

**Focus** Speed

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## Editorial

### Dear readers

Researching at the speed limit means overstepping existing boundaries, sometimes even the boundaries of what was previously imaginable. Fundamental physical processes that affect the behaviour of matter on an atomic level take place in the space of attoseconds: a billionth of a billionth of a second. ETH Zurich has broad expertise here, and we offer two examples in these pages. Peter Chen and his team study the extremely elusive intermediates that develop in chemical reactions, their aim being to understand and influence these transformation processes. And Ursula Keller's Ultrafast Laser Physics group is an international frontrunner as it ventures into a completely new area of metrology.

Professor Keller is also the Director of the National Centre of Competence in Research MUST (Molecular Ultrafast Science and Technology), which promotes research in this field all over Switzerland. The centre unites sixteen Swiss research groups that work at the cutting edge of international ultrafast science. They develop experiments and theoretical tools to study chemical reactions and energy transfer processes on an atomic and molecular level. They are also looking to gain a deeper understanding of electron and proton transfer processes with an ultrafast temporal and spatial resolution.

The findings from this basic research are crucial to gaining an in-depth grasp of the structural dynamics of molecules. This knowledge will be useful in a wide range of fields including energy issues, the pharmaceutical industry and information technology.



Speed limits are also broken in applied research at ETH Zurich – by Colombo Bolognesi, for instance, who keeps attracting the spotlight with his speed records, including a transistor whose electronic signals switch on and off up to 700 billion times a second. At the FIRST Lab, ETH Zurich's cleanroom facility, he gets the best out of various materials and produces customised transistors that are used in all walks of industry – such as in high-precision testing and measuring devices.

However, ever-faster transistors also lead to increasing amounts of data being transferred – and this has an impact on our everyday life, as we all know. We might well have reached our limits as far as the speed of social change is concerned, and it might not be wise to exceed them. As busy managers, politicians and scientists, it is more a question of dropping down a gear from time to time and allowing ourselves to pause for thought – and perhaps turn our attention to Globe. Happy reading!

**Ralph Eichler**  
President of ETH Zurich

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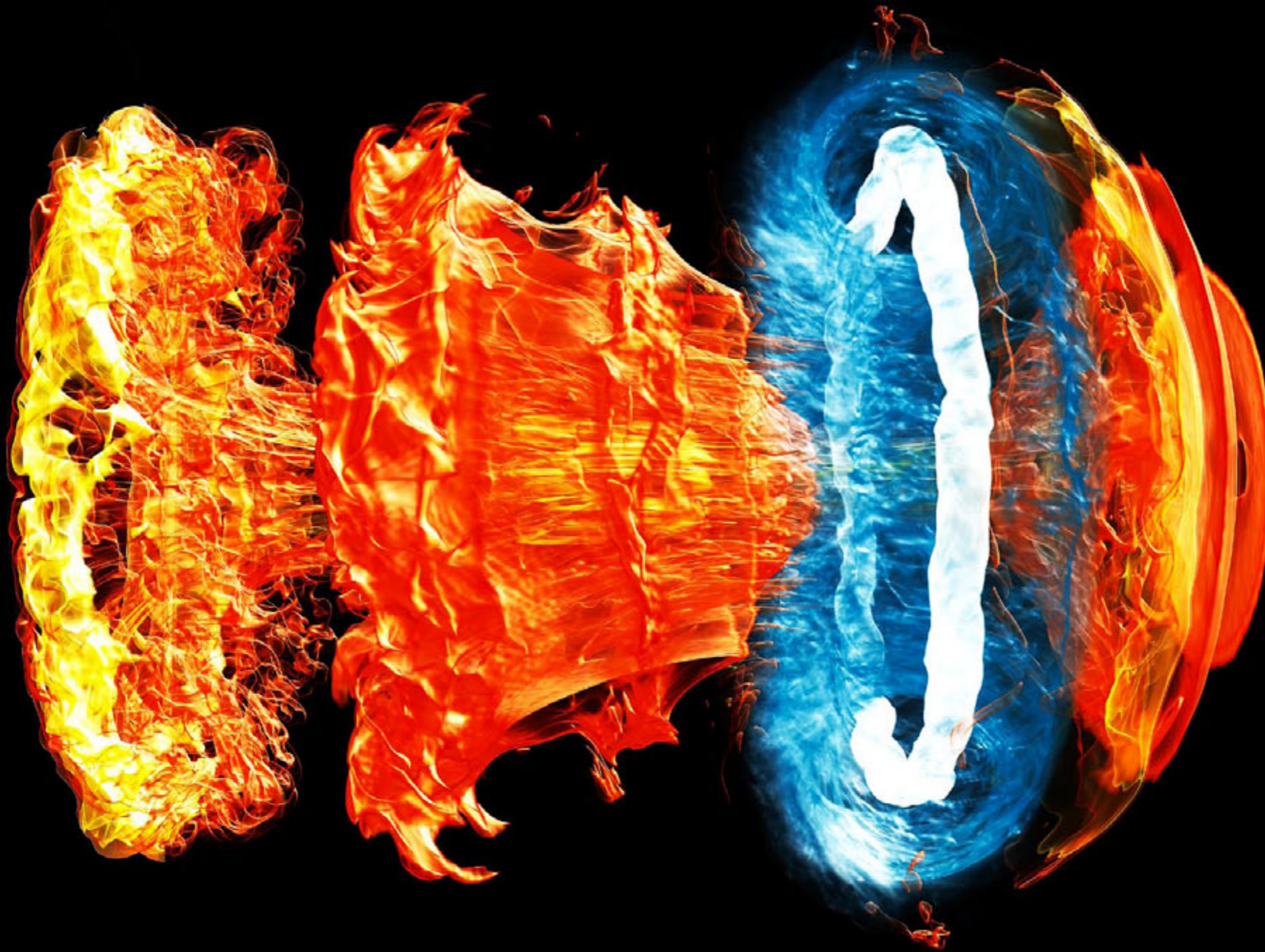
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**p. 4:** (bottom left) Nicole Pont, (top right) Winfried Wisniewski/Corbis; **p. 5:** (bottom left) Darren Decker/Ampas, (top right) Tom Kawara; **Flashlight:** Diego Rossinelli/ETH Zurich; **Ticker p. 9:** (left) Electron Microscopy ETH – EMEZ Zurich, (top right) Phonak; **p. 10:** (left) Christophe Stolz, (top right) flickr.com/rowanandoak;  
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## Scientific gas simulation

What might look like an especially flamboyant jellyfish is actually a scientific simulation of flow phenomena. In an extraordinarily detailed computer model, a research team from ETH Zurich demonstrates what happens when an air pressure wave hits a helium bubble. Similar phenomena are involved in rapid combustion processes or shattering kidney stones with shockwave lithotripsy, for instance. Gas bubbles also form in liquids in many hydraulic processes (cavitation), where they are mostly unwelcome. The simulation was created on a supercomputer at the Swiss National Supercomputing Centre (CSCS).

In November 2012, the Computational Science & Engineering Laboratory headed by Petros Koumoutsakos won the Milton Van Dyke Award – a prize that the American Physical Society's Fluid Dynamics Division awards to photographs and videos that depict or examine flow phenomena in an outstanding way.

Video about the simulation:

[www.globe.ethz.ch/gasblase](http://www.globe.ethz.ch/gasblase) →



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## Ticker

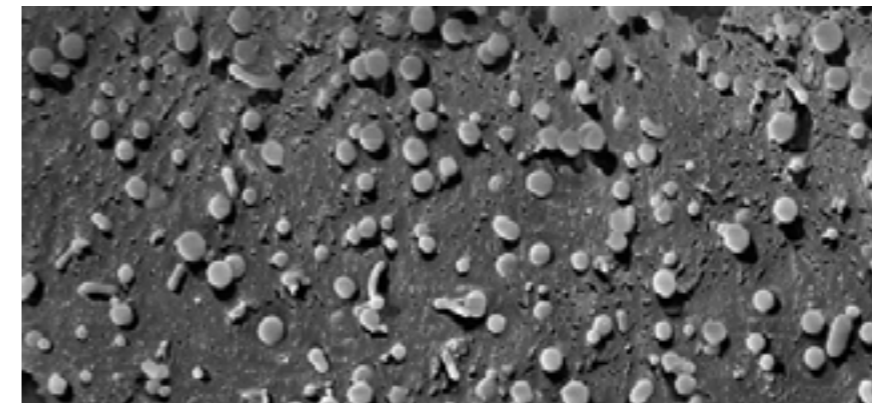
### Risk

## Real estate bubbles calculated

Scientists from ETH Zurich teamed up with the online comparative service [comparis.ch](http://comparis.ch) to analyse the real estate market in Switzerland. They were able to demonstrate that there are indications of bubbles in 11 regions and that the prices of apartments have increased by up to 50 percent in most areas since 2007. The areas exhibiting

signs of real estate bubbles are not the population centres or regions known for high prices.

It is areas nearby that are particularly affected: the districts of Horgen, Bülach and Hinwil in the Canton of Zurich for instance, but not the northern shore of Lake Zurich or the city itself. However, the scientists do not expect the trend to end badly. The kind of real estate bubble the data points to in Switzerland usually ends in a levelling-out or stagnation, not a crash.



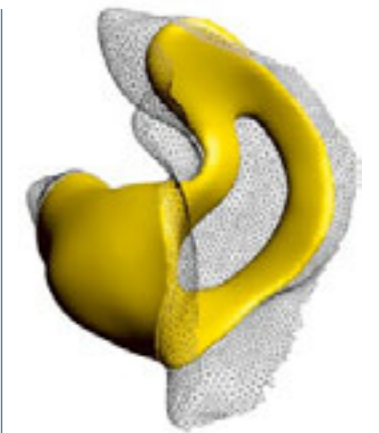
Liposomes can serve as a test system to detect Botox activity.

### Patent

## Liposomes instead of animal testing

ETH Zurich researchers have submitted a patent application for a method that enables them to test the biological activity of one of the strongest toxins there is: the botulinum neurotoxin (BoNT). BoNT is notoriously a food poison found in insufficiently sterilised canned vegetables, meat or sausages, for example. Since the 1980s, however, dozens of chronic conditions have been treated with the toxin. The cosmetics industry also uses the once-feared "sausage poison" on a grand scale

under the name "Botox" to smooth out wrinkles, for instance. According to the regulations, the toxicity of treatments containing BoNT has to be tested – until now on mice. For such routine tests, over half a million mice have to die in the EU and the USA every year. The new ETH Zurich test system, however, does not require any laboratory animals or living cells whatsoever, as it measures the toxic activity of the neurotoxin with the aid of synthetic lipid membrane bubbles – so-called liposomes. If the toxin enters the bubbles it cuts up a protein that begins to glow after cleavage. The more brightly the liposomes glow as a result, the higher the concentration of the toxin.



Ear mould (yellow) adapted to the ear canal.

### Modelling

## Better hearing

Phonak and computer science professor Olga Sorkine have teamed up in the production of precise-fitting hearing aids. For a number of years now, computer modelling and computer-aided production have been used to mould hearing-aid shells to the individual shape of the human ear as precisely as possible. For a long time, however, it was not possible to alter such models interactively in real time. Now, thanks to a new method by Olga Sorkine, the modelling process step can be simplified further and accelerated with the aid of software.

## Success with ERC grants

Twelve professors from ETH Zurich have received a prestigious ERC Advanced Grant from the European Research Council. Over 33 million Swiss francs will thus flow into ETH Zurich in this round of awards.

Book

### Zurich's buildings

The Masoala-Halle, the Viadukt and Prime Tower – these are just three of the 51 buildings in Zurich that are described and illustrated in the new book *StrucTuricum*. This specialized city guide arose from Bachelor theses by 26 civil engineering students.

*StrucTuricum – 51 bemerkenswerte Bauwerke in Zürich*, ed. Thomas Vogel et al., vdf Hochschulverlag AG, 2012, ISBN 978-3-7281-3475-2, CHF 39



Imported wild oats threaten indigenous plants in California.

Plants

### Ousted species dying out after all

Today, an increasing number of alien plants are introduced in other areas or continents, where they then spread out. Until now, however, researchers were unable to find much evidence that local species are dying out as a result. Two ecologists from the University of Toronto and ETH Zurich have now taken a closer look with the aid of a model. The researchers used

the events in a Californian nature reserve as the basis for their calculations. There, European grasses have already driven back the indigenous varieties considerably. The local species can only survive in scattered stony areas of the park. However, these islands are shrinking and the distances between them are increasing. This means that they host fewer plants that produce the seeds needed to ensure the survival of the species. In the long term, the isolated local grasses are thus condemned to extinction.

CO<sub>2</sub>-emissions

### Acting quickly is cheaper

The quicker the emission of greenhouse gases is reduced, the easier it will be to restrict global warming to two degrees and thus the cheaper it will be to achieve this goal. This is the conclusion of a comprehensive study by an international research team headed by ETH Zurich. By the same token, hugely expensive climate protection measures would be necessary after 2020.

The study also reveals that certain options are already no longer available and that our society cannot do without certain key technologies if the two-degree goal is to be attained.

One of these key technologies is the capture of CO<sub>2</sub> to store it below ground instead of releasing it into the atmosphere (carbon capture and storage, CSS). Without this technology, global energy consumption would have to be reduced drastically.



Mauro del'Ambrogio, the Swiss State Secretary of Education, and Ralph Eichler, President of ETH Zurich.

Bilaterale Programme

### Bilateral programmes

New performance agreement ETH Zurich has been "leading house" for the bilateral collaboration with China, Japan and South Korea since 2008. This role is now to be expanded to include additional nations in the Asia-Pacific region. On 15 February Mauro dell'Ambrogio, the Swiss State Secretary of Education, Research and Innovation, and President of ETH Zurich Ralph Eichler signed the corresponding performance agreement for the period of 2013 to 2016.



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Theory meets practice – four of the 18 seminar participants during their tour of the production hall at Georg Fischer AG in Sissach.

### Leadership seminar

# “You haven't got anything to lose!”

*Christine Heidemann*

**Eighteen handpicked master students from ETH Zurich had the honour of facing a special challenge during the Entrepreneurial Leadership seminar: in close collaboration with top managers at the long-established firm Georg Fischer, they developed strategic solutions for the company's three core areas. Globe shadowed the students for two months.**

Almost all of them turned up – the corporate management of Georg Fischer AG. And the curiosity was written all over the top managers' faces. What would the students present to them? Completely new solutions? Something that they had overlooked in their strategic planning? Or would they return to their departments in three hours' time and chalk up the project with ETH Zurich as a disappointment?

The project in question is the Entrepreneurial Leadership seminar at ETH Zurich's Department of Management, Technology and Economics (D-MTEC). Head of Department Volker Hoffmann, Professor for Sustainability and Technology, is looking to revive a successful seminar format with the course: collaborations between outstanding MTEC students and major Swiss companies at management level, such as with UBS, Zurich and Schindler a few years ago. The students are given a “real” challenge – effectively as a reward for their achievements. This time round, there are eighteen selected participants, the majority of whom (though not all) are from the D-MTEC.

The head of department entrusted the task of coordinating the extended new programme to Claude Siegenthaler, who for several years has been a lecturer in corporate management at the D-MTEC and a professor at ETH Zurich's twin university Hosei in Japan.

Now the final presentation is moments away. About two months have elapsed since the seminar participants and the Georg Fischer management met for the first time; a very intensive period marked by a sense of achievement, but also by frustration and doubt.

**28 September 2012, Georg Fischer AG, Schaffhausen** A pink pull-over provides the only splash of colour in the circle of grey and black suits. It soon becomes clear to the visitor that this is not just any seminar for which the ETH Zurich students (fifteen men and three women) have convened in Schaffhausen. They have travelled here from Zurich with their professors Volker Hoffmann and Claude Siegenthaler to meet the CEO of Georg Fischer AG, Yves Serra, and other top managers at the concern.

The occasion is a kick-off meeting for the “Entrepreneurial Leadership” seminar, with the aim of getting to know each other and finding out more about the challenging assignments that the Georg Fischer management have lined up for the course participants. No case studies here, no dry theory either. It is all about “real” issues, learning corporate management, assessing market potential – and big money.

“With the seminar, we want to give the master students the opportunity to talk to top managers about strategic directions on an equal footing”, explains Siegenthaler. “In doing so, it is vital for the students to feel the challenge, to accept it, then run the process themselves”. After all, it is ultimately about leadership. Such an opportunity, says the professor, is all too rare at universities. Consequently, during the kick-off meeting he repeatedly encourages his eighteen protégés to grasp this unique chance by the horns:



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Whether working in a team or taking a tour of the company with the management: the master students from ETH Zurich (here, members of the "piping team") were given a first-hand taste of corporate management during the two-month seminar, gathering valuable experience.

"You haven't got anything to lose and only stand to gain. Challenge your opposite number! Be proactive!"

After the official welcome, the master students learn that they will be working in three teams, one for each of the three divisions at Georg Fischer – one group for GF piping systems, one for automotive engineering (GF automotive) and one for production engineering (GF AgieCharmilles). The idea is to explore the market for new technologies in laser and vehicle production and to find an integrated system to improve drinking water hygiene in large buildings such as retirement homes, hospitals and hotels.

The "piping group" will be tackling the latter. The team includes construction engineer Ralph Hesterberg, mechanical engineer Mathias Hostenstein and electrical engineer Beat Schmid, all three of whom are doing the vocational Master of Advanced Studies in Management, Technology and Economics at the D-MTEC. They are joined by materials scientist Alain De Riz and software engineer Miao Xiao Xiao, both of whom are from the Master of Science in Management, Technology and Economics programme at the D-MTEC. The group is rounded off by Selim Kangeldi from the Department of Physics. One German, four Swiss and one Chinese aged between twenty-three and thirty-seven: a typical mixture for this seminar, which makes the project so international and interdisciplinary.

In no time at all, the roles have been allocated in the "piping group": Beat Schmid is immediately appointed spokesperson. 37-year-old Ralph Hesterberg soon emerges as the expert of the group; he has got the most professional experience. The "fledgling" is physicist Selim Kangeldi.

From the outset, the 23-year-old eagerly soaks up everything with a permanent smile on his face. He seems to be taking Claude Siegenthaler's words of encouragement to heart: "Work hard but enjoy it, too!" Over the next nine weeks, the six of them will meet regularly via Skype for several hours of conferences. They will conduct market

analyses, interview business associates and customers of Georg Fischer, visit project locations, clarify recurring issues with the GF managers responsible – and ultimately compile a written report and prepare their eagerly anticipated final presentation from the data they have gathered.

**14 November 2012, D-MTEC, ETH Zurich** It is time for the dress rehearsal of the presentation. To avoid throwing them in at the deep end unprepared, the budding managers are supported by several professors from the D-MTEC. This is a special feature of the new seminar format. Today, Pius Baschera, a professor of corporate management, is on hand with help and advice for the seminar participants.

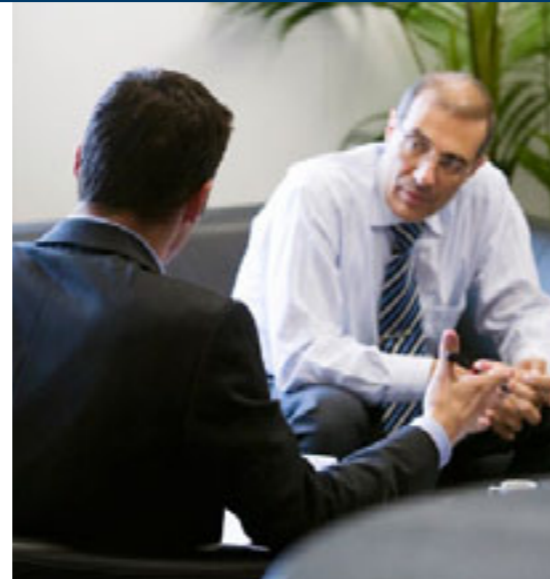
In order to make the dress rehearsal as realistic as possible, roles are dished out: the students from the groups not presenting play the part of the Georg Fischer managers, and the aim of the presentation is specifically to address and convince them. "You have to know who your listeners are and what expertise they bring to the table. Then you need to adapt your presentation so that no one leaves disappointed", says Baschera, warning against adopting too blasé an attitude towards the audience.

The piping group is first up. Beat Schmid and Ralph Hesterberg have spent the last few days going over their talk with a fine-tooth comb, which Hesterberg now delivers in the dry run. The expert Baschera listens intently – and promptly gives feedback: too many slides, not enough passion. It needs to improve.

The other groups also struggle. The automotive engineering team doubts whether they will be able to convince the managers responsible with their recommendations. "If you are unable to deliver any fundamentally new results, you can still challenge them with well-founded questions", encourages Siegenthaler, who is also present. He also has to cheer up the third group, which is supposed to assess investments in novel laser technology for the production



## Report



Listen, ask questions, discuss on an equal footing. Both the collaboration with their team mates – who brought completely different backgrounds and professional experience to the table – and the direct feedback from their professors and the managers of Georg Fischer were rated as particularly enlightening by the course participants.

engineering division. The students are feeling out of their depth and at cross purposes with the Georg Fischer management. "This is all about leadership. So think of yourselves as partners on a level playing field. Take the initiative; address the problems", urge Siegenthaler and Baschera. The professors eventually succeed in motivating the team again. There is still plenty of work to be done, but they are on the right track.

**3 December 2012, Georg Fischer Training Centre, Klostersgut Paradies, near Schaffhausen** The tension is palpable, the expectations high. Today is the day. The students present their solutions to the top managers who have travelled in. They do it professionally, entirely in English and on an equal footing with their audience. The ETH Zurich professors look relieved: the coaching sessions seem to have done the trick. And the Georg Fischer managers are visibly impressed. From the piping team, for instance, they learn whether and how quickly an integrated drinking water system in large buildings can actually open up new market opportunities. They are informed about the challenges that the various actors on the market have to face, and which competitors they will have to contend with in this segment. Frequent comments like "important", "interesting" and "very good" confirm the executive floor's satisfaction with the results, even if the students can only really acknowledge that the GF management is on the right path strategically. For some participants, this might be frustrating; they wanted to achieve more and present new solutions. According to the unanimous summary in the subsequent debriefing, however, the learning effect was tremendous. And surprisingly, those course participants who have been grappling with the biggest problems in the last two months are particularly delighted with the way the day has gone. "They really displayed strong leadership skills, overcame their frustration and refused to give in", lauds Claude Siegenthaler.

As far as the overall seminar is concerned, one person seems particularly enthusiastic: Selim Kangelidi, the youngest member of the piping team. "It was a fabulous experience for me and I learnt so much". But the experienced Ralph Hesterberg also says he has benefited from it all: "Staying focused as a manager, whatever happens, always sounds so easy in theory. In practice, however, it's a huge challenge".

And how do the managers and professors rate the seminar? Georg Fischer CEO Yves Serra is full of praise: "It is remarkable what the ETH Zurich students have achieved in the space of two months. We greatly appreciate this external perspective and input". And department head Volker Hoffmann is satisfied: "In the seminar, the students were able to experience management at first hand – both at Georg Fischer and in their team. This is how we can supplement the theoretically oriented programme at the D-MTEC with practical experience". The seminar is due to become a permanent feature of the teaching programme in future – albeit probably in a different form, hopes Claude Siegenthaler. "There is still considerable potential to use what was learned during the seminar to boost the personal skills of the course participants with individual coaching". ■

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# At the speed limit

Mere seconds are old hat. These days, scientists are venturing into time dimensions that most of us can barely imagine – such as when researchers are hot on the heels of chemical reaction processes. Or when they develop transistors where electronic signals switch on and off a billion times a second. Ever-faster computers, processes and means of communication: the acceleration doesn't even stop at science. We feel it in our everyday lives, sometimes with fatal consequences. A society at full throttle sometimes also has to pause for breath.

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# Inside the knowledge explosion

Information technology, faster computers and high-efficiency analysis methods make more and more knowledge possible in an increasingly short space of time. However, the acceleration of science is not only a consequence of the possibilities it has developed, but also of the incentives and evaluation criteria in science today.

*Martina Märki*

Perhaps it is all his fault: Gottfried Wilhelm Leibniz (1646–1716), a German philosopher, mathematician and polymath, developed the binary system with the digits 0 and 1 that is the basis of modern computer technology. He also made a calculator while he was at it. His goal: to create more free time for human ingenuity to think. It was “beneath excellent people to waste hours slaving over calculations”. It would be another few centuries before the advent of the computer age. Now, however, electronic calculators work faster and faster – and more and more.

The efficiency of computer systems has grown exponentially – and so has the amount of data they process. According to a study by the University of Berkeley from 2003, the amount of all new data stored between 1999 and 2002 increased by about thirty percent a year, totalling five exabytes in 2002. More specifically, the production of scientific publications is also increasing exponentially. At present, it doubles approximately every sixteen years, and in mathematics and natural sciences even every ten years. At least as many publications are believed to have been published in the last six years as in all previous centuries in the entire history of science. There is barely a branch of science that has not been changed and accelerated by this, but none more so than the natural and life sciences. Supercomputers and high-throughput methods enable enormous amounts of data to be analysed.

## Data hype in the life sciences

In the life sciences, for instance, the efficiency of bio-engineering methods such as gene sequencing follows very similar exponential laws to the production of computer chips. In 2003 the human genome with its roughly three billion letters was sequenced. By mid-2012, scientists had identified all the functional elements and published them in the Encyclopedia of DNA Elements. In the process, three billion gene pairs were analysed and four million gene switches identified. The dataset was compiled by 442 researchers from all over the world.

Successes like this arouse high hopes – of one day being able to prevent the development of diseases even before they break out, or of actually tailoring medicine to the individual, for instance. However, this goes hand in hand with a tendency to focus on purely quantitative aspects, as Gerd Folkers, a professor of pharmaceutical science and Chairman of the transdisciplinary Collegium Helveticum of ETH Zurich and the University of Zurich, criticises in an essay: “Personalised medicine is simply construed as personalised genomics; psychological or social approaches are no longer taken into consideration at all”. He claims that the dominance of quantitative methods has

also spread to other disciplines, misleading us into using increasingly large amounts of data to investigate and confirm quicker and more precisely what we in fact already know. “Instead of looking for the risks of what is radically new, many research projects present endless, incremental optimisations of what has already been found, but at an increasingly fast pace”.

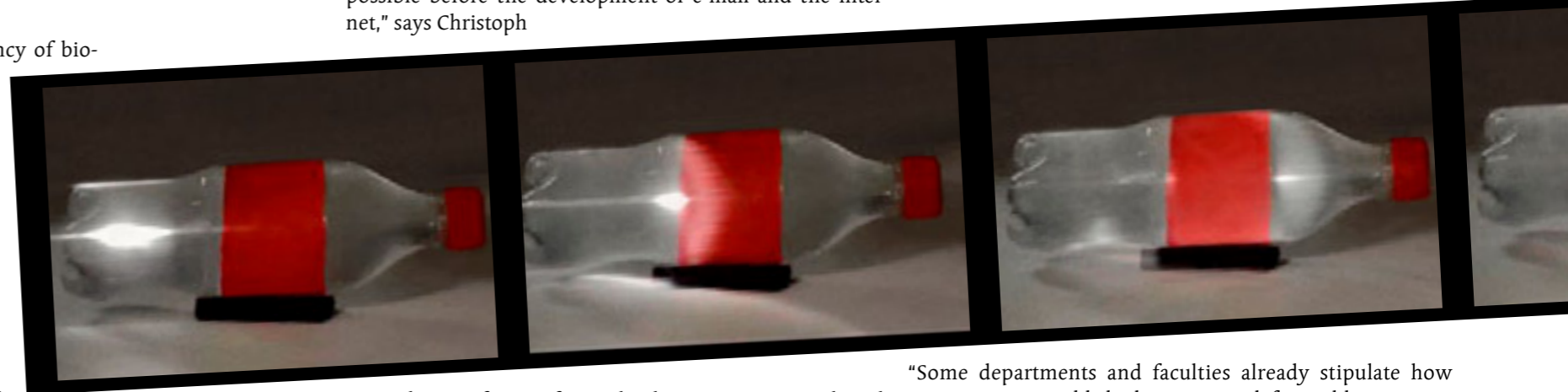
## In the force field of large-scale projects

Be it life sciences, climate research or particle physics, nowadays scientific issues are increasingly studied in large, international formations. On the one hand, large-scale projects are launched to trigger innovation boosts. However, the trend towards large formations is also a result of the enormous technological and financial investment that is necessary for many research endeavours today. And it is also a result of our current communication possibilities, for these enable us to connect data and people all over the world, even in real time. Around 5000 researchers from 300 institutions in 50 countries are involved in the search for the Higgs boson in the CMS and ATLAS research groups at Cern. “Projects of this magnitude would have been impossible before the development of e-mail and the internet,” says Christoph

Grab, a professor of particle physics at ETH Zurich and a member of the CMS research group. No wonder the world wide web was invented by scientists at Cern. The search for the Higgs particle is regarded as one of the biggest long-term experiments in basic research. Nonetheless, there is also a noticeable tendency to speed things up here when it comes to delivering results. After all, investors, politicians, the media and the public want to know what happens with the big investments. “Quite right, too”, says Grab, “but it’s not always at the right time”. He would have preferred not to have presented the sensational observations on the potential Higgs particle to the public in July 2012, but rather wait until the entire series of measurements and the evaluation planned had been completed. “These days, there is definitely pressure to go public, even if the results haven’t been fully evaluated yet”, notes the particle researcher. In the search for the Higgs particle, this apparently led to them going public with analyses that showed improvements of less than 50 percent. “In the past, we would only have spoken of a real improvement if there was at least a factor of two or three”. By this, Grab doesn’t mean that it is essentially worse to publish even smaller interim results. But he sees this as an indication that science is under more pressure today to present results quicker and more frequently.

## Publish or perish

However, the pressure to publish does not only come from outside. The science system itself has also developed benchmarks that favour increasingly rapid publication, even to the point of demanding it. Nowadays, academic progress often depends on the swift publication of as many papers as possible in respectable journals. This is also where the aforementioned publication flood stems from.



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“Some departments and faculties already stipulate how many papers published or accepted for publication are deemed necessary to earn a doctorate”, explains Gerd Folkers. This is directly linked to the fact that one increasingly tries to make the quality of research objectively measurable and comparable. In the age of global rankings, benchmarks, reporting and evaluations, it is becoming more important to have criteria that are simple to measure and to quantify.

The impact factor, a measure of the frequency at which articles of a journal are cited, is one of these. The h-index, another frequently used bibliometric criterion, is aimed at individual researchers, based on the number of citations of

Focus Speed

works by an individual author at a particular time. Christoph Grab and all his colleagues with him on the CMS project are in a comfortable situation. As he himself explains: since the names of all CMS researchers appear on every publication by subgroups of the CMS project, his h-index rises even if he hardly contributes to the publication.

"And if you write a basic textbook that everyone has to cite, you can also influence your h-index extremely positively", he says. Grab is no longer able or willing to take such criteria seriously.

**Getting out of the rat race?**

For many researchers at the beginning of their academic careers, little else remains. What impact this has is revealed in studies by the Austrian physicist and science researcher Ulrike Felt, who examined, among other things, the socialisation and situation of young scientists. Some of them describe their situation as a "rat race". Anyone who is smart in the eyes of the system plans his research topics with the h-index in mind. Scientific curiosity needs to be narrowly focussed; there is no room for

The German Research Foundation sent out a signal when it drew up rules against the publication flood in 2010: researchers would only be allowed to specify ten publications in grant applications from then on. Particle physicist Christoph Grab welcomes such approaches. With his subgroup of the CMS project, he has decided not to aim at the upcoming spring conference in particle physics as his next publishing deadline. Instead he wants to devote himself to the evaluation of his data as independently of such external influencing factors as is possible. "We will only publish once we have evaluated the data to our utmost satisfaction", he says. However, Grab admits that this decision caused ripples within the research project.

Research freedom must be defended. A fundamental aspect of this freedom is time: "Research must be allowed to develop a long-term perspective instead of being governed by short-term utility demands", says Gerd Folkers. And understanding also needs time; time that "can only superficially be saved by electronic means".



**299 792 458 m/s**

The speed of light.  
It takes light a billionth of a second to pass through a bottle that is thirty centimetres long.

an appetite for discovery beyond mainstream research. Needless to say, there are those who would like the "scientific rat race" to slow down again.

The sociologist and time researcher Hartmut Rosa, for instance, calls for scientists to impose publication restrictions upon themselves. "After all, if you publish quickly, it automatically and inevitably means that you are receiving quickly". Not only is the individual swamped; a central pillar of scientific quality control, the system of peer reviews, is also at risk of collapse. Respectable publications like Science and Nature report that they can no longer cope with the flood of papers submitted and that they have to have reviewed. Purely from a technical perspective, open access publishing would seem to recommend itself. But then who would separate the wheat from the chaff?

The Collegium Helveticum:

[www.collegium.ethz.ch](http://www.collegium.ethz.ch) →

Link to the CMS project:

<http://cms.web.cern.ch> →

Gerd Folkers: Freiheit in der Forschung. Pharmazie, An international Journal for Pharmaceutical Sciences, July 2013

<http://pharmazie.govi.de/index.htm> →



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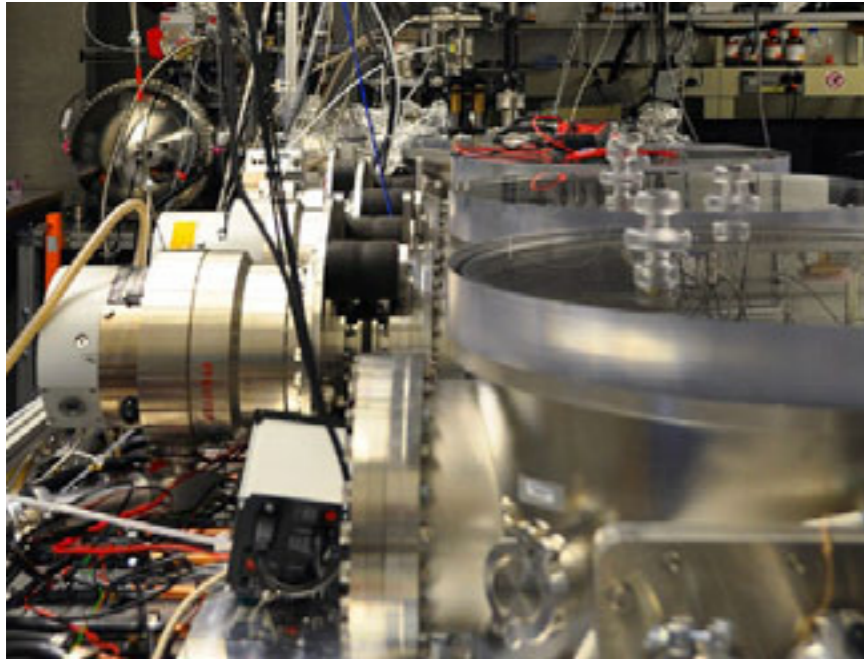
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The attolines (centre) enables ultrafast processes such as electron transfer in molecules to be studied at a higher temporal resolution.

## At the boundaries of the measurable

Felix Würsten

**With her ultrafast lasers, Ursula Keller studies inconceivably short processes that can only be explained with the ideas of quantum mechanics. These elusive phenomena have a big impact on our everyday lives. For without them there would be no photosynthesis, no breathing and no eyesight.**

Whether at her coffee machine in the morning, on her way to work in the car or at her computer in the office – Ursula Keller keeps seeing items in her daily life that were produced with the aid of laser processing. Nowadays, these powerful light sources are used

in many places to shape surfaces or cut materials to the right size, and Keller has had a major hand in this. As a professor of experimental physics over 20 years ago, she developed SESAM technology that enables laser light to be focused into ultra-short pulses. And it is these same, short, high-energy pulses that make it possible to process materials in a gentle, precise way.

In recent years, Keller's group has managed to generate such laser pulses in ever new colours and with increasing efficiency.

Despite the enormous progress, however, there is no end to the work in sight: "Whatever improvements we make, the users keep wanting new things" says Keller, laughing, indi-

cating that she accepts this challenge gladly.

### Rapid electron transfer

The further development of the lasers, however, is only part of Ursula Keller's work. For her group also uses these ingenious devices to study ultrafast processes. With the futuristic-looking attoclock and the equally impressive attolines, the physicist and her team can now study fundamental physical processes that take place in the space of a few attoseconds, thus lasting no more than a few billionths of a billionth of a second. "With our devices, we are moving into a completely new area of metrology", explains the scientist with visible pride.

For example, she also uses this complex equipment to study the tunnel effect, a quantum-mechanical phenomenon that is virtually impossible to investigate experimentally because it takes place at an inconceivable speed. In concrete terms, it concerns how quickly an electron excited with light can be transported away from an atom. According to the laws of classical physics, an electron only breaks away from its atomic nucleus if it exceeds a certain energy potential. Not in the world of quantum mechanics, where the electron can simply cross the "potential mountain", which prevents it from drifting away, through a "tunnel".

The question now is: how quickly does the electron cut through this tunnel? Theorists are at odds with each

other on this, and their predictions lie somewhere between zero and 500 attoseconds. Ursula Keller has now succeeded in demonstrating that it takes the electron 50 to 100 attoseconds to pass through the tunnel. "Our data provides key evidence as to which models might be right", she explains. "That our measurements are important is also apparent in the fact that we have frequently disproved predictions that theorists have made".

### Important for everyday life

It is by no means only theorists who have an interest in clarifying these questions. After all, the tunnel effect plays a key role in many everyday chemical reactions. During photosynthesis, for instance, sunlight is captured when an electron is excited by light in a specialised molecule. If the electron were then to remain in the same spot, this energy would immediately be lost again. Consequently, the electron has to be transported to another place as quickly as possible so that it can trigger a chemical reaction there. "To this day, artificial photosynthesis remains an ideal that's beyond our grasp", says Keller. "One major reason for this is that we don't yet understand this electron transfer sufficiently".

### Physics is not enough by itself

There are also similar rapid phenomena in other biological processes,

such as when oxygen binds to red blood cells or the incident light in the retina is converted into an electrical impulse.

"We have come on in leaps and bounds in optoelectronics in recent years", says Keller, summing up the current situation. "Nowadays, we construct semiconductors on the drawing board on an atomic scale and can describe the electron transfer in the crystal lattice with a simple model, which enables us to build slender, efficient mobile phones. Comparatively speaking, we are still in the early stages in biology".

So the crucial question is this: how can the behaviour of biologically active molecules be displayed in a model as easily as possible? "If we manage to do that, we can get creative and synthesise molecules selectively", says Keller optimistically.

This goal cannot be achieved with physics alone, for her that much is clear. "We need physicists, chemists, engineers and biologists, all working closely with one another", she explains. She finds precisely this interdisciplinary collaboration in the National Centre of Competence in Research, "Molecular Ultrafast Science and Technology", which she co-runs as director.

"We are setting up a versatile community in Switzerland that focuses on ultrafast processes on an atomic and molecular level".

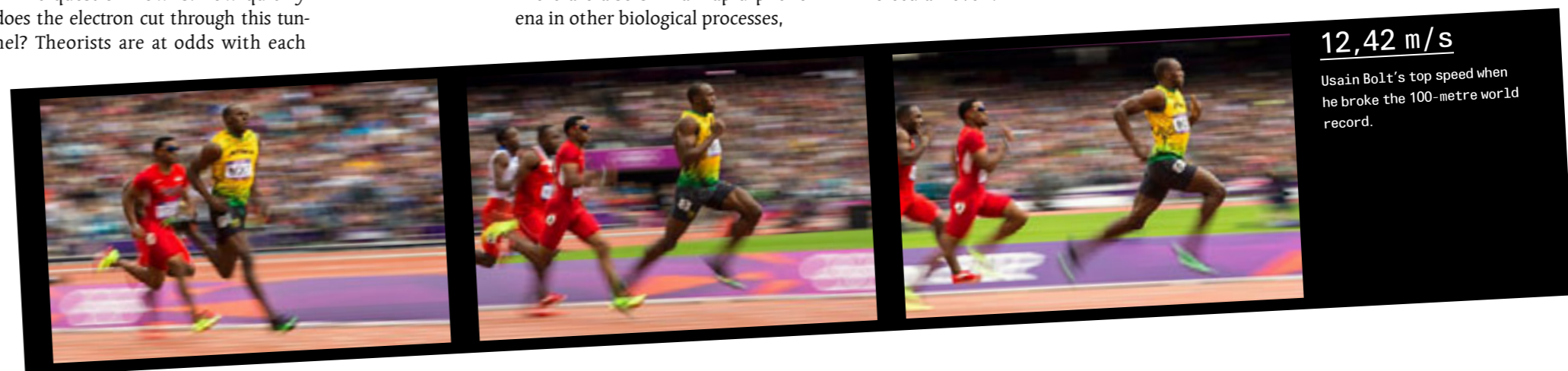
Ursula Keller would also like to facilitate the collaboration between the departments within ETH Zurich. With the Fast Initiative – abbreviated from Femtosecond and Attosecond Science and Technology – she wants to bring together as many scientists as possible who study rapid processes with powerful lasers. "If we could unite these people under one roof, it would give our research an enormous boost". ■

Ultrafast Laser Physics:

[www.ulp.ethz.ch](http://www.ulp.ethz.ch) →

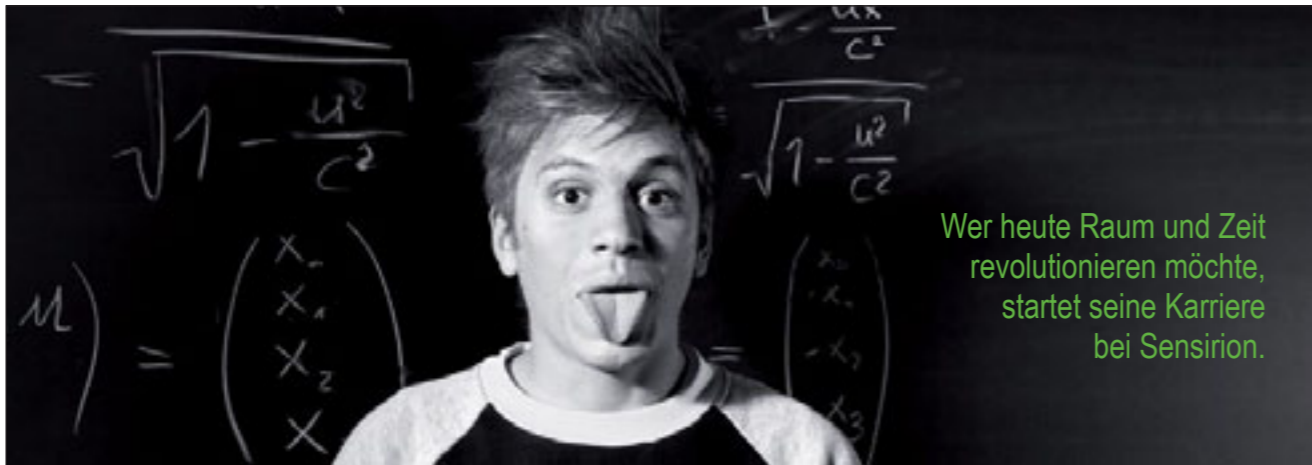
National Center of Competence in Research MUST:

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12,42 m/s

Usain Bolt's top speed when he broke the 100-metre world record.



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## Researching in the gap

Felix Würsten

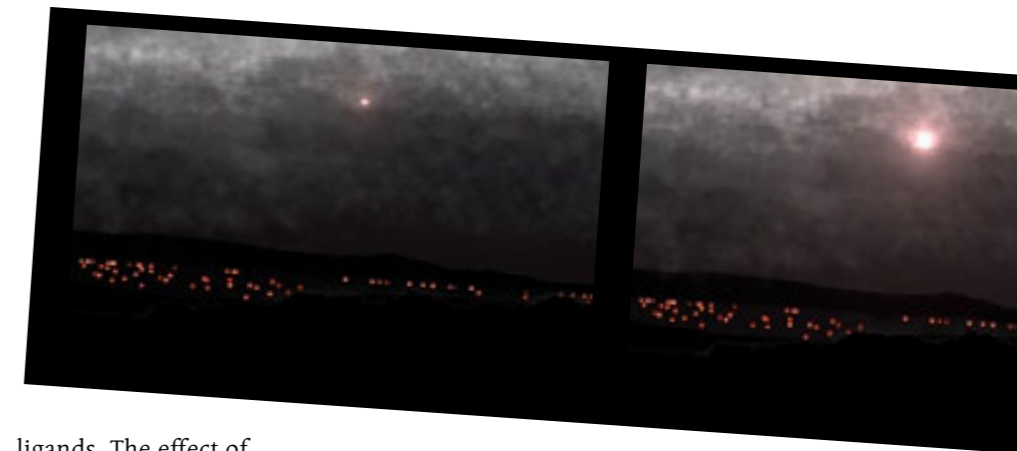
**In many chemical reactions, short-lived intermediates form that are extremely difficult to capture due to the speed at which they develop. If they are influenced successfully, the course of the reaction can be controlled in a targeted manner.**

How are new products actually produced from existing base substances during a chemical reaction? What exactly happens in the magical moment of that short gap between the old and the new? And how can this transformation be influenced specifically? These are the very questions that Peter Chen, a professor at the Laboratory of Organic Chemistry, is looking to answer in his research – questions that are far more than just a matter of scientific curiosity. Even if for him, as a university researcher, the basic aspects take priority: "In Switzerland, there are many companies in the field of specialty chemistry that are extremely interested in optimising the production of their products. In order to do so, however, they need to understand the reactions involved as precisely as possible".

A key factor in understanding the processes is the reaction speed. "In every chemical reaction, the molecules have to cross a 'landscape', the so-called potential surface", explains Chen. "Which path the molecules take in this landscape is decided by kinetics, i.e. the reaction speed. If you measure how quickly the molecules react with each other, you can find out how big the hurdles are that the molecules have to overcome in this landscape, for example".

These days, catalysts are used in the majority of chemical reactions in industry to speed up the processes or even make them possible in the first place. These catalysts change the potential surface and therefore the reaction speed, thus determining the course of the chemical reaction. Many catalysts essentially consist of a metal atom, to which chemical groups can be attached as

Consequently, together with his team, Chen has developed a special procedure which enables him to detach these reactive substances and study them in the mass spectrometer. He is even taking it a step further with his group: the researchers are building an appliance that enables them to capture a few hundred molecules of these short-lived compounds and study them in isolation.



ligands. The effect of the catalyst changes, depending on which ligands are attached. Thus, with a clever selection of ligands, the chemical reaction can be controlled selectively.

In principle, which ligand is most suitable for a particular reaction can be calculated with the aid of models. However, these are anything but complete and therefore frequently need to be tested in experiments. The challenge in these measurements is now that many chemical reactions do not simply take place in a single step, but rather over several stages. As a result, very short-lived reactive intermediates emerge that are difficult to capture with current measuring methods.

"These highly complex measurements allow us to determine the reaction speed of the individual steps precisely. This will enable us to understand better how we can influence the course of the chemical reaction", explains Chen. "Perhaps we will even manage to create a completely new chemical reaction based on the refined models". ■

Homepage of Peter Chen and his group:  
[www.chen.ethz.ch](http://www.chen.ethz.ch) →

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# The pacesetters of our world

Roland Baumann

**Transistors are ubiquitous, even if they are tucked away in electronic devices out of sight. Their speed is decisive in defining a device's performance. Ever-faster transistors open up completely new possibilities in communication, for instance.**

They have often set tongues wagging with their speed records: Professor Colombo Bolognesi and his millimetre-

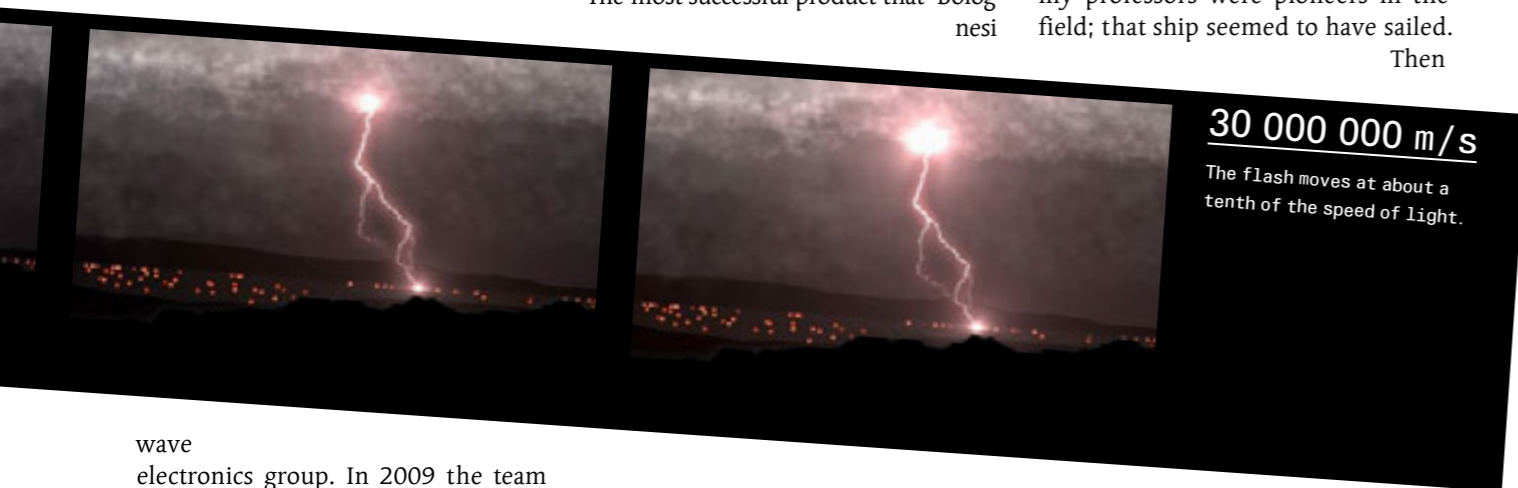
hertz, the electronic signals in a transistor switch on and off one billion times a second.

When asked about the records, Bolognesi describes himself as the "speed man" with a wink, immediately pointing out that these records are not about scientific fun and games for him: "This is applied research: it yields rapid transistors that are actually put to use".

**Products in use the world over**  
The most successful product that Bolognesi

In 2002, the researcher and his team presented the world's fastest bipolar transistor based on these new materials. "We were surprised ourselves: we had set our sights on 150 GHz and managed 300 GHz". Agilent quickly developed a product from it that also stands in Bolognesi's lab: a measuring device for transistors.

Another example is nitrides, a material Bolognesi originally had no interest in working with whatsoever: "When I completed my PhD in 1993, my professors were pioneers in the field; that ship seemed to have sailed. Then



wave electronics group. In 2009 the team became the first to produce transistors based on gallium nitride with a speed of over 100 gigahertz (GHz); other groups had only managed 28 GHz with similar technology by that stage. A year later, together with a research group from EPFL, the team cracked the 200-GHz mark. Based on indium phosphide, the group had developed transistors that reached a frequency limit of 600 GHz at room temperature and even 700 GHz in a cryogenic environment – at a temperature of minus 268 degrees Celsius, that is. But what do these figures mean? At a switching speed of one giga-

has developed in his career so far is a bipolar transistor based on indium phosphide. He got the idea as a young researcher at a conference, where a structure was presented that did not prove as successful in practice as had been predicted. "It occurred to me that I could solve the problem with a different combination of materials", recalls the Canadian. He approached a Canadian national telecommunications company: "I received the funding and soon afterwards was contacted by the American company Agilent, which had heard about the project and proposed a collaboration".

one day, a colleague from the company Nortel called and offered me money to research gallium nitride". When Nortel went bankrupt, however, the funding dried up. But Bolognesi didn't want his research to end like that, so he continued working on the topic after he joined ETH Zurich in 2006. "And thanks to its excellent infrastructure, the FIRST Lab gave me completely new possibilities".

Compared to transistors based on indium phosphide, those based on gallium nitride are not the fastest. However, they are able to withstand

immense stress and currents, and are thus used in transmitters for wireless communication with frequencies of under six GHz, for instance.

"Because I'm interested in speed, I told myself that gallium nitride might be much faster than had been published at that stage", says Bolognesi, explaining his motivation. And so he and his team got to work and broke a number of records.

When the researchers from ETH Zurich presented the results at a conference, they caught the eye of some American colleagues. Meanwhile, the Americans have set their sights on increasing gallium-nitride transistors to 500 GHz and the military in particular has developed an interest in the technology. The competition in America is fierce. "The sums of money invested over there are on an entirely different scale", explains Bolognesi, "which poses a major challenge for my relatively small group".

## Customised transistors

Dealing with different materials is not to be taken for granted. It never ceases to amaze Bolognesi that most labs opt for a particular technology on account of market research or personal preferences – and they sell this as the best solution without having tested the alternatives themselves. "As a lab without any commercial interests, however, we're keen to find the best material combination for a particular problem", says Bolognesi.

The ETH Zurich researchers choose materials they believe are best suited for a particular application. At the FIRST Lab they assemble the crystalline layers and apply one coat of atoms to the next. By determining the composition of the material, they can also define its electronic and physical properties, thereby producing customised transistors.

The range of possible applications is suitably vast – from mobile communications and fibre-optic networks, electronic test and measurement systems, all the way to detectors in the security sector.

## Signals from space

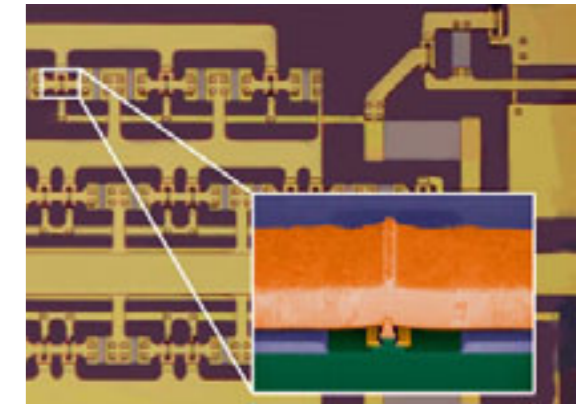
In collaboration with the European Space Agency, the group is developing special transistors for the Deep Space Network to improve communication over cosmic distances. Antennae on Earth receive signals from outer space that can be so weak that they only amount to a billionth of a billionth of a watt. These signals have to be amplified and distinguished from the unwanted white noise. "One possibility might be to build bigger antennae, which would not only be extremely complicated, but also very expensive", explains Bolognesi. "A cost-effective alternative would be to improve the quality of the transistors. And that's where we come in" ■

Homepage of the Bolognesi group:  
[www.mwe.ee.ethz.ch](http://www.mwe.ee.ethz.ch) →

## Transistors change our daily lives

Transistors, little semiconductor components that are switched on and off by the flow of electrons, are found in computers, mobile telephones, cameras, game consoles and the transmitters of mobile-phone companies – to name but a few applications.

Their speed has a direct influence on the performance of the devices, which increases exponentially, as the example of flash memory illustrates: the first USB sticks to appear on the market in 2000 could store around eight megabytes of data; today, thanks to quicker transistors, sticks are available with 256 gigabytes of memory. The same goes for the



Dyed scanning electron microscope cross-section of an indium phosphide bipolar transistor with a frequency limit of 500 GHz. Background: integrated millimetre-wave circuit built from these transistors.

wireless exchange of information. While data was still transmitted via wireless networks at around 100 kilobits per second in 2000, we will be able to send around 100 megabits per second with our Smartphones in two or three years. In experiments, transmission rates of over ten gigabits per second have even been achieved.

Wireless networks could soon be fast enough to compete seriously with fibre-optic cable networks over short distances, the "last mile". They are much cheaper because they are easier to install and are also suitable for temporary installations.

## Quicker or cheaper?

Felix Würsten

**Without sophisticated supply chains, the global trade in goods and products would be scarcely imaginable. In the business of international logistics, speed is an important factor. But it certainly isn't the only one.**

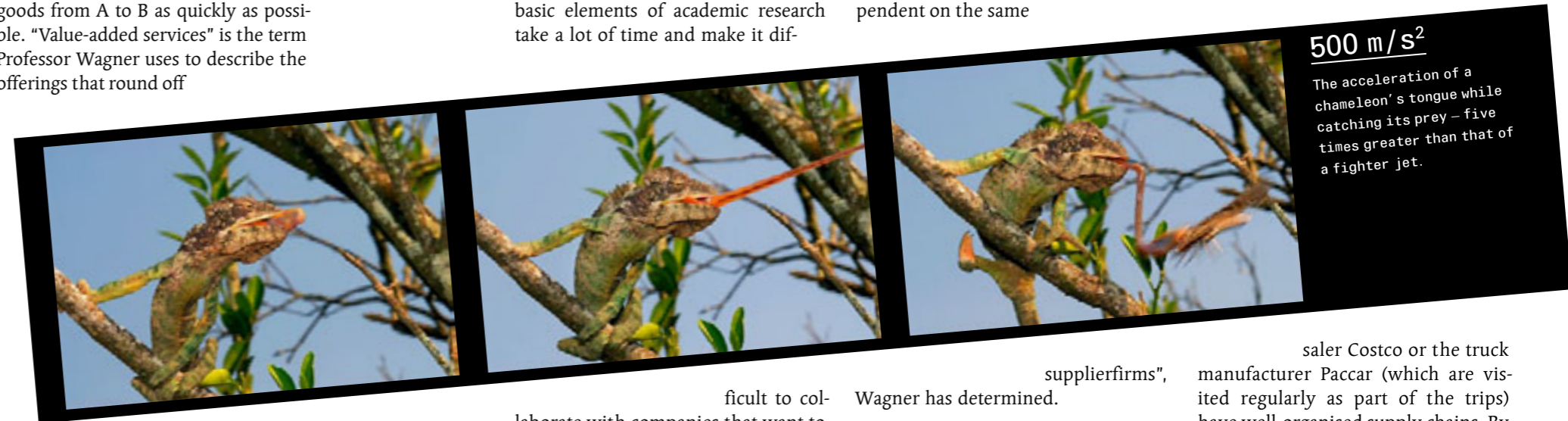
There aren't many areas that have changed as fundamentally in recent years as that of international trade. Countless goods and products are transported around the world every day, with ever-increasing volumes being moved to and fro in timeframes that appear to be getting shorter all the time. All of this works only because it has become the norm in the industry for sophisticated supply chains to bring products from one place to another quickly, on time and as inexpensively as possible.

Without a doubt, speed is a key factor for success in this business. But speed alone is not what counts, as Stephan Wagner, Professor for Logistics Management, hastens to explain: "We have to see the aspect of speed in a more differentiated light", he says. "In the case of high-tech products or medical items, customers are quite willing to pay a higher price to have goods delivered faster. In other industries, however, there is more of a focus on cost efficiency, i.e. transportation that is as inexpensive as possible".

The fact that speed is not the be-all-and-end-all in international logistics becomes particularly apparent during a crisis. In tough economic times, many customers are very willing to accept longer delivery periods if this allows them to cut costs. One example of how this can be done is when shipping companies save fuel by having

their freight ships sail more slowly.

Nowadays it is not nearly enough for a logistics firm simply to transport goods from A to B as quickly as possible. "Value-added services" is the term Professor Wagner uses to describe the offerings that round off



**500 m/s<sup>2</sup>**

The acceleration of a chameleon's tongue while catching its prey – five times greater than that of a fighter jet.

goods transportation. "In the automotive industry, for example, logistics companies now literally deliver parts to the factory production line", says Wagner. "For the companies involved, this outsourcing means focusing on their core business, reducing complexity and cutting costs".

### What makes up the core business

Supply Chain Management has become a strategic area in many companies in recent years.

"In the past, many companies used to view logistics as a peripheral task", remembers Wagner. "The situation is very different today. The central questions addressed include: Where will I manufacture my goods? What parts of production will I outsource to third parties? And how will I deal with my suppliers?" Companies have to make all of these decisions under severe

time pressure if they want to keep up with the rapid pace of development.

This is something that Professor Wagner also notices as an academic: coming up with theories, developing concepts, collecting data – all of these basic elements of academic research take a lot of time and make it dif-

icult to collaborate with companies that want to get the results of studies as quickly as possible. "That is why as university researchers we focus on those topics where we can use the way we work to make a contribution that is relevant for companies".

For example, Wagner is studying how companies deal with risks in their supply chains. How do they prepare for natural disasters that take place somewhere on the other side of the world and then paralyse the entire supply chain? Which option is more beneficial from this perspective: manufacturing in a low-wage country where disasters are more likely to occur, or choosing a country where wage costs are higher but where fewer interruptions can be expected? In his study, Wagner demonstrates just how susceptible the companies are: many firms try to protect themselves from the risk of business interruptions by purchasing their products from two suppliers. But this apparent security

can be deceptive: "Taking a closer look, it becomes clear again and again that, in an emergency, both suppliers would fail to deliver – for example because they both operate in the same region or because they themselves are dependent on the same

supplierfirms", Wagner has determined.

**Valuable practical lessons**

It is precisely topics like these that are dealt with in the "Executive MBA in Supply Chain Management", which has been on offer from ETH Zurich for 10 years now. "In this programme, we provide in-depth training that also teaches the fundamentals of corporate governance", explains Wagner, who has been in charge of the programme since 2008. It is particularly valuable to take a glance across international borders. "The programme has an international focus, which is why we take three trips: to Russia, to the USA and to China and Japan", reports Wagner.

"We go on site to prestigious companies to see how they operate in the markets in question". In every country, the students get to know a different culture, helping them to realise that, despite global standards, markets are still shaped by completely different cultures. In China, the

salier Costco or the truck manufacturer Paccar (which are visited regularly as part of the trips) have well-organised supply chains. By contrast, the situation in Russia is entirely different. Wagner sums it up as follows: "Russia stands for sluggishness. Russia provides a very valuable lesson for our students precisely because everything does not function perfectly there". They get first-hand experience of the obstacles that foreign companies face in this important market – for example, the fact that patience is a virtue in Russia and that transportation even across relatively short distances can take huge amounts of time. ■

economy is growing at an extremely fast pace, and the expectant mood in a metropolis like Shanghai is palpable. Business works excellently in the USA, where large firms such as Boeing, the whole-

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Reliable supply chains are vital in today's globalised world.



# When we can no longer keep up

In an ever-faster world, an increasing number of people fall out of step. Burnout expert Toni Brühlmann, work psychologist Gudela Grote and philosopher Michael Hampe discuss why this is, and what we can do to protect ourselves.

*Gespräch: Roland Baumann and Christine Heidemann*

*It seems paradoxical: we have faster means of communication and transport, so we save lots of time. But we still have less and less of it. Why is that?*

**Michael Hampe:** I think one reason is that we simply don't do the math. If you've got a lot of time-saving possibilities, you might not pay attention any more to how long it takes to do a certain task. And as a result you come under pressure. It's the same for me when I travel: I might arrange a meeting in London on Monday and one in Vienna on Tuesday, without allowing for the fact that flying can be stressful.

**Gudela Grote:** Because we can do everything quicker, we think we can do more. And our employers think the same of us. So we cram much more into the day. We set fewer priori-

ties and are quicker to say yes to everything because we think everything is easier.

**Toni Brühlmann:** From a psychological perspective, I'd say it's because we are so driven and controlled by outside influences. We are so well networked and so inundated with information – but our own demands and the many possibilities at our disposal also serve to spur us on. We can't get enough and never feel satisfied. Plus we lack the ability to draw the line, which means we never have any time. There is always something else to do: I can write one more e-mail; I can still get this or that done.

*So we haven't got less time, just more to do.*

**Grote:** Yes, that becomes glaringly obvious when you look at the working world. Technical developments increase productivity, which means fewer people do the same amount of work. And so the process goes on.

For many activities, especially so-called "knowledge work" and similar tasks that aren't technically limited, you often only get the objectives. How long you need to achieve these is left open – which may sound appealing. But the targets are mostly set in such a way that they tend to be virtually impossible to manage in the time available, even if you really hurry.

*So the pressure is both internal and external. Which factor is more important if someone is unable to cope with this pressure, as in a case of burnout?*



If we are too quick to say yes to everything, we put too much pressure on ourselves, explain Toni Brühlmann, Gudela Grote and Michael Hampe (f.l.t.r.).

**Brühlmann:** It's a mixture. I'll start with the external aspects. The development of society has led to businesses coming under enormous competitive and market pressure. The pressure to increase efficiency is mounting, and therefore so are the demands being made. We people internalise

## "Burnout has become an epidemic in the western world".

Toni Brühlmann

these and this gives rise to our excessive demands on ourselves: I have to do everything as well as possible and be as perfect as possible. We confront ourselves with these heightened inner expectations.

*Is this pressure new? How long has the phenomenon of burnout existed?*

**Brühlmann:** Although the term was coined in 1974, there are precursors that date back to industrialisation. In the seventeenth and eighteenth centuries it was called the English disease, in the nineteenth century neurasthenia. However, these phenomena aren't directly comparable. What has happened in the last two decades has taken on a different dimension. Globalisation has caused burnout to become an epidemic in the western world.

*Why is that? Do we have a different perception of time nowadays?*

**Hampe:** Time has become objectified. On the one hand, this stems from machines; on the other, from the competitive situation.

But people have their own personal times in which to get something done. Take the speed at which people produce works of art, for instance. Robert Musil practically spent his whole life writing one novel. Other authors have a far greater output. These personal times are no longer taken into consideration in competitive situations. Then time becomes an objective yardstick: a book can be written in two or three years. And if you internalise that, you find yourself under enormous pressure if you don't match this objective timescale.

Someone like Musil needs a lot of self-confidence if he wants to work under his own steam and doesn't care how long other people need to write a book.

**Brühlmann:** From this perspective, you can actually understand the burnout phenomenon in that this objective or quantitative time determines our inner time to an excessive degree. The inner, qualitative or spiritual time we need to process something, to keep up emotionally, is neglected.

If this qualitative time is quantified too heavily by mechanical time, it can lead to emotional burnout. We no longer leave ourselves our own time, although I would define our "own time" as a personal mixture of quantitative, social time, and the personal time that my inner life needs.

*As far as qualitative aspects of work are concerned, what is the situation in the creative professions? Or in science?*

### Interviewees:

**Toni Brühlmann** is a specialist in psychiatry and psychotherapy and has been Medical Director of the Private Clinic Hohenegg in Meilen near Zurich since 1989, where he also runs the Burnout and Life Crisis Centre of Excellence.

**Gudela Grote** has been a full professor of work and organisational psychology at the Department of Management, Technology, and Economics at ETH Zurich since September 2000. She specialises in job and organisational design in connection with changing technological, economic and societal developments.

**Michael Hampe** has been a full professor of philosophy in the Department of Humanities, Social and Political Sciences at ETH Zurich since 2003. He has published numerous books, one of which is about happiness. One of his research projects focuses on the philosophy of perception, consciousness and time.

It's all about your career.

**Hampe:** For creative tasks in science, art and philosophy, the time a person needs to solve a particular problem or to produce a work is difficult to calculate. If you see that a person isn't making any progress, for instance, you don't know as an outsider whether very profound development processes

“Because we can do everything quicker, we think we can do more”.

Gudela Grote

are taking place, or whether they have thrown in the towel. You can't test a person's inner development like in an exam.

Moreover, people are very different – take language-learning, for example. There are people who don't open their mouths for a good while, then suddenly start chattering away after six months. Others start with broken sentences and you see a continual improvement. Because people are so different, I think standardising time is extremely problematic for very creative tasks.

**Grote:** That's a huge topic. Because it's clear that creativity can't be regulated. In an organisation that is highly controlled by efficiency considerations, you can't really afford creativity anymore. And yet you need it to be competitive. How you deal with these contradictions is a major problem.

People increasingly try to control creativity through routine processes. Sometimes successfully, too. A new software release is planned for a particular point and brought out, but often only with minor, insignificant changes. Then there are areas where companies simply buy innovations from motivated people who develop something new – so they don't have any problem at all, because the time spent in development doesn't need to be paid for by the firm.

So you outsource processes which can't be standardised. The people who take them over instead then hope that they will be able to sell their ideas for a lot of money. Some succeed, too, but it's a bit of a lottery.

*If we take that idea further, we could say that those who work the fastest dictate the new rules. Everyone has to function in them. And then the system spits the rest out?*

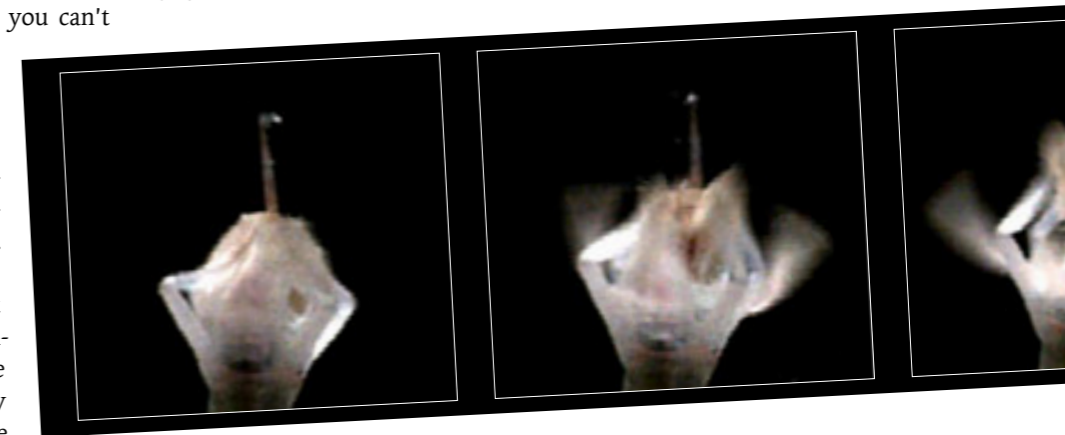
**Grote:** Not necessarily. Nor am I so sure how much everything is actually designed to increase efficiency. I'm amazed at how often you come across inefficient processes. You see it when you're a customer, or when you take a closer look at the working processes of certain organisations. Many people create niches that correspond to their needs.

That's also a strength, of course. We have already touched on it: to what extent can I allow myself to adapt the world a little to my needs? And I think these elements are still evident. It doesn't all go in one direction.

**Brühlmann:** It might be a stroke of luck that burnout has also become an economic problem today. Because we've realised that more and more people are no longer as productive because of it. And those who actually wave the white flag end up missing half a year or more. I've noticed that companies are increasingly taking the matter seriously.

*What role does pressure play? Many people need a certain amount of pressure to work productively, such as a deadline. And only when this pressure becomes too great does it result in negative reactions.*

**Brühlmann:** When it comes to burnouts, the boundary between a challenge (i.e. eustress) and overload (distress) is extremely important. There will always



be phases when you're swamped without it leading to burnout. But if these phases last for months or even years, it can happen. And what is the determining factor here? It comes back to the interplay of external and internal pressure. Are there resources in my social environment that can support me? Are there appreciative stimuli, too? Does my personal history or my social environment make me too hard on myself? As far as burnout is concerned, it would be quite wrong to think that simply having fewer demands is the answer. What is needed are healthy, beneficial ones.

*What are the first signs of an overload?*

**Brühlmann:** Burnout is a fatigue syndrome. You're physically, psychologically, emotionally and mentally exhausted. Your creativity and initiative are no longer the same. The irony is that, as an achiever, you're the last person to accept your own exhaustion. Your environment often notices it first. In hindsight, patients who come to us see that they have been trivialising their sleeping troubles or heart rhythm disorders for months. Then when they look forwards, they know the warning signs, which can help prevent relapses.

*And how can you claw your way back from a case of burnout?*

**Brühlmann:** Burnout is a drama of acceleration, so time management is a key factor. You need to set more priorities, to delegate more. The biggest challenge is taking a step towards more autonomy in your personal development; finding yourself more and not being controlled externally to such a degree. This requires courage – the courage to draw

people know that for themselves and also have the courage to communicate it and champion it, the sooner they can themselves determine how they work and live.

**Hampe:** That has also got something to do with recollection. After all, in considering time as a resource, we evaluate the past and future differently. Time gone by is effectively time used up, and so it's deemed worthless; the time that lies ahead is what's considered important. Therefore, recollection is supposedly something for elderly people who have retired and haven't got anything more to do. But permanent reflection really means remembering what went wrong in your own past and what you should change. This means you can't simply toss the past on the scrapheap as if it were a used-up resource.

**Brühlmann:** That's also important from a psychotherapeutic perspective. In retrospect, the patients might rediscover skills that have been lost. Then they recognise that they can achieve something themselves and don't merely have to be victims.

equally efficient all the time; in other words, a team-specific balance of quantitative and qualitative time.

**Grote:** One context in which this is widely discussed is so-called flexible working, where the working and private worlds overlap. Here, it is a question of very simple rules: how quickly do e-mails need to be answered? When do I need to be available and when not? The team should clarify mutual expectations and define rules. And then put them into practice, and maybe be prepared to answer unimportant e-mails later.

*Is it only the acceleration of things at work that makes us tired? Or does our free time also play a role?*

**Hampe:** I get the impression that the notion of time as a resource is completely independent of work. And if I consider time as a resource, the same happens to me as with an energy resource. It is always in short supply because potentially I can never get enough to make something out

of it. According to this logic, I also have to maximise my free time or cram as many leisure activities as possible into the time resource available.

**Brühlmann:** Really, we need something completely different: an ability to linger that isn't determined by thoughts of resources. There is a certain danger in managing your free time as efficiently as possible, like going into yoga to be more productive and efficient again. For then everything

goes into this *vita activa* and the *vita contemplativa* never gets a look-in.

**Grote:** Another aspect is that we have more and more possibilities. And as the self-organisation theory goes: always act in such a way as to maximise your possibilities. If we use our possibilities quickly, we can use more and more of them. But if these possibilities continue to increase, at some point this maxim will cease to be correct. Perhaps we need to have a rethink in this respect.

**Brühlmann:** What happens if we use as many possibilities as possible? You develop something like a surfer spirit. Not only do you surf on the internet, you also surf existentially, from one possibility to the next. What is lost in the process, and what the soul needs, is stories.

*So does it also need a kind of prophylaxis on a societal level?*

**Hampe:** If we are to be able to act with greater self-determination on an individual level, then society has to be prepared to accept it. Otherwise, you need enormous powers of resistance.

The change that would be necessary is very profound. That is to say, you'd need to de-economise social circumstances to such an extent that people wouldn't regard their

**“Time has become objectified. But people have their own personal time to do something”.**

Michael Hampe

time and social relations as merely something akin to money. But for something to change in society, we need a critical mass of people willing to change.

**Brühlmann:** Yes, the societal question is indeed difficult to answer. How can you dispense with unfettered capitalism or with this unfettered economic thinking? Do you think, Mr Hampe, that it's possible without revolution?

**Hampe:** I hope so. Because a revolution is the most painful process. I believe that processes of change can take place without violence if people appreciate their overall social responsibility. ■



boundaries.

You have to be prepared to put up with feelings of guilt if you say no, which is easier said than done. Moreover, you need to be able to embrace the good in your behaviour and let go of the bad.

*What do you mean by that?*

**Brühlmann:** Perfectionism, for example, isn't just bad. But I have to drop the excess that it brings and embrace the good in it – namely, that I am dedicated and want to perform really well.

**Grote:** In a nutshell, it's also about how much I know what's good for me. Often, the answer is not a lot. I have to find out what I need to be able to develop my full potential, i.e. to do what I can and want to be good at. The more

*How long does it take to get over a burnout?*

**Brühlmann:** That varies. A burnout usually develops over one to three years. Accordingly, it also takes months for you to come out the other side. You need to bank on half a year, really. Ideally, you should be motivated to undergo a process of self-development accompanied by psychotherapy, which can take one or two years. You are normally able to go back to work in this time.

*Self-determination, drawing boundaries and reflection are key words that have been mentioned with respect to protecting ourselves from burnout as individuals. But what can an employer or a team do to help?*

**Brühlmann:** The ideal situation in the team would be to have things balanced so that not everyone has to be

## Zoom



"Is the galaxy smooth and rounded or is it shaped like a disc?" This is the first question volunteer helpers have to answer when classifying galaxies.

## Astrophysics

## Researching with 100,000 helpers

Franziska Schmid

**Amateurs analyse complex patterns – a task at which they are more efficient than any computer – and make a crucial contribution to research. Kevin Schawinski, a professor of astrophysics at ETH Zurich, has 100,000 volunteer helpers to fall back on in his projects.**

A colour picture of stars appears on the screen. Is the galaxy smooth and rounded or shaped like a disc? Definitely smooth and rounded. How round? Very round, cigar-shaped or something in between? A moment's hesitation... Then the decision is made: the galaxy is round. Is there anything peculiar about it? Not really. Hundreds of thousands sit in front of their computers, look at pictures of galaxies and answer these and similar questions. But not for the fun of it. Their answers are making a key contribution towards

the research of astrophysicist Schawinski at ETH Zurich. Dubbed "citizen science", involving amateurs in research projects is becoming increasingly popular in a number of research fields.

### Evolution of galaxies

Schawinski's research field is the co-evolution of galaxies and black holes. As far as we know, all galaxies have black holes at their core. Black holes are the most efficient energy sources in the universe and researchers suspect that they work like a kind of thermostat, regulating the growth of galaxies. How this happens, however, is still largely unclear. Schawinski would like to find out when and how the black holes "switch themselves on and off". As far as we know, the shape of galaxies – be it elliptical or spiral-shaped – also governs their central properties, and the galaxy morphology and distribution of the different kinds of galaxies in the universe pro-

vide important clues to their evolution. Consequently, the ETH Zurich astrophysicist would like to categorise as many galaxies as possible – a complex and time-consuming endeavour. This is where the hordes of helpers come in.

The inhibition threshold to try one's hand as a "citizen scientist" should be as low as possible. The internet platform "Galaxy Zoo", co-initiated by Schawinski, states: "NASA's Hubble Space Telescope archive provides hundreds of thousands of images of faraway galaxies. To understand how these galaxies and our own were formed, we need your help". Anyone who follows this call and registers on Galaxy Zoo is assigned an image detail at random, containing galaxies which then need to be categorised.

But just how useful is the data the amateurs provide? "The quality is outstanding", explains Schawinski, as the method benefits from the "wis-

dom of crowds" effect. In other words: "With amateurs, the group average answers a question at least as well as if you ask individual experts". With Galaxy Zoo, seventy people classify one single galaxy independently of each another; the average result is, in all probability, correct.

### Superior to the computer

The categorisation of the galaxies cannot be automated. The human brain is by far superior to computers in recognising patterns. "Any child can do what we've painstakingly been trying to teach computers for years. Take facial recognition, for instance. Recognising patterns is actually a low brain function", says Schawinski. The Galaxy Zoo project also revealed that in next to no time most amateurs are able to categorise galaxies just as well as astrophysicists – and without any special training, either. "It's so easy that you don't need any prior knowledge. In fact, quite the opposite: we actually want people to look at the galaxies as unbiased as possible", explains Schawinski.

Man has another key advantage over computers: we notice if something is out of the ordinary. Hanny van Arkel, for instance, a Dutch teacher, spotted a previously unknown astronomical object in one picture in 2007 when she noticed that one galaxy did not fit into the normal scheme of things. The object – subsequently named "Hanny's Voorwerp" after her – was the light echo of a quasar, a rapidly growing black hole in the middle of a galaxy. The discovery triggered lively debates among the citizen scientists, which they organise themselves on Galaxy Zoo as they share their observations and discuss particular phenomena. Meanwhile, the members of Galaxy Zoo have found several dozen objects like Hanny's Voorwerp.

The idea of resorting to volunteers in research is nothing new. Since 1900, for example, amateurs have been counting birds in North America in the Christmas Bird Count project. As a medium, however, the internet makes "citizen science" possible in entirely new dimensions. The founders were completely taken aback by the success of the Galaxy Zoo project. "We thought a couple of thousand might join so we used a normal server. But then the media did a piece on us and suddenly so many people signed up that one of the server's cables melted", explains Schawinski, laughing.

### Doing something useful

Thanks to their sheer number, the participants can categorise a total of 50,000 galaxies in an hour; it took Schawinski one arduous week to manage that many by himself. There has been a new unit of measurement within the community ever since: the Kevin week, which denotes the time in which the citizen scientists complete the week's work of an individual scientist. Around 100,000 citizen scientists have been intensively involved in Galaxy Zoo for about a year. Schawinski has recently met and got to know many of the helpers personally.

"These people don't want to consume science news passively, but rather get their hands dirty themselves and do something that brings research a step forward. They want to do something useful and invest a portion of their free time in it". Schawinski therefore has the utmost respect for "his" citizen scientists – which includes not wasting their time unnecessarily. Consequently, the individual projects only run as long as the actual data is needed. Not only are the participants kept abreast of progress in their research via blogs and social media, but they are also considered as colleagues in Schawinski's mind.

"For the first paper we published with the Galaxy Zoo data, we asked the journal if we could submit 100,000 co-authors. Whilst that wasn't possible in the end, each of our articles contains a link to a list of everyone who contributed". Around thirty scientific articles have already sprung from the Galaxy Zoo data and Schawinski expects more publications. ■

Website of the project at [zooniverse.org](http://zooniverse.org):  
[www.zooniverse.org/project/hubble](http://www.zooniverse.org/project/hubble) →

### The "Zooniverse"

It is not only astrophysicists who are interested in dedicated amateurs: various scientific projects have converged on "Zooniverse" that call for complex pattern recognition, and thus are just the ticket for "citizen science". Over 780,000 people have been analysing whale songs, identifying cancer cells or helping to improve climate models by evaluating data from the Royal Navy.

[www.zooniverse.org](http://www.zooniverse.org) →



Peter Seitz, Managing Director of the ieLab, introduces the serial entrepreneur and investor Michael Dillhyon (2nd from left), who passes on his experiences to the young entrepreneurs.

## ieLab

## ETH "greenhouse" for young entrepreneurs

Samuel Schlaefli

**Many founders of start-up businesses dream of being able to devote themselves entirely to their own business idea for a whole year and a half. In the "ieLab", ETH graduates learn how to target the market when developing their scientific findings.**

"Tragkraft 2t" (load capacity 2t) is the description on the freight crane in the middle of the expansive hall at Leonhardstrasse 27, a stone's throw from ETH Zurich's main building. Suspended from the crane, hanging on solid steel chains, is a racing car. It not only pays homage to what was once a

metal workshop, but also serves as a metaphor for the spirit intended to permeate the "Innovation and Entrepreneurship Lab" (ieLab). The car is the product of a Focus project that a team of Bachelor students spent a whole year working on, and that was their first experience of collaborating with industry. It is a symbol of innovation, stamina and the will to carry through a project from the initial idea to the finished product.

It is Tuesday lunchtime, time for the Lunch Seminar, a fixed date in the ieLab's weekly schedule. A dozen new master and doctoral graduates are sitting or standing in a semi-circle around the lunch table in the northern corner

of the hall, armed with sandwiches and bowls of muesli.

A video projector is showing a PowerPoint presentation on the wall behind the kitchen unit. Today's speaker is the serial entrepreneur and investor Michael Dillhyon, who is using memorable images and talking in his strong American accent about common interests, mutual expectations and unwanted misunderstandings between capital providers and young entrepreneurs. After the 20-minute presentation, Dillhyon is bombarded by a flood of questions from the listeners. There's a sense of the American "let's do it" spirit in the air – a little bit of Silicon Valley in the heart of Zurich.

### From basic research to a market product

The ieLab is the brainchild of Roland Siegwart, who was once a postdoc student in the USA himself and now holds the post of Vice President Research and Corporate Relations at ETH Zurich. Siegwart has championed the cause of an exchange between research and industry. This "biotope" is expected to act as a breeding ground for precisely such activities. Roland Siegwart explains his philosophy as follows: "The ieLab is a melting pot for innovation, a place where young entrepreneurs meet our partners from industry and learn from experienced, serial entrepreneurs".

The Managing Director of the ieLab, Peter Seitz, explains: "There is a huge gap between the first scientific successes and their exploitation in a marketable product". According to Seitz, it is often difficult to marry the most recent findings from basic research with tried-and-tested production processes in industry, because the connecting bridges are missing. That is why, last September, ETH Zurich set up two rooms for its future young entrepreneurs to work in. The ieLab at the main campus is a hotbed for start-ups from the fields of mechanical engineering and electrical engineering, while the space at the Hönggerberg location is dedicated to life sciences. In addition to office space, the biology and chemistry graduates can also use laboratories there.

Another ieLab is to be created at Technopark Zurich in mid-2013 for information and communication technology. The workspaces are reserved for young spin-offs and especially for "Pioneer Fellows". This award allows graduates to spend a period of 18 months bringing their business idea to fruition. The 150,000 Swiss francs awarded for each fellowship are provided primarily by the ETH Foundation.

### Incubator and accelerator

Joël Busset and Florian Perrodin are two of the 24 Fellows currently receiving funding. During their master dissertation, they developed an acoustic camera at the Autonomous Systems Laboratory. The camera doesn't take any photos. Instead, it records noises and locates these in a three-dimensional space. Busset's and Perrodin's ambition is to create a new generation of focused hearing aids that can filter out what the wearer wants to hear from a large number of noise sources. Perrodin tells us about the advantages of his new workspace: this morning, he says, he received a non-disclosure agreement from an important partner in industry. Perrodin and his business partner did not have any experience of how to draft such an agreement in order to make it fair. So they went to Peter Seitz, who has also set up his office in the ieLab. Seitz put them directly in touch with "ETH transfer", where legal experts spend their days dealing with contracts like these. "The ieLab is an incubator and an accelerator", explains Seitz. "We put our Fellows in touch with the right people and make sure that everything happens a little quicker for them".

Fabian Nater is also a Fellow and has been attending the ieLab since September. Prior to that he completed his doctorate at the Computer Vision Laboratory and founded a limited liability company. His product is web-based software that automatically filters out the most interesting scenes from long film sequences and splices them together. The system is already up and running at several webcam providers, and the first mobile phone app is now also online. What Nater particularly appreciates about the ieLab is the range of coaching on offer, which is part of the fellowship. He and his business partner are being taken care of by

"Doodle" founder and ETH Zurich graduate Michael Naef. They meet up every three weeks to discuss challenges in the development and marketing of their products. "Naef asks the right questions and introduces aspects that we would never have thought of ourselves", says Nater. The coach may also join in negotiations, as was the case in the past for a meeting with a large webcam service which was a potential business partner. "Experiences like these and the feedback from a professional are extremely valuable", says Nater enthusiastically.

### Opening up for alumni too

With so much enthusiasm for entrepreneurship, this raises the question as to what role the ieLab plays in ETH Zurich's research and education remit. Seitz reminds us that ETH Zurich also has a statutory obligation to exploit its research findings. According to Seitz, not only does the ieLab provide an excellent means of fulfilling this remit, it also supports the professional and personal development of graduates at the same time. The graduates, he says, are confronted with all aspects of entrepreneurship and – depending on their interests and talents – they may become scientific entrepreneurs who build bridges between academia and practice. Also, the graduates are not the only ones who found start-ups: "Studies in the US tell us that around 90% of founders in the field of high tech first work in industry before going on to found their own company", explains Seitz. There are plans for these "Olderpreneurs", i.e. ETH Zurich alumni, to find an entrepreneurial home in the ieLab in the future, too. ■

More about ieLab:

[www.ethz.ch/research/ielab](http://www.ethz.ch/research/ielab) →

## Inside



University presidents meet against the backdrop of the World Economic Forum: Professor Tan Chorh Chuan, President of the NUS, and ETH Zurich President Ralph Eichler.

## University alliance

## Ralph Eichler presides at IARU

Martina Märki

**The International Alliance of Research Universities (IARU) has been under Swiss leadership since the beginning of 2013. Its new chairman, ETH Zurich President Ralph Eichler, sees the alliance as a great opportunity for universities to learn from one another.**

ETH Zurich President Ralph Eichler has officially held the position of Chairman of the International Alliance of Research Universities (IARU) since 1 January 2013. The unofficial handover of the torch took place in Davos about three weeks later: Professor Tan Chorh Chuan, President of the National University of Singapore (NUS) and outgoing Chairman of the Alliance, met his successor during the World Economic Forum to exchange ideas.

The IARU is a collaboration between ten outstanding international research universities with similar visions and objectives in the field of higher education and in training future interna-

tional leaders (see box). Their goal is a more intense exchange of experiences and knowledge. "We have established many useful partnerships and work closely with university members at all levels of our institutions. We have created a high degree of trust within the IARU", says Tan Chorh Chuan, looking back over recent years.

### Sustainable exchange

The flagship project of the IARU's hitherto activities is the IARU Global Summer Program, whose international workshops each year bring together students from all the universities involved. Within the framework of this year's summer school programme, ETH Sustainability will be organising a course in Singapore. However, the IARU universities do not just promote sustainability through teaching and research, but also in concrete terms in how they operate. Since 2007 the participating institutions have together been championing sustainable university operations and have developed and defined standards to reduce their CO<sub>2</sub> emissions.

For Ralph Eichler, it is also important to guarantee the future quality of the universities in what is a globally networked environment. "The political and social background is completely different in Asia, Europe, Australia and North America. Therefore, it is important that we not only understand these differences, but also learn from each other. Thanks to the IARU, we have the possibility of comparing higher education systems from four continents at first hand", says Eichler.

In March, representatives of the universities will be in Beijing, swapping ideas on technology transfer. A meeting at ETH Zurich in October is dedicated to the topic of equality. And another meeting will focus on issues relating to the increasing globalisation of research funding. Alumni also contribute to the universities' strong network: in 2013 the first joint alumni event is due to take place in San Francisco. ■

### The university alliance IARU

The International Alliance of Research Universities (IARU) was founded at the end of 2005 and includes the following universities: the Australian National University, ETH Zurich, the National University of Singapore, Peking University, the University of California, Berkeley, the University of Cambridge, the University of Copenhagen, the University of Oxford, the University of Tokyo and Yale University.

[www.iaru.ethz.ch](http://www.iaru.ethz.ch) →

# ETH STORE

## Exklusive Artikel im ETH-Design



### Flagship Store

Standort Zentrum  
ML-Gebäude (Ecke Tannen-/Clausiusstrasse)  
Montag bis Freitag 09.00 – 15.00 Uhr

### Shop in Shop

Standort Höggerberg  
HPI-Gebäude (SAB-Shop/Polybuchhandlung)  
Montag bis Freitag 08.00 – 18.00 Uhr  
Samstag 11.00 – 16.00 Uhr



Online bestellen: [www.eth-store.ch](http://www.eth-store.ch)

Connected



Alumni Business Dinner

The university talks to Nestlé

The first Alumni Business Dinner of 2013 took place in a special format on 28 February: Lino Guzzella, Rector of ETH Zurich, spoke with José Lopez, Executive Vice-President of the global food concern Nestlé, who explained the contribution that the group would like to make towards a sustainable

food supply and how his company collaborates with leading universities. This topic is especially important for ETH Zurich, as the university has declared global nutrition a key strategic issue with the World Food System.



Disney research

Oscar for smoke signals

It was a great honour for ETH Zurich Professor and Disney Lab Director Markus Gross: Together with a former postdoctoral student and two scientists from the USA, he was presented with a "Tech Oscar" from the Academy of Motion and Picture Arts and Sciences on 9 February. The scientists developed a process that leading special effects studios use to simulate smoke and explosions in Hollywood films.



Partnership councils

Exchange with industrial partners

On 25 January, the fifth Partnership Council took place on the topic of energy: Ten representatives from industrial partner companies discussed a wide range of issues related to the CO<sub>2</sub> problem with six ETH Zurich professors, selected doctoral students and post-docs. ETH Zurich and the ETH Zurich Foundation also organise similar partnership councils in the fields of sustainable building, risk research and global nutrition. They afford the partners a direct insight into research and promote an exchange between industry and academia.



ETH Day

New honorary doctors

Two extraordinary scientists received an honorary doctorate from ETH Zurich on ETH Day 2012: Hans G. Hornung (left) was honoured for his outstanding contributions to research on the gas dynamics of high-speed flows. The second new honorary doctor is Lord Martin J. Rees (right). The famous astrophysicist, who has been Astronomer Royal to the Queen of the United Kingdom since 1995, was distinguished for his explanations of cosmic phenomena.

ETH Zurich alumnus Anton von Weissenfluh

# The chocolate manager

Christine Heidemann

**Anton von Weissenfluh can do with a clear conscience what many take such great pains to resist: he can eat chocolate every day. In fact, he has to, for this ETH Zurich alumnus is the CEO of Chocolats Halba, the Coop's chocolate factory.**

Every morning, shortly after half past four, Anton von Weissenfluh leaps up and down – for ten to fifteen minutes on his trampoline. Then he has breakfast and leaves Kriens in the Canton of Lucerne for “his” chocolate factory. It is called Chocolats Halba. It belongs to the supermarket chain Coop and is located in Wallisellen near Zurich.

This ETH Zurich graduate, with a doctorate in food science, has been the CEO there for six years. And he loves his job: “It makes no difference to me whether I’m at work or on the tennis court; I just like doing it”. And who could blame him when he already gets to have his first piece of chocolate at around half past seven in the morning? For purely professional reasons, of course.

For as soon as von Weissenfluh reaches his office in Wallisellen he embarks on a tour of the factory. His 230-strong workforce produces 12,000 tons of chocolate a year in the form of around 400 different products. The CEO’s rounds take him past the development department, where just about every day the staff churn out something new that needs testing. Every slight recipe variation and every hand sample (as the prototypes are called in chocolate manufacturing) passes the boss’s taste buds.

“Unlike wine, where you have to draw air through it when you taste it, you simply let the chocolate melt in your mouth by moving it back and forth on the tongue like this”, explains von Weissenfluh to his visitor, who tries to mimic the expert.

“Now draw the chocolate through and taste: caramel, a hint of roasted almonds, vanilla, leather and a gentle, flowery note: violet”. He already lost his visitor at “leather”.

However, von Weissenfluh’s tongue was not always so sensitised: “When I joined Chocolats Halba I was a passionate milk-chocolate eater. Milk makes the flavour profile softer”. Nowadays, this ETH Zurich graduate prefers dark kinds, which are more varied in their aroma. “Chocolate consists of about 400 aroma components, much like coffee”, says the CEO, whose enthusiasm for his profession is infectious.

This 56-year-old manager also believes that his private and professional sense of satisfaction have something to do with his success. After all, before von Weissenfluh joined Chocolats Halba, the factory had been up for sale.

Since then, things have changed radically – due in no small part to his courage in pushing known boundaries. Together with his young team, von Weissenfluh took a step

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**“As a manufacturer, it’s no longer enough to sell good chocolate”.**

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Anton von Weissenfluh

closer to the origins of cocoa and also expanded Chocolats Halba into an international export company for its own brands. In Australia, Canada, the Netherlands, Germany, the USA and most recently in China, people have now been enjoying chocolate “made by Chocolats Halba”.

This has enabled the CEO to increase the company’s turnover by over 25 percent since he took up his position. “As

e pleasure begins



Anton von Weissenfluh has positioned his products on the market with a healthy dollop of passion and dedication – from Easter bunnies to the latest creation: fine chocolate made from Honduras beans.



an industrial manufacturer, it is no longer enough to grow cocoa and sell good chocolate; in the chocolate industry, you also have to safeguard raw materials and sales markets".

But ultimately, according to this ETH Zurich alumnus's personal aspirations, everyone should benefit from the success of his chocolate. Regardless of whether the beans come from Ghana, Peru, Ecuador or Honduras, von Weissenfluh and his team are regularly out in the field and fully committed towards improving the income and living conditions of the cocoa farmers. His flagship location is Honduras, where he launched a pilot project in collaboration with the Coop Sustainability Fund, the State Secretariat for Economic Affairs (SECO), the development organisation Helvetas, and the Honduras Foundation for Agricultural Research. Not only do the farmers receive more income and bonuses. Their revenue also increases constantly, thanks to the reforestation of cropland with precious wood varieties. "In such agroforestry systems, the biodiversity and soil quality improves, the water balance is stabilised, carbon dioxide is absorbed and the rainforest is protected", explains von Weissenfluh. Plus: cocoa thrives better in the shade. And thanks to optimised crop conditions, the harvests also increase.

In all of the CEO's projects, contact with people, especially the farmers, is extremely important to him. "I come from the countryside myself. I grew up in Rigi Kaltbad on a mountain and have always had very close ties with agriculture, ever since I was a boy". He will never forget when the small farmers from Honduras and Ghana were invited to Wallisellen and bit into chocolate made from "their" beans for the first time. He plans to launch the new Honduras chocolates on the Swiss market by the end of the year.

But von Weissenfluh is also a hands-on boss when it comes to his employees in Wallisellen. "My way of dealing with day-to-day business is proximity". The CEO doesn't think much of e-mails. He would rather go to see his colleagues in person and talk to them to get a sense of how they are.

But can he and his family, which he also eagerly supplies with the delicious sweet, actually stand the sight of chocolate anymore? "We still love eating chocolate", laughs von Weissenfluh. Apart from anything else, the family make ideal guinea pigs for new products. His children, who are now 26 and 29, even come home on weekends as often as possible for tasting sessions.

#### Fiercely competitive market

One of von Weissenfluh's mottos is: "Quality holds a mirror up to our abilities and is thus an engine for improvement". Resting on his laurels is therefore out of the ques-

tion and the next major challenge is already around the corner: the development of a new, state-of-the-art factory in Pratteln. Efficiency and high-quality products above all are crucial to keeping up with the fiercely competitive chocolate market – especially since gigantic market potential awaits producers in emergent countries such as China. After all, in contrast to the average Swiss, who treats himself to eleven kilograms of chocolate a year, nowadays the Chinese just about manage 100 grams.

### "My way of dealing with day-to-day business is proximity".

Anton von Weissenfluh

What makes Swiss chocolate so popular all over the world? "We grind our chocolate a little finer than manufacturers in other countries, which makes it more balanced and smoother – but also more expensive", explains the CEO, allowing another sample of his craft to melt in his mouth. Strength lies in calmness. Fortunately, he is rarely stressed and not in the slightest bit at risk of a burnout. And so the chocolate manager from Wallisellen will probably carry on doing his morning jumps for many years to come. ■

Anton von Weissenfluh studied food science at ETH Zurich, where he went on to obtain a doctorate. His topic: "The optimisation of maturing conditions for soft blue cheese". He subsequently ran the laboratory and development department at soft-cheese manufacturer Baer in Küssnacht. After a brief stint in the marketing department at the Mettler Toledo Group, which specialises in weighing systems, he returned to the food industry and took over the production management at baby-food manufacturer Galactina in Belp. After that, he was responsible for production at biscuit manufacturer Kambly for ten years before becoming managing director for another five years. He has been the CEO at Chocolats Halba since 2007.

 Alumni

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Four times a year, the latest from research and teaching at ETH Zurich, including background information, facts and features with pictures, videos and info graphics: Globe – the magazine of ETH Zurich and ETH Zurich Alumni, available in German and English. **Download tablet app now for free!**



Assistants in a chemistry lab at ETH Zurich in around 1930.

1933

## Miracle medicine from the ETH labs

Martina Märki

**Nowadays, popping vitamin pills is routine for many people. Over 110,000 tons of vitamin C are currently produced artificially every year. The methods for manufacturing synthetic vitamin C were developed in a chemistry lab at ETH Zurich eighty years ago – on what was initially a rocky road.**

Bleeding gums, tooth loss, fever, muscular atrophy and a weak immune system – the vitamin C deficiency disease scurvy was once the major stowaway on the high seas. During the era of the voyages of discovery, entire crews would fall victim to it. Although people had been aware since the mid-eighteenth century that citrus fruits and sauerkraut could remedy the problem, it wasn't until the first decade of the twentieth century that this helpful active substance could be identified and given a name: vitamin C. A dissertation by former ETH Zurich technology historian Beat Bächi (see box) explains how Switzerland became a pioneer in the artificial production of vitamin C.

From a scientific perspective, despite all the research, vitamins were barely more than a hypothesis until the end of the 1920s. Scientists only had indirect evidence of their existence through the effect their absence had on people and animals in cases of malnourishment. This also went for vitamin C, which is so popular today. In 1928 the Hungar-

ian researcher Albert von Szent Györgyi became the first to successfully isolate the vitamin from the adrenal glands of cattle. The amount obtained was so small, however, that it was insufficient to shed any more light on the substance. But the researcher did not let that discourage him. In January 1933 he was eventually able to showcase 450 grams of pure vitamin C that he had isolated from peppers. A short while later, scientists decoded the chemical structure of the substance and gave it the scientific name ascorbic acid. Soon afterwards, the first attempts began at producing vitamin C artificially. The ETH chemist and eventual Nobel Prize Winner Tadeus Reichstein played a key role in this. The so-called second Reichstein synthesis, where vitamin C could be obtained from glucose in five steps, laid the foundation for the industrial production of vitamin C.

### Coffee, "antikotzin" and vitamin C

Reichstein had made a brief foray into private food research before returning to ETH Zurich in 1929 to do a post-doctoral degree in Leopold Ruzicka's research group. He had primarily concentrated on coffee until then, but had also delved into all kinds of other interesting ideas, as Bächi describes vividly in his book: the topic of "cooking smells", African drugs as abortifacients, experiments with meat and meat extracts, or a remedy for vomiting, which Reichstein and a chemist friend from the food industry,

Gottlieb Lüscher, liked to refer to as "antikotzin" in their letters (literally "anti-puke"). For a time, they both toyed with the idea of producing coffee artificially, which is possibly what gave them another idea: why not try synthesising vitamin C? It seemed an obvious thing to do, since at the time it was still believed that vitamin C belonged to a particular sort of chemical compound that was present in coffee. While this was not the case, it proved a productive mistake, for it aroused Reichstein's enthusiasm for the topic of vitamin C synthesis. Sure enough, in April 1933 he and his staff managed to present the first synthesis procedure for the vitamin.

### Man-made or peppers?

The method initially encountered a few teething problems: it was extremely complicated, yielded little and, above all, it produced d-ascorbic acid. Unlike natural, left-handed vitamin C (l-ascorbic acid), this was a substance that was right-handed. No one could tell just what impact this would have on living organisms. So animal testing was unavoidable. Reichstein knew that Roche had already conducted scurvy experiments on animals using natural vitamin C, so he approached the company. For the moment, Roche still saw little demand for artificial vitamin C, but they agreed to test Reichstein's substance on guinea pigs. The results were truly disastrous. The guinea pigs that were given Reichstein's d-ascorbic acid all died miserable deaths from scurvy. A few months later, however, Reichstein found a way to produce l-ascorbic acid, too. And this time the results of the animal testing were satisfactory.

From Roche's perspective, this mainly begged the question as to which mode of production would make more sense and be more profitable in the long run: natural vitamin C extracted from peppers, a procedure that researchers from the University of Zurich and the Hungarian Györgyi championed, or the production of artificial vitamin C? At first, things did not look particularly promising for Reichstein on that front, either. His method simply yielded too little. What was the answer? Reichstein and his team came up with a rather unusual idea for the time: bacteria would carry out the second problematic conversion step, the transformation from sorbitol to sorbose.

However, the bacteria proved to be fairly temperamental colleagues. The first bacterial strains Reichstein ordered especially from various "offices for mould cultures" did not produce any sorbose at all. While studying older literature, Reichstein discovered that the right bacteria could also be found in the intestine of the drosophila fruit fly.

Consequently, the chemists took the matter into their own hands. Armed with wine, sugar and vinegar, they went

hunting for fruit flies. And lo and behold, the wild bacteria obtained this way proved to be extremely successful; the second Reichstein synthesis had been found. Roche came round to the view that the synthetic production of vitamin C might well be more worthwhile than extracting it from peppers, and submitted a corresponding patent application together with Reichstein in October 1933. At the time, however, no one had any inkling of the dimensions that the artificial vitamin C industry would eventually take on. They expected to sell 100 kilograms a year. In actual fact, by 1995 Roche had sold a total 486,508 tons of ascorbic acid worldwide. In 1950 Reichstein received the Nobel Prize for Medicine – not for vitamin C synthesis, but for his later research on hormones, especially cortisone. ■



ETH Zurich chemist Tadeus Reichstein in 1933.

### Vitamin C for everyone

In his dissertation published in 2009, *Vitamin C für alle!*, Beat Bächi did not merely outline the development of vitamin C synthesis. The book also describes impressively how vitamin C became a versatile miracle drug in the following decades through clever marketing, and how the company Hoffmann-La Roche came to occupy a market-dominating position in the vitamin C business.

Beat Bächi: *Vitamin C für alle! Pharmazeutische Produktion, Vermarktung und Gesundheitspolitik (1933-1953)*. Chronos Verlag, Zurich, 2009.

## Alumni life



Christoph Bünger and Olga Diamanti both support gifted master students with their donations.

#### Excellence Scholarship and Opportunity Programme

## Alumni support talented students

Felix Würsten

**For five years now, ETH Zurich has been supporting gifted master students with scholarships for academic excellence. Thanks to the "Excellence Scholarship and Opportunity Programme", the university can bring talented young students to Zurich and give them an education here. More and more alumni are supporting this important programme with a donation to the ETH Zurich Foundation.**

Supporting the brightest minds with an Excellence Scholarship – this is the goal pursued by ETH Zurich since 2007 with the "Excellence Scholarship

and Opportunity Programme". In future the university wants to award around 50 scholarships each year to exceptionally gifted students so that they can complete a master degree at ETH Zurich. The idea has had great feedback, particularly amongst alumni.

#### Important funding tool

Students who are awarded an Excellence Scholarship by ETH Zurich receive a maximum of CHF 40,000. This amount covers study costs and living expenses during the master degree and allows students to focus entirely on their studies. The Excellence Scholarships are funded by donations from companies, foundations and also individuals. "We currently have enough funding for around 40 scholarships per

year", explains Franziska Juch, who manages the programme at the ETH Zurich Foundation and is thus also responsible for acquiring the funds needed.

Well over a quarter of all Excellence Scholarships have so far been awarded to Swiss nationals. Almost 40% of the scholarships were awarded to students from Europe, 8% to students from North America and the remaining 26% went to students from the Asia-Pacific region. The results show that the funding tool is an efficient means for ETH Zurich to bring gifted students from all over the world to Zurich.

#### Inspiration for all students

One of those able to come to Zurich thanks to the Excellence Scholarship was Olga Diamanti, who was born in Greece. After completing her bachelor degree she wanted to continue her studies abroad, because there were no suitable training opportunities in her homeland in visual computing, her chosen field of study. "Studying in Zurich is particularly expensive for students from abroad", she explains.

"That's why these scholarships are a great help to students who want to do their master here". For Olga Diamanti, the switch to Zurich was in any case exactly the right choice for her. She is now working on her doctorate at ETH Zurich and has also become a donor in the process. She is the first former Excellence Scholarship recipient who now supports the programme herself with a donation. She explains her motivation as follows: "I benefited from this programme as a master student, and now I want to give something back to the university". The Excellence Scholarship and Opportunity Programme provides funding for just the best 2 to 3 percent of all new master students, regardless of where they come from or their financial situation.

But it is not just the recipients who benefit from the Excellence Scholarships – all the other students also benefit indirectly. That's because the Excellence Scholars inspire their fellow students with their talents in their area of expertise and contribute to a motivating environment.

#### Still potential for improvement

"With its clear focus on excellence, ETH Zurich is taking a path that is unconventional for Switzerland", says Christoph Bünger. "But I'm convinced that it's precisely the right path". This ETH alumnus, who graduated with a degree in process engineering in 1986, now works as a freelance interim manager and is also one of the alumni who actively support the programme with a donation. "I was also reliant on external funding during my studies", he remembers. "Now – thanks to the good education provided by ETH Zurich – I am in a position not only to finance the studies of my own children but also to support other young people".

For Bünger, his involvement is ultimately also a question of generations. "The older alumni support the young students and thus make a contribution to the next generation". He likes that fact that the Excellence Scholarship gives a degree of freedom to the students who receive it. "They can concentrate on using their talent to make an extraordinary contribution to a topic that interests them".

More and more alumni like Christoph Bünger are agreeing to actively support the programme. While 300 alumni contributed in 2008, this figure had already increased to more than 1060 by 2012. Between 2011 and 2012 alone, the number of donors increased by more than 400, much to the delight of Franziska Juch. "For the past three years we have been

writing to around 30,000 alumni", she explains. "The number of positive responses has risen continuously in that period. Today, in excess of 3 percent of all of the alumni we contact make a contribution".

The numerous smaller and larger contributions from former students come together to make up a princely sum. Last year, former students donated CHF 220,000 to the Excellence Scholarship Programme. "The programme is ideal for involving alumni, because it gives former students the opportunity to support the next generation directly and to experience their success at first hand", confirms Peter Brunner, Managing Director of ETH Alumni. And Juch adds: "This programme demonstrates directly the bond that the alumni feel with their alma mater. And we are grateful for every contribution that we can use to expand the Excellence Scholarships further". ■

#### Support talented students!

The Excellence Scholarship and Opportunity Programme supports the most talented students with an Excellence Scholarship and allows them to complete a master degree at ETH Zurich, regardless of where they come from or their financial situation. As alumni of ETH Zurich you can also lend financial support to this important programme – with a donation to the ETH Zurich Foundation. For more detailed information, please visit:

[www.globe.ethz.ch/esop\\_en](http://www.globe.ethz.ch/esop_en) →



#### From the President

### Dear ETH Zurich alumni

This is my last column, as I will hand the post over to my successor at the next delegates' meeting. In the autumn of 2002, I took over an organisation that had put in place all of the structures but did not work seamlessly. At the time there were over 10,000 members with twelve regional organisations and three subject-based organisations. Today, ETH Zurich Alumni has more than 21,000 members with 25 regional organisations, 18 subject-based organisations and five clubs (geared toward leisure activities).

The challenge of the first years was to get the association to function smoothly. After we succeeded in doing this, together with Peter Brunner as the Managing Director, the focus was on growth with new international chapters and specialist groups. In the past year we have concentrated on adjusting the structures. The new member ruling created the framework for this.

I would like to thank everyone who supported me during my time as President. I wish my successor all the luck in the world in making the new structures work.

Dr. Eduard M. Brunner  
President of the ETH Zurich Alumni Association

Alumni life

# Agenda

## Alumni Symphony Orchestra

14<sup>th</sup> concert, spring 2013

*Johannes Brahms (1833–1897)*

**Symphony No. 3 in F major, op. 90**

*Richard Wagner (1813–1883)*

**"Lohengrin":**

**Preludes to Acts 1 and 3**

**From the Wesendonck Lieder:**

**"Der Engel" and "Schmerzen"**

**From Tristan und Isolde:**

**"Liebestod"**

**Tannhäuser: Overture**

17 April 2013, 7:30 p.m.

Ref. Church Gossau (ZH)

20 April 2013, 7:30 p.m.

Zurich Tonhalle, great hall

## Alumni business events

**Roger de Weck**

Director General of Schweizerische Radio- und Fernsehgesellschaft (SRG SSR)

11 April 2013

**Hans Hess**

President of Swissmem

12 September 2013

Networking aperitif from 5:30 p.m.,

event begins at 6:45 p.m.,

Main ETH Zurich building, Dozentenfoyer

Register at:

[www.alumni.ethz.ch](http://www.alumni.ethz.ch) →



The next big alumni trip will be to Japan in October. Besides a visit to the famous volcano Fujiyama, the itinerary also includes various technical highlights.

## Alumni events

**Alumni trips**

Paris

22-26 May 2013

Japan

Mid/late October 2013

**Literature brunch**

Reading by Lukas Hartmann

22 September 2013, 10 a.m.

Main ETH Zurich building, Dozentenfoyer

**Working in the energy sector**

Alumni report from their professional lives

19 March 2013, 6 p.m. - 8 p.m.

Main ETH-Zurich building, E5

**Lead, delegate, motivate**

Careers training with Gerhard Grieb

14 May 2013, 8:30 a.m. - 5 p.m.

ETH Alumni Pavilion

## Graphics collection

**Fischli & Weiss and Friends**

Works from the collection

6 February - 28 March 2013

**Markante Köpfe**

Portraits of Anton van Dyck and his illustrious circle

24 April - 28 June 2013

Main ETH Zurich building, E53

## Exhibitions

**Fossil Art**

An exhibition you can touch and feel

Until 12 May 2013

FocusTerra, Sonneggstrasse 5, Zurich

[www.focusterra.ethz.ch](http://www.focusterra.ethz.ch) →

## Treffpunkt Science City

Entitled "Linked, networked, connected", the next issue of Treffpunkt examines the topic of communication as a basis for human life. How do cells, organs, nervous systems and the brain communicate in the body and guarantee that the complex human organism works? How do we connect the world with increasingly sophisticated communication technologies and how do they work? What connects people and how does communication change the world? Scientists from ETH Zurich answer these questions from 24 March to 16 April 2013.

[www.ethz.ch/news/treffpunkt](http://www.ethz.ch/news/treffpunkt) →



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# Problem?

Kein Problem: Zühlke löst gerne komplexe Businessprobleme – in den Bereichen Softwarelösungen, Produktentwicklung und Managementberatung. Deshalb suchen wir Talente, die lieber den Weg der besten Lösung als den des geringsten Widerstands gehen. Kein Problem für dich? Wir freuen uns auf deine Bewerbung.