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Globe

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The magazine of ETH Zurich and ETH Alumni

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Dear readers

Anyone who understands how to extract meaningful information from the tremendous flood of data holds the key to new worlds. And the possibilities to do just that have expanded dramatically in recent years: today, more data is produced in a year than in the entire history of humankind. And this has consequences for science: processing large amounts of data and calculating increasingly complex models are key pillars of research these days. ETH Zurich's scientists can benefit from an efficient infrastructure in their work – something which has been developed further in recent months. For instance, the CSCS in Lugano has activated the new supercomputer Piz Daint – one of the world's most powerful computers. And in mid-May ETH Zurich inaugurated the high-performance computer Euler (also at the CSCS), which all researchers at ETH Zurich can use as a "general-purpose computer."

ETH Zurich is also right at the cutting edge when it comes to software development. Teaming up with researchers from other Swiss universities, ETH scientists develop algorithms within the framework of the Platform for Advanced Scientific Computing that are optimally geared towards new computer architectures. Along with many other disciplines, the life sciences also stand to benefit from this, as rare diseases can be studied more effectively thanks to large data amounts, for example. It is also apparent that the data's potential is nowhere near exhausted. If nothing else, this is because medical data is not gathered in a standardised way these days.

In this regard, we also increasingly face questions of data privacy. In society, there is a mounting sense of unease that individuals are losing control over what happens to their data. And again this is where our university comes in – by ETH researchers developing concepts regarding how the risks for the individual can be minimised, for instance.

As far as the social and economic significance of the topic is concerned, ETH Zurich is looking to further expand the field of "data science." It will be creating three new chairs in the near future: one for medical IT in conjunction with the Zurich University Hospital, one for information systems and one for social network analysis. The knowledge generated as a result will not only stand research in good stead, but ultimately the whole of Switzerland as a science hub.

I hope you enjoy this new issue of Globe and wish you happy reading!

Ralph Eichler
President of ETH Zurich

Contents

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A critical bottleneck

In the summer of 2005, Zurich narrowly escaped a catastrophe. Back then the level of the Sihl had been rising steadily in central Switzerland after heavy rainfall. If the water had breached the banks, this would have caused damage amounting to billions. The most critical points back then were the culverts under Zurich's main railway station, which almost reached their capacity limits.

Researchers at the Laboratory of Hydraulics, Hydrology and Glaciology (VAW) are using a 30-metre long model on a scale of 1:30 to examine how this situation would develop if the flood event had been even more severe. In the image you can see the confluence of the Sihl (left) and the Schanzengraben, just before the water flows under the tracks of the main railway station (made with sheets of acrylic glass in the model). This set-up can be used to simulate the extent to which driftwood and floating debris could cause a dangerous backwater in the Sihl.

The Sihl model is the first large set-up in the new test laboratory on Hönggerberg, which VAW moved into in the spring of 2013.

Laboratory of Hydraulics, Hydrology and Glaciology (VAW):
www.vaw.ethz.ch →

Information on the project:
www.ethz.ch/sihl-modell →

ETH researchers developed a high-temperature solar reactor

Solarjet

Aircraft fuel from solar energy

As part of the EU project Solarjet, scientists have for the first time conducted experimental observations of the entire production chain of liquid fuel made from water and CO_2 using solar energy. The project is centred on a high-temperature solar reactor developed at ETH Zurich in which water and CO_2 are split in a cyclical, two-step process with the aid of highly concentrated solar radiation.

The result is a mixture of hydrogen and carbon monoxide known as synthesis gas, or "syngas" for short. Kerosene was produced from this gas mixture at a Shell research centre using an established method. In the next phase of the project, the partners involved would like to optimise the solar reactor technology further and explore the potential for a technological application. The researchers' aim is to achieve an efficiency level of fifteen percent in the long run, which would enable a solar plant with an area of one square kilometre to produce 20,000 litres of kerosene per day.

Miniaturisation

Miniscule magnets

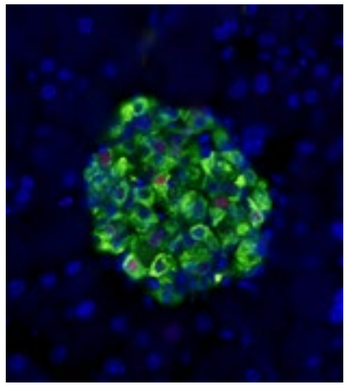
The smallest possible magnets are no bigger than a single atom. Scientists have now created single-atom magnets that are as strong and stable as is physically possible. This research team, headed by scientists from ETH Zurich, EPF Lausanne and IBM, manufactured the single-atom magnets by vapour-depositing a tiny amount of cobalt on a magnesium oxide surface so that individual cobalt atoms stuck to it.

Considered per atom, the cobalt atom system on magnesium oxide is three times stronger than one made of pure cobalt, and is extremely stable. The model could be important for the miniaturisation of MRAM storage media used in the control systems of aircraft and satellites.

Security

Hot foam

A new film that reacts aggressively when destroyed could deter criminals from damaging cash machines in future. Because this self-defence film, which is made of different synthetic layers, sprays hot foam into the assailant's face if its surface is breached. The inspiration was a beetle that repels its attackers with a gas explosion.



Insulin-producing beta cells (green) in the pancreas

Type-2 diabetes

A molecule as a trigger

An international team of researchers headed by Markus Stoffel has discovered a molecule that plays a central role in the development of type-2 diabetes. Micro-RNA-7 (miR-7) inhibits the production of insulin by the pancreas – a finding that could help detect the disease earlier by using miR-7 as a biomarker. On the other hand the production of molecular opponents to miR-7 could at least delay the disease.

Ticker

Buckwheat is gluten-free and boosts biodiversity.

Donations

Supporting research

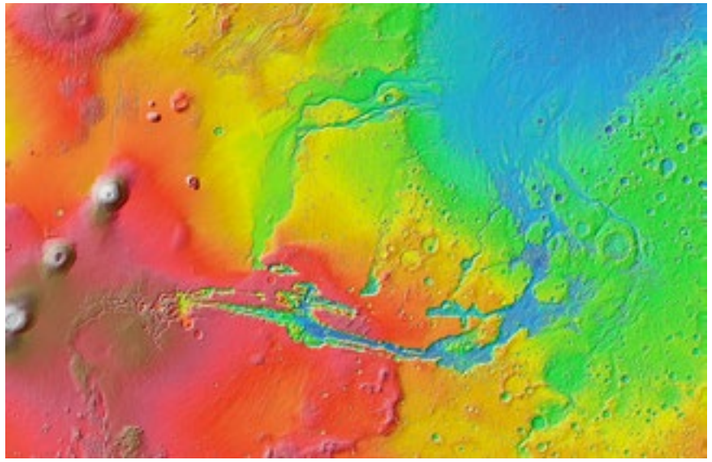
ETH Zurich is to receive five million francs from the Coop Sustainability Fund via the ETH Zurich Foundation to conduct research projects on sustainable food production over the next few years. The first projects are now underway under the auspices of the ETH Zurich World Food System Center. One will focus on a crop that has all but disappeared: buckwheat. The aim is to breed varieties that mature as synchronously as possible in order to improve crop yields. Another research project is concerned with how the entire lifecycle of chickens can be considered. Nowadays, egg and meat production are virtually decoupled, which leads to many animals being slaughtered unnecessarily.

Walter Fust supports the Pioneer Fellowship programme with a contribution to the ETH Zurich Foundation. Outstanding young researchers receive a scholarship to convert their research results into a product with a solid business plan. With his company Dipl. Ing. Fust AG, Walter Fust is one of the best-known engineers in Switzerland who studied at ETH Zurich.

Graphene

Thinnest membrane possible

Researchers from ETH Zurich have produced a membrane that is less than one nanometre thick – that's a hundred thousand times thinner than the diameter of a human hair. The membrane consists of two layers of graphene, which is often heralded as a miracle material. Every layer comprises a two-dimensional film of carbon atoms, into which the scientists burn tiny pores of precise size. This renders the membrane permeable for miniscule molecules while larger molecules and particles only pass through the pores slowly – if at all. At a thickness of only two carbon atoms, this is the thinnest porous membrane technically feasible. Potential applications range from the separation of gas mixtures or the filtration of liquids to functional rainwear. The membrane is light as well as flexible and a thousand times more breathable than Goretex.



Labyrinthus Noctis and Valles Marineris were formed on Mars by the erosive force of immense lava flows.

Mars

Lava, not water

A striking network-like system of deep gorges is visible in the equatorial region of Mars. Because these gorges resemble earthly canyons created by water, researchers always assumed that powerful water currents also gouged out these chasms on Mars once upon a time. ETH Zurich researcher Giovanni Leone has now put forward another theory: only lava flows could have created these special structures. For his research, Leone analysed thousands of high-resolution surface images that were taken by several Mars probes and are accessible on US Geological Survey image databases. The structures are comparable to lava structures on Earth and there is little evidence of any exposure to water. This researcher's work could cause quite a stir, especially among the many scientists who are in search of water on Mars.

"Honeycomb", the wind turbine for flat roofs

Student project

Wind turbine for the city

Students from ETH Zurich set out in search of a solution to use wind power efficiently in the city – and came up with a honey-combed wind turbine that can be mounted on flat roofs and joined together to form larger units. One wind turbine produces a nominal output of 400 watts – about the same as a two-square-metre solar panel. The honeycomb turbine is now to be tested on the building of the University of Applied Sciences in Chur. The idea was developed within the scope of this year's focus projects by Bachelor students from the Department of Mechanical Engineering.

ETH Zurich clinches university challenge

Who is sportier? Members of ETH Zurich and the University of Zurich spent a week competing against each other on the sports field. ETH Zurich won with 18,156 hours of sport while the university members managed 16,633 hours.

The brain and stomach in conversation: the stomach influences emotional brain processes.

Neurobiology

Dialogue between brain and stomach

We often sense threatening situations in our stomachs. However, it is not just the brain that controls processes in the abdominal cavity; the stomach also transmits signals back to the head. In order to get to the bottom of this mutual influence, researchers from ETH Zurich clipped certain nerve cords in rats that led from the stomach to the brain. While the switch from two-way communication to a one-way street meant that the brain could still control processes in the abdominal cavity, messages could no longer be received from the stomach.

Based on behavioural studies, the scientists discovered that rats with clipped nerve cords were less timid of open spaces and bright light than control animals. In other words, signals from the stomach to the brain influence innate fear behaviour. In this experiment, the ETH scientists were able to demonstrate for the first time that the targeted interruption of the signal pathway from the stomach to the brain changes complex behavioural patterns – findings which are also of interest to psychiatry.

Breast cancer

Improved early diagnosis

Researchers from ETH Zurich, the Paul Scherrer Institute (PSI) and the Kantonsspital Baden have succeeded in producing mammographic images that enable breast cancer and its prestages to be assessed more accurately. With their refinement of phase-contrast x-ray imaging, they can recognize the kind of microcalcification in the breast tissue more effectively than with current imaging techniques, and can then match it with a disease. Microcalcification in the breast tissue mostly occurs where rapidly dividing cells necrotise. Consequently, they are often an early indication of a disease. Compared to biopsies, however, mammographic images do not provide any clear evidence of what causes the calcification. This new technique could help use biopsies with greater precision and improve follow-up examinations.

Agrovet-Strickhof Metabolic Centre

Milk, methane and motherly love

Corinne Hodel

Cows that have just calved are more susceptible to diseases. A doctoral student from ETH Zurich has been studying why their immune system does not work properly during this phase. Globe visited her at work.

If there had been a cockerel at Strickhof Farm in Lindau-Eschikon, our feathered friend would have been crowing by now. For it is still early on this wet morning. However, the day on the farm doesn't just start at an unearthly hour for the farmhands. The biologist Susanne Meese is also already up and about. She is a doctoral student in the Animal Nutrition Group of Professor Michael Kreuzer and is today conducting tests on three pregnant cows. One by one, the animals are led into a special chamber where their energy consumption is measured. "I want to find out how the energy balance differs before as well as after calving and how it influences the immune system", explains Meese.

At the moment, the test animals are still in the cowshed with the other cows, while Meese prepares the two respiration chambers. She heaves open the heavy double doors, thanks to which the chambers can be sealed later on. Once the chamber is airtight, fresh air can only flow in via a pipe in a controlled manner and the used air is conducted away to various analysis instruments in the adjacent room.

Meese stocks the chambers with water and hay, scatters straw in the grate and slides in the drawers underneath to collect the dung. Because the chambers are raised slightly, Meese has to lug in some wooden pallets and build a small step. "The chambers are ready. We can call Sabine and fetch Jutta", she announces. Sabine Rinderknecht, the head of milk production and livestock fattening at Strickhof, is helping to transport the cows between the stable and the chamber today. Jutta is the first test animal.

By now, it is bucketing down outside. With her hood pulled down over her face and her overalls tucked into her wellies, Meese hurries across the yard to the cowshed. There it is warm, dry and smells of fresh straw – and, as you might expect, of dung. Folk music is blasting out of the radio. Around thirty cows are lined up in two rows on either side. One of them is Jutta, a Holstein cow. Sabine Rinderknecht makes her stand up. Her two neighbouring animals also have to get up, for otherwise the risk of Jutta injuring them with a stray hoof is too great.

Getting used to the chamber

Jutta is actually supposed to clamber onto the scales behind the cowshed now, but Meese postpones the weighing until later in the hope that the rain will have eased off by the time the cow has completed her three-hour stint in the chamber. Jutta seems perfectly happy as she trots calmly across the yard. Suddenly, however, she stops dead outside the entrance to the next building. "She doesn't know this place yet", whispers Meese. "That's why she's a bit wary."

Overcoming this confusion is the name of the game for today. After all, stress could influence the readings. That's why Jutta and the other two test animals, Rahel and Ibiza, will only spend three hours in the chamber at first – to get used to it. The measurements are only taken for test purposes, too. The three pregnant cows won't take part in the actual experiment for another couple of weeks, when they will spend two whole days in the chamber for the first time.

Thanks to some soft words and a gentle push, however, the two companions manage to get Jutta into the chamber without any trouble – but not without her first depositing

Susanne Meese leading her test animal Rahel back to the stable. This doctoral student from ETH Zurich has just conducted a successful test measurement with the pregnant cow in the respiration chamber

Doctoral student Susanne Meese (in the foreground) from ETH Zurich, and Sabine Rinderknecht, a member of staff at Strickhof Farm. Together they lead Rahel, the pregnant cow, into the respiration chamber, where her consumption of oxygen as well as emissions of carbon dioxide and methane can be measured. Meese weighs her test animals on mechanical scales – come rain or shine.

The respiration chamber remains closed while the measurements are made. Thanks to webcams, however, the two cows Rahel and Jutta can be observed from outside. Susanne Meese is allowed to enter the chamber to feed them, where she explains how she determines Jutta's body condition score.

a great, big cowpat barely three metres from the door. Later on, Ibiza, the third test animal, steps straight in it. Before the door has even closed, Jutta is already munching away. "That's a good sign", beams Meese. The hay in the respiration chamber is particularly tasty, like a Sunday dinner. They don't get that in the cowshed. "The good food in the chamber is supposed to woo the animals into a positive frame of mind", she says.

Meese has to weigh the food before tipping it into the trough – this is the only way of knowing how much energy the cows take on board. The oxygen consumption and carbon dioxide as well as methane emissions in the respiration chamber are also measured. Using both the data gained and default vales, the scientist can calculate how much energy the animal consumes. Meese conducts the two-day experiment four times with every cow – five weeks and a fortnight before calving as well as two and twelve weeks afterwards. She then compares the different measuring days.

Meese leaves the door open so that Rahel, the next test animal, can see her companion in the chamber. This reassures her. After all, cattle are not loners, which is why a mirror in the chamber tricks them into thinking that they have got company. Rahel is much feistier than Jutta. Sabine Rinderknecht needs to summon up a lot of strength to lead her. And Susanne Meese is not afraid to get her hands dirty, either. Having grown up on a stud farm, she is no stranger to handling big quadruped. The cow has also got a boil on its foot. Although it is harmless and already starting to heal, Meese notes it down for good measure as the infection could influence her data. After all, the doctoral student is especially interested in the animals' immune systems.

Sacrifice for offspring

It is not uncommon for new mother animals to suffer from infections or other health problems after calving. What's more, the amount of energy they consume during this phase is enormous. After the roughly nine-month gestation period, the exertions of giving birth and producing milk sap their energy reserves. So the young researcher is studying how the negative energy balance weakens the immune system. In order to test her hypothesis, Meese takes blood samples from the cows and uses them to produce cell cultures in the lab of Susanne Ulbrich, a new professor. Meese then adds a so-called mitogen, a substance that mimics an infection. Immune cells from the blood of cows that have just calved respond less strongly to the mitogen than immune cells from the blood of pregnant cows. Meese is studying why, based on various series of tests. "For the calf to survive, the mothers invest in milk production", she explains. Furthermore, high-yield dairy cows produce up to six times more milk than the calf needs to survive. "This investment in milk production can come at the expense of the immune response", Meese sums up.

But the doctoral student does not only work on the farm in overalls and rubber wellies. She also dons a lab coat and wields a pipette at a sterile bench. "I like the variety that my doctoral project offers", says the biologist, who is supervised by Angela Schwarm.

Meese closes the double doors to the chambers and vanishes into the computer room next door, where she can observe Jutta and Rahel on webcams. She switches on the measuring apparatus to analyse the used air from the chambers. The oxygen, carbon dioxide and methane curves appear on the screen. On the monitor, Meese notices that Jutta's trough is getting low on food, so she fetches some more hay. She has to enter the chamber through a side door now, as the large doors are no longer allowed to be opened; that would distort the reading.

Body mass index for cows

It is still pouring down outside. The three hours are up. Now Meese is unable to avoid the detour across the scales before Jutta is allowed to return to the stable. The scales consist of a plate embedded in the ground that is easily big enough to weigh a lorry if you really wanted to. Meese measures the weight mechanically. It takes time for all the levers to be adjusted properly. And Jutta refuses to stay still. She keeps trying to wriggle free. No wonder. How many ladies voluntarily climb on a set of scales? Especially when it displays an unflattering 790 kilograms.

Besides weight, the so-called body condition score is also a key measure of a cow's health – a kind of body mass index for cattle. Susanne Meese assesses different parts of the body, such as how strongly certain bones stick out. Depending on the result, she awards points and thus determines the score. And Jutta's is distinctly average. Even though a good three quarters of a ton is heavy for a pregnant cow, Jutta is patently a large specimen with a broad physique. "For me, the changes in the course of the pregnancy or in the weeks after the birth are more interesting than the absolute figures." After all, the degree of weight loss could also have an impact on the immune system.

As yet, Meese is still unable to draw any definitive conclusions about her research results. She needs to gather more data first. Next week it is Isabelle's turn for her final session before giving birth, followed by Fina, whose calf has already been born. For today, Ibiza still needs to do her practice run in the chamber before she also embarks on her four-part series of tests in three weeks' time.

Everything went like clockwork today. After their successful acclimatisation in the respiration chamber, Jutta, Rahel and Ibiza are back safe and sound among their kind in the stable. Now all that remains for Meese to do is clean up. A lot of dung has accumulated in the course of the day – and not just in the trays especially provided underneath the grate. But that's all part and parcel of doing a doctorate at ETH Zurich, too. ■

Institute of Agricultural Sciences:
www.ias.ethz.ch →

Agrovet-Strickhof

ETH Zurich, the University of Zurich and the Canton of Zurich's Office of Landscape, Agriculture and Environment are planning a joint educational and research centre at the present Strickhof site in Lindau-Eschikon. Thanks to this collaboration, the three institutions, all of which currently run their own facilities, are able to share livestock and infrastructure and thus benefit from specialist synergies. The costs of new and replacement buildings are to be shared equally between the canton and ETH Zurich. The construction work is scheduled for 2015.

www.agrovet-strickhof.ch →

Patterns in the sea of data

Thanks to high-performance computers, vast amounts of data can be collected, analysed and archived these days. However, it is not only computer scientists who juggle with big data: sociologists simulate wars, biologists refine diagnostic methods and geophysicists model earthquakes. All of them are searching for the same thing in the sea of data: patterns that reveal hidden nexuses.

Automating experience

Nowadays, evaluating large amounts of data enables us to examine issues for which there were still no viable theories until only recently. Two ETH computer science-professors, Joachim M. Buhmann and Donald Kossmann, explain how this will change society.

Interview: Felix Würsten and Martina Märki

The term "big data" is on everyone's lips, but not everyone understands the same thing by it. What does the term mean for you?

Donald Kossmann: My favourite definition of big data is the "automation of experience." Essentially, this means that you learn from the past with an eye on the future and avoid making the same mistake twice.

And why does this need vast amounts of data?

Kossmann: Large amounts of data help because experiences are varied. With large amounts of data, not only can you show what's obvious, what keeps happening, but rare phenomena too. So the more data, the better it is.

Joachim Buhmann: In artificial intelligence there is the strategy of "case-based reasoning" – a concept borrowed from the justice system. If you have to judge a case, you use precedence as a yardstick. That's a sound approach because it's usually easy to spot whether a case is similar. Scientific theories normally help describe phenomena globally. That doesn't work in all fields.

For example?

Buhmann: In medicine or sociology. While the human race has been working on developing viable theories here since the year dot, these have a negligible predictive value in practice. The best we can do in this situation is to say, "We haven't got a global theory so we memorise individual cases." And the more individual cases we consult, the better the picture will be.

Can you back that up with a concrete example?

Kossmann: Yes, a very vivid one: Google Translate. This translation service is based on the principle that a large number of examples from translated texts have been pooled. No one can describe a language conclusively. But you can achieve astonishing results if you take known individual sentence components and reassemble them again.

Buhmann: Formalising the aspect of language that isn't covered by grammar is incredibly complicated. But remembering examples and then saying, "Well, the machine makes a compromise" – that's possible today.

Interviewees:

Joachim M. Buhmann is a Professor of computer science and runs the Machine Learning Laboratory at ETH Zurich. His research focuses on pattern recognition and data analysis, specialising in methodological questions of machine learning, statistical learning theory and applied statistics.

Donald Kossmann is a Professor of computer science at the Institute of Information Systems at ETH Zurich. In his research, he studies the optimisation and scalability of database and information systems.

Donald Kossmann (l.) and Joachim M. Buhmann advocate developing new models for how we handle sensitive data as a society, so that we can benefit from it without violating the personal rights of the individual.

Do you look to human learning for inspiration when developing such systems?

Buhmann: Machine learning has a lot to do with human learning. Thanks to evolutionary pressure, however, we are built to recognise patterns as quickly as possible, not as faithfully as possible, which is why we have a tendency to see patterns in random data even when they don't exist. With big data, we can study phenomena so complex that we are no longer able to grasp them because the correlations are hidden away in the databases. In actual fact, we can process them, but just not in the rational part of our brain. We often judge based on experience and sub-rational thinking. Consequently, a rule-based system for diagnosing illnesses built on the explanations of doctors works less effectively than a system where you let the doctors work, then imitate them. The trick is to mimic as many doctors as possible.

Kossmann: There are also unsuitable applications. Big data tries to look into the future, using the past. This shouldn't be applied wherever it doesn't make sense. Financial markets are one example. If we want to learn what the future will be from the past, we automatically alter people's behaviour – and then you can no longer predict the future anyway. So big data isn't a formula to get rich on the stock exchanges – at least not for any length of time.

There are very different kinds of data. How can you combine these optimally?

Buhmann: Data fusion – that's a major issue. One of the most important questions in mathematics is what objects are and how they are compared. Typically, you begin with a definition: A equals B. The next step is to ask what's similar. This enables me to form classes of equivalent objects and to develop theories on these classes. However, this requires a vastly complex mathematical apparatus.

Does data still need to be available in a standardised form or have we moved on from there?

Kossmann: Unfortunately, 70 per cent of the work still involves cleaning up and preparing the data. If you want to find out whether Joachim Buhmann is a good researcher, for instance, the problem you face is that he sometimes publishes as Joachim Buhmann, sometimes merely as J. Buhmann. So it isn't easy to find out which publications stem from him. Another difficulty is that data is recorded with different levels of precision and resolution. One person might take your temperature with an electronic thermometer every hour, another once a day using his hand. Collating this different data still requires a lot of effort.

Buhmann: But ultimately, that's more of a technical problem than a conceptual one. If I have to compare extremely different health data, it does become tricky, of course.

That's precisely the aim of the "e-Health" initiative, which is looking to standardise patient data acquisition.

Buhmann: This initiative is necessary as it is the only way we will get a sufficient number of cases to be able to study rare diseases. We have just completed a study on schizophrenia with Klaas Enno Stephan. From the outside, the patients' symptoms might seem similar. But because schizophrenia is a spectrum disorder, different mechanisms operate in different patients' brains. If we succeed in dividing such a disease into sub-types, it will be a major step forward. That's what big data's all about: getting enough cases to have sufficient information on the rarer sub-types.

And if patients have qualms about data privacy?

Buhmann: Data security has to be guaranteed, of course. I'm convinced that we need a new social contract. As someone in good health, I supply my data for research and reap the benefits as a patient. But we haven't even created the ethical preconditions for this yet. How do I respond to someone who hasn't made provisions by donating data as a healthy individual? Do I want to withhold knowledge from this person when they are ill? This is how it works with health insurance: if I don't take out any insurance as a healthy person, I won't get any help when I'm ill.

Mr Kossmann, do you share this view?

Kossmann: Yes and no. This is a typical question from the issue of common good versus personal rights. In my opinion, data basically belongs to the individual, which is why I also see the tax analogy: while my money belongs to me, I accept that I have to surrender some of it for the common good. The same applies to data. We simply haven't got the right instruments yet.

So as an individual, how can I prevent this data from being used against me, later on down the line?

Kossmann: You have to guarantee that the data can't be used improperly, which isn't all that easy to define. What is proper in healthcare? Where is the purpose still served? And at what point have you gone beyond the purpose? That all needs to be regulated. A lot can already be achieved, even without any major rules or a tax model. Many people are willing to provide their data if they trust the institution in question. One idea, for example, is for people to contribute their data as members of a cooperative and thus control for themselves how their data is used. That might be a better model than the tax example I mentioned earlier.

All the same: as a Facebook user, for instance, I am constantly bombarded with new terms and conditions that I barely even comprehend. How can trust develop here?

Kossmann: Facebook is an extreme model: I provide a service that you can use and I can do what I want with your data in return. The national tax model is another extreme example: I tell you what data you need to give me. In both cases, the individuals lose control over their data. If we want to earn people's trust, we have to give them back control over how their data is used, and create new ways in which people can benefit from the utilisation of their data.

Buhmann: And we should display more composure. Taxes have been levied for thousands of years, but there has only been a well-founded taxation policy since the Enlightenment. It simply takes a long time for a social contract to be negotiated.

So it all boils down to a fundamental societal debate: How do we handle our data?

Buhmann: We humans are not solitary egomaniacs. Instead, the value of our lives largely consists in companionship, i.e. interaction. And that's where the question becomes blurred regarding who owns the data. Who owns the information I share on Facebook? The collective I interact with? Or only me personally? Those are things we need to clarify. The old values we adhered to when using rudimentary technology can't just be applied to new, high technology with its unknown possibilities.

Kossmann: As I said, we need to create new ideas and try them out. What do we enjoy? What works? Whatever we like will surely prevail. I'm optimistic that the human race will find a positive approach to the issue. ■

Efficient computing

Scientific high-performance computing should become more efficient – this is one of the goals for researchers from ETH Zurich. Their approach should also ensure Switzerland's future among the world's best in high-performance computing.

Simone Ulmer

Supercomputer power has skyrocketed in the last twenty years. Whereas a "supercomputer" could manage a few billion computer operations per second two decades ago, present-day supercomputers in the petaflop performance category carry out several quadrillion calculations in the same time – that's several million times one billion computer operations per second. This enables researchers to calculate increasingly complex models and to simulate real circumstances with mounting accuracy, such as the processes that take place during a chemical reaction or the development of the weather in the next few days. Driven by the fascinating insights that computer simulations can provide, the exaflop performance class is already on the horizon: according to optimistic specialists, it should become a reality by the end of this decade.

Improvements beyond hardware

In Switzerland, intensive research is being conducted into how the performance of supercomputers can be increased in an energy-efficient way. One of the driving forces behind this is physicist Thomas Schulthess, Director of the Swiss National Supercomputing Centre (CSCS) in Lugano, which is affiliated to ETH Zurich. He is convinced that an increase in performance and efficiency cannot be achieved solely via the hardware; better computer algorithms and software are also needed. Consequently, he initiated the High Performance and High Productivity Platform (HP2C) over four years ago, where developers of application software for scientific simulations collaborated with mathematicians, computer scientists, the CSCS and hardware manufacturers to make the simulation systems more efficient from the outset. One of the first milestones in this cooperative project is the supercomputer Piz Daint, which has officially been available to researchers since April. This petaflop computer is currently the world's most energy-efficient in its performance class – not least because its hybrid system comprising graphics processors (GPUs) and conventional processors (CPUs) boasts a sophisticated communication network and scientists in the HP2C have adapted their application software to an optimal utilisation of the computer architecture. In the follow-up project, the Platform for Advanced Scientific Computing (PASC), Schulthess aims to position computer-based research in Switzerland for the use of the exascale performance class. The project is coordinated by the Università della Svizzera italiana in conjunction with the CSCS, EPFL and other Swiss universities.

Interdisciplinary approach

The platform's focus areas are the climate and earth sciences, materials research, life sciences and physics. For instance, framework conditions are to be created to facilitate the handling of the large amounts of data that primarily accumulate in the climate and earth sciences or physics. The same goes for the simulations conducted, says Schulthess. It is a major challenge to maintain the accessibility of the data that is recorded experimentally and that is produced through simulations, as well as the scientific information thereby derived: thousands to millions of simulations produce a model based on the data recorded – such as a model of the earth's mantle, of a molecule or a new material. In order to get somewhere close to reality, the researchers adjust the parameters for every simulation, which can trigger an absolute flood of data. One of the goals in PASC is thus to control the simulations and the adjustment of the parameters in a sensible way.

"Compared to HP2C, PASC is geared more heavily towards producing application-oriented tools than to working

on monolithic codes", says Schulthess. It all boils down to being able to use the respective codes more flexibly and, at the same time, more efficiently.

A more flexible choice of architecture

This project is also backed up with a computer science project supervised by Torsten Hoefler. This 33-year-old assistant professor runs the Scalable Parallel Computing Lab at ETH Zurich's Institute of Computer Systems. And the lab's name is also the focus of his research: his team increases the efficiency of computers via the software that issues the computational instructions. The central method for this is parallelisation: as many operations as possible should take place at the same time by sharing the work among as many kernels (processors) as possible.

"We want to find out how we can bring applications in high-performance computing up to highly parallel systems with several million kernels", says Hoefler. He is talking about performance-centric programming in which all levels (from parallel programming language and compiling to the development tools) have to be taken into consideration – always with the aim of using the supercomputer as energy-efficiently as possible. In PASC, Hoefler and his team concentrate on the compiler, which converts the programs written in a legible programming language into an efficient computer language. Starting with a popular compiler, Hoefler wants to develop a heterogeneous one that translates and optimises applications for different computer architectures. If he succeeds, the operators of computer centres and their users will be more flexible in their choice of computer architecture.

Until now, this choice has been limited because the programs are usually geared towards a particular architecture. In other words: a code that was developed for conventional CPU-based processors runs less efficiently on a machine with GPUs – if at all. Consequently, the users keep having to adjust their programs when a new computer architecture comes into operation.

Hoefler now wants to change all this. In close collaboration with three other PASC projects from the fields of climate, earth and material sciences, Hoefler is seeking particular sequences in the program codes that are suitable for different types of computer hardware. On the one hand, he is looking for sequences that are just the ticket for so-called "low latency" processors, which are designed for high performance and solve a single complex calculation as quickly as possible. On the other hand, he is also on the lookout for sections that allow many parallel calculations and are thus ideal for processors that are slow but can handle high performance. "It's like the difference between a Porsche and a bus", says Hoefler. "I get to Munich faster with the Porsche than by bus, but I can only take a maximum of two people as opposed to sixty."

For an application's code lines to use the computer architecture efficiently, a programmer still has to decide and manually program which code sections the Porsche is allowed to use and which should take the bus – a painstaking task. However, Hoefler would now like to automate this process – the "holy grail of automatic compilation", in which many have already failed, he stresses. However, he is confident that he is up to the task. For the conditions that PASC and the innovative supercomputer Piz Daint provide are ideal for tackling this central problem. "With Piz Daint, Switzerland is technologically on a par with the USA and years ahead of many other computer centres. It's right up there in pole position in the Grand Prix of supercomputing."

Maximum information content

Another discipline to benefit from this development is life sciences, which have already been represented in HP2C with several projects and now rank among the key users in PASC. And here, too, the aim is to process the spiralling amounts of data in a sensible way. Statistics make a valuable contribution in this respect, such as genetic studies where tens of thousands of characteristics are recorded per test person. Mathematician Peter Bühlmann, a professor at ETH Zurich's Seminar for Statistics, develops statistical methods in collaboration with biologists that enable them to assess the relevance of every single attribute. For instance, the programs determine whether an unusual peak, an outlier, is relevant or has merely cropped up by coincidence. "With our models, we provide something like an error bar, which can be used to determine what's in the relevant range", explains Bühlmann. Besides software, he and his team primarily provide models that specify the framework for simulations. On this basis, the biologists can reduce their data by eliminating what is unusable. According to Bühlmann, however, the fact that the scientists obtain more accurate information through the information extraction is far more important. "The maximum information content can be fished out of the sea of data."

For this purpose, researchers in the Bioconductor project are developing software based on the popular statistics software "R." The software is open-source – apart from anything else, to guarantee reproducibility. It is not a kind of software where you feed your data into one end and it spits the result out at the other, stresses Bühlmann. Just as the mathematicians have to have some understanding of the biologists' data and their way of working, the biologists also have to learn to work with the programs.

Statistical selection of the best

Bühlmann states that he does not simply receive "a bucket full of data" from a researcher with instructions to look at what is inside. Instead, it is a question of concrete issues and hypotheses. For instance, Bühlmann collaborates with Ruedi Aebersold, a professor at the Institute of Molecular Systems Biology at ETH Zurich and the University of Zurich. Based on short peptide segments, the two scientists have developed a mathematical model that can illustrate which proteins are present how often in healthy and diseased tissue and how relevant these are for a particular disease. The model forms the basis for a future non-invasive diagnostic process for prostate cancer.

Bühlmann has also successfully completed a project with Wilhelm Gruissem, a professor of plant biotechnology at ETH Zurich, who was searching for a gene that makes the arabidopsis plant grow and flower faster. The researchers measured 20,000 gene expressions per plant for 43 wild varieties from different regions. They then processed the data using the statistical method they had developed, and produced a top-twenty ranking of the most promising genes as candidates for "growth accelerators." Field trials were subsequently conducted with these genes, some of which actually hit the bull's eye, reveals Bühlmann. Statisticians and computer scientists thus do not just seem to increase the efficiency of calculations and supercomputers; they also speed up research in the natural sciences. ■

CSCS:
www.cscs.ch →

Platform for Advanced Scientific Computing:
www.pasc-ch.org →

War and peace in bits and bytes

Can wars be predicted? Why do conflicts escalate? Big data can also provide valuable insights in the social sciences. The opportunities and risks of the changes that go hand in hand with big data are still hard to foresee, believes ETH Zurich professor Dirk Helbing.

Martina Märki

"Big data hasn't really hit the social sciences yet!" says Dirk Helbing, a professor of sociology at ETH Zurich. He is being deliberately provocative. This former physicist specialises in modelling and simulating social phenomena. For instance, he and his team study what causes traffic jams and how they can be avoided. Or how disasters occur in crowds, such as at the Love Parade in Duisburg, and how they can be prevented. They develop data-based models to predict the ways in which epidemics spread and to understand financial crises better.

In such contexts, data from social media (Facebook, Twitter, Google plus etc.) and geographic positioning data is worth its weight in gold. Not all that long ago, for instance, Google was able to reveal that flu epidemics and how they spread could be predicted faster and more effectively, based purely on the analysis of search requests for health-related topics than using the methods of the World Health Organization (WHO). According to Helbing, however, much of this data is difficult to access for researchers in Europe, which is not only a question of data privacy. Nowadays, most data material is in the hands of companies. And they soon cotton on to the fact that data is the capital of the future.

Many of Helbing's latest research projects are data-driven. However, only a few are actually based on big data. Examples of these projects include studies on scientific innovation and the predictability of armed conflicts between nations.

A colleague of Helbing's, Thomas Chadefaux, recently published an extensive paper on this topic, based on reports in the Google News Archive.

Conflict research with Google News

With over 60 million pages and newspaper articles from a period spanning more than a century, Google News is the world's largest newspaper database. The researchers subjected the articles to a computer-based text analysis. The programme searched for and registered the presence of certain keywords that are typically associated with tensions, such as "crisis", "altercation" etc. It also recorded which countries were mentioned in this context. If one of the keywords cropped up in combination with a certain country several times within a week, the programme judged this a sign of increased political tensions. As a result, the conflict potential between two nations could be gauged. Accordingly, every week from January 1902 to December 2011 was analysed.

The result is a finely woven time series that records the course of international tensions for over a century and between 167 nations. The researchers discovered that reports on conflicts often already become significantly more frequent, months before military interventions. Statistically,

the "reporting" variable was even more telling than other factors that conflict researchers believe influence the development of wars, such as the types of government, the balance of power and military spending. "We were able to demonstrate that analysing the frequency of articles about conflicts based on keywords alone can produce an effective early-warning system that is capable of alerting decision-makers to armed conflicts up to a year in advance, thus giving them the opportunity to take action in time", Helbing sums up. "The method is more precise than any other model we know."

More than early-warning systems

This approach becomes even more accurate if you are not only able to take the reporting frequency over time into consideration, but also how strongly it varies in the course of a year. The more unusual deviations occur, the more probable it is that a war could break out. "This is a particularly interesting feature", says Helbing, "because it doesn't just apply to the prediction of conflicts." Quite the contrary: striking variability generally appears to be a typical warning sign for transitions to new system states. Physical, biological and socio-economical systems can be observed to exhibit unusually variable behaviour before they finally become unstable and ultimately topple. "We have got a very efficient early-warning system here that can be used in many fields", says the researcher.

Unfortunately, he explains, such methods are still used far too seldom. Sceptics are quick to voice their concerns: an early-warning system is all well and good, but can data also explain how conflicts can be dealt with better or even prevented? "Yes, they can", Helbing is convinced, and gives another example from his research. Conflicts often develop their own dynamic; their reciprocal reactions are interdependent and provide for mutual escalation. In order to understand such patterns better, Helbing's co-authors analysed the events in the Middle East and the Iraq War, concentrating on incidents in the Baghdad area between 2004 and 2006.

After the US invasion there were several uprisings. The US troops attempted to track down insurgents and arms caches with large-scale raids. Innocent civilians are often caught up in such campaigns. Proponents of these raids argue that they not only help ferret out rebels; they also deter the civilian population from supporting the insurgents. Others, however, believe that they tend to fan the flames because sheer indignation prompts the civilian population to pledge its allegiance to the rebels. By evaluating all known altercations using special statistical methods, the researchers were able to show that the deterrent hypothesis doesn't hold water. Large-scale raids tended to lead to more bomb attacks. Deterrent and punishment methods only worked if they were recognised as legitimate; otherwise, they actually inflamed conflicts.

From big data to smart data

This example also reveals that data analyses are especially fruitful if used in a theory-based way. Helbing thus prefers the term smart data to big data. Big data is already used in many areas of our society and changes our lives forever. Advertising, online commerce, financial markets and news services are only the most obvious users. "We are currently experiencing the digital revolution, without really understanding what the consequences will be", Helbing stresses. "And we are still a far cry from consciously shaping the transition to a digital society."

There are burning questions that need answers. How will the digital revolution change society and the economy? How can we use this as an opportunity for everyone? How can we reduce risks? How can individuals regain control over their own data? It is in these questions that he sees the key challenge – not only for politics and society, but also for science. "Used wisely, big data can help us to make better-informed decisions – be they on the financial market, in environmental politics or when dealing with epidemics or conflicts", believes Helbing. However, models still need to be developed to handle big data responsibly – a goal that he feels is well worth investing in. ■

Activities of the Chair of Sociology, especially modelling and simulation:
www.soms.ethz.ch →
www.futurict.eu →

Refining cancer diagnosis

System biologists at ETH Zurich are developing a new method to diagnose prostate cancer more reliably. To this end, the scientists analyse thousands of proteins.

Corinne Hodel

The doctor faces a dilemma. Today, a pathologist can clearly diagnose prostate cancer from a patient's tissue samples. However, he cannot always estimate how aggressive a tumour actually is. The appearance of the biopsy sample alone only supplies limited information about the type of tumour. There is a risk that the doctor may "overtreat" his patient. He proceeds to surgery on the prostate cancer with all the related side-effects and consequences, although this may not actually be necessary. The quality of life of the men concerned is impaired unnecessarily. However, if the tumour really is aggressive, surgery of this kind can save a patient's life.

There is a major need for a more precise test. This is because the prostate carcinoma is the most frequent type of cancer in Switzerland. Every year 6,000 men develop this disease.

Ruedi Aebersold, Professor of Systems Biology at ETH Zurich, is currently engaged in research into a more refined diagnostic method for prostate cancer. Together with other research groups he is looking for cancer markers which enable more precise statements about the aggressiveness of a tumour. "Our test should prevent unnecessary surgery", says Aebersold.

Thousands and thousands of proteins

To refine the diagnosis, Aebersold and his team analyse proteins in the tumour tissue and in healthy tissue. The scientists want to find out how, for instance, the protein profiles of harmless tumours differ from those of aggressive tumours.

As the researchers are unable to predict which proteins will be of assistance for the diagnosis, they have to look at several thousand proteins under the magnifying glass. The scientists are not, however, searching for a single protein which could prove to be a reliable cancer marker. They are far more interested in the overall picture of several proteins for proteins are not lone rangers, but are part of a complex network. They react, for instance, to environmental stimuli by occurring more or less frequently. "We hope to be able to recognise characteristic protein profiles for the various types of tissue", says Aebersold.

A database as the benchmark

The long-term objective is a test that is able to analyse and assess, in the space of a day, the protein profile of the biopsy sample. "Our test will not in any way replace the pathologist", says Aebersold. "Our analysis will simply supplement his findings."

The researchers have already examined more than 100 samples from around 40 patients. Several thousand proteins are analysed for each sample. However, no results are as yet available. The evaluation of this enormous volume of data is very time-consuming and complex. An interdisciplinary team is currently using mathematical models and statistical methods to identify differences in the protein profiles.

Aebersold sources the tissue samples for the study from the pathologist Peter Wild at the Zurich University Hospital. In the laboratory, Aebersold's research group analyses protein composition using a mass spectrometer. It sorts the protein fragments by size and identifies which proteins are present in the sample. This leads to a mass spectrum for each protein or fragment. The tissue samples are to a certain extent digitalised.

Twenty years ago it took a whole day to analyse a single protein using mass spectrometry; modern devices can handle up to 5,000 proteins an hour today. It was this technical progress that made possible Ruedi Aebersold's search for a new diagnostic method.

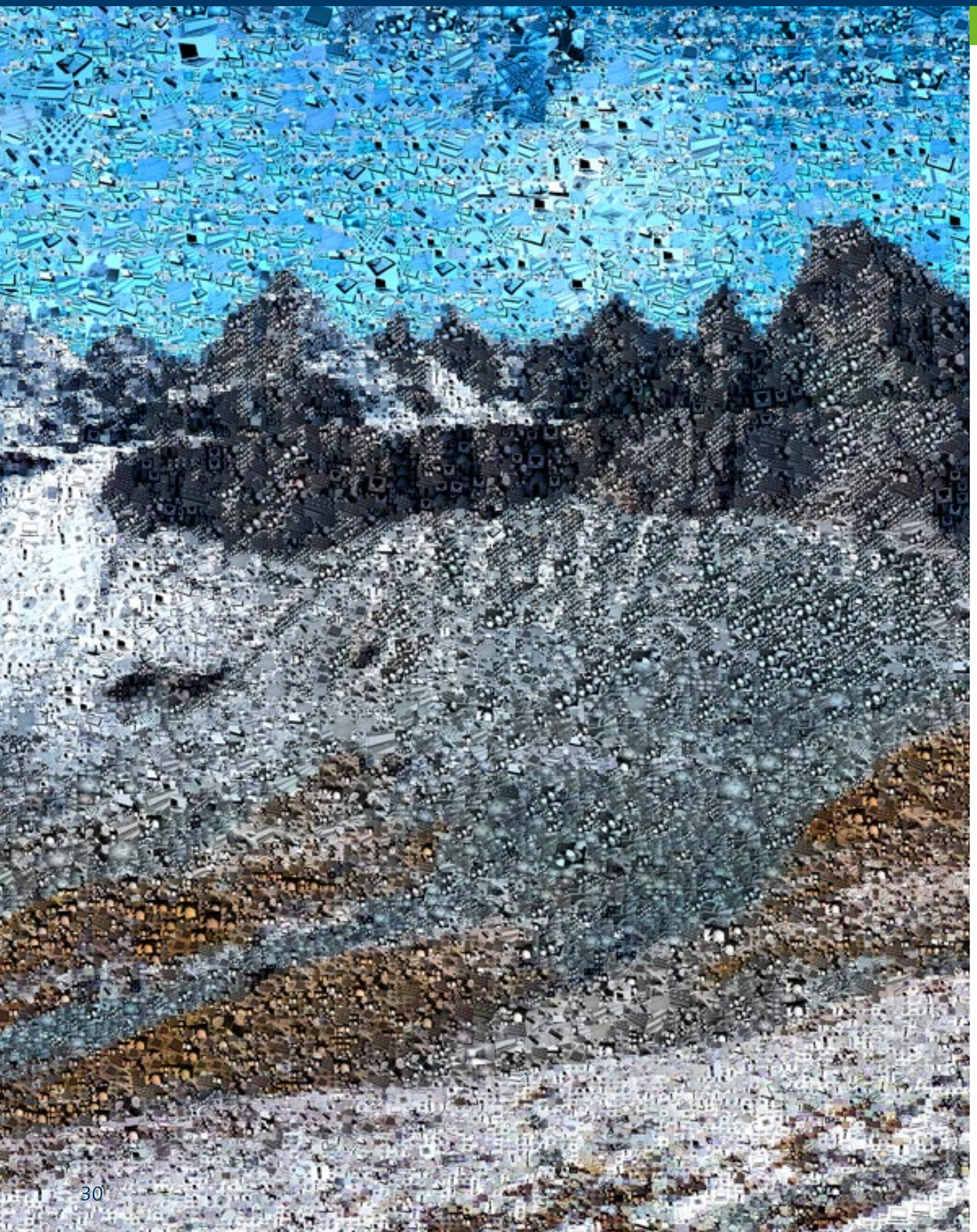
New research approach

The researchers compare the mass spectroscopy data with the entries in a protein database. It contains around 20,000 proteins and 100,000 protein fragments. Aebersold was involved to a major degree in the development of this benchmark work. A "PeptideAtlas" is now also available for various living organisms. Each of these entries is based on several hundred measurements that stem from researchers across the globe. Quality assurance is ensured by a computer program rechecking the raw data and depositing a reference dataset for each fragment or protein. Scientists all over the world can compare their own data with a dataset and, if they correspond, identify the samples they have measured.

The digitalisation of patient data not only serves research purposes. It is also gaining a foothold in the health care system. "The digitalisation of patient data is not, however, very far advanced in Switzerland", regrets Aebersold. "Above all, the system is highly fragmented." Cases of cancer, for instance, are recorded in the cantonal cancer registers to the extent that the cantons even have any record of this kind. On a national level, there is only a register for children's cancer. The situation is completely different in Denmark, which is exemplary when it comes to digital patient files. It is standard practice for the data collected from patients to be stored in a database. There are now more than five million datasets. "Switzerland, too, must aim to set up a system of this kind", says Aebersold.

Aebersold believes that this kind of data collection can be helpful in identifying connections that are not yet apparent today. "This approach to research is not driven by hypotheses, but it does carry medical research forward decisively", says Ruedi Aebersold with conviction. ■

Institute of Molecular Systems Biology:
www.imsb.ethz.ch →



A sharper image of the earth´s structure

Felix Würsten

Today, thanks to earthquakes, we know fairly accurately how the solid earth is constructed. Geophysicist Andreas Fichtner is now taking things a step further: he gains new insights into our planet's interior from seemingly useless data.

What does the earth look like on the inside? Considering that this part of the world is completely out of bounds, we have got a remarkably differentiated picture of which structures are hidden away beneath the earth's surface. We have come a long way from the rough breakdown of the earth into a solid inner and a liquid outer core made of metal, which is surrounded by a mantle of siliceous rock and a thin crust as an outer shell. For instance, geophysicists are in the process of reconstructing in detail the powerful convection currents in the earth's outer crust that generate the earth's magnetic field. And we now also know that there is a zone underneath the volcanic island of Iceland made of hot rock that extends to a depth of 1,000 kilometres.

Conclusions regarding the structures

These glimpses inside the earth were made possible by geophysical readings at the earth's surface. One key instrument, for instance, are seismic waves: if an earthquake occurs somewhere on earth, the tremors travel straight across the entire world. If you now register these waves at different places using the right measuring devices, you can use their propagation rate to draw inferences about the structures that these waves crossed inside the earth.

Messages amidst the noise

However, this method has a drawback: earthquakes do not occur uniformly on earth, but preferably along the edges of the tectonic plates. And the measuring stations are not distributed evenly either, which means that the picture we have of the earth's interior is not equally differentiated everywhere. Andreas Fichtner, an assistant professor of computer-based seismology and head of the Solid Earth Dynamics Network, which coordinates CPU-intensive geophysical activities in Switzerland, is now developing a process as part of the GeoScale project that should plug this gap.

Fichtner uses data that at first glance seems useless: the chaotic background noise that the seismometers constantly record. "Most of the time, they only record minute vibrations from which no clear signal is discernible", he explains. "These tremors are caused by various factors: for instance, sea waves, turbulence in the atmosphere or even human activity."

Together with his doctoral student Laura Ermert, Fichtner has now resorted to a trick to filter a signal out of this data all the same: they take the datasets from two stations at a time and compare them using a correlation function. "If you correlate the data from one station with that of many others, you end up with a pattern as if an earthquake had taken place at the station in question", explains Fichtner. "We can then process these artificial earthquake signals in exactly the same way as normal earthquake signals."

Hundreds of thousands of correlations

Nevertheless, it still takes a lot of computer work to get to that stage. Every seismometer records a signal twenty times per second, which adds up to dozens of gigabytes over several years. These vast amounts of data need to be processed first, as the readings can become distorted slightly by the instruments. Once the values have been revised, the correlations have to be performed. "If you want to correlate 1,000 measuring stations in pairs, you need 500,000 calculations", explains Fichtner.

The result of the calculation work, he is convinced, will yield a much more accurate picture of the earth. "We will especially be able to unlock the structures beneath lesser-researched regions such as Africa, South America and Siberia with far greater precision." And Fichtner would also like to clear up another unresolved issue. "Thanks to the new data, we might be able to understand better which factors actually produce the chaotic background signal – and possibly even fathom what interactions there are between the seas, the atmosphere and the solid earth more effectively." ■

Solid Earth Dynamics Network:
http://hpcsolid.ethz.ch →

Search and find

It's not just the scientists at ETH Zurich who generate huge amounts of data; the ETH-Bibliothek is also a venue with "big data." More and more resources are now available in digitalised form.

Corinne Hodel

Books, periodicals, maps, documentary photos, recordings and videos: In the ETH-Bibliothek, huge volumes of media are lying dormant. More than eight million resources are available in analogue and digital form in Switzerland's largest library for natural sciences and technology. They have almost all been meticulously catalogued.

Metadata is absolutely essential for structured cataloguing, i.e. datasets which describe the actual data. What looks like a contradiction at first sight – generating even more data in order to navigate your way around the wealth of data – is in fact the only way of creating order out of chaos. "Our users can access this metadata and find what they are looking for, thanks to targeted search terms", says Wolfram Neubauer, Director of the ETH-Bibliothek.

Although the stocks are catalogued and described in a detailed manner, the huge choice still makes the search for the right media a challenge. "The most important thing is, and continues to be, the mind that processes the data", says Neubauer.

Lack of longstanding experience

However, the digital age doesn't just replace card catalogues with electronic catalogues; it also changes the way in which books and other analogue media are presented. New purchases are increasingly of e-books, and analogue stocks are continuously being digitalised. A robot at the DigiCenter of the ETH-Bibliothek can scan 30,000 periodical pages a month. Already today, the ETH-Bibliothek offers its users a total of almost half a million electronic resources – with an upward trend. Based on the digitalised data of the library, completely new research orientations are emerging. Linguists, for instance, can now conduct database searches by keywords and monitor how a term or its use has changed over the years or even centuries. If the source texts were available only in analogue form, then no analysis could be conducted on this scale.

Once media have been digitalised, the question is how much sense it makes to keep the analogue versions. Library director Neubauer is reticent about disposing of books and periodicals which are now also available in digital form. But not for reasons of nostalgia. "In the case of books we can fall back on experience spanning centuries. We don't have this with digital data", he concedes.

Archive for research data

In accordance with ETH Zurich guidelines, scientists are bound to keep their research data. First, so that it can be consulted and checked at any time, and secondly because certain data is a one-off phenomenon – such as environmental observations – and cannot be obtained again.

To ensure that research data can be sensibly archived, the scientists must familiarise themselves with its archiving even before starting a project. The ETH-Bibliothek offers scientists "Digital Data Maintenance" for this very purpose. Thanks to individual solutions, archived data can even be assigned a quotable Digital Object Identifier (DOI) if necessary. This permits global access.

What the library cannot offer, however, is the storage or archiving of giant volumes of data generated in simulations or modellings, as at CERN for instance (see box). "This is where we come up against our limits", observes Wolfram Neubauer. In a case like this, the scientists work closely with the information services of ETH Zurich.

Letters from Einstein

Whereas scientists are obliged to keep their research data, there are no such requirements for administrative data. Documents like minutes of meetings or e-mails don't necessarily have to be stored. "But it is these very documents that may have considerable historical value", says Neubauer. "They may perhaps reveal to later generations why a specific decision was taken at a given time." The library director believes archiving data of this kind constitutes a special challenge. "We are very quick to press the 'delete' key. But you may think twice about whether you really want to get rid of a folder on the shelf." It's not just about the inhibition threshold, but also about clarity. The contents of a folder can be perused sheet by sheet and then archived or thrown away. In the maze of a hard disc, datasets may remain undiscovered or may even be deleted by mistake.

Finally, original documents of historical value are often given to the library. For instance, the 90-year-old widow of an ETH physics professor discovered letters in her attic from Einstein to her husband. The letters are now safe in the library. If the two physicists had communicated by e-mail, this exchange would have ended up, at best, on a hard disc when they retired. Who knows whether anyone's wife would ever have found them? ■

ETH-Bibliothek:
www.library.ethz.ch →

Overcoming capacity limits
With this volume of data, even a supercomputer reaches its limits. 25 million gigabytes are generated every year in the experiments with the LHC particle accelerator at CERN. To handle this data volume, researchers have built the Worldwide LHC Computing Grid. This network links up computers from more than 150 computational centres in almost 40 countries. Thanks to this globally networked computer cluster, the research data can be archived and processed. Scientists from all over the world can access it. ETH Zurich participates in this network through the CSCS supercomputing centre in Lugano. It mainly analyses data and does simulations.

Zoom

Fragments of a meteorite weighing tons hit the Russian Lake Chebarkul last year.

Cosmos chemistry

Contemporary witnesses from space

Corinne Hodel

The earth scientist Maria Schönbächler looks at the formation and development of the earth. Amongst other things, she wants to establish how water came to be here. To this end she compares volcanic rocks from the earth's mantle with extra-terrestrial material that has fallen from the skies.

Again and again meteorites hit the earth. The strike by a 12,000-tonne meteorite in Chelyabinsk in Russia in February last year was particularly impressive. What is dangerous for the people affected and spectacular for lay persons is extremely interesting for scientists. This is because cosmic material that lands on earth as a meteorite in most cases started its journey several million years ago in the asteroid belt – a field of rubble between Mars and Jupiter. Since its formation, this extra-terrestrial rock has largely remained unchanged.

This is what makes these meteorites interesting for researchers like Maria Schönbächler. This professor in Isotope Geochemistry at ETH Zurich examines the formation and early development of the earth. In order to be able to understand its processes, she takes a closer look at meteorites in her laboratory. They represent the building blocks from which planets like our earth have been formed. Hence they provide important information about their composition. "Meteorites give us indirect insights into the earth's deep interior", says Schönbächler. "Because they literally fell from the skies, they are easily accessible." Instead of observing space with a telescope, Schönbächler examines extra-terrestrial material in her laboratory.

Meteorites as water messengers?

Meteorites also help to answer the questions about how water came to be on earth. This is because earth is made from the same material of which meteorites consist today. However, in contrast to the meteorites the early earth initially heated up markedly, which made its building blocks melt. Only then did today's three layers form – the core, mantel and crust. In this process the precious metals migrated towards the "They don't like oxygen", says Maria Schönbächler. She makes use of this chemical property. If she finds precious metals outside the core today, then they must have arrived at a later stage – after the earth had reached almost 99 percent of its present size and its core formation had been completed.

Highly precise analyses

Maria Schönbächler is currently examining the occurrence of the precious metals palladium and platinum in selected volcanic rocks that originally came from the earth's mantle. In her samples she determines the frequency of various palladium and platinum isotopes using mass spectroscopy. Isotopes differ in terms of the number of their neutrons. Some isotopes are not stable, however, and decay over time at a constant rate. "The relationship between the various isotopes is like an hourglass", explains Schönbächler. "We can determine how much has already run through and how much is still in the top." In this way scientists can date the material examined.

Thanks to high-tech devices it is possible to pinpoint the age of a sample to within less than a million years. That may sound like a rough estimate. However, "Our methods are highly precise – if you compare them with the age of earth." After all, it was created more than 4.5 billion years ago. In order to achieve even greater accuracy, Maria Schönbächler's team is constantly refining its analytical methods. For instance, each precious metal must be washed out of the sample with a different chemical cocktail. Certain elements are found in the rocks in such small amounts that the researcher has to conduct her analyses in a clean room laboratory.

Cooled lava: rock samples of volcanoes in Hawaii provide information about the structure of the earth's interior.

Maria Schönbächler compares the analysis of the earth's mantle with meteorite measurements. In this context she looks for meteorites that have the same isotope ratio as the volcanic rock from the earth's mantle. If she finds a concordance, the next step is to analyse the corresponding meteorite class more precisely. Amongst other things, she examines how high their water content is. If it is high, it may be that this meteorite class brought water to our blue planet after the creation of earth.

The definitive results of the current study are not yet available. However, with a study prepared four years ago, when Maria Schönbächler was still at Manchester University, she was able to use the precious metal silver to show that water was already present at the end of earth's creation. She now wishes to underpin this theory with palladium and platinum and, by extension, push aside the theory that comets brought water to earth at a far later stage.

Maria Schönbächler's work helps to promote our understanding of the earth's formation and development. A glimpse into the past helps us to explain the present day and to look ahead to the future. Further meteorite strikes or climate shifts will continue to change the earth. Maria Schönbächler's research helps to find answers to the questions of when and how the earth was created, and when water arrived here – the same water that made all life on earth possible in the first place. ■

Institute of Geochemistry and Petrology:
www.geopetro.ethz.ch →

Understanding planetary systems better

At the end of last year the Swiss government launched eight new National Centres of Competence in Research (NCCRs). One of them is the NCCR "PlanetS" which looks at the origins, development and characterisation of planets and planetary systems. The data is collected using astronomical observations, space probe measurements and laboratory analyses. Theoretical modellings will help to provide answers to the research questions. The NCCR "PlanetS" is coordinated by the universities of Bern and Geneva. ETH Zurich is represented by Maria Schönbächler and Michael Meyer, professor of astrophysics, who also has a project. A total of five Swiss universities are involved in the NCCR "PlanetS." The Swiss government has provided funding amounting to CHF 17.6 million for the first phase from 2014 to 2017. The maximum term is 12 years.

http://adonis.unibe.ch/planets →

IARU members at ETH Zurich (from left to right): Leszek Borysiewicz, Erik Lithander, Tan Chorh Chuan, Junichi Hamada, Ralph Eichler, Ralf Hemmingsen, Nicholas B. Dirks, Andrew Hamilton, Wang Enge and Don Filer.

Annual IARU meeting

Creating role models for a sustainable campus

Marianne Lucien, Martina Märki

The presidents of ten of the world's leading research universities convened at ETH Zurich to discuss how research institutions influence society and offer it added value. One example of this is the "Sustainable Campus Initiative" launched by the universities involved.

From 24 to 25 April 2014 ETH Zurich welcomed the members of the International Alliance of Research Universities (IARU) to its annual get-together. IARU comprises ten internationally renowned, research-intensive universities, and is keen to promote collaboration in research and teaching. So the presidents and important leading members of the Australian National University, the National University of Singapore, the University of California Berkeley, the University of Copenhagen, the University of Tokyo, the University of Peking, the University of Cambridge, the University of Oxford and Yale University convened at ETH Zurich to renew their commitment to the alliance and to address key social issues – from ageing, longevity and health to climate change and the impact of university activities on the environment.

One pivotal element of their discussions was how research institutions influence society while offering it added value. A prime example of how the IARU member universities do their bit in their own regions is the Sustainable Campus Initiative, a flagship project launched by the organisation.

The Sustainable Campus Initiative

The aim of this initiative is to provide an example of sustainability by organising campus activities as environmentally friendly as possible, and by implementing sustainable technologies and modes of behaviour. During the meeting, Dominik Brem, Head of ETH Zurich's Safety, Security, Health and the Environment (SSHE) staff unit, presented an update of the IARU's Sustainable Campus Initiative. For instance, a publication with the working title The Green Universities Guide is to be published this summer, showcasing the joint efforts and successes of the IARU member universities.

The manual will include recommendations as to how universities can become more sustainable with regard to environmental issues, and will present best-practice case studies that illustrate what leadership roles IARU member institutions have assumed in their respective regions. The manual is to be launched at the IARU conference Making Universities Sustainable, which takes place in Copenhagen in October 2014 and is open to decision-makers, university facility managers and other representatives of academia.

A comparative study is also due to be published at the same time, showing how and whether the IARU member institutions have achieved the goals they set for the reduction of their campuses' own greenhouse gas emissions.

Reports from the individual universities on their sustainability activities can already be found on the IARU website, such as the "Campus Sustainability Report for Presidents' Meeting 2014", where ETH Zurich can score points with its efforts to reduce the CO_2 emissions caused by heating on the Hönggerberg campus. ETH Zurich has been able to achieve its objectives consistently since 2007 and even undercut them significantly in 2013. Similar successes have not yet been recorded on the historical campus at ETH Zentrum due to its predominance of old buildings. However, ETH Zurich is also looking to develop and realise new concepts here to manage its historical buildings more sustainably from an energy perspective. For new buildings, ETH Zurich consistently implements strict sustainability standards – as with the LEE building in Leonhardstrasse, which is scheduled to open shortly. It was planned according to the Minergie-Eco standard, which not only takes the minimum consumption of energy into account, but also sustainability standards with regard to recycling, inside air quality and noise control.

Pioneers who promote topics

Speaking at the 2014 annual meeting, Ralph Eichler, president of ETH Zurich, stressed how important it is to back up all the talk about sustainability and environmental problems with actual deeds. "ETH Zurich is a prime example of a university that also puts research into practice. Alliances like IARU help us to compare tried and tested practices with other universities", Eichler continued. In his view, this possibility for comparison also boosts the competitive spirit between the universities participating. It strengthens the institutions involved in their determination to reduce CO_2 emissions and increase energy efficiency. ETH Zurich takes a holistic view of energy issues and greenhouse gas emissions. For instance, it also considers how students, staff and lecturers commute to and from the individual university premises.

As Professor Andrew Hamilton, the rector of the University of Oxford, reported, "Student exchange programmes and benchmarking are all part and parcel of the most valuable results that institutional collaboration can produce. These programmes facilitate the discussion of good practices and enable leading institutions to learn what works best at other universities."

Ralf Hemmingsen, rector of the University of Copenhagen, explained that, thanks to investments in infrastructure and campaigns to change campus culture, his university has managed to achieve its goal of reducing CO_2 emissions by twenty percent. For the IARU Sustainability Congress five years ago, the university built "The Green Lighthouse", the first carbon-neutral building in Denmark, which just goes to show how collaborations and alliances can yield pioneering projects. Apparently, many foreign guests flocked to see the building. "This example is proof of what you can achieve if you set yourself a target and channel your resources towards it. IARU has also helped us to maintain the momentum", explains Hemmingsen.

Added value for society

ETH Zurich and other IARU member universities show the way forward – not only for their own members, but also via an international forum. By taking part in university alliances such as IARU, they are able to provide added value for society in that they adopt best practices in environmental management and advocate responsibility and transparency. ■

Further information on IARU's Sustainability Initiative:

www.iaruni.org/sustainability/campus-sustainability →

Quantum sciences

On the way to practical use

Felix Würsten

ETH Zurich enjoys a leading position in the quantum sciences. The Executive Board now wants to develop this field to ensure that ETH researchers can be on the front line, not only in basic research, but also in the development of applications.

Almost all areas of physics would be practically inconceivable without quantum physics. This applies in particular to microscopically small systems like the ones used in information and communication technologies. With quantum physics it is possible to develop completely novel systems, such as storage media that can simultaneously assume status 0 and status 1 instead of just one of these two values. Quantum bits of this kind can be precisely steered today in the laboratory. This is possible thanks to the findings of ETH scientists who have developed the scientific basis for it. This will open the door to developing increasingly high-performance technologies in data processing, sensory technology and image production.

A huge effort is needed

Despite major progress in basic research, quantum theory has hitherto scarcely been used in a goal-oriented manner in technology. "A huge effort is needed to ensure this potential can be tapped into", explains Andreas Wallraff, Professor for Solid State Physics. A team of professors from the department of Physics as well as the department of Information Technology and Electrical Engineering (ITET) would now like to further extend research in this area. "ETH Zurich has secured itself a good starting position and now wishes to use this favourable situation in order to be on the front line in the development of viable systems", says Wallraff. And Lukas Novotny, Professor of Photonics at the department ITET adds, "We are entering an age where quantum physics will become the tool of the engineer."

Fundamental development

Together with the ETH Zurich Foundation, the ETH Executive Board has therefore launched the "Quantum Engineering Initiative." This aims to come up with concrete solutions in the areas of quantum data processing, quantum simulation, quantum sensory technology and image production.

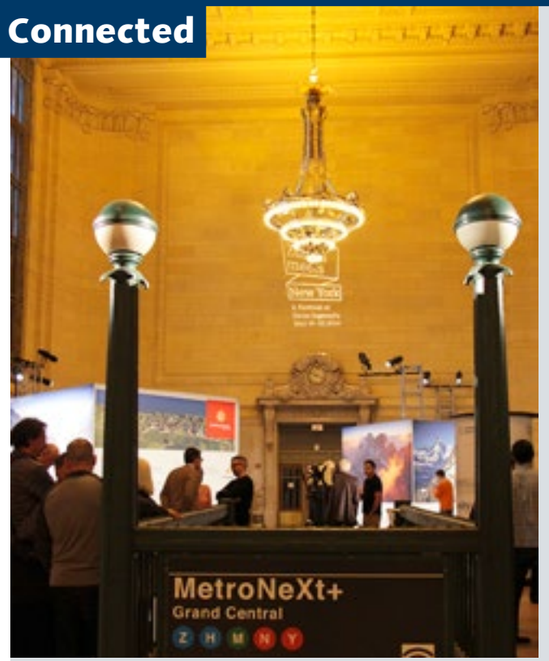
A key element in this initiative is the new "Quantum Engineering" chair, for which recruitment is about to begin. It was intentionally set up within the department ITET, says Wallraff: "Up to now, quantum research was mainly the domain of physics. However, if we want to develop viable systems, engineers' knowledge is essential." The chair comes with a second objective: quantum physics should be included as a subject in the curriculum of electrical engineering and IT to enable specialised experts to be trained in this field in the future.

A second important element in this new initiative is the "Quantum Engineering Centre" (QEC) which is to be developed over the next few years as a research workshop. Compared with ETH centres, for instance the clean room laboratory "First" or the Electron Microscope Centre, which are both available to researchers in already established technologies, QEC is all about developing new technologies and processes which are needed for the construction of quantum physics elements. Finally, the initiative also envisages a support tool for specific questions. With "Quantum Engineering Grants", individual dissertations and post-doc projects will be funded in order to examine concrete topics in a clearly defined field.

In the initial stage, the researchers involved want to develop basic scalable elements for quantum physics systems. ETH Zurich was able to report a major success in this direction at the end of February. With its promise of a donation to the ETH Zurich Foundation, the Baugarten Foundation has paved the way for the procurement of two high-tech laboratory devices which can be used to manufacture basic elements of this kind. ■

Your contribution makes a difference
With your financial support you can make a decisive contribution to strengthening the promising field of quantum physics at ETH Zurich. Corinna Adler from the ETH Zurich Foundation will be happy to provide you with more information:
corinna.adler@ethz-foundation.ch →

Connected



Zurich meets New York

Swiss ingenuity in the Big Apple

From 16 to 23 May, Zurich showcased itself in New York, with the University of Zurich and ETH Zurich both playing prominent roles. An exhibition and a special metro station at Grand Central Station in the American metropolis grabbed the attention of commuters. MetroNeXt invited visitors to take a virtual tour from New York right into the heart of Zurich. At a special event, ETH Zurich offered an opportunity to get to know researchers – from students to Nobel-Prize winner Kurt Wüthrich. And ETH Zurich's Rector, Lino Guzzella (see photo, below right) joined other runners in Central Park to try out a running shoe that was developed and tested at ETH Zurich and has already caused quite a furore in sporting circles.

Education in civil engineering

Present and future

Civil engineering students and graduates of ETH Zurich convened in ETH Zurich's main lecture hall in April. On the podium, representatives of ETH Zurich conducted a discussion chaired by ETH Zurich professor Sarah Springman (centre) with (from right) Implenia CEO Anton Affentranger; Cristina Zanini Barzaghi, Lugano City Councillor, head of the Department of Structural and Civil Engineering and co-owner of Ing. Büro Borlini & Zanini SA; and Dominik Courtin, Basler & Hofmann AG. The main topic of debate was future demands on education at ETH Zurich.

Singapore-ETH Centre

Singapore's president at ETH Zurich

At the beginning of May, Tony Tan, the President of Singapore, paid ETH Zurich a visit. He also met a group of ETH students, including some from Singapore who are currently doing a degree in Zurich, and Swiss students who have spent time at the Singapore-ETH Centre for Global Environmental Sustainability (SEC).

ETH Alumni business event

A technology get-together

At the ETH Alumni business event on 25 March 2014, CEO of the technology company Bucher Industries, Philip Mosimann (left) and ETH Zurich rector Lino Guzzella discussed the merits and dangers of investments in research and innovation. They agreed that innovations can only be achieved via long-term investments. Only with a truly long-term commitment can innovation unfold and even trigger an industrial revolution in certain areas.

Excellence Scholarship and Opportunity Programme

An evening among promising talents

The "Meet the Talent 2014"event presented an opportunity for the scholarship holders of the "Excellence Scholarship and Opportunity Programme" to introduce themselves. These scholarships are partly funded by donations from graduates, friends and sponsors to the ETH Zurich Foundation. Talking to the Excellence Scholars in person, the donors present could clearly see that their money was being well spent. Lino Guzzella, the rector of ETH Zurich, expressed his gratitude to all the donors in his speech. In 2013, 36 Excellence Scholarships were awarded, with 44 percent of them going to women.

ETH Zurich alumnus Hans Herren

Allergic to monocultures

Samuel Schläfli

In the 1980s, Hans Herren performed an agricultural and ecological miracle in Africa that saved the lives of approximately 20 million people. Today he's no longer waging war on mealybugs, but on the influence of the agricultural industry and on short-term thinking.

Hans Herren seems impatient and tense. Like someone who is running out of time. And time is what he urgently needs in order to put into practice his convictions of thirty years' standing: that organic farming can be a remedy for hunger and hardship. It is difficult to catch this perpetual jetsetter for a conversation. Herren commutes between continents and is forever donning a different cap: in Rome he conducts meetings with the Food and Agriculture Organisation (FAO), for which he spent five years coordinating the most comprehensive world agriculture report to date and where his wife, Barbara, an American ecologist and project coordinator, also works. In Zurich he visits his "Biovision" staff, a foundation he set up sixteen years ago to promote organic agriculture in East Africa. And in his office at the Millennium Institute in Washington D.C. he has been preparing workshops that he will shortly be giving for government representatives in Africa. "I have to keep on my toes and maintain the tension", Herren confesses. "Otherwise, the tiredness will soon catch up with me."

With eco-activists in America

Herren is at home everywhere and nowhere; a citizen of the world whose Swiss German dialect by now sounds American and who seems to spend more time in the air than in any particular nation. Besides, his heart was never really in Zurich, despite having spent eight years at ETH – four as a student of agricultural engineering, then four as a doctoral student on a quest to find a biological control for the larch bud moth pest. For him, California is the closest thing to a home. He bought a house and land there some twenty years ago, and since then spends his days off in the Capay Valley, trading in his suit and tie for wellies and an apron and indulging in his passion as a hobby wine-grower in his own vineyard.

Herren first came to California in 1977 to do a postdoc in Berkeley, where he conducted research in the field of entomology and integrated biological pest control in Robert van den Bosch's group. Van den Bosch was a pioneer in the field and, at the same time, a diehard eco-activist and adversary of Norman Borlaug, the father of the "Green Revolution." Global hunger was to be wiped out through the mass use of artificial fertilisers, pesticides and herbicides, or so his popular opinion went anyway. Under van den Bosch, Herren not only learnt a lot about biological pest management, but also about politics and lobbying in American companies.

> "We managed to increase crop yields with the same varieties by adjusting the methods."
>
> Hans Herren

There were practical reasons behind his subsequent departure for Africa: "My National Science Foundation grant had run out, I couldn't stay in the USA and I knew that there was no longer any interest in biological pest control in Switzerland", Herren explains. He spotted an opportunity

Hans Herren is often out and about, campaigning for the breakthrough that will put his convictions into practice.

to put his knowledge into practice when he saw a job vacancy at the Institute of Tropical Agriculture in Ibadan, Nigeria: a mealybug introduced from South America in the early 1970s was threatening the cassava harvests in large parts of Africa.

"Even though I had long hair and a Ho Chi Minh beard back then, I managed to win over the International Fund for Agricultural Development in Rome with my idea." With 250,000 dollars, Herren set up a mobile lab in a minibus and drove off to Mexico in search of the useful creature that keeps the cassava mealybug in check in South America. Two years later, he discovered the ichneumon fly Anagyrus lopezi in Paraguay, which was subsequently studied in London under quarantine. Herren set up a research station in Cotonou, Benin, where his team bred millions of ichneumon flies in greenhouses and devised a system to "spray" the insect by plane. Over ten years, Herren's brigade released around 1.6 million ichneumon flies in thirty countries. By 1992 the battle had been won: the cassava had recovered and a famine had been averted. Moreover, the final studies in 2003 revealed that the effect was long-term; the friendly fly is still keeping the pest at bay to this day.

> "It was high time I continued my fight in politics."
>
> Hans Herren

Harvests five times greater thanks to organic farming

Herren had proved for the first time that ecological pest control works. Economists subsequently estimated the benefit to African agriculture at 14 billion dollars. As Director of the International Centre of Insect Physiology and Ecology in Nairobi, Herren and his team developed a series of methods for smallholders from 1994 to 2005, including the "push & pull" system. This involves using the fragrance of desmodium, a ground-covering bean plant, to oust the stalk borer that kills off maize and sorghum fields in Africa (this is the "push"), while farmers also plant napier grass around the fields, the scent of which attracts the stalk borers (the "pull") and captures them in its sticky blades. Moreover, desmodium binds nitrogen, thereby improving the soil quality and elbowing out the striga weed. "The advantages are well documented. We managed to increase crop yields with the same varieties by adjusting the methods." Today, 40,000 farmers in Kenya, Ethiopia and Uganda successfully produce organically, explains Herren. On a continent with a population of over 1 billion, that's a modest number and begs the question as to why ecological methods are not more widespread. "Because the agricultural industry can't earn any money with organic farming", answers Herren indignantly.

Efforts at persuasion using dynamic models

Herren is convinced that "too many good initiatives are blocked by industry and politics." Which is why, in 2005, he swapped his office in Kenya for one in Washington D.C., where he combines science and politics as Director of the Millennium Institute, a platform for system-dynamic modelling. "It was high time I continued my fight at the top, in politics." He explains how this works based on the current project "Changing Course in Global Agriculture": together with DEZA and his foundation Biovision, the "Millennium Institute" brings representatives from politics, science, civil society and industry to the table in Senegal, Kenya and Ethiopia. Herren and his experts use models to simulate scenarios as to how the nation's objectives can be achieved. Based on the simulations, he hopes to get the decision-makers on board with his vision.

Would it be easier or more difficult for an "ecofreak" with long hair and a beard to repeat his career path today, 35 years after the launch of his campaign against the cassava mealybug? "More difficult!" declares Herren. He's convinced of it. "Agricultural research is increasingly being shifted to the private sector, where no-one is interested in ecological pest control anymore." He claims that biotechnology and molecular biology have supplanted all other fields – in both research and teaching. Herren remains allergic to monocultures to this day, regardless of whether they are intellectual or biological in nature. ■

About Hans Rudolf Herren

Hans Rudolf Herren grew up on a farm in Unterwallis. After attending agricultural school, he took his secondary school certificate and embarked on a degree in agricultural engineering specialising in plant protection at ETH Zurich in 1969. Following a postdoc at the University of California in Berkeley, Herren ran two research institutions in Africa. He received the FAO's World Food Prize in 1995 and the Right Livelihood Award in 2013 for his successful project against the cassava mealybug. Herren has been President of the Millennium Institute in Washingto D.C. since 2005.

Anno

In Semper's design for the west façade of the main building of ETH Zurich, sculptures adorn the "temple to the sciences and arts." Ultimately, however, they were omitted on cost-cutting grounds.

1864

A temple to science

Martina Märki

Nine years after it was founded, ETH Zurich was finally able to move into its own home in 1864. 150 years ago, this building designed by Gottfried Semper became a symbol of the ambitions of the city of Zurich and the young federal state of Switzerland. However, the road there was rocky.

"The Federal Polytechnic School is the pride of Zurich …" reads an illustrated chronicle of the city of Zurich from 1896. However, such an enthusiastic assessment could not have been easily foreseen from the outset, as the story of ETH Zurich's main building reveals. Such a monumental structure was alien to the building style to which Zurich had previously been accustomed, for its urban planners had hitherto tended rather towards a spirit of "republican simplicity."

Controversial star architect

It was certainly not a foregone conclusion that the star architect Gottfried Semper, who had been teaching at ETH Zurich since 1855, would be the primary candidate to design the university's main building. He had previously dazzled the German public with buildings such as his glitzy opera house in Dresden, the precursor to the Semperoper that is still famous today. Although Semper had also demonstrated a true republican spirit as an active participant in the Dresden May Uprising alongside Richard Wagner in 1849, his buildings and plans lacked the "republican simplicity" that was so dear to Zurich's urban planners. When Semper moved to Zurich to take up a position at the Polytechnic School, needless to say he expected to be the architect for the new university building that was in the pipeline. And so he was suitably put out when he was instead invited to enter the competition for it that was advertised internationally.

In the end, Semper did not compete but was made a judge for it – and ultimately, none of the entrants managed to convince anyone. Or perhaps it had all just been something of a sham. Either way, the construction contract was awarded to Semper and the urban planning inspector Johann Caspar Wolff in 1858. The latter had expressly been assigned to Semper as a "guardian of the budget", which the architect never really forgave. But in financial terms, Zurich did tend more towards frugality than largesse. The construction programme initially proposed by the University Board was deemed far too big by the Zurich cantonal government. Whereas the Board envisaged a building for 400 students, the Cantonal Council thought they would be lucky if they got even half of that. Three years later, in 1857, following some tough negotiations, a compromise was agreed: the original, more generously dimensioned construction programme would largely be adopted, albeit on condition that the University of Zurich would also be housed in the new university building. The construction costs were estimated at around one million francs. Both estimates would soon prove to be wide of the mark.

Enthusiasm and thriftiness

Semper evidently saw little reason to stick too rigorously to the specifications. He neither adhered to the original competition programme nor was he impressed with the budget he had been set. At CHF 1,740,000, it was plain to see that the confident design he submitted to the cantonal government in the autumn of 1858 would require almost twice as much funding. Nonetheless, he must have been persuasive and even managed to arouse enthusiasm for it. In the end, the main council voted in favour of the construction and the budgetary demands it entailed by a whopping 170 votes to two. It is quite possible that it was the yes vote from the entrepreneur Alfred Escher that ultimately tipped the scales – he had been the driving force behind the foundation of ETH Zurich from the very beginning. And if nothing else, the prospect that the building as planned by Semper could compete with the elegance and monumentality of the federal parliament building in Bern might have lured Zurich into showing more generosity. The Federal Council also approved the building project in February 1859.

The foundations for the main ETH Zurich building were finally dug in the autumn of 1860. After this the construction work progressed fairly quickly, even though Semper repeatedly saw himself forced into compromises for reasons of cost. For instance, the upper façade areas were fashioned out of brickwork covered in plaster, not of the sandstone ashlars he had originally envisaged. And Semper also had to kiss goodbye to the sculptures that were supposed to adorn the middle section of the west façade that towered above the city and formed the main entrance to the building at the time. However, his "temple to the sciences and arts", as he imagined ETH Zurich's main building, would be given a worthy interior, which is still evident today in the building's elaborately decorated Aula.

Semper's legacy

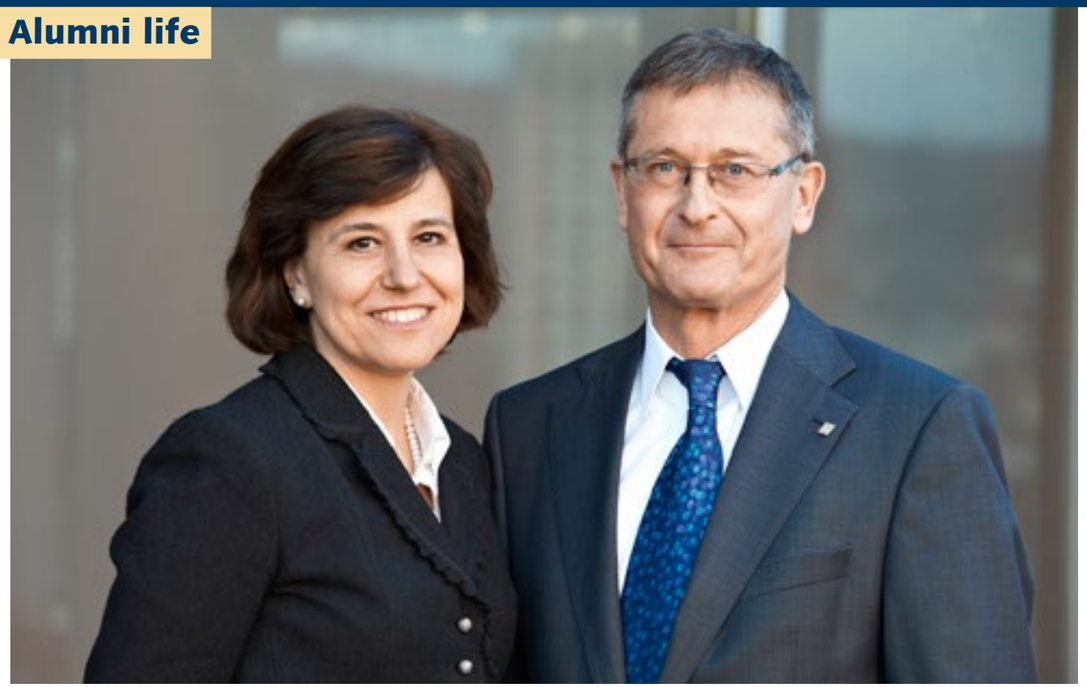
Much of what leaves a lasting impression on today's visitors to ETH Zurich's main building, however, is not actually the work of Semper, but was realised with Gustav Gull's renovations in the early 20th century. He moved the main entrance from the west to Rämistrasse in the east and remodelled Semper's original one-storey, central "Antikensaal" as a multi-storey main hall. And he crowned ETH Zurich with the dome still regarded as the emblem of ETH Zurich today. It was a fitting counterbalance to the tower of the new university building, into which the University of Zurich moved in 1914.

Gottfried Semper in 1865

Initially, however, the University and ETH Zurich were united as planned under the roof of Semper's ETH Zurich building, into which they were able to move gradually during 1863 and 1864. The University of Zurich was allocated the south wing. It soon became clear that the plans for the new building hadn't been too ambitious after all. In fact, it was almost bursting at the seams from the word go, as the student numbers already surpassed all original expectations in the very first year. As it happened, the students were the least enthusiastic about the new main building because they feared (not entirely without cause) that with everything centralised in one building, they would be too much under the thumb of the University Board and its professors. Nevertheless, Semper's building was soon regarded in neighbouring countries as a textbook example of an especially aesthetic, highly successful university building. Semper had "given Switzerland a university building that was second to none and that no other country had produced with such magnificence", as a report in a contemporary German journal swooned. ■

Source:

Werner Oechslin (ed.): Hochschulstadt Zürich. Bauten für die ETH 1855–2005. gta Verlag, ETH Hönggerberg, 8093 Zurich, 2005. ISBN 3-85676-154-3



The new Managing Director Nicole Frick and President Walter Gränicher are leading the ETH Alumni into the future.

New Managing Director

"We have every right to be proud."

Interview: Felix Würsten

Nicole Frick, the new Managing Director of ETH Alumni, will implement the "Alumni 2015" vision and chart a new future course for the association of former students. In this context she can build on wide-ranging activities.

Nicole Frick, you became Managing Director of ETH Alumni at the beginning of April. How did you experience your start in this new function?

I had to deal with very many new things, even though I am an alumna myself. I studied at ETH and I have been a member of ETH Alumni for a long time. Hence I was very familiar with the alumni world. Nonetheless, I was surprised when I took up office to discover just how diverse today's offering is. One of my first tasks was to create a benchmark. What do other alumni organisations do and where do we stand in comparison? That really helped me settle into my new position.

What did the comparison with other alumni organisations reveal?

If you compare alumni organisations on the international level, then you see that, abroad, alumni are normally integrated into the universities. Some of them are large organisations which have the clear task of winning over alumni for fundraising purposes. In Switzerland the situation is very different. At ETH Zurich – just as at the University of St. Gallen (HSG) and the University of Zurich – we have an alumni association which is a separate legal entity from the alma mater. A comparison with the offerings and services of these two alumni organisations shows that ETH Alumni is in a good position. In comparison with the HSG alumni, some ground does still have to be made up in terms of the network and the voluntary commitment to the organisation.

What did the comparison with the University of Zurich reveal?

At the University of Zurich the members of the alumni association are legal entities, i.e. individual professional associations which have direct contact with the members. Individual professional associations have even hired staff or have positions in the University that actively support the associations. In the case of ETH we have an office and numerous member associations which work on a voluntary basis. Consequently, as we also have direct contact with our members, we have a slightly different focus.

What is the situation with events organised by your Office and in the association?

First of all I would like to stress how impressed I am that more than 140 events were staged last year, despite the largely volunteer structure of ETH Alumni. The most important events organised by the Office are business events. Here, too, I see a need for improvements in communication. We should communicate more clearly that we organise these events together with ETH and the ETH Zurich Foundation and that the ETH very much appreciates receiving its alumni in the main building. Furthermore, we will also be organising the Alumni Ball. The events staged together with the HSG alumni take us in a relatively new direction. Furthermore, discussions are ongoing about extending this cooperation to other alumni organisations, for instance to the Alumni UZH or to the Oxford and Cambridge Club Zurich.

The career services are an important pillar. Are they to be continued?

Very definitely. We have an online job platform which is very attractive for ETH graduates because they can access jobs for which people with an ETH degree are actively being sought. We will also continue the career events. At these events we can pass on information to our members about advanced training.

In an interview with this publication one year ago, the new President of ETH Alumni, Walter Gränicher, called for a cultural shift amongst the alumni. Do you share this view?

Walter Gränicher took an important step when he introduced the "Du" (the informal form of address) as a visible symbol. Anyone who studies at ETH Zurich experiences demanding years. This experience knits people together – this is expressed by the "Du." Every graduate can be proud of having mastered this challenge. Later, in your working life, you find it actually means a lot to have studied at ETH Zurich, and many students are not yet aware of this. What's more, the image of engineers has changed. When I was at university the public perception of an engineer was that he had to be a graduate of ETH. That's no longer the case today. The training of engineers has diversified and can be undertaken today at various training institutes. That's why the three letters "ETH" are so important to us as a mark of quality. ETH alumni should be proud of their training – we have to strengthen this self-image.

What about the implementation of the "Alumni 2015" vision, which will enable ETH Alumni to look to the future?

We are heading in the right direction. One important change is that the members of the various associations and groups have a new opportunity to benefit from the offers and events of other member organisations. When the "Alumni 2015" vision was launched, there were all of a sudden many ideas. That led, understandably, to some resistance. In the meantime things have calmed down and integrating measures have been taken. The cultural changes and modernisation efforts now enjoy broad support amongst our member organisations.

Does this pioneer spirit also help to attract new members?

One goal is to increase our presence in future amongst the students, for today's students are tomorrow's alumni. The students must be aware of the fact that there is an alumni organisation and why it's worthwhile coming on board. Many people ask what the benefits of becoming a member are. There are several. Publications can be ordered free of charge from the ETH-Bibliothek. Members can attend interesting events and enjoy discounts on various offers. The main advantage is, however, non-material: access to a large, exclusive network with contact opportunities around the world, for instance through our international Chapters. ■

About Nicole Frick

Nicole Frick studied at ETH Zurich at the then Department IV (Chemistry) and graduated in dye and textile chemistry. After a year in industry she felt the pull of the University of Zurich, where she obtained a PhD in 1995 in biochemistry and molecular biology. She then worked for BASF (Switzerland), initially in technical sales, later in the fields of quality assurance, HR and technical advice. Over the next 12 years she assumed various functions in the Swiss Association of Varnish and Paint Chemists, including that of President. The last position she held was a technical appointment in the food sector. In April 2014 Nicole Frick took over as Managing Director of the ETH Alumni Association.

Alumni life

Agenda

Alumni business events

Suzanne Thoma
CEO, BKW Group
2 October 2014

Susanne Ruoff
CEO Post
23 October 2014

Networking aperitif from 6:00 p.m.; event begins at 6:45 p.m., ETH Zurich, main building, Dozentenfoyer
Register at:
www.alumni.ethz.ch →

Alumni trips

Scotland
7 – 14 August 2014
Information:
www.alumni.ethz.ch/events →

Alumni Ball

Autumn leaves
In late September, when the leaves are changing colour in Zurich and the sun often disappears behind a veil of mist, ETH Alumni holds a dance. As part of the 8th ETH Alumni Ball, we can look forward to an elegant, colourful dinner dance with plenty of fun and excitement for the non-dancers among us, too.
27 September 2014
The Dolder Grand
Information at www.alumni.ethz.ch/events/alumniball_2014 →

In a special exhibition, focusTerra documents the life and career of Rudolf Staub, who made ground-breaking contributions to alpine geology as a professor at ETH Zurich. The exhibition also depicts how a geologist conducted research in the first half of the twentieth century.

Alumni Symphony Orchestra

Autumn concert 2014
Ludwig van Beethoven
Symphony No. 9 in D minor, op. 125
Together with the Lucerne LehrerinnenLehrerChor Choir
Conductor: Johannes Schlaefli
Choirmaster: Moana Labbate
9 November 2014, 7:30 p.m., Casino Basel
11 November 2014, 7:30 p.m., Kultur- und Kongresszentrum, Lucerne
www.alumniorchester.ch →

Schwinget @ Polyterrasse

Wrestling – "Schwingen" – is as Swiss as fondue and looks back on a long tradition: reason enough for the Academic Sports Association Zurich (ASVZ) to open its doors to this sport in its anniversary year. The ASVZ will be teaming up with the Zurich Kantonal-Schwingerverband for three days on the Polyterrasse for a slice of traditional Swissness, coupled with some international academic spirit.
24 – 26 September 2014
http://75jahreasvz.ch →

Exhibitions

Architecture of the Alps
In the footsteps of the geologist Rudolf Staub (1890 –1961)
Until 10 August 2014
focusTerra
Sonneggstrasse 5, Zurich
www.focusterra.ethz.ch →

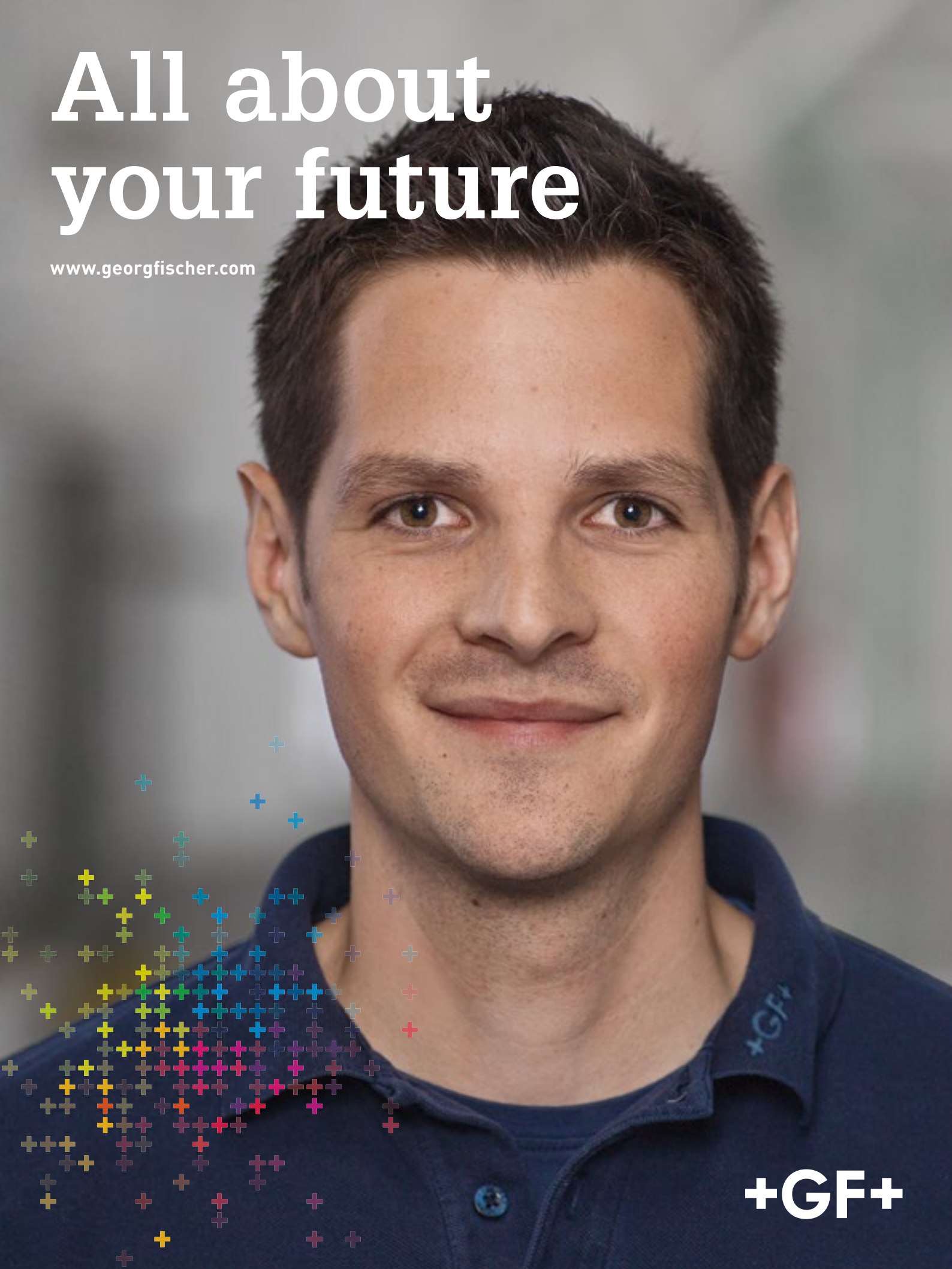
Mireille Gros
Ouvrir les archives
Delicate vines and mysterious, shady plants; cell-like structures and velvety ferns – growing and flourishing as far as the eye can see. The works of the Basel artist Mireille Gros are unquestionably a hymn to nature.
Until 6 July 2014

Annelies Strba
Madonnas
20 August – 19 October 2014,
Collection of Drawings & Prints, ETH Zurich, main building, E53
www.gs.ethz.ch →

All about Max Frisch's "Berlin Diary"
Special exhibition
Until 29 August 2014
Max Frisch Archive
ETH Zurich, main building, E26
www.mfa.ethz.ch →

All about your future

www.georgfischer.com



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