view

PAGE 38

Corine Mauch talks about her city and her alma mater

PAGE 46

KNOWLEDGE KNOWS NO BORDERS

Lino Guzzella, President of ETH Zurich

Ever since it was founded in 1855, ETH has drawn in knowledge from around the world in technology, mathematics and natural sciences to its base in Switzerland. It then makes this knowledge accessible to society and the economy at large. And all the while, ETH researchers are making new discoveries and advances that benefit not only Switzerland, but the whole world.

Knowledge doesn't stop at borders, but is, by its very nature, international. New ideas and concepts compete at the marketplace of global knowledge, whether in scientific journals, on the internet, or in the battle for research funding. To hold its own in these arenas, a university needs access: access to marketplaces, access to international networks, access to the pool of international talent.

Researchers at ETH come from more than 100 countries; yet they have much in common – in particular, a commitment to the pursuit of excellence. And a look at the approximately 8,000 individual contacts with academic and industrial partners around the world shows just how well-networked our researchers are.

The map on page 14 in the Focus section shows how the 8,000 contacts of ETH researchers are spread around the globe.

This issue of *Globe* is packed with articles giving you a close view of collaboration and teamwork at ETH. I very much hope you enjoy reading them!

Lino Guzzella
ETH President

Globe, the magazine for ETH Zurich and ETH Alumni.

ETH zürich

Title: ETH Zurich/Gian Marco Castelberg, Benedikt Rugar Editorial: Giulia Marthaler

CONTENTS

GLOBE
NO. 1/2016

Moss animals as carriers of diseases – page 10

An atomic-scale view through a ScopeM microscope – page 38

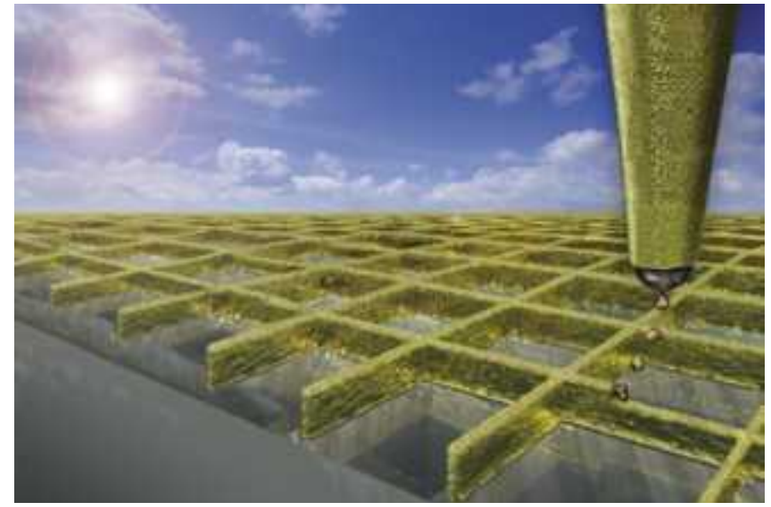
MIX Paper from responsible sources FSC® C016003 www.fsc.org

ClimatePartner° climate neutral
Print | ID: 53232-1502-1013

Publisher: ETH Alumni/ETH Zurich **Editorial team:** Roland Baumann (head), Corinne Johannssen-Hodel, Martina Märki, Felix Würsten **Contributors:** Samuel Schlaefli **Advertising administration:** ETH Alumni Communications, globe@alumni.ethz.ch, +41 44 632 51 24 **Advertising management:** print-ad kretz gmbh, Männedorf, info@kretzgmbh.ch, +41 44 924 20 70 **Design**: Crafft Kommunikation AG, Zurich **Printing and proofreading:** Neidhart + Schön AG, Zurich **Translation:** Burton, Van Iersel & Whitney, Munich; Clare Bourne, Nicol Klenk, ETH Zurich **Circulation:** German: 32,600; English: 30,900; published quarterly **Subscriptions:** *Globe* is available in print in German or English for CHF 20.– annually (four issues); full membership of the ETH Alumni Association includes an annual subscription to *Globe* **Orders and changes of address:** globe@hk.ethz.ch, +41 44 632 42 52, and for alumni at www.alumni.ethz.ch/myalumni **Further information:** www.ethz.ch/globe, ISSN 2235-7289 ***Globe* is also available in English and German as a free tablet version for iPad and Android devices.**

Photos: Hanna Hartikainen/Eawag; Daniel Winkler; Tanja Demarmels

NEW AND NOTED



Using a specialised variation of electrohydrodynamic inkjet printing, scientists can create a grid of ultra-fine gold walls.

Touchscreens

MORE TRANSPARENT, MORE CONDUCTIVE

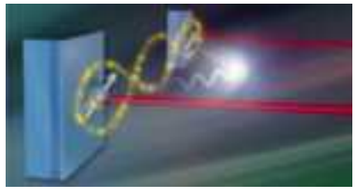
Every touchscreen needs transparent electrodes to recognise precisely if and where a finger touches the surface. Researchers at ETH Zurich have now developed a specialised nano-printing process to create a novel kind of transparent electrode: a grid of gold and silver on a glass surface. The new electrodes have a higher conductivity and are more transparent than those made of indium tin oxide, the standard material used in smartphones today.

Information technology

AN ATOMIC LIGHT SWITCH

The amount of information exchanged over communication networks around the world is proliferating at breathtaking speed. At present, the data quantities for wired and wireless communication are increasing every year by 23 and 57 per cent respectively, with no end in sight. This means that all the network components must constantly be made more efficient. Some of these components are known as modulators, devices that take information in the form of electricity and convert it into optical signals. Modulators are essentially fast electrical switches that turn a laser signal on or off, in tandem with incoming electrical signals. Vast numbers of modulators are installed in computing centres, but being rather large, they take up a great deal of space.

ETH researchers demonstrated six months ago that it is possible to make modulators smaller and more energy-efficient. At that time, they presented a micromodulator measuring just 10 micrometres. Now they have improved the world's smallest optical modulator yet again, developing a component that works at the atomic level and is even significantly smaller than the wavelength of the light it modulates. The new modulator is not yet ready for mass production, however; the main problem is that it currently works at a relatively slow pace. ETH researchers now want to fine-tune it for today's standard speeds.



Quantum physics

FASTER ENTANGLEMENT

Entanglement, a phenomenon of quantum physics, is predicted to play an important role in many future IC technologies. However, creating it over large distances demands an inordinate amount of time and effort, and this complicates its use in practice. ETH researchers have now developed a process that allows them to create entanglement faster than was previously possible.

Photos: Ben Newton/Digit Works, Aymeric Delteil

NEW AND NOTED

This restored figurative work can be seen on level C of ETH's underground car park.

Online art inventory

CLICK FOR CULTURE

Whether it's the ornate Semper façades on the north side of ETH's main building, or the sculptures and paintings that have been created since ETH was founded – the university's buildings and grounds are a veritable treasure trove of cultural artefacts. But by no means all of these are well known or even easily accessible. Thanks to the new art inventory, some 300 objects can now be studied in more detail online. All objects have been catalogued, photographed and published on the internet. For three-dimensional works, there are even views from various sides.

Even graffiti works by artist Harald Naegeli (also known as the Sprayer of Zurich) have made it into the inventory, despite the fact that they were not commissioned by ETH. The inventory includes some 27 figurative spray works that Naegeli created in the underground car park of ETH's main building between 1977 and 1978.

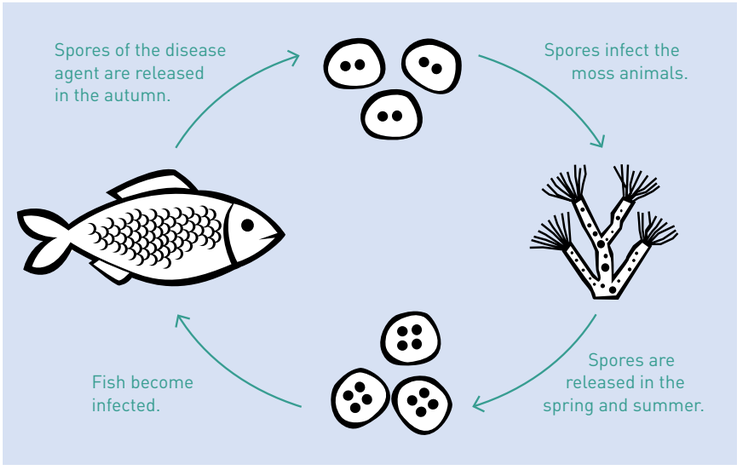
Link to the art inventory:
→ ki.e-pics.ethz.ch

Picture credits: ETH-Bibliothek, art inventory

Fish mortality

A team effort

More and more fish in Swiss rivers are contracting proliferative kidney disease. ETH researchers and Eawag are partnering several groups to see how they can stem the tide.



Proliferative kidney disease is based on a complex host-parasite system.

At Eawag's Aquatikum in Dübendorf, Switzerland, the basement is cool and loud, with a damp, swampland smell in the air. Snails, algae and other freshwater creatures flourish along a stretch of water that has been brought into a controlled environment. Powerful pumps have diverted a small part of the Chriesbach, a stream that flows past the recently opened research building, into the basement. There, water flows through basins and trickles down onto shelves equipped with glass plates and yoghurt containers.

For Hanna Hartikainen, a postdoc in the Aquatic Ecology research team, the main appeal of this "pond lab" lies in three small aquariums. Several glass plates hang in the water, on which a careful observer can detect a milky translucent growth – "moss animals". Hartikainen is one of a handful of researchers worldwide who study these tiny invertebrates.

Complex host-parasite system

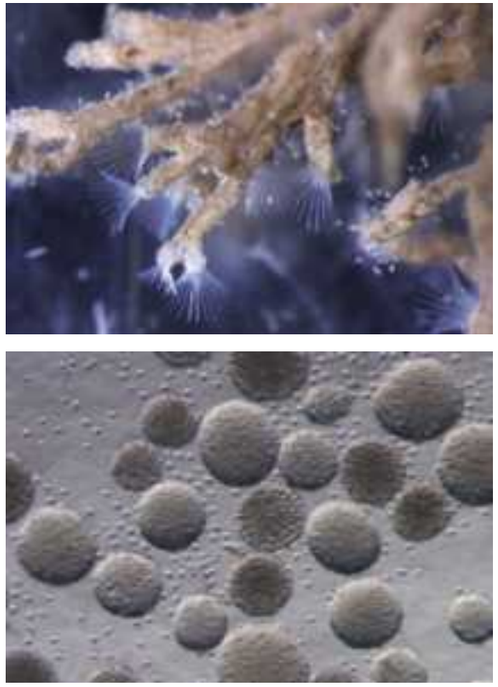
Moss animals, or Bryozoa, grow in colonies on the underside of stones and on tree roots that dangle in water. Research on these organisms focuses primarily on their role as a host for *Tetracapsuloides bryosalmonae* (Tbryo), the agent that causes proliferative kidney disease (PKD). PKD is a parasitic infection that affects mainly salmonid fish, such as rainbow trout, brown trout, char and salmon. The disease's host-parasite system is extremely complex: in summer, Bryozoa releases Tbryo into the water in the form of spores, which infect the fish primarily via the gills. From there, the parasites make their way to the kidneys, where they grow and multiply. In this way, the fish itself becomes a host for the disease agent. In the autumn, the fish excrete infected spores through their urine, passing the infection to bryozoans.

Parasitic infection spreads

The fish normally show initial signs of the infection once the water temperature reaches 15 °C. At that point the trout kidney, usually a thin red line running through the middle of the body, begins to swell to become a grey tube as thick as a human finger. On salmon and trout farms in the US and the UK, PKD can occasionally affect up to 90 percent of the stock. The disease has been present in Europe for a long time, but its spread has increased markedly in recent years: the first cases of PKD in Scandinavia were reported not too long ago. In Switzerland, the situation is becoming critical. In summer 2015, Hartikainen and her team conducted test catches in the Wigger River. At certain points, nearly all the brown trout they tested were infected with PKD.

Temperature has been identified as a key factor in the accelerated emergence of PKD. As long-term measurements from Swiss rivers show, water temperatures have risen by as much as 1.5 °C within the past 30 years. In addition, the Centre for Fish and Wildlife Medicine at the University of Bern has demonstrated that at present, PKD occurs mainly in low elevations, where the water is warmer. "There is much to indicate that global warming both fosters the spread of bryozoans and also increases the mortality rate among infected fish," Hartikainen explains.

Jukka Jokela, professor of aquatic ecology at ETH Zurich, assumes that other factors are also at play: "Rivers are being straightened, dams are being built and new chemicals are finding their way into the aquatic systems – all of which may promote the spread of bryozoans and PKD." For example, it has been determined that crevices between concrete elements used for straightening rivers provide the perfect growth substrate for bryozoans.



In the winter, Bryozoa (top) carry the parasites (bottom).

A sample archive of 8,000 fish kidneys

Jokela and Hartikainen are presently investigating how the parasite interacts, genetically and immunologically, with its two hosts. Their work is part of a research project launched in February 2014 and funded by the Swiss National Science Foundation. Three partner universities are also involved in the project. Hartikainen works most closely with the Centre for Fish and Wildlife Medicine at the University of Bern. She regularly transports laboratory-grown bryozoans from Dübendorf to Bern, where fish specialists place them in large aquariums stocked with juvenile brown trout. After that, the researchers study the progress of the disease in relation to the parasite concentrations in the water, the temperature, and the genetic background of the parasite. In addition, the University of Bern (FIWI) has preserved and catalogued approximately 8,000 fish kidneys from Swiss rivers over the last ten years, testing them for PKD. "This data set is very valuable and opens up exciting opportunities for research. It was one of the reasons I moved to Switzerland from the UK," Hartikainen says. By extracting DNA from the preserved kidneys, the researchers can accurately reconstruct how the parasite has changed over the years, potentially revealing adaptation to changing environments and hosts.

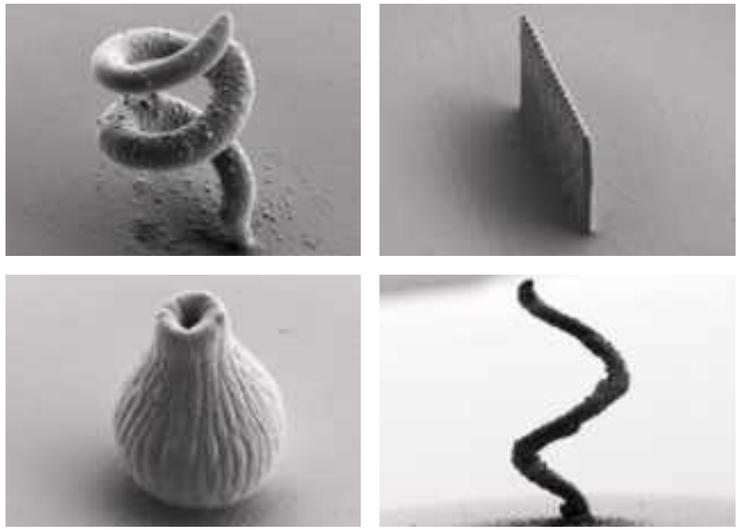
By the start of 2017, the project team aims not only to better understand PKD's biology and epidemiology, but also to simulate its future spread. A third group, located at EPF Lausanne, is developing a model to create such predictions. The project also focuses on creating a basis for an effective way to combat PKD. For this reason, the University of Aberdeen has been looking into the parasite's molecular characteristics, knowledge that could one day lead to a vaccine. "Our multidisciplinary collaboration is producing new and fundamental findings about PKD and the evolution of aquatic diseases in general," Hartikainen says. "These range from the smallest of molecular interactions to the epidemiology of entire populations."

— Samuel Schlaefli

The group of Aquatic Ecology:
→ www.ae.ethz.ch

Photo: Eawag, Crafft

Photos: Hanna Hartikainen, Eawag



The objects shown in these microscope images have a width of 15 to 35 micrometres.

3D printing

TINY COPPER OBJECTS

ETH researchers have developed a new 3D microprinting process that allows them to manufacture tiny structures out of metal, some with overhanging parts, easily and in a single step. The new technique is a refinement of the FluidFM system developed at ETH Zurich several years ago. Nowadays, FluidFM is used primarily in biological research and medicine, but one day soon, the new version could pave the way for manufacturing complex watch parts or microtools.

Climate research

2 DEGREES MAY BECOME 4

At the recent climate conference in Paris, delegates reached an agreement to limit global warming to below 2 °C. However, this target is abstract and may lead to misunderstandings. Many will interpret the global target as applying to their region and, accordingly, will not be proactive enough in reducing CO_2 emissions in their countries. And this figure is deceptive, as various climate models predict that the temperature will rise more sharply over land than over oceans. It raises a major question: how will a two-degree rise in global temperature affect individual regions around the world?

A team of climate researchers from ETH Zurich, the University of New South Wales (Australia), and Loughborough University (UK) has now calculated for the first time the levels of extreme and average temperatures, as well as of heavy precipitation, that will occur in individual regions if the average global rise in temperature is taken as a reference. In the Mediterranean, for example, if the average global temperature increases by 2 °C, the region will see mean temperatures increase by an average of 3.4 °C. If, however, the aim is to limit warming in the Mediterranean to 2 °C, then the global temperature must rise by no more than 1.4 °C. The most extreme changes might be seen in the Arctic: if the global temperature rises 2 °C, the average temperatures in the far north will increase by 6 °C. In fact, the 2 °C target for the Arctic had already been exceeded when global warming reached 0.6 °C on average (this figure is now approximately 1 °C).

Materials science

HIGHLY EFFICIENT FILTER

At the heart of the highly efficient water filter developed by ETH researchers is a hybrid membrane made up of activated charcoal and rigid whey protein fibres. Both components are cheap and easy to obtain. The membrane absorbs various heavy metals such as lead, mercury, gold and palladium, in addition to radioactive substances such as uranium or phosphorus-32. It also eliminates highly toxic metal cyanides from water. One of these is gold cyanide, commonly used in the electronics industry to produce conductor tracks. The filter provides a simple way to recover the gold.

Photos: Luca Hirt

Nanoprinting

TINIEST COLOUR PICTURE IN THE WORLD

This image is actually only as large as the cross-section of a human hair.

Researchers at ETH Zurich and ETH spin-off company Scrona have broken the world record for the smallest inkjet-printed colour image. Their achievement is due to groundbreaking 3D nanoprinting technology, invented at ETH Zurich and now being commercialised by Scrona. The printed image measures a minuscule 0.0092 square millimetres, or 80 by 115 micrometres – roughly the same size as the cross-section of a human hair.

The printed image shows three clownfish near a sea anemone. Thanks to 24bit colour depth, the underwater scene appears natural and true to life. To achieve this effect, the researchers printed layers of red, green and blue quantum dots. The thickness of the individual layers had to be defined with incredible atomic precision – for each individual pixel. From the researchers' perspective, this new technique offers a promising alternative for the manufacture of screens and optical devices.

Physics lessons

GIRL PUPILS AT A DISADVANTAGE

In physics classes, girls are often given poorer marks than their male classmates. This was the conclusion of a study conducted by ETH Zurich among secondary school physics teachers from Switzerland, Germany and Austria. The 780 study participants, a mix of men and women, were asked to mark an exam answer in an online test. All received the same question from the field of classical mechanics and the exact same fictitious – and only partially correct – pupil answer. Based on the introductory statement, half of the trial participants assumed that they had to grade an answer from a "male pupil", the other half "a female pupil". As it turns out, they marked the answers differently.

The study thereby revealed some serious differences: for teachers who had been teaching for at least ten years, the gender of the pupil had no influence on the mark. But teachers in Switzerland and Austria who had taught for less than ten years gave the girls a significantly poorer grade than the boys. Teachers with five years or less of professional experience discriminated against girls by a margin of 0.7 points (Switzerland) and 0.9 (Austria). The results for German secondary school teachers with less than ten years of teaching experience are striking: the male teachers marked the girls and boys the same, while the female teachers behaved like their Swiss and Austrian colleagues and marked the girls more harshly.

In conclusion, girls and women cannot count on being rewarded for their efforts; and this has potentially disastrous consequences: girls who feel that they are not being marked fairly in the sciences will tend to lose interest in these subjects.

Girls' scholastic achievements are not always given appropriate recognition.

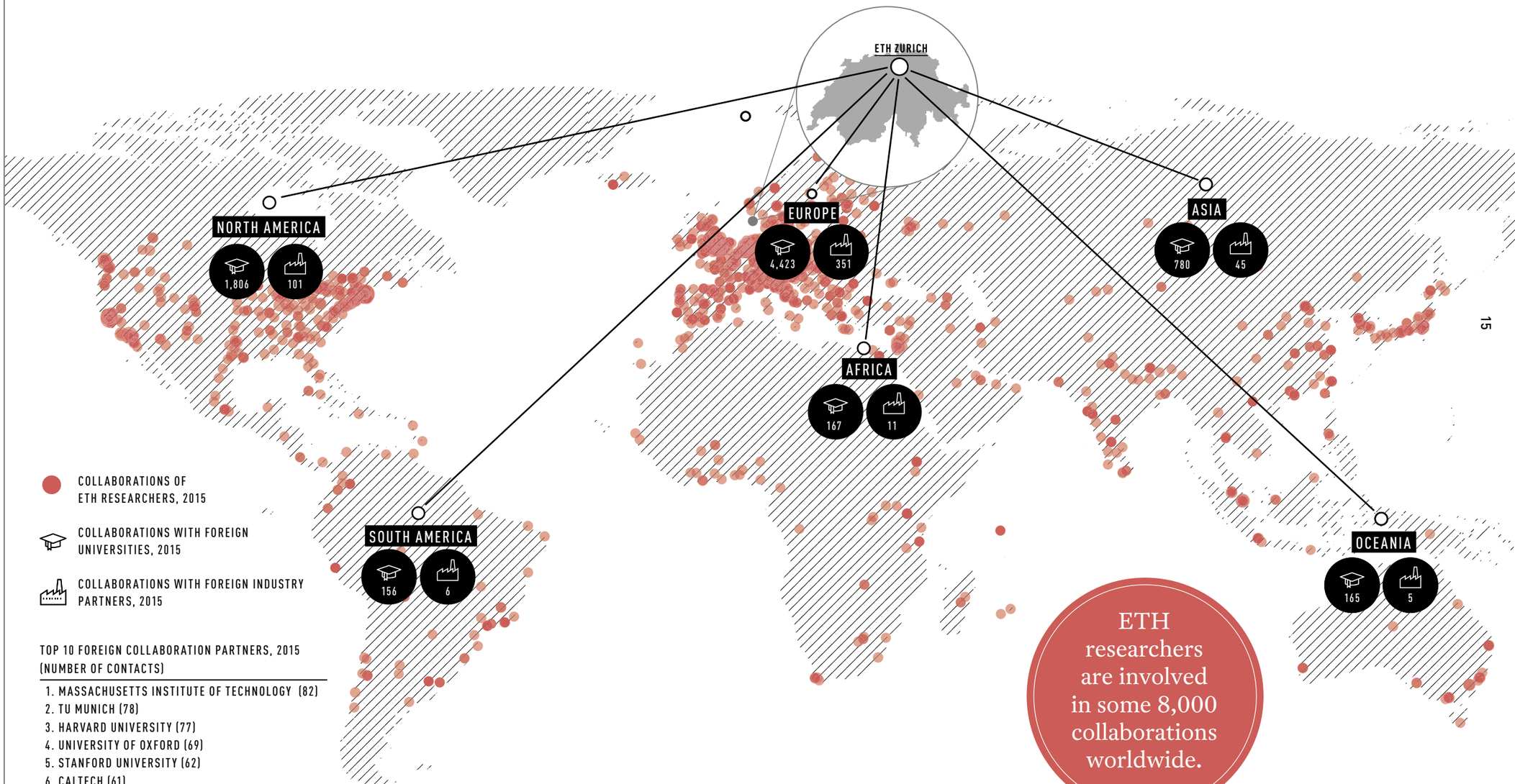
Photos: Scrona/ETH Zurich; Colourbox

FOCUS

CONNECTED TO THE WORLD

ETH researchers work around the globe with colleagues from other universities and industry partners. It is precisely this international network that makes world-class research possible at ETH Zurich.

ILLUSTRATION Benedikt Rugar



COLLABORATIONS OF ETH RESEARCHERS, 2015

COLLABORATIONS WITH FOREIGN UNIVERSITIES, 2015

COLLABORATIONS WITH FOREIGN INDUSTRY PARTNERS, 2015

TOP 10 FOREIGN COLLABORATION PARTNERS, 2015 (NUMBER OF CONTACTS)

1. MASSACHUSETTS INSTITUTE OF TECHNOLOGY (82)
2. TU MUNICH (78)
3. HARVARD UNIVERSITY (77)
4. UNIVERSITY OF OXFORD (69)
5. STANFORD UNIVERSITY (62)
6. CALTECH (61)
7. UC BERKELEY (58)
8. UNIVERSITY OF CAMBRIDGE (53)
9. IMPERIAL COLLEGE LONDON (49)
10. KARLSRUHER INSTITUTE OF TECHNOLOGY (48)

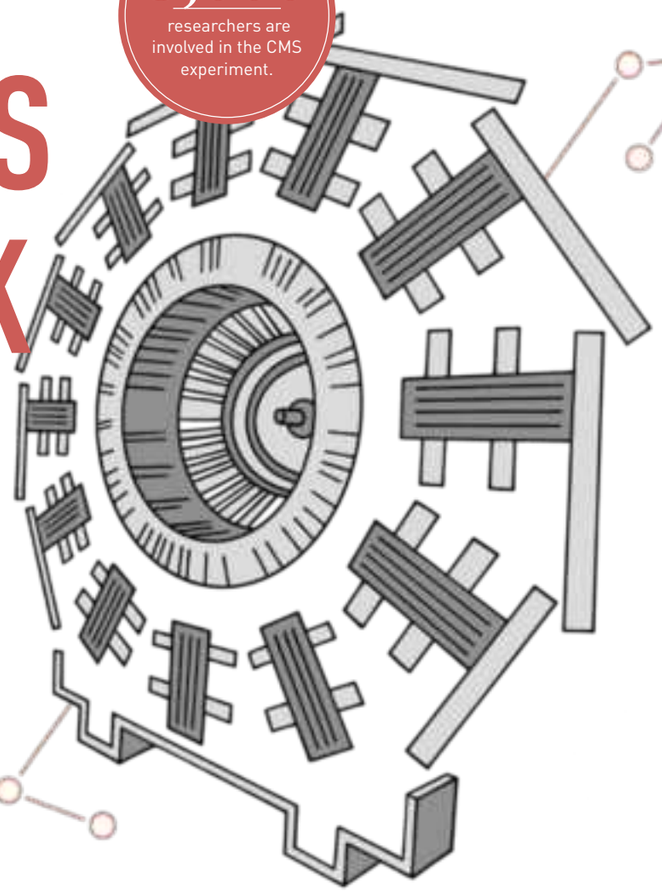
ETH researchers are involved in some 8,000 collaborations worldwide.

Sources of data: www.ethz.ch/ikb

ETH GLOBE 1/2016

FROM GENIUS TO NETWORK

3,000 researchers are involved in the CMS experiment.



Teamwork is becoming ever more important in science. Research is increasingly being conducted through international collaboration. Particle physicist Felicitas Pauss and systems biologist Rudolf Aebersold discuss what forms of cooperation make sense in their respective fields.

INTERVIEW Martina Märki and Felix Würsten

Professor Pauss, you've been involved for many years now in the CMS experiment at the LHC particle accelerator at CERN, and you played a part in the discovery of the Higgs boson. How many people are there in the CMS team?

FELICITAS PAUSS – There are around 3,000 scientists in our team from roughly 40 countries and 200 institutes, so we list around 3,000 authors in alphabetical order in our publications.

Are major projects like that absolutely necessary in particle physics?

PAUSS – Of course, not all questions in particle physics require the same level of effort. But experiments involving particle accelerators have a long tradition of international collaboration. When CERN was founded over 60 years ago, it was recognised that the only way to guarantee long-term international competitiveness – and at the time all eyes were on the United States – was by working together and setting up a common laboratory. So it was that 12 European countries decided back then to set up an international research campus in Geneva in the interests of peaceful collaboration. Now CERN has almost twice as many member states, and our experimental programme at the Large Hadron Collider is one of the biggest and most ambitious scientific projects on a global scale.

> "At ETH we can afford to take the long-term perspective."
>
> RUDOLF AEBERSOLD

Would it still be possible to launch such a project today?

PAUSS – It's a huge challenge to obtain a binding, long-term financial commitment from so many nations. It took more than 20 years to get from the first conceptual study for the LHC to the start of operations in 2008. The CERN Council, which brings together representatives of member state governments, had to plan a budget for at least 20 years – and then approve it, too. Had confidence in the institution not been built up over many years, and had there been no compelling scientific goals, this could never have happened.

RUDOLF AEBERSOLD

Rudolf Aebersold is one of the world's leading proteomics researchers and a systems biology pioneer. He co-founded the Institute for Molecular Systems Biology in Seattle in 2000. Since 2004 he has been a professor of systems biology at ETH Zurich and at the University of Zurich.

FELICITAS PAUSS

Felicitas Pauss is a particle physicist and was heavily involved in the design and construction of the CMS experiment at CERN's LHC. She also held important management positions at CERN. Since 1993 she has been a professor of particle physics at ETH Zurich.

Professor Aebersold, do you sometimes wish that systems biology had something similar?

RUDOLF AEBERSOLD – We're clearly interested to see what forms of collaboration are proving useful in the world of physics. But we're coming from a very different starting point. In biology, research groups are still very autonomous and publications are mainly produced in the traditional way by just a few authors. At the same time, our field of research is developing along lines that demand new organisational setups.

Why is that?

AEBERSOLD – Many of today's questions in systems biology or clinical research just can't be tackled in the traditional manner. To find answers, you need intricate animal or cell models, complex measurement technology, clinical cohorts, statistical methods and computer-aided analyses. There's no one group that can offer all that; perhaps it's even beyond the means of any one university. But the answer isn't to set up a giant "systems biology machine" somewhere. In our case, it's more a question of bringing together expertise and lots of data sets that have been collected by separate groups. So we're moving more towards a collaborative network – and ETH could play a pioneering role in this.

Are today's normal publishing arrangements a problem for networked research?

AEBERSOLD – They're a huge problem. When it comes to awarding grants or appointing faculty, it's generally the first- and last-named authors of a publication that are taken into account. We're really struggling to find a way to share out the credit for major interdisciplinary projects in a way that enables each researcher to show what their contribution was. Just listing authors in alphabetical order is not an approach that would be acceptable in biology today.

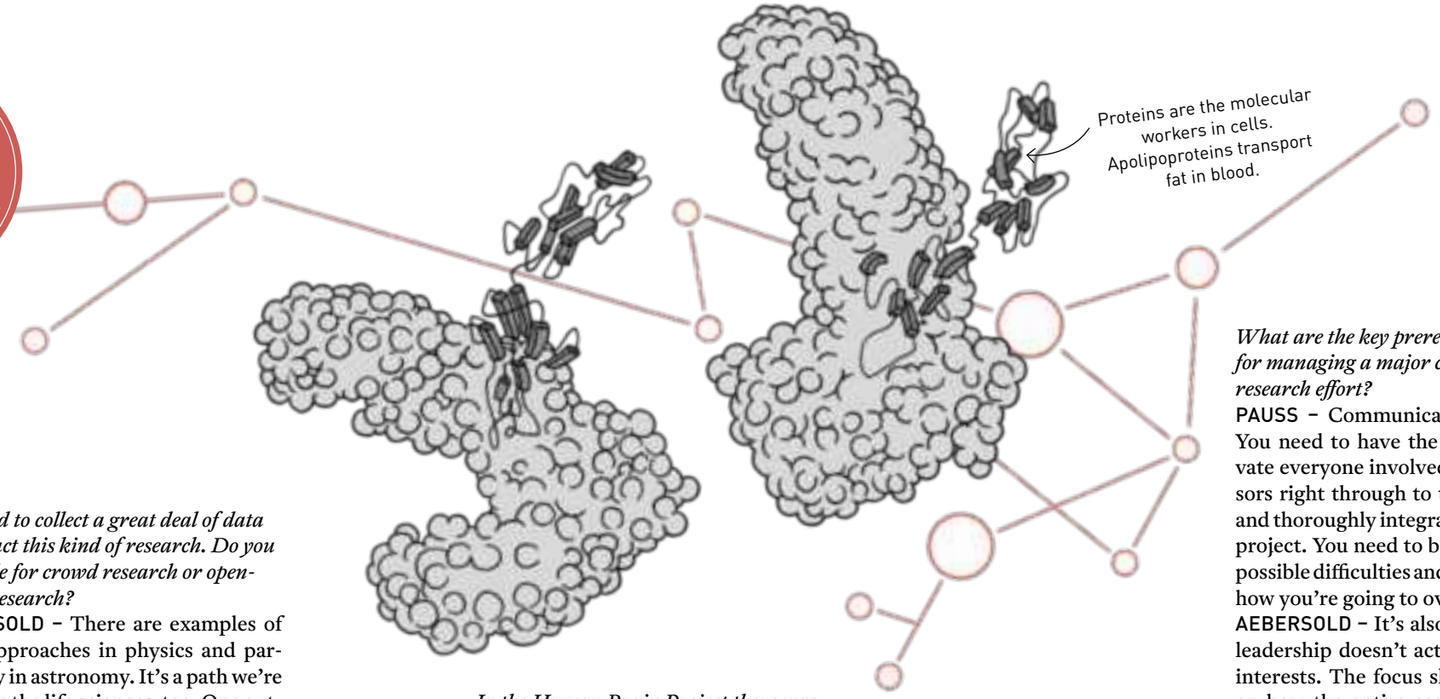
PAUSS – It's essential that a solution is found to this problem. We've set up special publication rules within the CMS collaborations. But even so, we often find ourselves having to explain that the number of publications to a researcher's name doesn't bear direct relation to the quality of their scientific work, because all major projects have long planning and development phases during which there's little for people to publish. This is a particularly important point when it comes to appointing faculty. One option would be for these selection procedures to switch to presenting only the contributions to the five most important publications, rather than simply drawing up a long list of all published work. That's one possible way to come up with a more sensible approach to assessment. >

CERN

CERN (Conseil Européen pour la Recherche Nucléaire) near Geneva is one of the biggest centres for fundamental physics research. Its aim is to research the tiniest constituents of matter. Using data collected by the ATLAS and CMS experiments at the Large Hadron Collider (LHC), the world's largest particle accelerator, the Higgs boson was discovered in 2012.

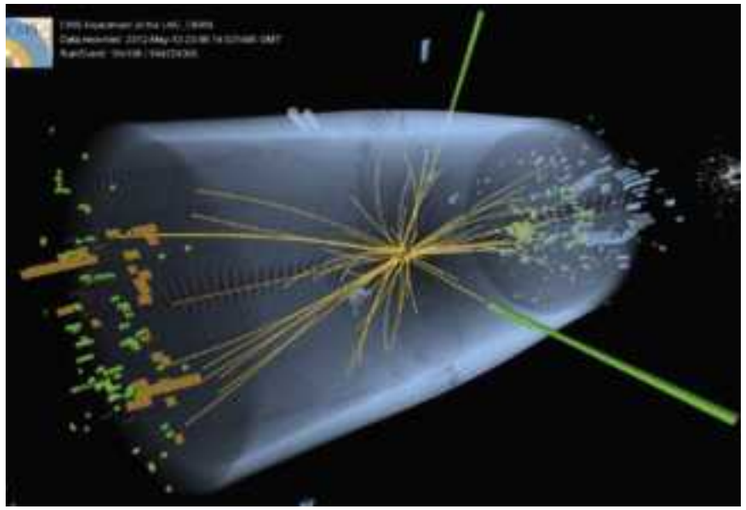
Photos: Giulia Marthaler (2)

20,300
proteins have been catalogued by systems biologists.



Are there any other aspects that stand in the way of a move to greater collaboration?
AEBERSOLD – Time horizons are a major issue. Whereas CERN was able to plan over decades, we operate in a world where time frames generally don't exceed two to five years. This is related to our dependence on third-party financing. If you work as a life sciences researcher in the United States, there's no such thing as longer-term funding from your institution, so you're always chasing the next grant. If you're in this system and you want to build up a project that won't let you publish anything for a period of five or six years because there's a lot of groundwork to cover first, then as a researcher you're dead. In contrast, at ETH and in Switzerland we can afford to take the long-term perspective. We really ought to be more aware of the opportunities this gives us.

Are you working on a project with a long-term perspective?
AEBERSOLD – Our field of research is proteins, which are the basis of all biochemical processes. There are thousands of different kinds of protein at work in every cell. One of our goals was to measure them all and draw up an inventory – and it's a goal we recently attained. Now we're trying to find out how these units organise themselves and how they cooperate in order to carry out the complex functions of living cells. In essence, this is the question at the heart of personalised medicine, a promising field that the ETH Board has designated as a strategic area of focus for research in the period 2017–2020. We would like to launch the Personalised Medicine initiative to tackle human diseases even more systematically. To do so we'll need a research network that motivates lots of researchers across different fields to work together on this topic.



Reconstruction of a Higgs boson decaying into two photons as observed in the CMS experiment

You need to collect a great deal of data to conduct this kind of research. Do you see a role for crowd research or open-source research?
AEBERSOLD – There are examples of these approaches in physics and particularly in astronomy. It's a path we're taking in the life sciences, too. One outstanding example is genomics, where the research community has agreed to grant open access to all the data collected before any work is published.

What does it take for different forms of collaboration to succeed?
PAUSS – In my experience, big collaborations can work well if their members are truly driven by scientific curiosity. If the motivation is more a question of career advancement, then I have my doubts.
AEBERSOLD – The CERN model works because it addresses a very clearly defined challenge. Genome research is similar: to fully sequence the genome of a population, whether of a thousand or a hundred thousand individuals, is a clear target that you can plan for and budget for. With open-ended issues – for instance the question of how an organism behaves as a complex system – the goal and the methods are much less easily defined. Of course we could just say we want a computer model that simulates the relevant system as accurately as possible; this is what the Human Brain Project in Lausanne has done. But we're light years away from this goal. That's why I believe we'll make better progress in my field by pursuing a network approach.

In the Human Brain Project there was debate as to which areas of research should be represented, and how to divide up the funding. Were there similar discussions at CERN, too?
PAUSS – In our search for the Higgs boson, our prior theoretical knowledge implied that we knew what it would take to obtain experimental evidence of this particle. So there was general agreement even back in the mid-1980s that we would need an LHC-type machine with very high beam energies of the colliding protons. Naturally, we too have to deal with critics who say that our projects are too big and cost too much money. But I think it was money very well spent, and I believe there's a strong chance that we'll make further fundamental discoveries in future.

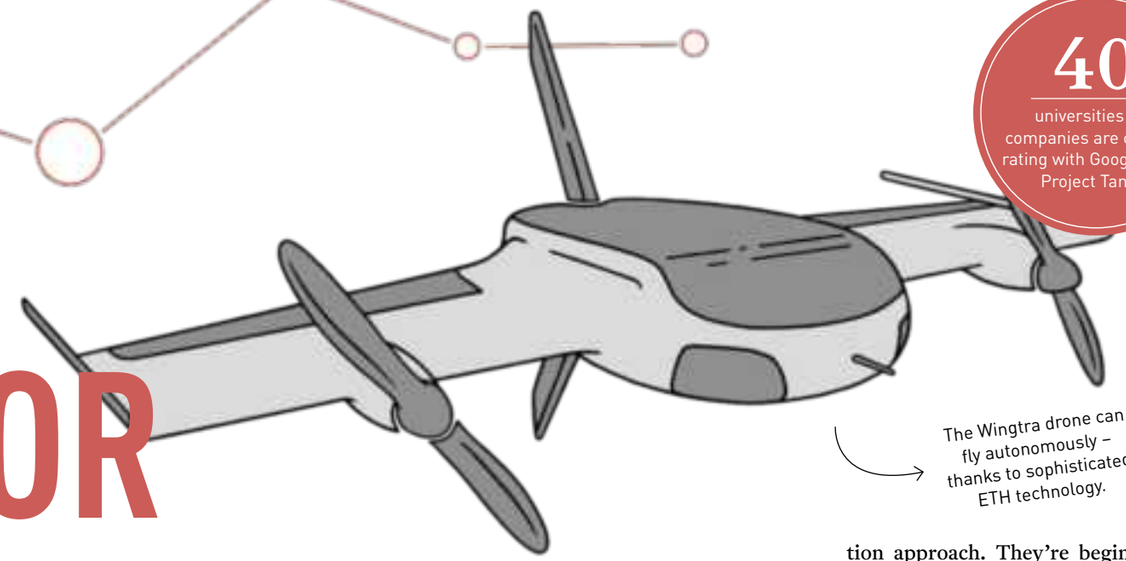
How does collaborative working affect individual research freedom?
AEBERSOLD – I see no fundamental difference between working in a major cooperative project and working as a solo researcher. In each case I have to answer to the scientific community and to the bodies that fund the work, and I have to come up with convincing ideas. Every scientist is free to decide whether they want to work alone or participate in a wider network.

What role do the interests of individual countries play in international collaborations?
PAUSS – For us it's important, indeed it goes without saying, that what we publish is independent of any political system or opinion. Even if our experiments at CERN involve researchers from countries where that isn't always the case. I always find it very satisfying to see that this kind of scientific collaboration is possible.
AEBERSOLD – Politics has a major impact on the life sciences. For instance there are countries that forbid the export of clinical material. At the individual level, though, nationality is barely a factor in the composition of research groups.

> "Big collaborations work well if their members are truly driven by scientific curiosity."
> FELICITAS PAUSS

What are the key prerequisites for managing a major collaborative research effort?
PAUSS – Communication is the key. You need to have the ability to motivate everyone involved – from professors right through to technical staff – and thoroughly integrate them into the project. You need to be able to foresee possible difficulties and plan in advance how you're going to overcome them.
AEBERSOLD – It's also important that leadership doesn't act only in its own interests. The focus should always be on how the entire consortium is progressing. And there needs to be someone who is the face of the collaboration to the outside world. While this representational role is central, it doesn't necessarily follow that the researcher who speaks for the group must also be the one to lead the scientific work. ○

Photo: 2012 CERN, for the benefit of the CMS Collaboration



The Wingtra drone can fly autonomously – thanks to sophisticated ETH technology.

40

universities and companies are collaborating with Google on its Project Tango.

A MAJOR PLAYER

ETH Zurich is an attractive partner for scientific collaboration. This is a big draw for companies like Google – for example when developing a novel navigation system that doesn't use GPS.

TEXT Corinne Johannssen-Hodel

For Roland Siegwart, it's no mere coincidence that Google set up its headquarters in California while also establishing a centre of expertise in Zurich. An ETH professor for Autonomous Systems, he is impressed by the many talented young researchers who work in Zurich, and no less so by the numerous promising spin-offs. "We are very well-positioned here," says Siegwart, continuing, "Zurich holds a strong appeal." He even refers to Zurich as the Silicon Valley of robotics. The city on the Limmat River has long held its own in the research community, as also evidenced by the numerous projects on which ETH has collaborated with renowned universities and industry partners from the US West Coast.

Roland Siegwart has been a professor of Autonomous Systems at ETH since 2006. He develops robots that are able to interact and adapt to new situations. Application examples include service and walking robots, and autonomous drones and vehicles.

Siegwart's stipulation for any such collaboration is that it must be open. His team must be allowed to also put the knowledge acquired to use in other projects. He has noticed a paradigm shift in this respect: "Companies are increasingly following an open innovation approach. They're beginning to see that this accelerates development." Faster development benefits both sides. Google in particular cultivates a very open collaboration process with selected universities. Currently, three of Siegwart's doctoral students are supported by Google. They're working on Project Tango, which involves a total of 40 universities and companies collaborating with Google. Marc Pollefeys, a professor of Computer Science at ETH Zurich, is among those participating.

The goal of Project Tango is to develop devices that use a camera and multiple sensors to perceive their surroundings in three dimensions, and even allow indoor navigation. The device should be able, for instance, to recognise obstacles and estimate distances. Siegwart's team is concerned primarily with using a camera to autonomously create three-dimensional maps with centimetre-scale precision. In this way, the device, be it a smartphone or a drone, knows where it is and uses local surroundings as its reference points. Unlike GPS-based navigation, this technology can also be used indoors. But the information goes beyond the mere position of the device: the camera images also convey its orientation, so it can do without the compass required for GPS-based navigation.

Testing in the railway station

The ETH researchers have just completed an extensive test run in Zurich's main railway station. Using Google Tango tablets, they captured images from a nearly 15-kilometre route, which generated an enormous amount of data. Their next task is data reduction. Only features that are constant are helpful and of interest, so their software has to filter out people and other moving objects from the images. Furthermore, such features must be recognisable from different perspectives and under varying lighting conditions.

The next milestone will be the market launch. "Once the Tango software becomes available, there will be nothing more standing in the way of app development," says Siegwart. He goes on to list some possible applications: "Tourists would be able to get their bearings even in the subterranean levels of the main railway station, the gaming industry could further blend virtual and real space for their gamers, and home furnishing stores could project an image of a sofa into the lounge of a potential buyer." But no one can predict exactly what the software will spark off once it's been launched. It won't be any different than with other new technologies: ultimately, the inventive spirit of the app developers and the needs of the customers will determine what unfolds. ○

Out and about to map Zurich's streets

ETH MEETS CALIFORNIA

ETH Meets California will bring the two research hotspots together on the US West Coast from 6 to 15 April 2016. Roland Siegwart will be presenting some unconventional flight concepts, such as the Wingtra drone, which takes off like a helicopter but flies like an airplane.

www.eth2cal.org

Autonomous Systems Lab:
→ www.asl.ethz.ch

Photo: Giulia Marthaler

Photo: Google ATAP Project Tango

RESEARCH IN SINGAPORE

Since 2010, ETH Zurich has forged strong links in Singapore – now its researchers can continue to carry out a number of programmes there in the coming years, focusing on cities of the future and the robustness of infrastructure systems.

TEXT Roland Baumann

Singapore, 7 July 2015. It's rush hour and nothing seems to be working. The metro line linking the South and the North is out of operation, and to make things worse, the East-West connection goes down for two hours, too. Over 250,000 commuters are affected. It's far from normal for this well-organized city in Southeast Asia. In fact, the episode prompted an article by Hans Rudolf Heinimann in the Straits Times, Singapore's biggest daily paper. In it the ETH professor also mentions a power outage that had forced a temporary shutdown of Singapore's stock market six months earlier.

More robust networks

Heinimann is interested in how to make systems more resilient and so strengthen infrastructure in its function as a city's backbone. He is of course also keen to show decision makers in the city state that the Future Resilient Systems research programme can provide the answers to specific issues. The programme is a joint project between ETH Zurich and the National Research Foundation of Singapore that Heinimann has led since the end of 2014 at the Singapore-ETH Centre (SEC).

Future Resilient Systems addresses a whole range of different infrastructures, from the power grid to transportation and banks. The approach is holistic. "Often systems fail not because of the technology but because of the organisation – or because of users, for example in transportation," explains Heinimann. These, then, are the three factors the researchers look at together. What's more, the underlying principles are transferable to different systems, as Heinimann points out.

The programme is still in the set-up phase, with 45 out of 60 researchers recruited. Heinimann puts a great deal of effort into committing them to a joint purpose: "It's crucial to work on developing a shared understanding – and it's an ongoing task, given how many countries and universities the researchers come from. For instance, while some doctoral students develop their own ideas in pursuit of a given objective, others expect to be assigned subtasks for the next weeks," Heinimann explains. It's easy to see how much work has to go in at the beginning given this array of backgrounds.

Real data for real solutions

Still, Heinimann and his colleagues have an even greater challenge on their hands: winning the trust of the Singapore government agencies so as to obtain real-world data for use in their research. "People in Switzerland tend to underestimate how difficult this is," he says. The agreement with the National Research Foundation, for instance, states that in the first three years, models are to be developed using generic data. Only then will decision makers in Singapore decide whether or not to supply the researchers with real-world data. It is obvious that infrastructure data are highly sensitive – the programme's Partnership Council is made up of governmental establishments that work with highly confidential data, such as the National Security Coordination Secretariat.

That Future Resilient Systems was approved in the first place is a testament to the level of trust established in the course of the first research programme, the Future Cities Laboratory, which ETH Zurich launched together with the National Research Foundation in 2010. "Our partnership with the National Research Foundation is excellent," says Gerhard Schmitt, Senior Vice President ETH Global and the driving force behind the ETH research location in Singapore. He adds that ETH's prominence in Asia has also risen significantly – a strategic goal of ETH's involvement in Asia.

"The Singapore-ETH Centre has become a scientific and political platform for Switzerland," says Schmitt, who headed the SEC for the first three years as its first director. His assertion is supported by numerous visits from political and business figures – the SEC has already had the honour of welcoming three Swiss federal councillors. And there have been visits in the opposite direction, too: in 2014, Singapore's President Dr. Tony Tan visited ETH in Zurich before being received in Berne by the Swiss President. ETH has >

SINGAPORE-ETH CENTRE (SEC)

The Singapore-ETH Centre for Global Environmental Sustainability (SEC) was founded by ETH Zurich in 2010 together with the National Research Foundation of Singapore (NRF). It is ETH Zurich's research hub in Asia and serves to establish links with local university researchers, research facilities and industry. The SEC carries out individual research programmes that run for five years each. The first of these was the Future Cities Laboratory (FCL) in 2010, joined by the Future Resilient Systems programme in 2014. When FCL came to an end in 2015, ETH and NRF took the decision to launch the second phase of FCL, meaning that ETH is currently working on two programmes in the CREATE tower.

www.fcl.ethz.ch
www.frs.ethz.ch

The rooms in the Singapore-ETH Centre (SEC) foster collaboration.

CREATE

The SEC's home is the sixth and seventh floors of the CREATE tower. CREATE stands for Campus for Research Excellence and Technological Enterprise and unites the research centres of the top global universities that work with NRF, including MIT, UC Berkeley and TU Munich.

www.create.edu.sg

particularly close links to Dr. Tan, as it was he who founded the National Research Foundation before he became president.

Schmitt's successor Peter Edwards arrived in Singapore in autumn 2013 and was astonished at how quickly the first ETH research programme had managed to establish itself within Singapore's research community. Edwards is full of praise for the links with government authorities, industry partners and universities in Singapore, Indonesia and Malaysia. "These were vital in obtaining real-world data and finding solutions to real problems," he says. The researchers from Zurich have, for instance, created a digital model of Singapore's urban traffic flows that can serve as an instrument for urban and transport planning. Professor Kay Axhausen and his team used a tool called MATSim to simulate the traffic in Singapore. The software was developed by researchers from ETH Zurich, TU Berlin and ETH spin-off Senozon, and can be applied to cities around the world.

Significance far beyond Singapore

"3for2" is another project with significance far beyond Singapore that also demonstrates why certain research topics cannot be addressed in Zurich. Cooling buildings is a necessity in hot regions of the world. Together with his group of researchers in Singapore, ETH Professor Arno Schlüter has developed a suite of air cooling technologies that uses substantially less energy than traditional air conditioning systems – and also takes up far less space. The "3for2" technology allows three floors to be built in the volume of space a conventional building needs for two. The system was first employed at the United World College South East Asia Campus in Singapore.

These two examples illustrate the impact the first ETH research programme has had. The National Research Foundation also considered it a success and approved the financing of the second phase of the Future City Laboratory, which was launched last year. According to programme director Stephen Cairns, the researchers want to take the insights gained in the course of the first phase to focus more on specific living situations in specific cities, and then formulate general findings on that basis. He says that the challenges of urbanisation are global in character but local in their manifestation.

Identifying opportunities

Will there be more programmes to come? "It's a sizeable challenge," says SEC director Edwards. Not only must the programme topic align with ETH's and Singapore's own research priorities, researchers at ETH must be able to recognise its potential as well. "Sometimes it's hard to convince colleagues 11,000 kilometres away in Zurich of the opportunities such collaborations present," says Edwards. But the programmes are also of interest from an institutional perspective, as Schmitt is quick to note: "The SEC is one of the biggest externally funded projects outside Switzerland in which ETH research groups are enjoying success in direct competition with research groups from other top universities such as MIT or UC Berkeley." ○

Photo: SEC

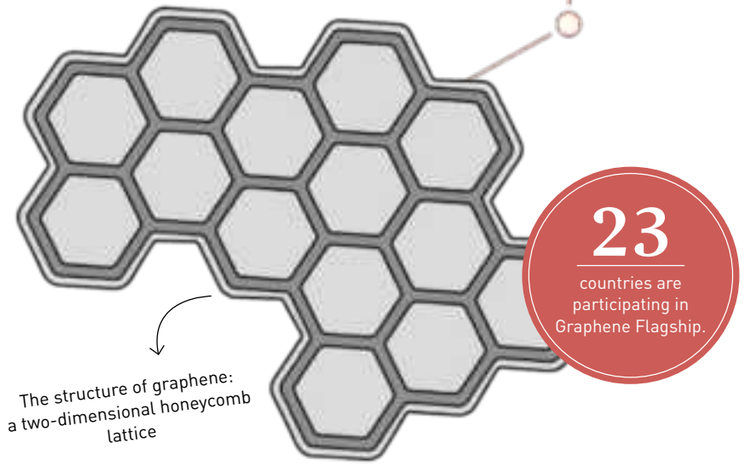
A DECISIVE STATEMENT

A bright future is in store for graphene because of its remarkable properties. It's therefore a logical step for the EU to devote one of its two Flagship projects to exploring this material. ETH physicist Klaus Ensslin is on the project team.

TEXT Felix Würsten

It was a good ten years ago that Andre Geim and Konstantin Novoselov, two physicists at the University of Manchester, caused an uproar with a new material. Their development, graphene, consists of just a single layer of regularly arranged carbon atoms and possesses qualities that characterise it as a genuine wonder material. Graphene is virtually transparent and conducts electricity; it is elastic and yet stable; it is dense enough that no atom can pass through it; and it can also be economically produced in near-perfect quality.

With characteristics like these, it is no surprise that many are hoping for great things from graphene. And since Asia is already working feverishly to develop possible applications, Europe doesn't want to be left behind. Two and half years ago, the EU awarded one of its two prestigious Flagship projects to a consortium for researching this material more intensively and on a broader level. Research groups from across Europe have since then been working on developing applications for graphene in 16 fields.



The structure of graphene: a two-dimensional honeycomb lattice

23 countries are participating in Graphene Flagship.

Stubborn edges

One of the people on the project is Klaus Ensslin, ETH professor at the Laboratory for Solid State Physics. Together with research colleagues in Manchester, Geneva, Regensburg and Madrid, he is investigating whether it would be possible to use graphene in the manufacture of quantum structures, which could then be employed in building quantum computers. The researchers aim to produce the tiniest of structures within which they can control the spin of the electrons.

Graphene appears to be an ideal material for this process, since the ›

nuclei of carbon atoms affect electron spin less strongly than those of other elements. In any event, graphene has proven to be a surprisingly stubborn candidate. The edges of the 20 to 50 nanometre quantum structures affect the behaviour of the electrons more intensely than expected. For this reason, the researchers want to take a closer look at the structure of the edges.

THE PROJECT

"Graphene" and the "Human Brain Project" are the two Flagship projects launched by the EU in 2013. The Graphene project is designed to run for ten years and has a total budget of about one billion euros. Under the leadership of Chalmers Technical University in Sweden, 142 research groups are participating in the project.

Transparent, conductive, flexible, robust: Industry is pouring all its hopes into graphene.

Basic research of the sort Ensslin conducts is actually quite important for graphene research. Yet the Flagship project is clearly oriented toward application, given that the overriding goal is to inject new life into European industry. This is also why so many industrial groups are participating in the Graphene project. "Korea has launched a national graphene programme, and China has big plans in this area as well – it makes perfect sense for Europe to nail its colours to the mast, too, and consolidate its position," Ensslin says. Indeed, graphene could conceivably be incorporated into a broad range of products: aircraft support structures, water filters, tires, sensors, touchscreens, batteries, even condoms – the possibilities are many and varied.

Clear potential for application

Ensslin is the sole ETH researcher participating in this EU showcase, a situation that is due to an administrative rule. He was already involved in the undertaking during the initial phase; when the Graphene Flagship project was approved, those institutions that had already participated in the first phase were not allowed to send any other researchers. This rule prevents all other ETH professors working with graphene from working on the project.

Ensslin was always certain that Graphene would receive the go-ahead: "There are four Nobel laureates actively participating in our project; that alone shows how relevant the endeavour is in a scientific sense. And the potential for application is plain to see." Although the administrative effort for this kind of project is enormous, Ensslin's impression is positive overall – "The collaboration functions well." This is in no small part due to pragmatic management: the director of the Flagship project has highly developed diplomatic skills. Whether or not the funds invested overall are being allocated truly efficiently can always be discussed. "At the end of the day," Ensslin says, "the decision on what type of big projects to finance is a political one. With Graphene, the EU is sending a strong message: Europe will not relinquish its leading role in this area." ○

KLAUS ENSSLIN

Klaus Ensslin has been a professor of experimental physics at ETH Zurich since 1995. His research focuses on the electronic properties of new types of semiconductor components. One of his primary objectives is to control the quantum properties of electrons in nanostructures.

Graphene Flagship Project:
→ http://graphene-flagship.eu

Photos: Dreamstime; Giulia Marthaler

PRECISION IN SPACE

In space, success and failure are never far apart: ETH researchers had barely had a chance to raise a glass to the successful launch of the Lisa Pathfinder mission when NASA announced the delay of the Insight project for Mars.

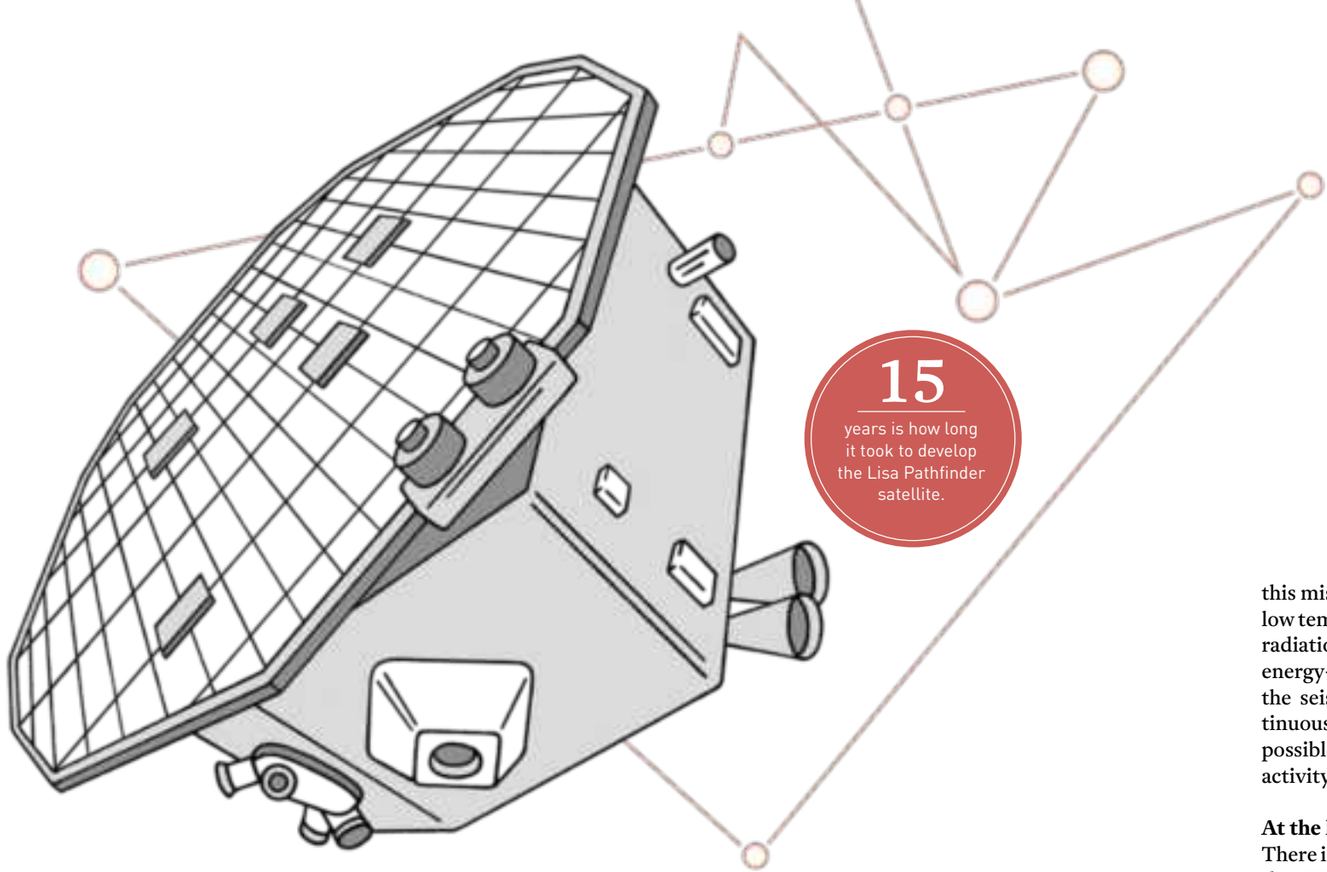
TEXT Felix Würsten

The bad tidings came just before Christmas: U.S. space agency NASA announced that there would be a delay to the launch of the Insight mission to Mars, which had been planned for this March. Recurring technical problems with the seismometer, the mission's main instrument, was the reason, and this despite the best efforts of the project's engineers. In view of the tight timeline to meet the launch window, NASA decided to push the mission back to 2018. The seismometer is being built by a French-led European consortium that involves ETH researchers and engineers. The mission's aim is to land geophysical measuring devices on Mars in order to gain a precise picture of the planet's interior structure. Researchers are hoping to record the seismic waves from marsquakes, which will tell us about how the planet's interior is organised. The problem was that the engineers were unable to insulate the sensor in such a way that would guarantee it the necessary vacuum to work under the extreme conditions on Mars. ›

DOMENICO GIARDINI

Domenico Giardini has been a professor of seismology and geodynamics at ETH Zurich since 1997. Director of the Swiss Seismological Service until 2011, he is active in numerous committees and involved in a variety of international projects.

Photo: Giulia Marthaler



15
years is how long it took to develop the Lisa Pathfinder satellite.

LISA PATHFINDER

The Lisa Pathfinder satellite is designed to test technologies that will be used for the eLISA space mission, which is set to begin its quest to record gravitational waves in 2034. ETH and the University of Zurich are both playing major roles in the international mission, which will run for a total of 12 months.

Long-term vision

Domenico Giardini, a professor at ETH Zurich's Institute of Geophysics, and his group were involved in two areas of this mission, which was supported by the Swiss Space Office. First, a part of his group, the Aerospace Electronic and Instrument Laboratory (AEIL), working with the Swiss industrial partner Syderal, developed the electronics for recording the Mars seismic waves. Second, once the mission lands on the Red Planet, his group will work with the Swiss Seismological Service to operate the marsquake service, analysing the readings and localising any marsquakes or meteoric impacts that occur. The postponement of the mission came as a disappointment to the researchers – especially as until very recently it had seemed that the launch would be able to go ahead as planned. "We've been working extremely hard on this project ever since NASA awarded our consortium the mission over two years ago," says Peter Zweifel, head of AEIL. It was a blow for Giardini, too: in his work as a seismological researcher he has long been working to get a seismometer to Mars. It's a vision he has pursued together with colleagues in France and other countries through various European Space Agency (ESA) projects, including Mars NetLander and ExoMars. But each time their plans were dashed by changes in the mission priorities. In 2012 NASA, which had successfully installed a seismometer on the moon 40 years ago, took up the idea. And now the researchers' hopes are on hold yet again, this time for technical reasons.

However, all those years of hard work haven't been for nothing: the mission is now set to head to our planetary neighbour in May 2018. Giardini is convinced that the two extra years "will let us fly better, safer instruments to Mars." Zweifel adds: "A space mission is always fraught with uncertainties. The technical challenges are immense." Indeed, his lab had to develop a robust electronic device for this mission; one that works reliably at low temperatures and when exposed to radiation, while also being extremely energy-efficient. Once it reaches Mars, the seismometer is supposed to continuously record data for as long as possible, so as not to miss any seismic activity.

At the limits of the measurable

There is another space project to which the ETH engineers and seismologists have contributed their expertise in how to design electronic components and measure waves. Just a few weeks earlier, they had toasted the successful launch of ESA's Lisa Pathfinder mission, which aims to demonstrate the technical feasibility of a giant interferometer that is set to be put into space several years from now. Known as the Laser Interferometer Space Antenna (Lisa), this device will be in a position to measure gravitational waves.

According to the general theory of relativity, gravitational waves are radiated by extremely high-energy phenomena in our universe, such as supernovas or black holes. The Lisa concept is based on the fact that there will be a minimal change in the distance between two masses that are very far apart whenever a gravitational wave passes through the space between them. In this case 'minimal' means a few picometres, or just a fraction of the diameter of an atom.

This future giant interferometer tasked with recording gravitational waves will consist of three satellites, each over a million kilometres away from the others. Only on this kind of scale does it even become possible to register the extremely long gravitational wavelengths.

Lisa Pathfinder's job is to determine whether the concept is technically feasible. At the satellite's heart lies an optical bench for measuring the distance between two cubes of gold and platinum in free fall using an interferometer. The electronics, which ETH helped to develop, measure the position of the two cubes and will steer the satellite by way of microjets so as to follow the masses in free fall. "We had to develop absolutely stable electronics that are capable of measuring the position of the masses down to very low frequencies and with very high accuracy," Zweifel says, explaining the most important task faced by his team in collaboration with technology company RUAG Space.

The golden Lisa Pathfinder satellite is prepared for launch.

A breadth of expertise

It's not just the experience ETH Zurich has in developing electronic components for space-based projects that makes it an ideal partner in this mission; there are also scientific reasons. Giardini explains: "The seismologists here at ETH Zurich work closely with the astrophysicists at Zurich University. As seismologists, we're in a position to help them in one key area: measuring waves is what we do, and we know very well how to disentangle a mixture of different wave signals to tell their sources apart. That means we'll be able to use the future measurements from space to pinpoint the sources of the gravitational radiation, which the astrophysicists can then go on to study." ○

Photo: ESA-CNES-Arianespace

Rice is now cultivated in nearly all of the world's tropical and subtropical regions.

FAIR AND ENVIRONMENTALLY FRIENDLY

India is the world's second largest producer of rice. A research project involving aid organisations, retail and industry is helping rice farmers in India to use organic methods of rice cultivation and sell their crops at fair prices.

TEXT Martina Märki

2,000
Indian rice farmers are involved in the project.

For more than half the Earth's population, rice is the most important food staple; and flooded rice cultivation accounts for 80 percent of the world's rice harvest. This method is problematic not only because of the large amounts of water it requires, but also because of the greenhouse gases it produces, particularly methane. Next to CO_2, methane is the most significant anthropogenic greenhouse gas. It is estimated that flooded rice cultivation is responsible for 17 percent of the methane in the Earth's atmosphere – about 60 million tonnes annually. In addition, there are emissions of nitrous oxide, another potent greenhouse gas, which vary according to the kind of fertiliser used.

"There's room for improvement," says Charlotte Decock, a researcher at ETH Zurich's Institute of Agricultural Sciences. As an expert on greenhouse gases, she is leading a research project in the Indian state of Uttarakhand. Here at the base of the Himalayas, aromatic basmati rice is grown as an important cash crop. The project aims to study the impact of alternative organic cultivation methods on rice production, in terms of both crop yield and greenhouse gas emissions. As one of the ETH World Food System Center projects, it is funded by the Swiss food wholesaler Coop and provides evidence-based decision support for its subsidiary Reismühle Brunnen, an importer and processor of fair-trade and organic rice. The project is in cooperation with Swiss aid organisation Helvetas and local aid organisation Intercooperation Social Development India, who have been supporting more than 2,000 rice farmers in converting their rice fields to organic production in the state of Uttarakhand since 2011.

Finding practical methods

Decock is now Skyping with her Indian postdoc Monojit Chakraborty to get an update on the local situation. He is currently at ETH's partner university in India, Govind Ballabh Pant University of Agriculture and Technology (see box for a list of all partners), to analyse data from field experiments that are run by young scientists from the university. "What's special about our project is that universities, local producers, retail companies and aid organisations – Swiss and Indian alike – are working together," explains Decock. This is extremely helpful. The Swiss retail chain, for instance, is already well established, so the local rice farmers experience the benefit of these activities first-hand. This generates a lot of goodwill among the local farmers towards the current research project. The local support is important because the researchers want to test their methods not only on the university's test fields, but also directly in everyday farming. Decock believes this is key, stating: "We could invent wonderful methods of reducing greenhouse gas emissions, but they would be completely useless if the farmers can't implement them in their day-to-day routines." That's why, in addition to measurements on university test fields, the project also collects data on farmers' fields. The tests systematically compare different fertilisation methods and different types of irrigation to measure their impact on methane and nitrous oxide emissions, and on crop yield. Validation of the experimental methods on the farmers' fields is important because data that was already available from Helvetas had shown that, even when the cultivation methods appeared to be identical, yields on the test fields were generally better than the yields on the rice farmers' fields.

The university's test fields

Photo: Helvetas

Test fields and farming reality

Chakraborty believes this is closely tied to local conditions, explaining: "For the university test fields, everything needed is available. A poorer peasant farmer, however, may not be able to procure the required organic fertiliser; maybe he doesn't have any livestock to provide manure, and buying fertiliser would be too expensive. So he uses less fertiliser, or a different kind." The researchers now aim to better account for such influences. Using a computer model that reflects reality as closely as possible, they want to incorporate not only measurement data from test fields and real fields, but also socioeconomic information and relevant findings on the farmers' work methods. For instance, they will record how much and what livestock a farmer has, what characteristics the farmed fields display, what types of fertiliser are used, which irrigation methods are used, and how much manpower and financial resources are available. "The model can help us find out whether richer farmers and poorer ones require different strategies, and what the best recommendation is for each set of circumstances," says Decock. The link the researchers want to create between ecological and socioeconomic data isn't yet common in this form. Decock is therefore happy to have specialists from the University of Wageningen on board, who already have experience in the field of modelling.

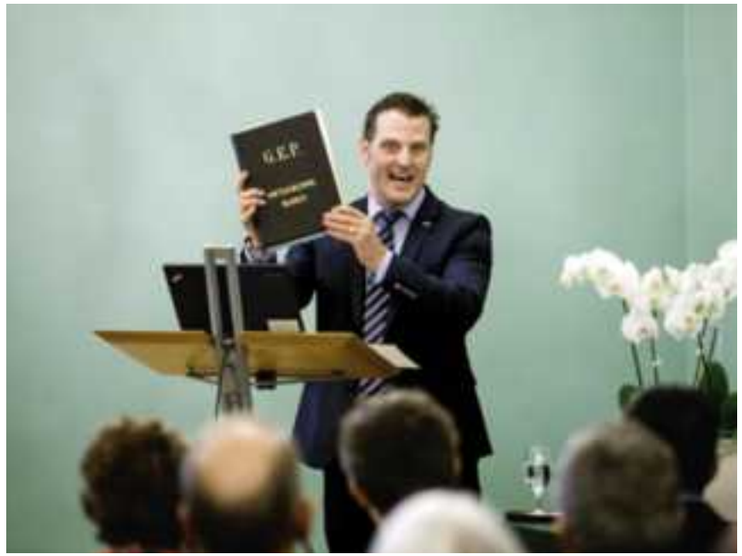
As she explains, having so many different partners work together on a project requires a lot of coordination and communication, but the collaboration also offers many advantages. Decock is convinced that "on our own, we researchers could never incorporate our findings into practical applications as quickly as this project allows." ○

BasmaSus project:
→ www.worldfoodsystem.ethz.ch/basmasus

PARTNERS

Project participants
Research leader: Dr. Charlotte Decock, Chair of Sustainable Agroecosystems at ETH Zurich
Postdoc: Dr. Monojit Chakraborty, Chair of Sustainable Agroecosystems at ETH Zurich
Research participants: Prof. Johan Six, ETH Zurich; Dr. Jeroen Groot and Prof. Pablo Tittonell, Wageningen University
partners: Reismühle Brunnen, Helvetas Schweiz, Intercooperation Social Development India, Govind Ballabh Pant University of Agriculture and Technology
Funding: World Food System Center at ETH Zurich, Coop

COMMUNITY



Jürg Suhner, President of ETH Alumni GEP Baden and CEO of Suhner Holding, makes alumni history tangible.

First local alumni group

100 YEARS OF ETH ALUMNI IN BADEN

Alumni GEP Baden celebrated its 100th anniversary on 14 January 2016. Founded in 1916 as the first local ETH alumni group, it offered the graduates of ETH Zurich a platform for networking with one another, irrespective of their fields of study.

Although ABB (formerly BBC) was once the main reason for an ETH engineer to move to the small city on the banks of Switzerland's Limmat River, ETH graduates today have a much broader selection of jobs to choose from. Nevertheless, ABB remains an important partner. Remo Lütolf, CEO of ABB Switzerland, was thus invited to be the keynote speaker at the anniversary celebration at Villa Boveri. In his speech, he underlined how important ETH alumni are for ABB.

The local alumni group currently has around 300 members, who represent nearly all disciplines and graduating classes from 1952 to 2015. The group organises a series of events offering members the opportunity to cultivate their network. "Despite the diversity amongst our members," says Jürg Suhner, President of the ETH Alumni GEP Baden and CEO of Suhner Holding in Lupfig, "we always find some similarities that invoke a palpable sense of ETH Zurich as a whole. The common denominator is often the analytical perspective we learned to use at ETH and still use today."

ERC Starting Grant

12 MILLION FOR YOUNG TALENT

Eight researchers from ETH Zurich received an ERC Starting Grant in 2015, funding awarded by the European Research Council to support young, talented researchers at the start of their academic careers. The researchers receive around 1.5 million Swiss francs each. More than half of the grants awarded at ETH went to young female researchers. One of them is Maryam Kamgarpour, whose ERC project is aimed at developing algorithms for a power grid feedback control system that accounts for fluctuations in the generation of renewable electricity.

Spin-offs established

RECORD

Last year, 25 spin-offs were established at ETH Zurich – more than ever before in a single year. This new record shows how helpful it is to provide very early support for young talent, and demonstrates that the ETH funding programme is bearing fruit. The Pioneer Fellowships, for instance, help Master's degree students who want to turn a business idea into reality.

Photo: Martin Stollenwerk

"Critical Thinking" initiative

Room to think

Acquiring professional skills is a matter of course for ETH students; but ETH Zurich also wants to teach them to be critical and independent thinkers. To this end, ETH is developing new approaches for teaching and communication.

Sometimes it also takes creative chaos: Students at ETH Week 2015

In our digital age, information and facts are becoming increasingly accessible through the click of a button, which poses many new challenges – not least for our education system. Skills that help people scrutinise facts, look beyond the boundaries of their professional disciplines, and form and articulate their own opinions are becoming more and more crucial. Universities therefore need to impart not only professional skills, but also critical-creative thinking and leadership skills, believes ETH President Lino Guzzella, who launched the "Critical Thinking" Initiative. ETH Zurich wants its graduates to be both intellectually agile and able to take responsible and entrepreneurial action. It wants to ensure they have the tools they need to incorporate socially relevant and ethical aspects and the principles of sustainable development into their activities. One way to do this is to go beyond merely teaching students methodological expertise and discipline-specific knowledge, by giving them opportunities to address complex, interdisciplinary and system-oriented issues.

New momentum in teaching

What began in 2014 with an internal expert group and a workshop involving representatives from industry has since sparked numerous ideas within ETH. The recently published annual programme "Critical Thinking 2016" offers the second year of events promoting critical thinking skills in teaching. There will be workshops for skills that extend beyond the boundaries of departments and disciplines, as well as innovative teaching formats to help faculty inspire students to be more creative in their analysis, reflection and problem-solving. "Critical Thinking" was launched as a teaching issue," says Andreas Vaterlaus, Vice-Rector for Curriculum Development, taking stock two years later. He continues, "This inspired us to critically examine our course offerings and degree programmes, leading to numerous new projects in the field of teaching."

The most visible new project was ETH Week, which was first held in September 2015. The idea behind it was to combine practice and theory in a new way, namely across all disciplines and hierarchical levels at ETH. Around 130 ETH students from 15 departments participated. They were given a week to develop creative and feasible solutions for a sustainable food system in Switzerland. However, the primary goal of the task was to give them the experience of independently developing meaningful questions and working together across disciplinary boundaries to find possible solutions. "The special spirit that emerges during ETH Week lives on – both while the students are still at ETH and later on in society," says ETH Rector Sarah Springman, who opened ETH Week 2015. ETH Week 2016 has already been announced; this year's focus is water.

Space for experiments

For Gerd Folkers, who was appointed by the ETH Executive Board as the new head of the "Critical Thinking" Initiative in early January, thinking beyond professional boundaries and exploring avenues off the beaten path is nothing new. As Director of the Collegium Helveticum, the joint ETH Zurich and University of Zurich laboratory for transdisciplinarity, he knows what a challenge it is to actively communicate between disciplines and practise new skills. "The 'Critical Thinking' Initiative can't be about assigning students a couple of additional hours of critical thought and then awarding them a couple of credits for it. We have to offer them truly new models, and that may also require more profound changes," he says.

One such new model is the Student Project House. This is a place where students will be able to develop and carry out their own projects, from the initial idea all the way through to prototyping. The ETH Executive Board has pledged the required funds for the first project phase. Now a work group comprised of students, professors, and teaching and construction specialists is developing the operating concept for the space. "We are developing the Student Project House together with students. They play a major role in the project and also bear responsibility for it," emphasises Anita Buchli from the Rector's office, who is supervising the project. It's through projects like the Student Project House that the "Critical Thinking" Initiative creates the space, not only in people's minds but also in the design of their surroundings, that is needed for critical thinking to develop. — Martina Märki

Critical Thinking Initiative:
→ www.ethz.ch/ct-en

Spin-offs

BOUGHT BY APPLE

A dream has come true for the founders of Faceshift: Apple bought the ETH spin-off in December. Faceshift developed a software program that makes avatars of people in real time, based on video recordings. It was used in the latest Star Wars film. Faceshift CEO Thibaut Weise developed the basis for this program while a doctoral student at the ETH Zurich Computer Vision Laboratory. He readied the product for market launch at ETH Lausanne, where he founded the company with additional colleagues in 2012.

→ www.faceshift.com

A CLEVER LIGHTBULB

Founded in 2015, Comfylight is a new spin-off of ETH Zurich and the University of St. Gallen. Their brilliant idea was to create an intelligent LED lightbulb that uses sensors to analyse the behaviour of people living in the house and then reproduces this behaviour in their absence to scare off potential intruders. The idea is a compelling one: in their first crowdfunding round, the young entrepreneurs reached their funding goal in just seven hours. Comfylight has won multiple sponsorship awards, including the W.A. de Vigier Foundation's 2015 prize.

→ www.comfylight.com

Photo: Alessandro Della Bella

Archilogic produces and showcases interactive 3D models of building interiors.

Dominique Burgauer from Archilogic presented his spin-off at the first Investor Summit at Zurich Airport.

Investor Summit

WINNING OVER INVESTORS

Founders of spin-offs aren't usually short of good ideas. But for most of them it's not all that easy to find the right investors: backers who have not only the financial means, but ideally know-how as well. In mid-January, seven promising new companies had an opportunity to present themselves to over 100 Swiss and international investors during the Investor Summit at Zurich Airport. The entrepreneurs had four hours in which to make valuable contacts and meet potential partners who could support them in building up their company.

New chair

RESEARCH TO COUNTER FOOD WASTE

ETH Zurich will receive a total of 5 million Swiss francs in funding from Swiss companies Bühler and Migros for the Chair for Sustainable Food Processing. The money will also help fund postdoctoral research projects in connection with the ETH World Food System initiative. The Chair, which resides in the Department of Health Sciences and Technology, focuses on the entire product cycle, from molecule right through to saleable food. It is currently held by Alexander Mathys.

Partnership

OPEN SYSTEMS FUNDS ZISC

ETH Zurich is a world-leading centre for information security. The company Open Systems is an international provider of IT security services, offering major corporations comprehensive protection against IT risks. In cooperation with additional funding partners, Open Systems is providing one million Swiss francs to support ETH's Zurich Information Security and Privacy Center (ZISC). By doing so, it aims to further strengthen teaching and research in the field of information security, while at the same time facilitating access to market experience.

SSIC

NEW PRESIDENT

In January of this year, Gerd Folkers, professor of pharmaceutical chemistry at ETH and long-standing president of the Collegium Helveticum, was appointed as the new President of the Swiss Science and Innovation Council, for the next four year term. The SSIC advises federal government on policy relating to science, higher education, research and innovation.

Photos: Sandra Blaser Photography; Giulia Marthaler

Column

Almost like home

Every day over 25,000 students, lecturers and employees gather at ETH Zurich. We want our people to feel comfortable and taken care of whilst going about their daily business. So what does this entail? First, the premises must be clean and safe, and the essentials such as electricity, heating and water must all be in good working order. Second, our property must be well-maintained and tidy, the rooms welcoming. Our working areas must meet users' needs, for instance by promoting the informal discussions that are so important in the field of science. IT services must be reliable and secure, providing all necessary applications and protecting against the threat of viruses. Many of our people need to consult books both old and new, and they need virtual access to global publications. Finally, they require reliable administrative support that guarantees well-drafted contracts, punctual payment of salaries, and assistance at times of personal difficulty.

Just as the Swiss Federal Railways like to say "at home on the move", so our slogan "at home at ETH Zurich" sums up perfectly how our people want to feel. As Vice President of Human Resources and Infrastructure, it is up to me and my 1,000-strong team to make this vision a reality through our daily work. Our projects range from those with tangible, lasting results, such as the construction of new buildings and the planning of entire urban districts, to others with a more fleeting impact, for instance the engaging events we organise. They offer safety and security, ensure a pleasant working environment, and provide documents and information. In fact, they deliver (almost) everything people need to feel at home at ETH.

Everyone in my team works to support talented people. Our demanding clients come from all walks of life – they are diverse in terms of gender, culture, discipline, family situation and aspirations. For that reason, everyone who works in my team must also be a talent in their field. We need talented librarians and caretakers, HR professionals and security specialists, architects and computer scientists. And we need talented learners.

In the future, all of them will face the challenge of providing first-class services to even more students and staff, with the same or fewer resources. We must proactively review our current offering, whilst anticipating the future needs of our clients. What's true at home is also true at ETH: the best way to save money is by doing away with outdated things and focusing on timely renewal. This ongoing task is something that I and my team will carry out in dialogue with everyone at ETH – because at the end of the day, it is the users themselves who know best what they need.

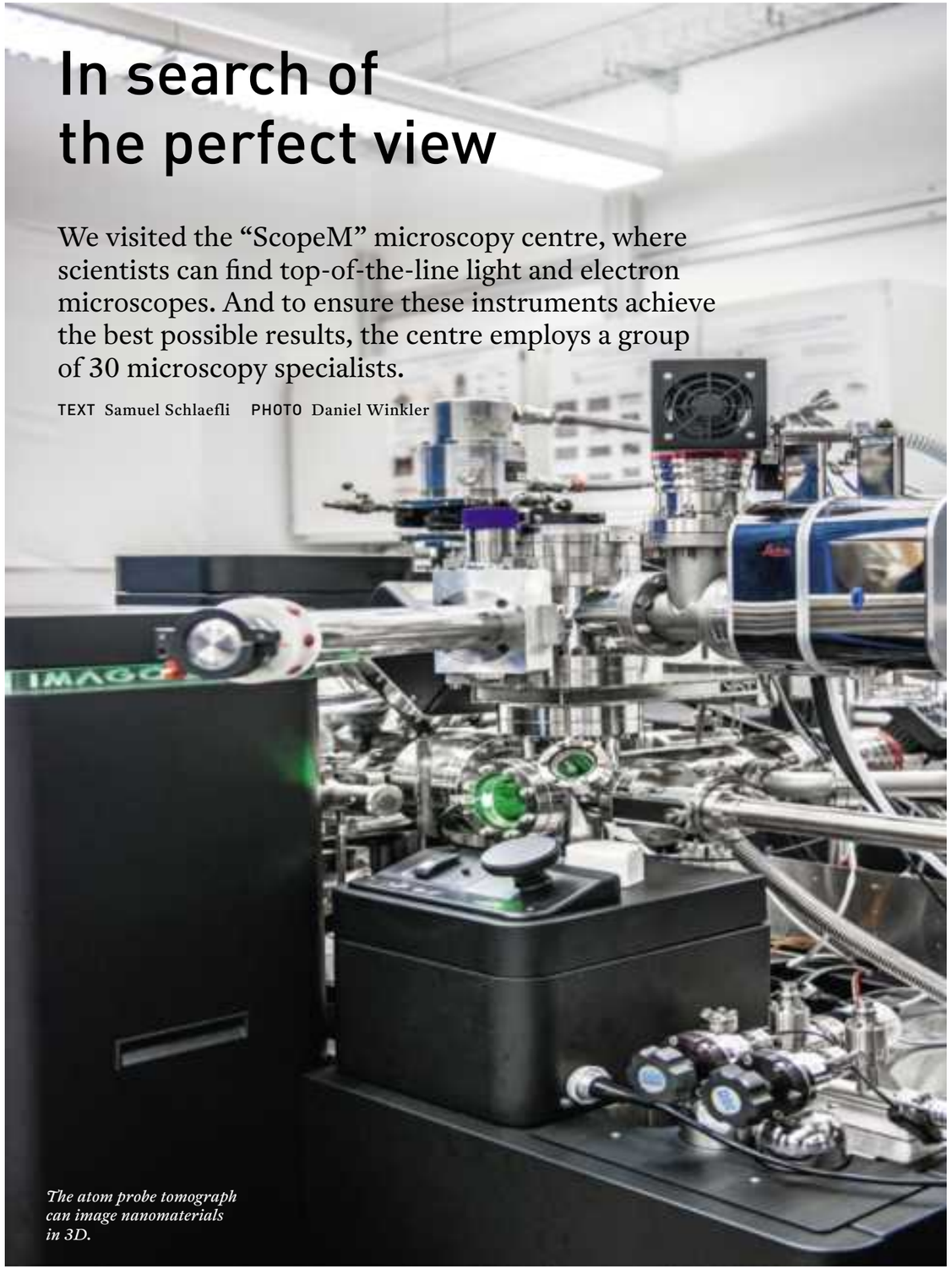
Ulrich Weidmann was named Vice President of Human Resources and Infrastructure at the beginning of this year. He has been a full professor of transport systems at ETH Zurich since 2004.

Illustration: Thomas Fryscak; Photo: Giulia Marthaler

In search of the perfect view

We visited the "ScopeM" microscopy centre, where scientists can find top-of-the-line light and electron microscopes. And to ensure these instruments achieve the best possible results, the centre employs a group of 30 microscopy specialists.

TEXT Samuel Schlaefli PHOTO Daniel Winkler



The atom probe tomograph can image nanomaterials in 3D.

Nicolas Ruffray uses an electron microscope to characterise his cement sample.

We're standing in one of 30 labs at the Scientific Center for Optical and Electron Microscopy (ScopeM), which is spread over three buildings on the ETH Hönggerberg campus. Nicolas Ruffray is sitting with two of the Center's technical specialists facing a row of three monitors. Next to these stands a bulky grey box – a focused ion beam scanning electron microscope. As a materials engineer, Ruffray began working on his doctoral thesis last year. His enthusiasm is evident as he explains his project: developing a cement with an improved ecological footprint. To this end, he is currently analysing the microstructure of a cement produced at the Institute for Building Materials. One of the monitors shows an image of Ruffray's cement sample. It looks like a porous sponge from which a slice has been cut out with a sharp knife. It isn't a sponge, though; it's a tiny drop of an aqueous, high-pressure-frozen cement suspension. Ruffray had previously "amorphised" it, shock-freezing it under high pressure at −196 °C. This is the only way to prevent ice crystals from forming during sample fixation. Using a highly focused ion beam, he cut multiple ultra-thin slices from the sample – 20 nanometres thick and 30 micrometres in length and width. The second monitor displays the picture of one such section, on which tiny inclusions are visible. Ruffray will later use hundreds of sections like this one to compile a three-dimensional model of his sample. This will allow him a spatial glimpse into his material on the nanometre scale.

ETH research accounts for 90 percent of analysis time

ScopeM was established in 2014 through the merger of ETH Zurich's electron (EMEZ) and light microscopy (LMSC) facilities. Since then, a staff of 30, including biologists, chemists, engineers and physicists, have been advising and supervising some 500 users from 180 research groups on the full spectrum of microscopy topics. ETH researchers account for around 90 percent of the microscope time, but the Center is also open to other universities and industry partners. The range of materials measured here is broad indeed: biologists aim to characterise live cell material, physicists are interested in the nanostructure of their semiconductors, and materials scientists examine the surface properties of novel metals. Nicolas Blanc, Managing Director of ScopeM, and his staff are microscopy specialists; they know what researchers need for analysing the various types of material. "Each project has its own requirements for the microscopic analysis, which is what makes our work here so interesting," says Blanc. Although their clients are allowed to work at the microscopes on their own after completing the necessary training, many of them are happy to rely on the long-established expertise of the ScopeM staff.

Roger Wepf is the Technical Director in charge of electron microscopy. He takes us along on a tour through 'his' instrument kingdom. "First we have to go nine metres underground," he says, leading us along the winding paths beneath the HPT building. We walk a long way through subterranean hallways, where there is space for cables, building services technology and rubbish bins. It's cool, and the white light of the fluorescent tubes glistens brightly. After several hundred metres, Wepf opens a door leading off from the hallway at a right ›

angle. “This tunnel can be accessed only from the side,” he says. “In addition, there’s no construction around it, in order to keep external disturbances and vibrations to a minimum.” That’s why the electron microscopes are sitting on massive, 1.5-metre-thick concrete bases anchored in the ground. In order to take any measurements at the scale of individual atoms in the first place, all external influences must be eliminated – including electromagnetic radiation. So the tunnel is a Faraday cage as well.

Wepf shows us the labs. They’re five metres high and partially darkened. Apart from the hum of a pump, there is usually no sound to be heard. Researchers are sitting in some of the labs, engrossed in the microscopy images on their monitors. Other labs are currently inaccessible, in a bid to keep the interior climate as constant as possible. Wepf shows us one of his high-end devices: a scanning transmission electron microscope, which consists of a one-meter-high metal cylinder protruding from a bulky, waist-high box. There’s a lot of high-tech inside there.

At the very top is the electron gun, which accelerates free electrons toward the sample. Ring-shaped anodes and electromagnetic lenses bundle these electrons to form a focused beam. All this happens under high vacuum so that, during acceleration, the electrons aren’t slowed down or scattered by collisions. The impact of the electrons on the sample causes the sample itself to scatter and emit electrons and X-rays, which are then picked up by detectors at the upper and lower end of the microscope and transformed by a computer into a visual signal. Since these highly specific “electron images” depend on the sample’s atomic composition, this STEM instrument makes it possible to characterise materials up to a resolution of 78 picometres (10^{-12} metres).

The electron microscopes in the tunnel are particularly popular with biologists. On a monitor, Wepf shows us black-and-white microscope images of ultrathin slices of a rat brain. Several such microscopic brain sections can be merged together to reconstruct tiny areas in 3D. “That’s what the big race in neuroscience is currently about,” says Wepf. The goal right now is to recreate a few cubic millimetres of an animal brain; however, he goes on to say that “being able to reconstruct a whole human brain in 3D is still a long way off.” The amount of data that would have to be processed for such an endeavour is simply too massive. Another low temperature-type electron microscope (−190 °C) housed in the tunnel is often used to clarify proteins: “Using our instruments, we can reconstruct cellular nanomotors at atomic level and decode their macromolecular structure,” Wepf explains. Today, the microscopes often run for weeks without interruption, operating fully automatically. Structures that previously took years of work can now be clarified within just a few months.

The most sensitive microscopes are located nine metres underground.

“Each project has its own requirements for microscopic analysis,” says Nicolas Blanc, Managing Director of ScopeM.

Using light microscopy to characterise cellular processes

Electron microscopy is still unparalleled in its resolution, which is why it’s so popular for structural clarification. However, it has a serious disadvantage: liquid or gaseous samples must be fixed for analysis, like Nicolas Ruffray’s “amorphised” cement suspension. It’s not possible to observe living or dynamic material. This is where light microscopy is useful. Its resolution may be around 100 to 1,000 times lower, but it also allows researchers to examine living samples. We now leave the underground area and walk up to the C floor of the HPM building, where bright green partitions create several small chambers for light microscopy.

Behind a black curtain which protects the microscope from incidental light, we meet Sumit Pawar. The 26-year-old Indian came to ETH Zurich to work on his doctoral thesis. He works at the Institute of Biochemistry and has been using the facilities here for several months – particularly because of the powerful spinning disk microscope. Pawar shows us the luminous green image of the highly magnified nucleus of a human cell. The young biochemist is currently examining how proteins get to the nuclear envelope that serves as a protective coat for the cellular genetic material. An abnormal distribution or dysfunction of such proteins can trigger muscular dystrophies. Using a joystick, Pawar can move the sample in all directions and position it ideally. A tempered Plexiglas case keeps the sample at a constant 37 °C, and a built-in high-performance camera shoots one photo per second for one minute. The images are then automatically compiled to create a film. Pawar pulls the film up on the monitor and zooms in. Now we can see how, in a certain region (the endoplasmic reticulum) of the cell, connections develop and are restructured within seconds. The doctoral student’s goal is to characterise these processes more precisely.

Sumit Pawar uses a spinning disk microscope to study cellular processes.

Data deluge presents a challenge

Just as in the electron microscopy set-up in the basement, much of the equipment here is now automated, too. In a small room across from Pawar, a robot arm takes black scanning plates holding cell samples from a rack and slides them under the light beam of the microscope. Equipment like this often runs 24 hours a day, 7 days a week, shooting millions of high-resolution images. This is now one of ScopeM’s biggest challenges. “We produce 50 to 100 terabytes of data here each year – and this figure is set to rise,” says Gábor Csúcs, Technical Director of Light Microscopy and Screening. The data isn’t usually stored or analysed here; instead, that is handled at the Swiss National Supercomputing Centre (CSCS) in Lugano, on ETH’s supercomputer Brutus or on one of the research groups’ computing clusters. Still, the data must first be transferred to one of these locations. “Because the data transfer takes so long, many researchers prefer to store their data on a large hard drive and then deliver it to the supercomputer themselves for transferring,” says Csúcs.

In order to keep pace with the world’s best microscopy labs, ScopeM has to do more than just continually upgrade its IT infrastructure. Microscopy, too, is evolving. Staff members are currently evaluating a transmission electron microscope with an experimental chamber for in situ experiments. Such a device would primarily benefit materials scientists and chemists, who would then be able to measure their materials under dynamic conditions – for example at a certain temperature or pressure curve, or under the influence of a specific gas. A decision on the instrument is expected in summer; it will be the first of its kind in Switzerland. ○

“ScopeM” microscopy centre:
→ www.scopem.ethz.ch

CONNECTED

1 *Executive Board*

HANDING OVER THE BATON

The ETH Executive Board saw some changes in its membership at the beginning of the year (from left): Detlef Günther, Vice President Research and Corporate Relations; Sarah Springman, Rector; Lino Guzzella, President; Robert Perich, Vice President Finance and Controlling; and Ulrich Weidmann, Vice President Human Resources and Infrastructure. The handing over of the baton at the traditional Executive Board Christmas reception in December was a truly athletic affair: Roman Boutellier effortlessly scaled the vertical wall to symbolically pass the key to his successor, Ulrich Weidmann. Afterwards, the Executive Board and members of ETH Zurich raised a glass to the bygone year in the main hall of the ETH main building.

2 *Center for Learning Systems*

TEACHING MACHINES TO LEARN

It is hoped that machines will become not only more intelligent, but also more capable of learning. To promote research in this field, ETH Zurich and the Max Planck Society officially established the Max Planck ETH Center for Learning Systems. In attendance at the opening gala in Tübingen were (from left) ETH Professor Brad Nelson, MPI researcher Stefan Schaal, Swiss Ambassador Christine Schraner Burgener, ETH President Lino Guzella, President of the Max Planck Society Martin Stratmann, Baden-Württemberg's Minister of Science Theresia Bauer, MPI Professor Bernhard Schölkopf, and ETH Professor Thomas Hofmann. All were very pleased about this new partnership.

1 *Executive Board*

2 *Center for Learning Systems*

Photos: Markus Bertschi; Oliver Bartenschlager (2); Wolfram Scheible/MPI-IS

3 *Wyss Zurich*

4 *Biennale in Shenzhen*

5 *ESOP and Sensirion*

Photos: Jonathan Chan (2); zVg; ETH Zurich Foundation

3 *Wyss Zurich*

BUILDING BRIDGES

The Wyss Translational Center (Wyss Zurich), which ETH Zurich and the University of Zurich (UZH) were able to establish thanks to a generous endowment from Hansjörg Wyss, aims to reduce the time required to turn innovations into practical applications. At the opening ceremony, the donor (left, top image) spoke about what motivated him to make this gift, in front of an audience that included ETH President Lino Guzzella, Swiss Federal Council Member Johann Schneider-Ammann and UZH Rector Michael Hengartner (left, bottom image, from right).

4 *Biennale in Shenzhen*

ANALYSING URBAN DESIGN

ETH professors Hubert Klumpner and Alfredo Brillembourg (on the far left in the image) are pleased to be in attendance at the opening of the Shenzhen Bi-City Biennale of Urbanism\Architecture. Together with American art critic Aaron Betsky (fourth from left) and Chinese architect Doreen Heng Liu, they make up the curatorial team for the exhibition, which takes a critical look at contemporary urban design. Another ETH professor, Gerhard Schmitt (third from left) attended the event as a guest.

5 *ESOP and Sensirion*

TALENTS MEET SUCCESSFUL ALUMNI

Some 30 young, talented students from ETH Zurich's Excellence Scholarship & Opportunity Programme (ESOP) met with representatives of ETH spin-off Sensirion for a lively question-and-answer session. This gave the students the opportunity to delve into the history of the successful company.

Agenda

EXHIBITIONS

Until 3 April 2016
Venetian Prints
The Print Collection's current exhibition "Della Grafica Veneziana – The Age of Anton Maria Zanetti (1680 – 1767)" aims to highlight Zanetti's contribution to eighteenth century Venetian printmaking and his significance.
Collection of Prints and Drawings, ETH Zurich, ETH Main Building
→ www.gs.ethz.ch

CONCERTS

1 and 4 April 2016, 7.30 p.m.
Spring Concert 2016
The Alumni Symphony Orchestra, conducted by Johannes Schlaefli, will perform works by Jean Sibelius, Maurice Ravel and George Gershwin.
Rudolf Steiner School in Wetzikon (1 April)
Zurich Tonhalle (4 April)
→ www.alumniorchester.ch

The spring series of Treffpunkt Science City revolves around the issue of health.

Treffpunkt Science City

(IM)PERFECT HUMAN BEINGS

6 – 22 March 2016 Will there soon be personalised treatments for cancer? Or artificial organs that grow with young patients? Microrobots as early warning systems inside our bodies? What's the benefit of vitamin pills? How does one stay fit in old age? How much sleep do human beings need? The spring series of Treffpunkt Science City revolves entirely around the issue of health. In addition, there will be a panel discussion on the topic of burnout, an exclusive guided tour of the recently opened Balgrist Campus Research Centre, and exciting attractions for children and young people on Family Sundays.

Programme and registration:
→ www.ethz.ch/treffpunkt-en

Brain Fair 2016

ON THE MOVE

14 – 19 March 2016 Without movement, we would be unable to communicate with the people around us. After all, the motor system is involved not only in mobility but also in the production of speech, sign language, facial expression, gesture and writing. This year's line-up of events at Brain Fair 2016 will explore the whole range of issues concerning the topic of movement – from motor development in children, the peak performance of athletes and musicians, through to movement disorders and their treatment.

Information at:
→ www.brainfair-zurich.ch

Photos: Alumni Sinfonieorchester; Alessandro Della Bella

EVENTS

9 May – 5 June 2016
Scientific food adventure
An improvised cooking lab, complete with integrated restaurant, will be serving modernist cuisine for four weeks on the Polyterrasse. The modernist cuisine movement studies biochemical, physical and chemical processes that occur during the preparation of food and drink. The project is called "TasteLab – scientific food adventure", and is the initiative of five ETH Zurich alumni from different disciplines.
Polyterrasse, ETH Zurich
→ www.tastelab.ch

19 May 2016
Entertaining – and succinct
Young scientists from all over Switzerland will be competing at the FameLab competition. They have just three minutes to get the audience enthusiastic about their topic. This year's Swiss final will take place at ETH Zurich.
bQm, ETH Main Building
→ www.famelab.ch

29 March / 17 May 2016 / 6.15 p.m.
Einstein in the university district
Discover new and unknown facts about ETH Zurich by joining our free guided evening tour "In the Steps of Albert Einstein – A Walk through the University District".
ETH Main Building
→ www.ethz.ch/eveningtours

17 – 20 March 2016
Challenge trophy up for grabs
ETH Zurich and ETH Lausanne will be competing against each other again in the 25th Challenge event. All kinds of challenges are in store for those taking part – from ski cross, slalom and downhill, through to playing in the snow.
The participants will be supported by over 300 former Challengers, alumni, professors and sponsors. After four days of competition we will know: which university has won the famous Challenge trophy?
→ www.challenge16.ch

Book Tip

FEDERAL BUILDINGS CHANGING

Federal Palace, administrative building, or Swiss embassy – the Federal Office for Buildings and Logistics builds, maintains and manages the Confederation's 2,600 or so civilian properties. In recent years, there have been some exciting renovations and new builds. These are documented in texts, architectural photographs and plans in "Federal Buildings: The Architecture of Official Switzerland" – a book of essays that examines the Federal Government's approach to building. The richly illustrated collection shows the architectural development of federal buildings from the establishment of the Swiss federal state in 1848 until today, in the light of changing state functions. The publication is part of the "Federal Buildings" touring exhibition, on display from 22 April – 4 May 2016 in the main hall of ETH Zurich.

ISBN 978-3-909928-35-4
Hochparterre Verlag
Price: CHF 68.00

Photos: TasteLab; Challenge XVI; Hochparterre

A passion for the city

With a degree in agricultural science from ETH, Zurich mayor Corine Mauch has dedicated her life to combining scientific environmental analysis with political involvement.

TEXT Samuel Schlaefli PHOTOGRAPH Tanja Demarmels

Corine Mauch, Zurich's first female mayor, seems to be doing something right: according to the latest poll, 98 per cent of the city's residents are happy or very happy to be living in Zurich, and 89 per cent of them rated the quality of life with a 5 or 6 (out of 6). The city is on solid financial footing, and Mauch can depend on support even from outside her party. For six years, Social Democrat Mauch has embodied the cosmopolitan, dynamic and sustainable facets of Zurich. She rides her bike to work, wears fiery red suits, and in her free time plays bass in the rock band Trugschluss. Mauch was born in the USA, speaks six languages, is an art lover and makes no secret of the fact that she is in a relationship with a woman.

"Something with nature and the environment"

Corine Mauch's path to the city on the Limmat River went via ETH. She was born in Iowa (United States), because her father, an ETH structural engineer, was completing his doctorate at the Massachusetts Institute of Technology (MIT). Four years later, the family moved to Oberlunkhofen, which at the time was still a 500-person farming village in the Swiss canton of Aargau. Mauch enjoyed living there and developed a strong bond with nature. While growing up, she helped out from time to time on a local farm, where she learned from the farmer that agriculture was something you could study. "I knew very early on that I wanted to do something with nature and the environment," she says. "If I chose today, I would probably study environmental sciences."

Her interest in these issues had a political aspect as well, as she grew up with the environmental movement. The anti-nuclear protests in the 1970s, the push for twelve car-free Sundays, the "albatross" initiative against air pollution caused by vehicles – Mauch was right on the front lines, gathering signatures before she was old enough to vote. A further political influence was the feminist movement. Swiss women had won the right to vote in most cantons by 1979, when Mauch's mother Ursula became the first woman to represent the Aargau canton on the Swiss National Council. A member of the Social Democratic Party of Switzerland (SP), she would look on proudly 20 years later as her daughter was voted Zurich's first female mayor as a member of the same party.

When Mauch began her agricultural economics studies in 1980, she was often the only woman present at the lectures. It didn't bother her, and today she still gets enthusiastic about the diversity of her fellow students. Many were from French- and Italian-speaking regions of Switzerland, and several were children of academics as she was; others were sons of farmers who were in line to one day take over the family farm. Among these "wild" classmates, where there was always something going on, Mauch felt especially at home. For her mandatory practical semester, she toiled for half a year on a farm in the Bernese Oberland. Three months of that were on Spätenalp, a mountain about an hour's hike from Wengen. The farm kept pigs, billy goats, horses, and cattle. Cows were milked by hand, cheese made over an open fire, and Mauch slept in the same room as the farmer and his farmhand. This simple, old-fashioned life suited her quite well – "it was good to realise that I can get along just fine with a simpler lifestyle." ›

"I realised that I can get along just fine with a simpler lifestyle."

ABOUT

Corine Mauch

was born in Iowa City (USA) in 1960. Four years later, her family returned to Aargau. From 1980 to 1986, she studied agricultural economics at ETH Zurich, then did four semesters of China studies at the University of Zurich. From 1989 to 1993, Mauch served as the first commissioner for waste and the environment in the city of Uster. She next returned to ETH Zurich, where she did research and taught in the human ecology group at the Geographic Institute until 2000. In 1990 she joined the Social Democratic Party (SP). Nine years later she was elected to the Zurich city council, where her duties included participating on the city development and auditing commission. On 29 March 2009, she triumphed over Kathrin Martelli in the second round of elections to become mayor of Zurich. She was re-elected in 2014, this time defeating Filippo Leutenegger.

"People from 170 countries live together peacefully in Zurich."

And the alpine experience was also a good preparation for her thesis. Knowing that her father Samuel Mauch was a pioneer in system dynamics, her professor encouraged her to use system dynamics to analyse the extent of the connection between forest dieback and the conditions for making a living in mountain agriculture. Back at MIT in the early 1970s, Samuel Mauch had come into contact with associates of Jay Forrester and Donella and Dennis Meadows, and was inspired by the ground-breaking modelling put forth by the Club of Rome and the book "The Limits to Growth". After returning to Switzerland, Mauch's father founded Infras, one of the first agencies for scientific policy advice and still active today. For her thesis, Corine Mauch still had to map the relationships among various influential factors by hand. It wasn't until years later when she was researching sociological issues of sustainability at ETH's Geographic Institute that she would become familiar with computer-based system dynamics as well.

Struggling with doubts

At the time Mauch completed her degree in 1986, the Swiss agricultural sector was dealing with excess: mountains of butter and lakes of milk. "It made no sense to me to figure out how to cope with this kind of first-world problem," Mauch recalls. Finding herself at a bit of a loss, she considered getting involved with development work, but she was plagued by doubts about that as well. This was due to an internship she had done on an irrigation project in Nepal: "It felt strange to go to the locals as an 'expert' and tell them what they should do with their land." Nowadays she is of the opinion expressed by the Berne Declaration development organisation, which she helped guide over many years as a member of the board: "It is more important to take less than to give more", as they say in their motto. Mauch adds: "We, and the Swiss especially, should push for fairer trade relations." When it came to deciding on her career, the freshly minted agronomist ultimately reconsidered her original interest in the complex relationships between the environment, economy and society. Right up until she was elected mayor, Mauch advised politicians and federal agencies on environmental issues, got a waste and recycling system up off the ground as Uster's first environmental commissioner, and evaluated business innovations for the Swiss Parliamentary Services.

Diverse ways of life

Although she grew up in the country, Mauch is now an urbanite through and through. She moved into her first shared flat in Zurich 33 years ago as a young student. Since then her loyalty to Zurich has been unwavering and she is now the city's biggest champion: the cultural scene, the different kinds of people and their ways of life, the energy, the dialogue that results from the friction of people living closely together – Mauch loves Zurich's urban diversity and openness. She quotes Swiss writer Hugo Loetscher, who spoke of cities as the "greatest possible synchronicity of human possibilities". And at least since 1999, when Mauch was first elected to the city council, she has been active politically in trying to realise these possibilities. "Today in Zurich, people from 170 countries live together in peace – without ghettos or parallel societies. This is immensely valuable, and we invest a lot in it!" At present, however, this diversity has come under pressure from right-wing populist circles. Mauch counters with facts. Figures from a recent study by the Grosse Kernstädte interest group show that between 2002 and 2008, the economic strength of Switzerland's ten largest cities grew by 3.2 per cent more than it would have without the free movement of persons. And Mauch emphasises that innovation and creativity often come from the outside – that's the only way Zurich could become the melting pot of science, culture and enterprise that it is today.

ETH has been a key part of this process for more than 150 years, the mayor was quick to point out: "The University's talented graduates are among the most important reasons why innovative companies like Google, Disney and IBM open locations here today." After Bern was named the federal city of Switzerland and was crowned with the parliament building, ETH in Zurich was initially seen as a consolation prize, Mauch says. But then she adds, grinning, "And yet when you look at all ETH has done for our residents, educational policy and urban development, it's clear that Zurich won the big prize!" ○

ETH AND THE CITY OF ZURICH

ETH partners with the city of Zurich on many fronts. For example, the "2000-watt society" energy policy model was developed at ETH Zurich in the 1990s and was incorporated into the Zurich constitution as a goal in 2008. The city and the University both support the private "DigitalZurich2025" initiative, which aims to strengthen Zurich as a location for digital technology innovation. ETH also works closely with the city as part of the overall plan for the university area in Zurich city centre.

5 QUESTIONS

David Norris encourages students and young researchers to take advantage of opportunities: *"We need to expose ourselves to risk and try something new."*

1 *Why is it important for a university to be truly international?*

For ETH to provide students at all levels with the best education possible, we need to continue to have the most talented people at ETH. This includes not only hiring the best faculty from around the world, but also attracting the brightest students from Switzerland and abroad. Students challenge and stimulate each other. When I was a student at MIT, one of my favorite aspects of the university was the caliber of my fellow classmates coming from all corners of the globe. ETH has the same atmosphere.

David Norris
is a Professor of Materials Engineering and Head of the Department Mechanical and Process Engineering
→ www.omel.ethz.ch

2 *What were your first impressions of ETH Zurich?*

During my first visit to ETH in 2007, I found it to be an absolutely amazing place. Certainly, this impression has not changed since becoming a professor in 2010. ETH offers fantastic students, world-class colleagues, and state-of-the-art facilities to a professor. Also students are exposed to tremendous opportunities at ETH. They sometimes need to be encouraged to take advantage of them.

3 *Where have you met with failure?*

I meet failures all the time. And by failures I mean setbacks that make me question the direction I am heading. In scientific and engineering research we are exposed to persistent criticism, and our ideas are constantly tested. The research enterprise would not work without this feedback. Sometimes we are wrong, or our ideas fail to deliver on their promise. This can be painful, but I believe if we are never experiencing such failures, we are probably not doing our job. This can be especially difficult for young students who often believe that everything should work exactly as planned. But of course, like life, research does not work this way.

4 *What does the term "critical thinking" mean to you?*

Scientists and engineers approach a problem, or even life, in a certain way. For me, this is "critical thinking." It is a necessary skill for answering important questions in research. Our students develop this ability at ETH. However, because it takes years to develop, a professor cannot simply offer a single course on "critical-thinking" and transfer the knowledge. Rather, the process occurs slowly over their entire studies. Eventually, students are able to generalize their knowledge and approach unfamiliar problems in a systematic way.

5 *What do you think about the current system of publishing? Is it good or bad for science and research?*

I feel the current emphasis on high-profile publications sometimes corrupts the scientific process. Publishing in Science or Nature brings attention, and opens career opportunities for young authors. Certainly I have benefitted from such publications, along with many other ETH professors. If they occur because a researcher identified an important question or problem and then worked to provide a definitive answer, I fully support them. However, these publications are increasingly becoming the goal. If we begin by asking which problem will lead to such a publication, everyone ends up working in the same trendy areas of research.

— Recorded by: Martina Märki

Photo: Giulia Marthaler