Quantum research network 36 New ETH handlebars steer the way to success 40 Profile of alumnus Peter Schmidt 45

GLOBE

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1/2023

Emotional!

What our feelings say about us 14

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EDITORIAL

"Understanding the science of emotions requires a knowledge of multiple disciplines."

Our emotions affect how we think and act. Whether happy or sad, fearful or angry, the spectrum of our emotions is incredibly broad. Little wonder, then, that science has a lot of questions to ask. For instance, what role does gut feeling play in our decision-making? Can intuition really be taught? And – as AI becomes ever more pervasive – what happens on an emotional level when humans interact with robots?

Feelings are also associated with all sorts of biochemical reactions in the brain and body, which affect the way we talk, the way we move, or the rhythm of our heart. Studies by ETH researchers and others have shown that the effects of emotional stress can even be passed on to the next generation. Meanwhile, mathematical models are giving us new insights into hidden states of the brain, which would appear to play a key role in mental illness.

Understanding the science of emotions requires a knowledge of multiple disciplines. Hence the decision by ETH Zurich and the University of Zurich to launch their new interdisciplinary Master's degree in brain sciences. And lest we forget, emotions are also an indispensable tool in our search for scientific knowledge, as Michael Hagner explains in his fascinating essay.

I hope that reading this issue of *Globe* will be an emotional experience for you – in a positive sense, of course!

Joël Mesot,
President of ETH Zurich

Globe – the magazine for ETH Zurich and ETH Alumni

Illustrations: Oriana Fenwick (emotions image series; cover page: surprise); Alexandra Compain-Tissier (editorial)

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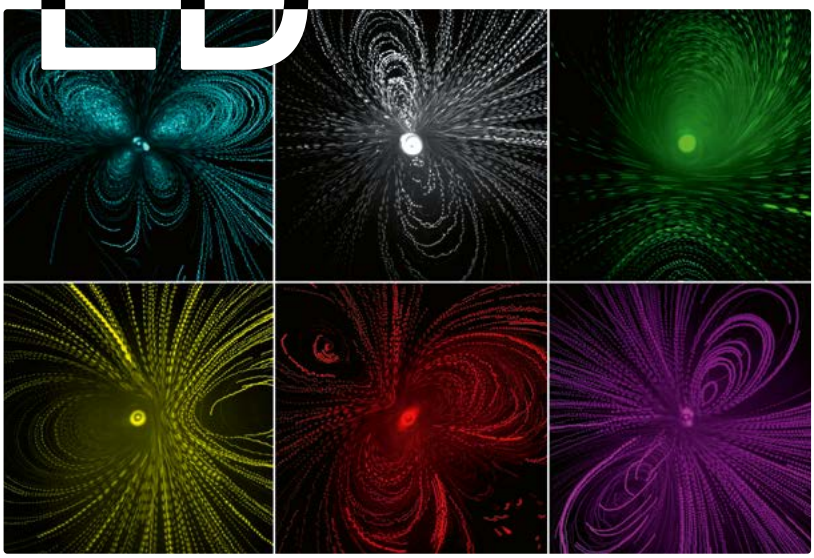


Image: ETH Zurich

Various vortex patterns, viewed from above and rendered visible by particles in the liquid. The dot in the middle of each image is the glass needle.

Oscillation for more automation

A microfluidic chip, also known as a lab-on-a-chip, is a miniature system of fine capillaries through which external pumps are usually used to transport minuscule volumes of liquid. To date, there has been little success in automating such systems. Now, however, a team of scientists led by ETH professor Daniel Ahmed has developed a device comprising a fine, pointed glass needle and a piezoelectric transducer which causes the needle to oscillate. Similar transducers are used in loudspeaker technology, ultrasound imaging and professional dental hygiene equipment. The oscillation frequency of the glass needle in the ETH device can be varied. When this needle is immersed in a liquid, it creates a three-dimensional pattern composed of a number of vortices. The precise pattern depends on the oscillation frequency and can therefore be adjusted accordingly.

The researchers have already demonstrated a number of applications for this device. For a start, its ability to generate a complex 3D pattern made up of multiple strong vortices means it is good at mixing together minuscule drops of highly viscous liquids. Similarly, it can be made to pump liquids through a system of capillaries when the oscillating needle is placed close to a capillary wall and used to create a specific pattern of vortices. Finally, the research team also discovered that it can be used to trap fine particles in a fluid: when the needle is placed in the liquid, the relatively large particles move towards it and accumulate there. ○

Acidity inactivates airborne viruses

It is well known that viruses such as SARS-CoV-2 and influenza are transported through the air by aerosols. Less clear, however, is how long these aerosol-borne viruses remain infectious. One factor that was formerly underestimated is the acidity of the exhaled aerosol particles. This is important because many viruses are pH-sensitive. A team of researchers from ETH Zurich, EPFL and the University of Zurich has now shown for the first time how the acidity of exhaled aerosol particles changes over time and under different ambient conditions – and how this impacts the viruses in those particles.

The new study shows that exhaled aerosol particles acidify much faster than might be expected. The speed of this depends on the concentration of acid molecules in the ambient air and the size of the aerosol particles. In air typical of living spaces, particles of nasal mucus and lung fluid synthesised specifically for the study – all less than a micrometre in diameter – reached a pH of 4 after only 100 seconds or so. The researchers believe that nitric acid is largely responsible for this acidification. Nitric acid sticks rapidly to surfaces, furniture, clothing and skin, where it is taken up by tiny exhaled aerosol particles. This increases their acidity, thereby lowering the pH value.

The research team was also able to show that this acidity decisively affects the speed at which viruses trapped in mucus particles are inactivated. At a pH value of 4, up to 99 percent of influenza A viruses in aerosol particles are inactivated in around three minutes. By contrast, SARS-CoV-2 is so acid-resistant that the team initially believed its readings to be false. In fact, a pH value of below 2 is required to inactivate the coronavirus. And since the pH of aerosol particles rarely falls below 3.5 in typical living quarters, it takes a number of days for 99 percent of coronaviruses to be inactivated. ○

Neophyte invasion accelerates

To date, mountain regions have remained largely untouched by invasions of neophytes – alien plant species. However, a new study led by ETH Zurich reveals growing pressure on mountain ecosystems and their unique vegetation worldwide. Between 2007 and 2017, the number of alien plant species in each of the regions covered by the study increased on average by 16 percent. Moreover, in 10 of the 11 mountain regions studied, the scientists discovered neophytes growing at significantly higher elevations than was the case ten or even five years ago.

Whether deliberately or unintentionally, people are often responsible for introducing alien plants to lowland regions, where they then spread to higher elevations. Roadsides are a typical axis of propagation since it is here that the propagules of neophytes are readily dispersed by human activity. Since the natural flora in these places is disrupted, competition with native species that have adapted to the prevailing climate is also less fierce. ○

Image: ETH Zurich / Fiona Schwaller

An ETH Zurich researcher hunts for alien plant species along a mountain road in the Canton of Wallis, Switzerland.


ERL

Image: WSL / Gottardo Pestalozzi

Gathering eDNA by drone

SAMPLED ○ In their quest to map species diversity, ecologists gather traces of genetic material that living creatures have left behind on the ground or in rivers and lakes. When it comes to treetop dwellers, however, the search for samples of environmental DNA (eDNA) poses more of a challenge. But now a team from ETH Zurich, the Swiss Federal Institute for Forest, Snow and Landscape Research, and the company Spygen has developed a drone that can take the hunt to the heights of the forest canopy. Equipped with adhesive strips and technology to gauge the thickness and elasticity of individual branches, the drone is able to autonomously fly to a branch, land on it and collect samples. In tests, the drone was able to collect material from a total of seven trees in three days. To prepare the drone for its next challenge, the robotics team are currently putting it through its paces in a re-creation of the Masoala rainforest at Zurich Zoo. In an upcoming competition, which is to be held in a Singapore rainforest, the drone will have just 24 hours to gather samples from 70 trees. ○

Video: "Drone gathers environmental DNA" youtu.be/sqU86EZn9c4

→ ethz.ch/specialdrone

Restoring nature equitably

Efforts to restore degraded ecosystems have so far fallen short of meeting global targets. Sound restoration must better incorporate social processes promoting equity in order to effectively benefit people, climate and biodiversity, says Sara Löfqvist.

SARA LÖFQVIST is a doctoral student at the Environmental Policy Lab at ETH Zurich.

The United Nations Biodiversity Conference in Montreal closed this past December with an unprecedented agreement to place 30 percent of global degraded landscapes under protection by 2030, especially emphasising the need to respect indigenous and local communities' rights in the process. Yet, despite ambitious policies and strong financial interest, recent restoration efforts have not reached targets: only 18 percent of land pledged for restoration by 2020 had been restored by 2019, and the world is currently off track in meeting targets set for 2030.

Global restoration agenda setting has so far primarily been driven by insights from ecologists, especially by mapping studies outlining potential of restoration across scales. These studies have provided important advances on the global scope and geographical heterogeneity of the challenge and have played a crucial role in mobilising attention and efforts toward restoration. However, social aspects such as power relations, governance systems and value tradeoffs also play a key role in determining whether a restoration project succeeds over time. Yet these factors have been given less attention in policy.

In a recent external study, my colleagues and I show how areas identified by other scholars to be of highest restoration priority around the world are inhabited by more than a billion people who disproportionately belong to groups with below-average health outcomes, education levels and income. These people are in many cases directly dependent on their landscape for food security and often have strong cultural ties to their lands.

SOCIAL ISSUES Current restoration often takes place in the context of strong power imbalances, where external funders typically have more power to decide on if, where and how restoration is carried out, while local communities who are most vulnerable to its outcomes often are the ones with the least say. Furthermore, favoured objectives are likely to differ substantially between actors. Whilst local people tend to benefit from restoration projects that are integrated in agricultural systems, follow cultural forest practices and / or yield economic benefits, private financers often favour restoration projects with strong climate change mitigation profiles. This translates to a preference to invest in fast-growing monoculture carbon farms which may go directly against the objectives of local communities and may have detrimental effects on ecosystems.

In all of this, the question of who governs a landscape becomes apparent. Land-use policies driven by actors in the Global North but implemented in the Global South have a burdensome track record of increasing marginalisation of local

communities for the benefit of carbon objectives, especially when decisions are made by distant but powerful stakeholders. Conversely, a growing body of evidence shows how local communities can benefit from sound ecosystem restoration when decision-making is decentralised and equitable. There's an obvious moral argument for more equitable restoration: the people living in restorable areas are the most affected by how a landscape is altered and should therefore have the strongest say in decision-making.

HARNESSING FULL POTENTIAL But beyond ethical reasoning, restoration projects will be more likely to sustain and achieve ecological objectives if they align with local communities' desires for their landscapes. People are simply more likely to maintain a participative restoration project that benefits them.

Restoration outcomes are a result of both ecological and social processes. By better integrating the two in restoration agenda setting and implementation, we can increase our chances of restoring Earth's degraded ecosystems in a way that helps mitigate climate change, preserves biodiversity and benefits vulnerable communities today and generations to come. ○

Read more blogposts at:
⟶ ethz.ch/zukunftsblog-en

A promising way to restore farmland: agroforestry combines crops or pastures with trees.

Image: smug / Adobe Stock

Bright dyes at low cost

Image: ETH Zurich

Polymer fluorescent dyes can now also be produced in red.

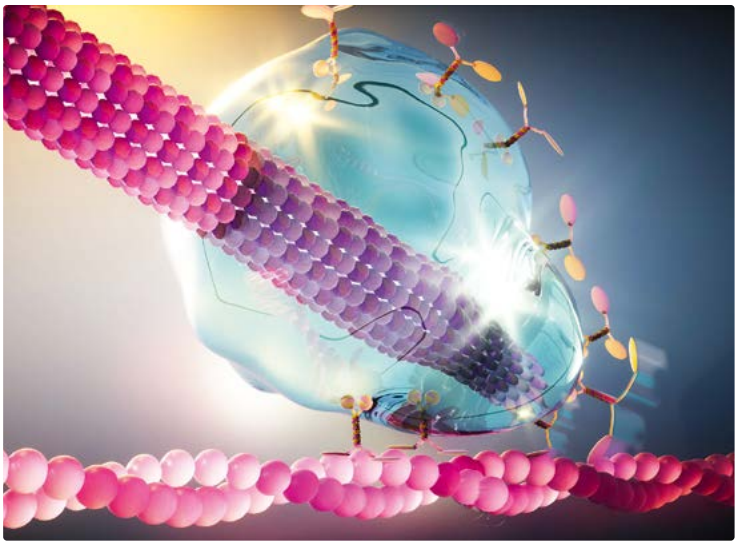
ETH researchers have developed a set of novel fluorescent dyes that are relatively easy and inexpensive to produce. The dyes are polymers with a modular structure, with each molecule consisting of a different number of subunits depending on the colour. The subunits are chemically simple molecules that are commercially available or can be produced by chemists in a single reaction.

Together with scientists from RMIT University in Melbourne, a research team led by ETH professors Jean-Christophe Leroux and Chih-Jen Shih has now used this new approach to create a wide range of colours – including red, which is difficult to produce conventionally. The team developed artificial intelligence algorithms that help decide which subunits are required for a particular colour and in what amount.

Potential applications include UV-activated security inks for banknotes and passports. This method can also be used to produce inks that change colour after prolonged UV illumination, which is a useful property in other security features.

Further applications for the new fluorescent molecules lie in the field of solar-power generation. They could also be used together with semiconducting molecules to produce low-cost organic light-emitting diodes for displays. ○

Image: Ella Maru Studios



A liquid droplet (turquoise), made up of protein molecules, acts as an adhesive.

Smart glue

Researchers from ETH Zurich and the Paul Scherrer Institute (PSI) have discovered how proteins in yeast cells form minuscule drops of liquid that act as a smart molecular glue. During cell division, this liquid ensures that the nucleus is brought into exactly the right position between the mother cell and the budding daughter cell. If the nucleus is in the wrong position, the result is a non-viable daughter cell without any genetic material.

"Biomolecular liquids can be extremely sophisticated and display a much wider range of properties than we are familiar with from our macroscopic viewpoint," says Yves Barral, Associate Professor of Biochemistry at ETH Zurich and one of the study authors. ○

More investment needed for net zero

Both the European Union and Switzerland are aiming to become climate-neutral by 2050 and reduce all greenhouse gas emissions to net zero. To achieve this target, major investment in renewable power generation, transmission networks, storage capacity and other climate-related infrastructure will be required. In the past, however, it was unclear just how much capital expenditure this would necessitate over the next 15 years and which areas should take priority.

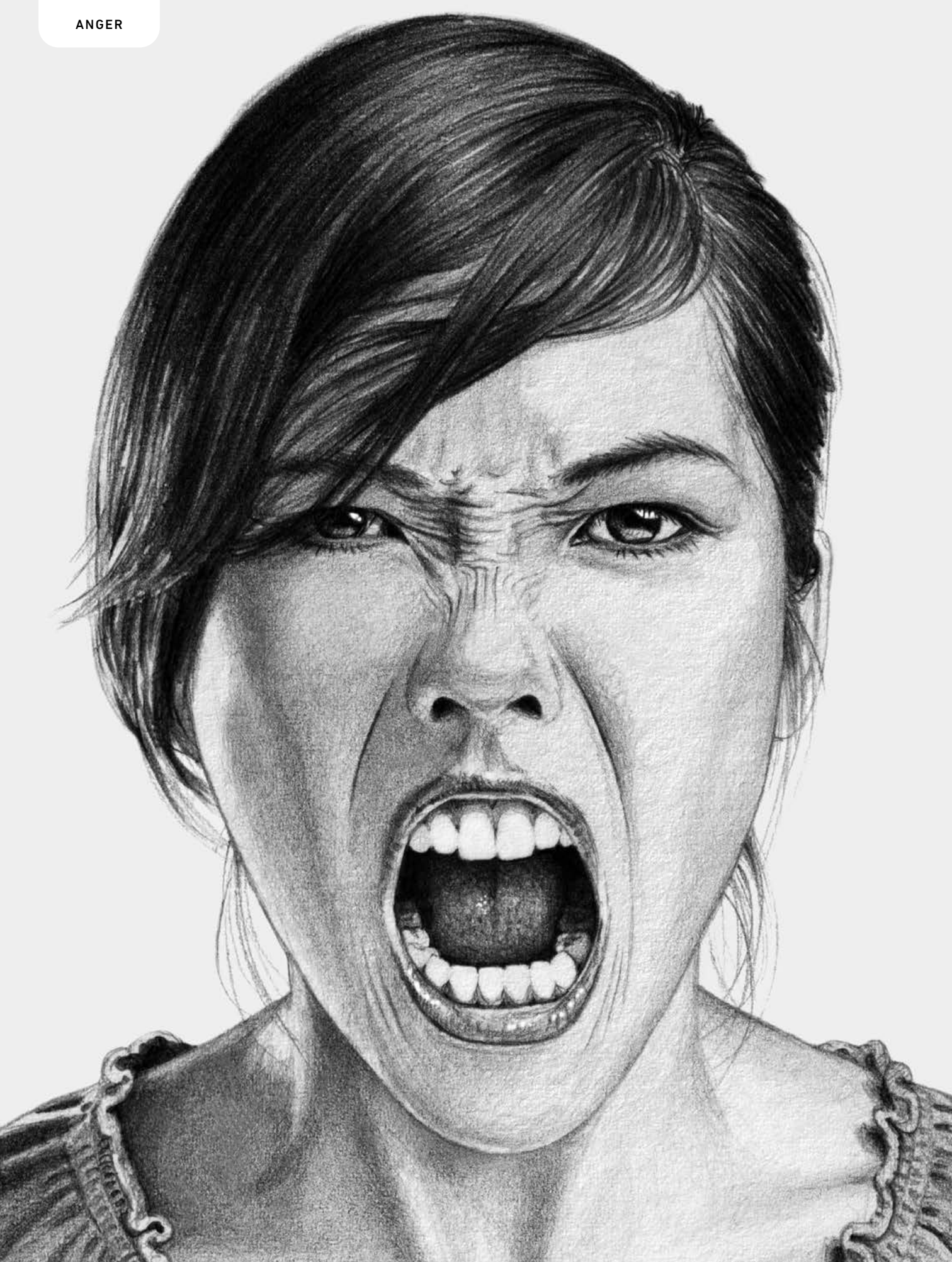
ETH professor Bjarne Steffen and doctoral student Lena Klaaßen have recently completed a meta-analysis that provides some answers to these questions. The authors conclude that without annual investment of 302 billion euros in climate-related infrastructure over the next two years, Europe will risk missing its net-zero target.

Steffen and Klaaßen analysed 56 technology- and investment-related studies from academia, industry and the public sector. While focusing on EU member states, they also took into account data on the UK, Norway and Switzerland.

The clearest need for investment is in the area of renewable power generation. Decarbonisation in all spheres of life will require annual investment of around 75 billion euros in photovoltaic and wind power plants over the coming years, an annual increase of 24 billion euros from recent levels.

To make capital rapidly available for the funding of new green infrastructure, policy in this area should concentrate on those sectors where the need for investment is most acute. According to Klaaßen, however, current EU regulations tend to focus on green stocks, despite the fact that capital for key climate-related infrastructure is almost never raised via the stock market.

Instead, the expansion of renewable power is generally funded by equity from private investors such as banks and pension funds. The public sector should therefore act to minimise the attendant risk through guaranteed revenue streams and by ensuring that approval procedures are quick and reliable. At the same time, public investment in new technologies such as carbon capture and storage can also help encourage private investors to venture into this sector. ○



THE POWER OF HABIT

FOCUS | Life is a constant stream of decisions that pit sober reflection against powerful emotions, conscious deliberation against gut instincts. Using complex models and sophisticated experiments, ETH researchers study how we combine these different decision-making strategies.

TEXT Felix Würsten

One mention of insects is enough to draw a sceptical smile from Michael Siegrist. As Professor of Consumer Behaviour at ETH Zurich, he is constantly reminded how conservative people are when it comes to food. "If we want to make food production more sustainable, insects are probably the hardest way to go about it," he says. "Insects turn almost everyone's stomach, which is difficult to overcome."

Siegrist and his team study how consumers are guided by their emotions – and their findings suggest that emotional responses are often more powerful than rational ones. In various experiments, the researchers have confirmed that, when it comes to assimilating information, we are influenced considerably more by symbolic information than by pure facts. In other words, pictures speak louder than words.

Give people the fuel-consumption data for two car drivers, for example, and almost everyone will say that the one who uses less fuel is more environmentally friendly. But tell them that the fuel-saver drives an SUV, while the other driver has a hatchback, and their opinion flips: the SUV driver is now perceived as less environmentally friendly, even though they consume less fuel. "Eighty percent of test subjects jump to the wrong conclusion," says Siegrist. "I find that astonishing."

Symbols exert particular power in relation to food. "People say they want their food to come from nature, not technology," says Siegrist. This stems from a naïve concept of nature that is firmly rooted in our minds, he says – a concept that is heavily promoted by government and by corporate marketing departments. "In fact, we only end up glorifying nature because technology has enabled us to make huge improvements in food safety," he explains.

What's intriguing is how technological change has left a different legacy in our kitchens than in our offices or living rooms. Floppy disks, CRT televisions and CDs have long since disappeared from everyday life – but in the kitchen, new technologies tend to supplement, rather than supplant, old ones. "We don't really need cans anymore, and we certainly don't need to prepare our food over an open fire," says Siegrist. "Yet we still choose to buy canned fruit and barbecue on the patio."

Siegrist's observations are based on the findings of the Food Panel Switzerland survey, in which he and his team built up a detailed picture of ⟶

Swiss consumer behaviour. The researchers also analysed intuitive eating strategies and how a partner's eating habits can influence our own behaviour. Siegrist's conclusion is that we only ever make gradual changes to our eating behaviour unless we are forced to do so by external factors. This matches his previous experience: "After all, it's not like we rethink our eating habits every single day!"

Siegrist also reaps the benefits of technical progress in his own research. "Twenty years ago, most of our studies were based on printed questionnaires," he says. "Nowadays, we can expose study participants to a whole new array of stimuli thanks to video and virtual reality (VR)." For example, Siegrist's team recently conducted an experiment into the feeling of disgust, where they asked participants wearing a VR headset to eat a real piece of chocolate while simultaneously watching the virtual depiction of something neutral – in this case a table – or of a defecating dog. Although the dog and the faeces were clearly not real, a large proportion of the second group refused to eat the chocolate. "Disgust is a powerful emotion," says Siegrist. "And it has a much stronger effect on us than cognition."

DOES INTUITION HELP WOMEN? Researcher Katharina Fellnhofer also uses lab experiments to better understand people's decision-making behaviour. She is currently a Marie Curie Fellow at the Chair of Education Systems, where she is focusing on an aspect that has received very little research attention, namely what role intuition plays in our decision-making process and how we can harness it to make better decisions.

Fellnhofer has developed a new method to help answer these questions. She starts by presenting the test subjects with graphs showing (real) companies' earnings performance over a five-year period. The participants are then given a short time to decide whether they wish to invest in the companies or not. Half the companies are a good investment, as shown by their earnings performance over the subsequent five years, while the other half are not. "My study method is essentially akin to a game of chance," she says. "So you would think women would do just as well as men." In fact, however, women make significantly worse investment decisions than men.

"Disgust is a powerful emotion."

Michael Siegrist

"The more complex the organism, the more complex the decisions."

Rafael Polania

But it turns out there is more than meets the eye in half of the graphs. These contain a hidden message in the form of emotionally charged three-dimensional images that are concealed in the graphs using a special technique and are only perceived subconsciously. Initially, the experiment is run using emotionally neutral images, but when it is repeated with the graphs containing emotionally charged images that intuitively guide the viewer towards the right decision, then female participants do better and achieve similar results to the men. "This shows how women can overcome a disadvantage by drawing on information that is only available through intuition," explains Fellnhofer.

Fellnhofer noticed a rapid improvement in the study participants' decisions, which suggests that subconscious learning had taken place. By fine-tuning her measurement method, she now hopes to explore whether intuition can be taught and, if so, to what degree.

Fellnhofer's conclusion is that intuition can help us make better decisions: "That's especially true when it comes to making risky decisions quickly." But she cautions that intuition is affected by all sorts of factors, such as memories of past events. Experience, in particular, plays a pivotal role. "Experienced chess players intuitively see the right move with minimum cognitive effort. That's what makes them so much faster than beginners," she explains. Conducting research into intuition is challenging, says Fellnhofer, precisely because it's so hard to grasp: "Intuition is tremendously multifaceted, which is why we need experiments that include a wide array of input from different disciplines."

OPTIMUM USE OF RESOURCES Bringing all these different aspects together is the goal of Professor Rafael Polania, who heads the Decision Neuroscience Lab at ETH. "All organisms make decisions based on the signals they receive from their environment," he says. "And the more complex the organism,

the more complex the decisions." That said, he notes that all living beings are essentially confronted with the same challenge: how can they make optimum use of the resources that biology has given them in order to make the best possible decisions?

Polania hopes to use mathematical models to predict the behaviour of living creatures: "We try to model the factors that influence our decisions. Then we run experiments to test the model's predictions." His work draws on insights from a wide range of disciplines including psychology, computer science, neurobiology and economics.

Polania believes his findings will have ramifications for many different disciplines. "Economists have long thought that human decisions are fundamentally rational," he says. "That's why it was difficult to explain why people tend to avoid risks in certain situations even when it goes against rational judgement. This is easier to understand once you take into account our biological limitations."

Polania cites two crucial factors that shape our behaviour. First, our brain processes familiar situations faster and in a more nuanced way than it does new ones. That's why we find it easier to distinguish between individuals from our own culture than people from far-away countries. "It's not a question of racism; it's about how our brain processes information," says Polania. The second factor is our desire to link new perceptions to previous experiences. "We like things that are new, but not too different from what we already know," he says. "When we manage to forge a connection between a new experience and something familiar, it gives us a positive feeling."

> "Intuition is especially helpful for making risky decisions quickly."
>
> Katharina Fellnhofer

Human decision-making processes can also offer interesting insights into the future development of AI. Just like us, machines have to make the best use of limited computing capacity, so it makes sense for them to stick to what they know. Viewed from this perspective, Polania says we shouldn't be surprised if a chatbot starts making racist comments or forensic software shows a tendency to discriminate against certain groups. But he believes this is something we can change: "If we understand the mechanism that leads to those biases, we can correct them."

There is one further aspect that guides our decision-making processes – our capacity for introspection. "Acquiring a sense of how well you judge things gives you an important corrective mechanism that helps you realise when you make a mistake, allowing you to make better decisions in the future," says Polania. In a recent study, he was able to show that it is precisely this ability that distinguishes good leaders. "There are very optimistic people who are convinced they're always right. And there are pessimistic people who constantly question the decisions they make. Neither of those attitudes is helpful," says Polania. "You need to find the right balance – and that's where introspection can help." ○

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THE LEGACY OF TRAUMA

Emotional trauma can have far-reaching ripple effects and may even reverberate across generations. Professors Isabelle Mansuy and Katharina Gapp study how the effects of trauma can be inherited through epigenetic mechanisms.

TEXT Fabio Bergamin

Our parents and grandparents form part of who we are. They reared us and served as our role models, and they also passed on their genes. That's why we are similar to them, and why we share a genetic predisposition to develop certain diseases. Yet genes may not be the only molecular factors we inherited from them. The effects of the lifestyle and experiences of previous generations – including how well they ate and whether they suffered emotional trauma – can also be passed down through the generations via biochemical markers in sperm and egg cells.

A study conducted in the village of Överkalix in northern Sweden, which analysed family data stretching back over more than a century, showed that the sons of men who ate a hearty diet as children had a higher risk of cardiovascular diseases than the sons of men who grew up on leaner fare. The effects of diet even extended to the second generation: the grandsons of men who ate abundantly had an elevated risk of diabetes.

We also know that traumatic conditions in early life, physical or sexual abuse and violence affect health across generations. These increase the risk of depression, anxiety, personality disorders and metabolic and cardiovascular diseases. The children of Vietnam War veterans and Holocaust survivors are more likely to suffer from post-traumatic stress disorder and depression.

Scientists as well as psychologists, psychiatrists and social workers have long been aware of such intergenerational effects, but are not clear on what causes them. Professors Isabelle Mansuy and Katharina Gapp have been working on this question – and their findings suggest that so-called epigenetic factors play a role.

Epigenetic factors are an ensemble of molecules or molecular tags on and around the DNA that do not directly change its sequence (the genetic code). Instead, they regulate DNA activity and the expression of genes by complex molecular and structural processes.

Like DNA, which is transmitted from parents to children, epigenetic factors in germ cells can also be inherited. It is not known, however, if these factors are inherited in full, and if they are modified by a traumatic experience or poor diet, how many downstream may be affected. Today, symptoms are

known to be passed down from one generation to the next, but more research is needed to determine if epigenetic anomalies persist across generations.

This is particularly relevant with respect to stress and trauma experienced by victims of child abuse or domestic violence and by refugees fleeing conflict. The psychological scars inflicted on trauma survivors are already tragic enough. But if the effects extend to their descendants, this makes the number of victims considerably higher.

CHARACTERISTIC SIGNATURE Mansuy and Gapp studied how the effects of trauma are inherited in mice. They were able to show that male mouse pups that are exposed to stress over long periods of time grow up to become antisocial adults that display depression-like symptoms, greater risk-taking behaviour and memory deficits. When the researchers mated these animals with control mice and studied their offspring, they discovered that the next generation also exhibited the same kind of altered behavioural patterns, with some of the abnormal behaviours even persisting into the fifth generation.

Gapp began her research career several years ago as a doctoral student in Mansuy's group. Today, she runs her own research group at ETH Zurich. During her doctoral project, she discovered that the RNA profile in sperm is partly responsible for passing on the effects of stress in mice. To demonstrate this, she analysed thousands of RNA molecules from sperm cells of animals that had been exposed to traumatic stress themselves, or whose fathers had experienced stress, and compared them with those of non-traumatised control group animals.

In this way, she was able to identify a characteristic signature of these RNA molecules that was only found in traumatised animals. In a subsequent experiment, she isolated RNA from the sperm of traumatised male mice and injected it into fertilised eggs produced by non-traumatised parents. The results confirmed that sperm RNA was passing on information about prior trauma – a clear case of epigenetic transmission.

> "Unlike genetic changes, epigenetic changes can be reversed."
>
> Isabelle Mansuy

UNPREDICTABLE STRESS Gapp's work built on a pioneering model developed by Isabelle Mansuy that helps researchers study the effects of stress and emotional trauma in mice. In Mansuy's model, pups are separated from their mother for three-hour stretches at random, unpredictable times. This is repeated every day over a two-week period. In addition, the mothers are subjected to severe and unpredictable stress situations.

The fact that RNA may be an indicator of past traumatic experiences not only in mice, but also in humans, was demonstrated by another doctoral student in Mansuy's group. The researcher carried out a study in collaboration with SOS Children's Villages Pakistan and a Pakistani biological diagnostic laboratory. In one of the studies, he was able to show that the quantity of certain RNA molecules in the blood of orphaned children was different from that of the control children. The same RNA molecules were also altered in the blood of adult men raised as orphans. In a more recent study, which has already been peer-reviewed but not yet published, he was also able to show that men who experienced one or more traumatic events in their childhood exhibit changes in their sperm RNA molecules.

However, RNA is probably not the only molecular factor through which the effects of trauma are inherited. The way in which chromosomes are spatially organised in sperm – in other words, whether they are closely packed together or more loosely arranged at certain points within the cell nucleus – may also be significant. Numerous proteins are able to bind to DNA in a way that affects chromosome structure. And it is this structure that has an influence on which genes are active or not in the cells during processes such as embryonic development. ⟶

> "Men's behaviour prior to conception may play a role in the embryonic development of their offspring."
>
> Katharina Gapp

One of the proteins that binds to chromosomes is the glucocorticoid receptor, which interacts with the hormones released in response to stress as well as with the hormonally active agents that can be found in solvents, plastic products and pesticides. Gapp therefore suspects that combined effects may occur when, for example, someone who is already exposed to pollutants and eats an unhealthy diet also experiences trauma. In 2021, the European Research Council (ERC) awarded Gapp a Starting Grant now funded by the State Secretariat for Education, Research and Innovation (SERI). This grant will support a project to explore the role of the glucocorticoid receptor in non-genetic intergenerational effects.

"As the evidence mounts that men's behaviour prior to conception may play a role in the embryonic development of their offspring, we're starting to see men sharing responsibility for the health of their unborn children," says Gapp. Until now, this burden has been placed squarely on the shoulders of the expectant mother in the form of advice such as abstaining from alcohol and giving up smoking during pregnancy.

POSITIVE NEWS Yet even if the epigenetic effects of trauma have so far primarily been found in fathers and their descendants, this does not exclude the possibility of intergenerational effects involving female germ cells, called oocytes. Put simply, researchers have studied inheritance via the female germline far less because it is much harder to obtain oocytes, which are rare, than sperm cells.

Even though the epigenetic effects of traumatic events may echo through generations, the good news is that they are reversible. Gapp demonstrated this in mice by exposing traumatised pups to environmental enrichment. As well as being placed in larger groups and given bigger enclosures, the mice had access to objects that encouraged them to move and explore. As a result, many of the symptoms that traumatised mice would otherwise exhibit, such as increased risk-taking behaviour, disappeared. The stimulating environment reversed the effects of trauma not only in the previously traumatised mice, but also in their subsequent offspring. In a smaller study, the researchers confirmed this reversibility not only in the animals' behaviour, but also on a molecular level in individual epigenetic factors. "The main characteristic of epigenetic changes is that, unlike genetic changes, they can be reversed," says Mansuy.

This ties in neatly with our knowledge of psychology and psychiatry. The earlier an abused or otherwise traumatised child begins therapy, the greater the chance of minimising any long-term effects. Mansuy's and Gapp's research is helping to change our perception of mental health. "Unfortunately, people with mental health disorders are sometimes made to feel that they have brought their situation upon themselves," says Mansuy. But if hereditary factors play a role in the development of such disorders, such presumptions become even less plausible than before. ○

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ISABELLE MANSUY is Professor of Neuroepigenetics at the Faculty of Medicine of the University of Zurich and in the Department of Health Sciences and Technology at ETH Zurich.
⟶ hifo.uzh.ch/en/research/mansuy

DETECTING HIDDEN BRAIN STATES

Mental disorders can only be diagnosed on the basis of symptoms. An ETH scientist hopes to change that with the help of mathematical models.

TEXT Corinne Johannssen

Why do we have emotions? Klaas Enno Stephan, a professor at ETH Zurich and the University of Zurich, considers the question carefully before answering: "It seems very plausible that the purpose of the emotions is to make us aware of unconscious processes in the body." As a doctor and researcher, Stephan is particularly interested in the interaction between brain and body. He cites the example of how insulin is released at the mere sight of food, before we even take a bite and our blood sugar rises. "Yet we have no conscious control over this physiological response," says Stephan.

Our brain is constantly interpreting and updating information from the world around us. "The brain constructs models of the world and uses them to make predictions," says Stephan. These predictions then serve as a basis for taking anticipatory corrective action, such as releasing insulin prior to eating. "Maintaining homeostasis is the brain's ultimate goal here," he explains. Homeostasis is the internal balance that the body tries to achieve by regulating parameters such as blood sugar levels, core body temperature, blood pressure and acid-base balance. When this equilibrium is disrupted, the brain acts to correct it – generally without us even noticing.

But when our body is confronted with an acute threat to homeostasis, it makes sense for us to perceive this on a conscious level. "It's very plausible that emotions are states of consciousness that are connected with very specific actions aimed at maintaining certain bodily functions," says Stephan. "For example, fear and anxiety make us aware on a conscious level of the urgent need to respond to a threat."

MANAGING EXPECTATIONS But not all fear is acute; in fact, some people live in a constant state of heightened anxiety. One possible explanation for this might be overly precise predictions. "If my brain creates a model that assumes my heart rate should be perfectly regular, this expectation will be contradicted by reality. That, in turn, will trigger anxiety," posits Stephan. In such cases, we interpret even small and natural deviations as a threat and perceive our healthy body as being in constant danger. Corrective action is initiated to deal with this apparent breakdown in homeostasis. Yet attempts to regulate the heart's rhythm can make it beat faster and even more irregularly. This negative spiral is then intensified by the sympathetic nervous system, the part of the autonomic nervous system that prepares the body to react to situations of stress.

Together with his colleague Olivia Harrison, Stephan came up with an ingenious experiment to test the theory that heightened anxiety is accompanied by overly precise predictions of bodily states in a specific brain region, the anterior insula. Using

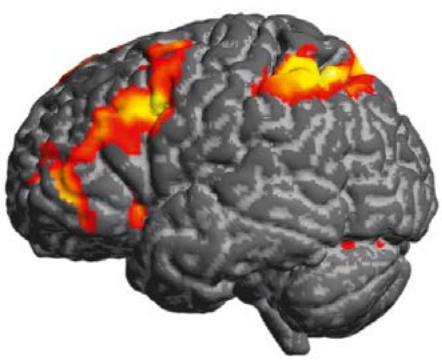
functional magnetic resonance imaging (fMRI), the researchers studied the brain activity of people with differing levels of anxiety. The participants lay in the MRI scanner while wearing a kind of snorkel that could be used to suddenly increase breathing resistance. In the first stage of the experiment, participants learned that the display of certain images was a predictor of whether they would be able to breathe normally or whether breathing would become harder. In a second stage, the correlation between images and breathing resistance was reversed. Using mathematical models, the researchers were able to study the extent to which measured brain activity mirrored learned expectations and changes in expectations. This confirmed their theory that signals for predictive accuracy are clustered in the anterior insula. The scans also revealed differing levels of activity in this brain region depending on the individual's level of anxiety.

UNDERLYING MECHANISMS "Our ultimate goal is always clinical application," says Stephan. He explains that mental health disorders are currently only diagnosed on the basis of symptoms: "Psychiatrists simply don't have any measurement tools or quantitative tests to identify the underlying causes or mechanisms." Hence his enthusiasm for applying mathematical models to observed brain activity in order to infer hidden – i.e., not directly measurable – states of neuronal populations. In principle, such models could be useful for identifying possible biological mechanisms of disorders, such as changes in the strength of certain synaptic connections.

"We can also apply these models to specific clinical problems and use them to predict individual outcomes," says Stephan. He cites the example of an fMRI study in which patients with depression were presented with pictures of faces expressing different emotions. Using a mathematical model of how different brain regions communicate with each other when viewing emotional faces, the researchers were able to predict with 80 percent accuracy whether individuals would recover from their depression within two years or would remain chronically depressed.

The methods developed in Stephan's lab are not yet ready for clinical application, but his enthusiasm remains undiminished: "Mathematical models can help us unlock access to hidden states of the brain." ○

KLAAS ENNO STEPHAN is Professor of Translational Neuromodeling and Computational Psychiatry at ETH Zurich's Department of Information Technology and Electrical Engineering and at the University of Zurich. The professorship was funded by the René and Susanne Braginsky Foundation.
⟶ tnu.ethz.ch



Functional magnetic resonance imaging (fMRI) is used to study brain activity.

Image: ETH Zurich / Sandra Iglesias

MASTER'S DEGREE IN INTERDISCIPLINARY BRAIN SCIENCES ETH Zurich and the University of Zurich have joined forces to offer a new interdisciplinary Master's degree in brain sciences. The programme, which was launched in the 2022 Autumn Semester, combines biology, neuroscience and clinical methods.
⟶ ethz.ch/master-brainsciences

TRACING A DIGITAL SHADOW

Psychologist Verena Zimmermann joins computer scientists Joachim Buhmann and Elgar Fleisch to discuss whether our feelings can be measured, what role they play in human-machine interactions, and the use of smart technologies.

INTERVIEW Karin Köchle, Michael Walther IMAGES Daniel Winkler

Mr Buhmann, will computers soon have their own emotions?

JOACHIM BUHMANN: Emotions drive human behaviour. If algorithms learn to behave like humans, then they can also imitate the emotional component of that behaviour. But whether a computer could then be said to have emotions is arguably more of a philosophical question!

Ms Zimmerman, how exactly do psychologists define emotions?

VERENA ZIMMERMANN: Emotions are so complex that not even psychology can come up with a clear definition. But there are certain aspects that many of the definitions agree on, namely that emotions are triggered by a particular situation and are experienced intensely, that they are relatively short-lived, and that they always involve a physiological reaction such as rapid breathing or a quickened heartbeat. Basic emotions such as anger, happiness or sadness are easy to distinguish from one another, and many people exhibit them in similar ways. But feelings such as resignation or unease can be much harder to identify and consequently are harder to measure accurately.

BUHMANN: That's a crucial distinction. Categories such as frustration, annoyance, pleasure and enthusiasm certainly help us package up the processes that lie behind emotions in ways that make communication with others easier. But we need to explore what we're actually trying to describe with these terms. They are descriptions of highly complex mental states that I believe are sub-rational. The terms encapsulate an incredibly complex dynamic – something our language is too narrow to capture in its entirety.

Does that mean machines can learn things that humans don't understand?

BUHMANN: Yes, and that's the central premise of machine learning: instead of giving a computer a concept of reality, we let it learn directly from the data. When algorithms are learning to behave like humans – say, writing an article – they take us ⟶

as examples even though we are not actually capable of rationalising our own behaviour. Algorithms have become incredibly good at imitating things that we can barely grasp on an intellectual level.

Mr Fleisch, your field of research has a strongly applied focus. What project are you working on at the moment?

ELGAR FLEISCH: My research group recently launched a number of clinical studies to measure the effect of emotions. For example, we're currently exploring whether certain physiological signs correlate with inflammation markers in the blood of test subjects; we hope this will tell us whether individuals are on a path towards illness even when they're still healthy. This method could eventually offer a simple and affordable early-warning system to help us prevent chronic illnesses before they occur.

BUHMANN: It's true that many diseases manifest themselves in mechanical ways. For example, it's possible to detect early-stage Parkinson's disease solely from the way someone types on a keyboard – even before a diagnosis has been made. Scientists discovered this from the keystroke patterns of people worried about having Parkinson's who entered questions about the disease into search engines.

How accurately can emotions be measured?

FLEISCH: Emotions trigger an amazing number of responses in the body. They affect how we speak – the pace, volume and tone of our voice – as well as our eye movements and movements in general, our pulse rate, our breathing…

ZIMMERMANN: We all respond in different ways and are capable of registering, manipulating or even suppressing our emotions. That poses a real challenge for the technology. If I limit myself to just one measurement technique, I might end up misinterpreting the data. As researchers, we therefore need to combine multiple methods by, for example, using voice and facial recognition together with other physiological factors.

Are there any other areas where machines are used to detect emotions?

BUHMANN: Human-computer interaction is obviously one area where it's helpful for the algorithm to know something about the emotional state of the person it's interacting with. It's easy enough to phrase questions slightly differently depending on whether the person responds positively or negatively. That can be a useful way of influencing the emotional impact of an interaction.

ZIMMERMANN: Emotions and our attitudes towards machines are highly relevant to my area of research. Part of my job is to study the role of human behaviour, including our emotions, in cybersecurity. One of my doctoral students is currently investigating how emotions affect our perception of cybersecurity and our attitude towards it. For example, someone who feels anxious about cybersecurity issues may exhibit avoidance behaviour and choose not to engage with the topic at all. As a result, they may fail to learn anything, which leaves them unable to behave safely.

"Evolution gifted us with powers of abstraction and creativity but went easy on the storage capacity – otherwise we would be databases!"

Joachim M. Buhmann

"I don't see a danger of humans being sidelined, but rather an opportunity to enhance our capabilities."

Elgar Fleisch

"We shouldn't look at humans and technology in isolation."

Verena Zimmermann

How can we encourage people to feel positive about interacting with machines?

ZIMMERMANN: It depends on what you hope to achieve with the technology in question. For instance, do you want to help people experience emotions via virtual reality? Or are you aiming to create genuinely humanlike social interaction in environments such as the care sector, where human connection might be increasingly harder to come by as society ages? Some studies have shown that, depending on how they're designed, robots can trigger certain emotions in people, thereby creating an emotional bond between humans and technology.

In other words, the more humanlike a robot is, the more affinity we feel for it?

ZIMMERMANN: Yes, but only up to a point. As robots become more humanlike, our affinity for them increases. But then comes a dip in the graph of our emotional response, which is called the "uncanny valley". That's the eerie, uneasy feeling we get when we interact with something that is close to appearing human yet is somehow imperfect and out of the norm.

So it's better for machines not to bear too much similarity to us?

FLEISCH: Our experiments with chatbots certainly suggest that machines don't need to be perfect to create a bond with users. One of our chatbots was used in therapy for obese children as a kind of intermediary between doctors and patients. ⟶

The goal was to improve the children's adherence – in other words, to encourage them to comply with their treatment plan. The chatbot was available from morning to night. It learned from the children's reactions, and they could even give it a name. Whenever they had a question, they could choose whether to ask the doctors or the chatbot. In 99 percent of cases, the kids chose the chatbot!

Computers are making inroads into areas that, until recently, were the domain of humans. What will the task division between humans and machines look like in the future?

FLEISCH: In the example I gave of the chatbot for obese children, you always need doctors behind the scenes to support the technology. I don't see a danger of humans being sidelined, but rather an opportunity to enhance our capabilities. Smart assistants don't replace doctors, but they can assist and support a patient through a lengthy illness. According to our analyses, chatbots are rarely on par with, or better than, the best doctors, but they are better than the average. And that means digital coaches have the potential to boost treatment quality across the board.

BUHMANN: As humans, our capacity to think and perceive things is clearly limited. Evolution gifted us with powers of abstraction and creativity but went easy on the storage capacity – otherwise we would have become databases. When you look at all the scientific knowledge we've managed to piece together so far, it has actually required very little descriptional complexity. In fact, all the scientific theories that are accepted today would fit on the back of an envelope. But obviously that's not reality; it's simply a selective slice of what our brain is capable of processing. That means we have no way of dealing with higher levels of complexity or building predictive models. What we need is a kind of "thinking co-processor" that can help us adopt a broader view.

Are there any functions that machines shouldn't take on?

BUHMANN: That's not the question we should be asking. We need to be harnessing these technologies to redefine what our world will become, not hobbling them so as to ensure our old powers of organisation keep working in the future! These new tools will also give rise to a new ethics. Things that may have previously been unethical will suddenly become acceptable.

In the future, what role will emotions play in the technical sciences?

FLEISCH: What we measure is not the emotions themselves, but rather the digital shadow of our feelings registered by the measuring device. As we move forward, our technical understanding of this useful shadow will get better and better. We have an obligation to use those insights to benefit society while leaving the emotions themselves safely separated from the computer.

ZIMMERMANN: As a researcher working at the interface between the social and technical sciences, I think it's important not to look at humans and technology in isolation, but rather to consider the interaction between them. Because that's where emotions play a crucial role. ○

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AT NIGHT

ESSAY by Michael Hagner

Recently, *Nature* caused quite a stir with an article that suggested science is becoming less disruptive. According to the authors, the number of groundbreaking scientific discoveries has dwindled steadily over the past 60 years, despite ever-increasing funding; instead, more and more research merely seeks to refine or extend our existing knowledge.

There is some debate as to whether the results of the study, which were based on the digital analysis of 45 million academic articles and 3.9 million patents, may also be open to a different interpretation. Indeed, one might argue that the very concept of the disruptive scientific breakthrough is overrated and caters more to the idea of science as a story of heroic endeavour than to the daily practice of science in the lab.

Even if one takes that view, however, the notion of science as a buccaneering tale of disruption is not without its merits. After all, why would any young person embark on a risky career that requires hard work and offers no guarantee of financial stability if all they are going to do is plug some minor gap in the research literature? Obviously not everyone can win a Nobel Prize, but surely anyone who opts to become a researcher will at some point have felt the urge to try out something completely new and upend the existing scientific consensus. Yet giving in to that urge can be a frustrating experience, either because nature, as studied in the lab, stubbornly refuses to yield – initially, at least – anything but the most meagre, contradictory or baffling results, or because eminent figures in the field – and indeed those who hold the purse strings – consider this research to be ultimately futile.

Faced with this situation, researchers must summon up every ounce of determination, courage, tenacity and speculative imagination and hold tight to their gut feeling that scientific treasure may lie exactly where the prevailing orthodoxy refuses to tread. And thus we find ourselves plunging into the realm of emotion; after all, rational thought alone would never persuade us to embark on a journey that could potentially expose us to such epistemic uncertainty or turn us into a social outcast! One person who has dared to take this less travelled road is Hungarian molecular biologist Katalin Karikó, whose research into mRNA unwittingly laid the foundations for the COVID-19 vaccine. During her time at the University of Pennsylvania, Karikó failed to obtain a tenured professorship and was eventually forced to leave. But she refused to become discouraged.

> "Breakthroughs in knowledge often rely on emotionally rooted characteristics such as boldness and humility, perseverance and determination."

The fact is that breakthroughs in knowledge often rely on emotionally rooted characteristics such as boldness and humility, perseverance and determination. Passions such as curiosity and amazement also belong in this context. Granted, these latter two qualities are universal traits that are relevant to numerous aspects of life. But delve into the history behind these terms and we find that amazement and curiosity were two of the most important characteristics of the 17th-century natural scientists, whose findings paved the way for the Scientific Revolution. It was this that led science historian

Lorraine Daston to define curiosity and amazement as cognitive passions that have been essential in advancing scientific knowledge and, no doubt, still are today.

However important such emotionally conditioned behaviours might be to scientists, it is nonetheless tempting to argue that rational criteria alone will surely hold sway once they actually roll up their sleeves and embark on their chosen course of theoretical or applied research. After all, philosophers and scientists have spent the past 200 years issuing any number of edicts that have one goal in common: to drive out not just emotions, but any subjectivity at all from academic work. A good example is the idea of mechanical objectivity of the 19th century, in which technical methods of visualisation such as photography, spectrography and instruments to measure bodily functions were celebrated as advances that would exclude the notoriously unreliable subjective intervention of the researcher.

The goal of such methods was to expunge personal idiosyncrasies from scientific endeavour – in other words, to eliminate that rich tapestry of human emotions that includes the likes and dislikes, beliefs, prejudices, hopes and craving for recognition peculiar to each and every one of us. The ascetic virtues are undoubtedly a prerequisite for successful and reliable research, yet their presence alone is not enough – a necessary condition is not always a sufficient one. Throughout its history, science has shown us that idiosyncratic beliefs, aesthetic decisions and curious hunches all play a role in research; in fact, new avenues of knowledge can hardly be explained without them.

There are even those in the scientific community who have highlighted these irrational components. One example is the molecular biologist and Nobel Prize-winner François Jacob, who proposed a distinction between "day science" and "night science". By day, everything is clear and rational, every line of reasoning assumes a logical progression, and science is like a machine in which one gear automatically meshes with the next. This is the side of science that is usually presented to politicians, funding bodies and the public. Yet they know nothing of the night, when science wanders blindly, harbours doubts, questions its every move, and lurches into blind alleys, possessed of a vague and anxious hope that it will stumble across a solution. In this state, thought processes cling much closer to intuition and feeling than to logical reasoning. Many such nocturnal activities never even see the light of day and are simply chalked up as failed experiments. Even so, Jacob argues, night science is an indispensable workshop of possibility that allows us to explore new scientific avenues. These will, of course, ultimately have to prove themselves by day – but without those tortuous night-time wanderings, there would be nothing worth seeing in the daylight at all.

Another scientist – physical chemist and social scientist Michael Polanyi – introduced the concept of tacit knowledge to explain our inability to express and codify every step in a creative activity. In addition to our rational thought processes, there is always an implicit form of knowledge that helps us gain experience and insights. Polanyi regarded tacit knowledge as a kind of master key that could unlock the skills of an artist, the mastery of an experienced medical diagnostician, or the creative power of a scientific researcher. And he argued that renouncing this kind of knowledge would have dire consequences: "But suppose that tacit thought forms an indispensable part of all knowledge, then the ideal of eliminating all personal elements of knowledge would, in effect, aim at the destruction of all knowledge."

Since night science remains invisible in day science – just as implicit knowledge remains invisible in explicit knowledge – it is not possible to pin down either of these phenomena and their corresponding emotions even in a digital analysis of 45 million scientific articles. Nonetheless, if a problem with groundbreaking research does exist, then it is certainly worth making another careful examination of the conditions that favour breakthroughs in science. This will not give us a magic formula, but it may well encourage scientists to draw not only on reason, but also on their emotions. And perhaps to understand that original research requires more than just two gears meshing smoothly together. ○

Image: Suhrkamp Verlag

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Christian Wolfrum has been Vice President for Research at ETH Zurich since January 2023.

Image: ETH Zurich / Markus Bertschi

New Vice President for Research

Christian Wolfrum was appointed Vice President for Research at ETH Zurich in January 2023. He succeeds Detlef Günther who, after eight years in the post, is returning to his own research work. Wolfrum developed an interest in science from his early schooldays. He subsequently gained a solid grounding in the natural sciences at the University of Münster, including a doctorate in biochemistry. At ETH Zurich, Wolfrum's interest turned to exploring the molecular processes behind the formation of fat cells and the development of metabolic disorders. He has remained deeply involved in this area of research, focusing in particular on obesity and two of the diseases it causes: diabetes and fatty liver. One of his most influential findings is that white fat cells can be converted into brown fat cells and vice versa. Wolfrum works in biomedicine, an interdisciplinary field of research that combines experimental medicine with methods from molecular biology and cell biology. He has been teaching and researching in this field as a professor at ETH Zurich since 2008. He also heads the Laboratory of Translational Nutritional Biology and serves as the director of studies for the Health Sciences and Technology degree programme as well as for the Bachelor's in Human Medicine, which he helped to establish. He was the Executive Board's Associate Vice President for Medicine until 2022.

In his role as professor and director of studies, Wolfrum gained hands-on knowledge of the various aspects of collaboration between basic research and clinical work. His appointment as Associate Vice President for Medicine gave him a greater understanding of how institutional frameworks and research development influence each other. This gave him important insights into creating the kind of institutional environment that allows Switzerland

to conduct top-class international medical research while simultaneously safeguarding the provision of regional healthcare.

Throughout his career, Wolfrum has worked in research areas where different disciplines overlap and where interdisciplinary collaboration is as natural as it is necessary. Much has changed since the turn of the millennium, especially in laboratory and computer technologies. The rapid development of these two fields means that advances in biomedical knowledge can now only be achieved through a division of labour: "For our research to be effective, scientists, physicians and bioinformaticians need to work together along the entire chain – from the first lab results to translation into clinical practice." Topics such as obesity have a direct bearing on people's lives, and Wolfrum's research has given him a keen sense of how best to communicate with the public: "When science communicators tackle subjects such as nutrition and health, which have a direct impact on people's behaviour, it's important to separate correlation from causation."

Wolfrum intends to approach his new role with an open mind while drawing on his wealth of experience as a researcher, Director of Studies and Associate Vice President for Medicine. ○

Sustainable food and agriculture

Around the globe, agricultural and food systems face serious challenges. Future agri-food systems will need to provide enough healthy and affordable food for a growing world population while also delivering sufficient returns for farmers.

At the same time, the entire food production system is under severe stress due to climate change, the increasing scarcity of natural resources, and declining soil health and biodiversity.

To help address these challenges, ETH Zurich's World Food System Center has teamed up with Bayer to launch a new research programme for sustainable agricultural and food systems. Its goal is to understand the benefits and trade-offs of various interventions in agricultural systems and production practices while safeguarding the agricultural sector's capacity to produce and strengthening its overall resilience to climate change and biodiversity loss.

The World Food System Center and Bayer look forward to sharing the results with the agriculture sector, other research institutions and businesses, as well as with the general public. In future, the research project may also be expanded to include other industry partners. ○

Image: ETH Foundation / Valeriano Di Domenico

Detlef Günther, formerly Vice President for Research at ETH Zurich, and Natasha Santos, Head of Global Stakeholder Affairs & Strategic Partnerships at Bayer Crop Science.

Image: Andreas Eggenberger

The "AI, Future, Europe" workshop sparked lively interest.

ETH at the WEF

Once again, ETH Zurich was in attendance at this year's World Economic Forum (WEF) in Davos. Representatives from ETH joined researchers and business leaders for a workshop to examine two key challenges of our time: the regeneration of ecosystems and the future of artificial intelligence. Among the topics discussed was how Europe can spearhead AI research and lead the way in entrepreneurship. The workshop – entitled "AI, Future, Europe" – was organised by the ETH AI Center, Venture Studio Merantix and the Tübingen AI Center. ○

Alliance of European universities

The Enhance Alliance of ten European technical universities aims to improve student and staff mobility, thereby making it easier for students to study at partner universities. This involves reducing red tape and piloting new forms of educational exchange and collaboration. ETH Zurich officially signed up to the alliance in November 2022.

Along with ETH, the alliance has also welcomed two other new members: TU Delft and Gdańsk University of Technology. They join existing members TU Berlin, Chalmers University of Technology, NTNU Trondheim, Politecnico di Milano, RWTH Aachen, Warsaw University of Technology and Universitat Politècnica de València. ○

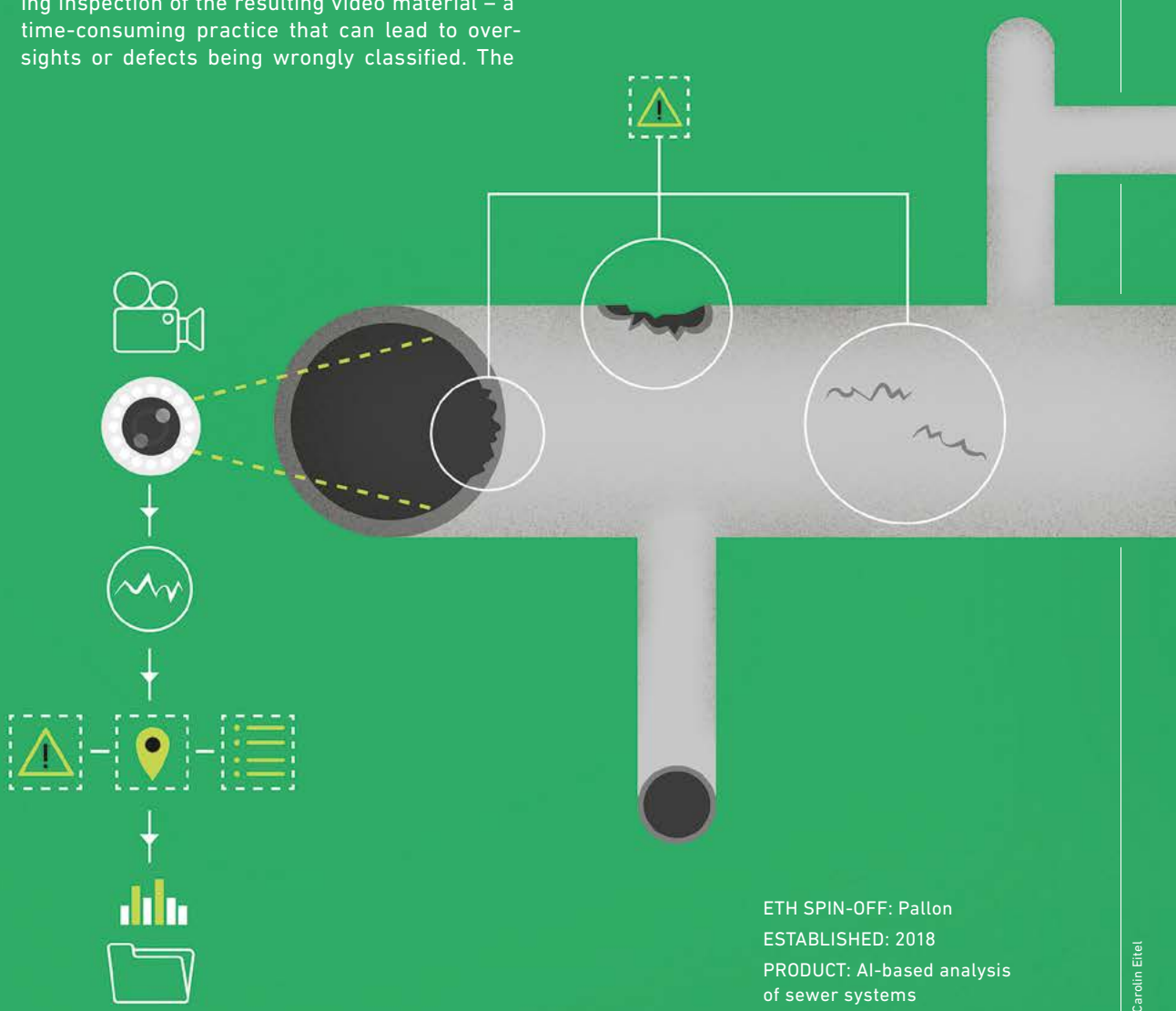
Image: Andreas Schmitter

Rectors and presidents from Gdańsk University of Technology, Chalmers University of Technology, ETH Zurich (Günther Dissertori), Politecnico di Milano, Warsaw University of Technology, Universitat Politècnica de València, TU Delft, NTNU Trondheim, TU Berlin and RWTH Aachen.

Monitoring for cracked sewers

Hidden underground, sewers transport rain- and wastewater for processing at treatment plants. To guard against leaks and overflows, camera crawler systems are employed to inspect the pipework for defects. As a rule, any cracks or signs of corrosion are manually documented during inspection of the resulting video material – a time-consuming practice that can lead to oversights or defects being wrongly classified. The ETH Zurich spin-off Pallon has now come up with a technology that provides rapid automatic monitoring of damage to sewers. Deep neural networks, trained with huge datasets containing millions of images from around the world, are used to accurately detect, localise and quantify any problems. In addition, the company builds a detailed 3D reconstruction of the sewer in order to precisely locate and then repair the defect. ○

→ pallon.com



ETH SPIN-OFF: Pallon

ESTABLISHED: 2018

PRODUCT: AI-based analysis of sewer systems

Illustration: Carolin Eitel

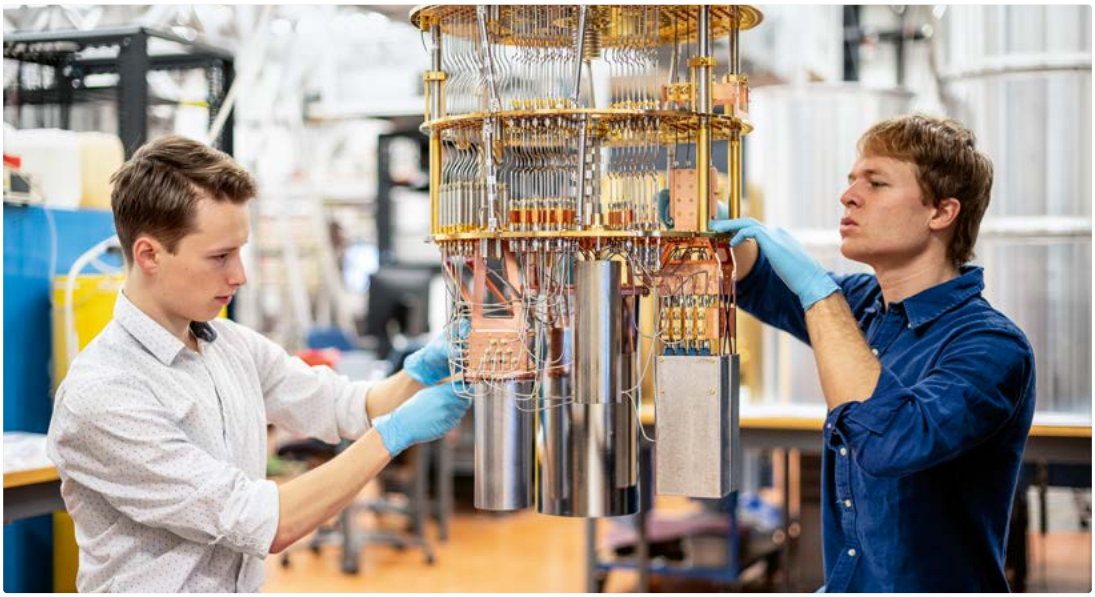


Image: ETH Zurich / Daniel Winkler

In the lab of ETH professor Andreas Wallraff, quantum chips are connected via a mass of signal lines.

Quantum research network

Around the world, the race is on to achieve a decisive breakthrough in quantum research. ETH Zurich is spearheading its own challenge.

TEXT Felix Würsten

After 12 successful years, the work of the National Centre of Competence in Research into Quantum Science and Technology has come to an end. Klaus Ensslin, Professor of Solid-State Physics at ETH and NCCR QSIT Director, is delighted with the progress made. "We've had key breakthroughs in a whole range of areas, which has taken quantum research to a totally new level," he explains. "Researchers are getting better and better at combining quantum objects to form complex systems, and that brings us a whole lot closer to building things like quantum computers."

With the conclusion of NCCR QSIT, attention will now focus on advancing this work and consolidating Switzerland's strong position in this exciting field. The recent progress in quantum research has fuelled high expectations, with huge investment continuing to flow from both national research authorities and companies around the world. This was what prompted ETH Zurich, back in 2021, to set up its very own Quantum Center, which brings together a range of disciplines under one roof. To date, thirty-four professorships from six departments have joined. "The idea is to raise the public profile of quantum research at ETH Zurich," explains ETH professor and founding director Andreas Wallraff. "At the same time, we aim to encourage internal interaction and collaboration."

If an interdisciplinary setup makes sense in this field, it is because quantum research has long ceased to be the exclusive domain of physics. Building a powerful quantum computer, for example, means being able to hook up a multitude of quantum objects. This, in turn, requires the combined knowledge of physicists as well as engineers and computer scientists.

On a national level, the new Swiss Quantum Initiative aims to preserve this crucial network of research and collaboration. "Equally important, it will give greater weight to quantum research on the national research agenda," explains ETH professor Jonathan Home, who sits on the Swiss Quantum Commission at the Swiss Academy of Sciences and is also Co-Director of the Quantum Center. "This is vital because quantum research is directly impacted by the current political differences between Switzerland and the EU." With Switzerland no longer an associate member of the EU's Horizon research framework programme, Swiss researchers are now ineligible to participate in the EU's Quantum flagship programme. As a bridging solution, the Swiss government has therefore instructed the Swiss National Science Foundation to set up the Quantum Transitional Call funding scheme, which replaces funding for quantum research that could otherwise have been applied for via the EU programme.

QUANTUM MASTER'S PROGRAMME In addition to building new networks and setting up its own quantum research centre, ETH is also making a number of key changes to teaching and infrastructure. It has now been four years since the launch of its specialised Master's programme in quantum engineering, which accepts between 30 and 40 graduates a year. The course is proving very popular as it gives students the opportunity to work closely with a research group while still at the Master's stage. In fact, the model has been such a success that it is already inspiring other universities to offer similar courses.

At the same time, construction of a landmark physics building is now under way on the Höngerberg campus. From 2029 onward, ultrasensitive quantum experiments will take place here, deep below the earth's surface. The special labs will be protected against external vibrations, electromagnetic radiation and temperature fluctuations. ○

ETH Quantum Center:
⟶ qc.ethz.ch

FUNDING FOR THE ETH QUANTUM CENTER
Donor support for the Quantum Center at ETH Zurich helps fund the development of the technologies behind quantum computer production as well as a fellowship programme for outstanding doctoral students and postdocs.
⟶ ethz-foundation.ch/quantum

PHILANTHROPY

BY
Donald Tillman

Good ideas for a good cause

When it comes to celebrating anniversaries, retirement parties and similar events, most companies seem to follow the same old format. So why not be bold and shake things up a little? That was the thinking behind a recent initiative by Headcount AG, a Zurich-based recruitment consultancy specialising in the healthcare and life science sectors. To mark its tenth anniversary, it decided to organise an auction of ten "artworks for a good cause" in collaboration with the ETH Foundation and the ETH AI Center. The selection of photographs and other works by ETH researchers and students was curated by the AI Center and auctioned at Kunsthaus Zürich as part of the company's anniversary celebrations, with all the proceeds going to scholarships for ETH students with limited financial means. Bidding was enthusiastic, and the scientists enjoyed the unique opportunity of seeing their research work elevated to the status of art. One of the lots even came from an Excellence Scholar, Rachel Sava, thereby bringing the process full circle. So if you're looking for ideas for your next corporate event, why not get in touch with the ETH Foundation?

⟶ ethz-foundation.ch/en/artworks

Image: Hannes Heinzer

Start-ups 2022: 26 spin-offs and three unicorns

Last year, no fewer than 26 spin-offs emerged from ETH Zurich. Confirming the trend of recent years, the lion's share of the 2022 crop – ten in all – were in the field of IT and communications technology. An appreciable number of the new ETH spin-offs are developing solutions in the healthcare sector, with three of the companies working on novel cancer drugs or to improve existing therapeutics.

Investment in this sector was also up on previous years, with ETH spin-offs attracting capital of around 1.2 billion Swiss francs – more than ever before. Furthermore, three of the 2022 batch have already attained unicorn status – start-ups with a market value in excess of one billion dollars even before going public. ○

Security robotics for Switzerland

ETH Zurich and armasuisse S+T – the science and technology wing of the Swiss Federal Department of Defence, Civil Protection and Sport – are launching a joint programme in security robotics.

ETH and armasuisse are already cooperating closely on a number of projects. These include the quadrupedal robot ANYmal, which may well have a promising future in search and rescue operations in disaster zones. This collaboration is now being widened, with armasuisse to invest half a million Swiss francs annually for at least the next five years. This money will go towards select robotics projects with potential applications for Swiss rescue and security forces in unarmed operations. Research into weapons systems is explicitly prohibited. ○

Watt d'Or prize for smart solar façade

Solar panels developed by a research group under ETH professor Arno Schlüter track the sun's movement and thereby maximize the amount of energy harvested. At the same time, they act as a smart sunblind, regulating a building's exposure to sunlight. Depending on the ambient temperature and the building's actual use, they either provide shade or let the sun's rays through, thus conserving energy that would otherwise go to heating or air conditioning.

This development has now received the Watt d'Or award from the Swiss Federal Office of Energy (SFOE), taking first place in the buildings and spatial development category. This award confers a hallmark of energy excellence. No prize money is involved. Zurich Soft Robotics, a company founded in early 2022, is now working to bring the façade to market under the name of Solskin. ○

Image: ETH Zurich / Arno Schlüter

Award-winning solar façade.

IN PERSON

GREGOR WEISS is fascinated by the inner workings of our cells and is driven by the hope of finding a non-antibiotic therapy for urinary tract infections.

TEXT Karin Köchle

GREGOR WEISS is a Project Leader at the Institute of Molecular Biology and Biophysics. He won the Lopez-Loreta Prize in 2022.
⟶ pilhoferlab.ethz.ch/weiss-group

Urinary tract infections often require antibiotic treatment. Could your research change that?

That's my ultimate dream. But before we can start developing new therapies, we need to understand how pathogenic bacteria can lodge in our bladder cells and cause recurring urinary tract infections. In my research, I explore the strategies bacteria adopt to evade our immune system and resist antibiotic drugs.

One of the methods you use is electron cryotomography. What makes that approach so fascinating?

Cryo-ET allows us to see the tiniest details inside cells, such as proteins. Sitting in front of a microscope and knowing you might discover something nobody has ever seen quite that way before makes you realise just how complex – and how marvellously functional – our cells are.

What was so special about your collaboration with the children's hospital in Zurich?

Working with patient samples is incredibly exciting for a biologist, but it also poses some challenges. Every sample is different, and unfortunately they behave differently to samples in a test tube! It's tremendously motivating to know that behind each sample is a sick person who we might one day be able to help.

You've already achieved a lot in your work. Are you equally ambitious in your private life?

The second great passion in my life is biking and skiing in the mountains. But it's not about setting some kind of personal best. I simply like the feeling of being in nature with my friends. It's a great contrast to my work in the lab, and I can't think of a better place to combine those two things than at ETH in Zurich!

It's been a decade or so since you worked as a research assistant at Caltech in California. What lessons did you learn there?

In the US, and particularly at Caltech, there was an incredibly open-minded research community that introduced me to all sorts of new opportunities and laid the foundations for the work I do today. As a young researcher, it was tremendously inspiring to work there and to be accepted so readily as part of the team. That feeling of openness and trust is something I try to pass on to my own students. ○

Image: Annick Ramp

NEW HANDLEBARS RAISE

TEXT Christoph Elhardt
IMAGES Daniel Winkler

Flurina Rigling in action at the Tissot Velodrome in Grenchen.

REPORT | ETH student Luca Hasler developed a new set of handlebars for para-athlete Flurina Rigling. The cyclist hopes these will boost her chances of qualifying for future events – including the 2024 Paralympics in Paris.

PARALYMPIC HOPES

The municipality of Grenchen in the Swiss canton of Solothurn is home to the Tissot Velodrome, which boasts a 250-metre-long racetrack made from Siberian spruce. The steeply banked, 7-metre-wide track is housed in an arena that normally seats up to 3,500 spectators. Today, the venue is empty, though the electronic music that has flooded the space since early morning means it's far from quiet. Flurina Rigling is absorbed in the solitary task of completing one lap after another on her red track bike. It's a special day for the 26-year-old Swiss para-athlete, who has a disability in both of her hands and feet: she's trying out new handlebars for the very first time.

Standing next to the track, his gaze fixed on the two lap-time displays, is Luca Hasler, an ETH mechanical engineering student who developed the handlebars as part of his Master's thesis. For the past six months, he has been entirely engrossed in the development of this black aluminium bar and the two plastic hand-rests that are moulded to the shape of Rigling's hands. He has spent countless hours with Rigling, puzzling over the best design, and now the moment of truth has arrived. Have the new handlebars really made her any faster? And do they feel safe and comfortable under race conditions?

But first: how did Rigling even get to this stage in her career? Her rise in the world of para-cycling has been nothing short of meteoric. She only took up cycling seriously three years ago, but her titles already include vice-world champion in the time-trial event and European road-race champion. She also took gold in the world track championships in a record-beating time.

Rigling, a Zurich native who is currently enrolled in the Swiss Army's top athlete programme, achieved all this with handlebars that were far from perfect. Not only did she have to balance her hand on a 3-centimetre-wide cantilever; she also had to operate the brake and gearshift with her only finger.

With so much pressure concentrated on one spot, the old handlebars made for an uncomfortable ride. In addition, they forced her into an awkward posture with poor aerodynamics – sometimes enough to make the difference between victory and defeat. "I realised some time ago that I needed new handlebars," says Rigling. But she had no idea who might be able to help.

AN UNUSUAL MASTER'S THESIS Help eventually arrived in the form of Peter Wolf from the Sensory-Motor Systems Lab at ETH Zurich. He ⟶

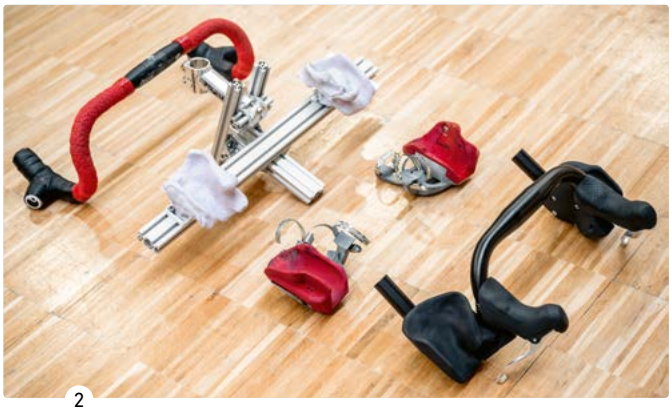
1

1
Flurina Rigling presses her hands into silicone putty to mould the hand-rests into the right shape.

2
From left to right: the old track handlebars, the initial hand-rest moulds, the first prototype and the new handlebars.

advertised the project as a Master's thesis and, in spring 2022, 26-year-old Luca Hasler accepted the challenge. "It was the perfect combination for me because I'm interested in applied product development, and I ride a racing bike," he says. He was given six months to develop the new handlebars.

But where to start? "I tried to put myself in Flurina's shoes and to learn as much as I could about the difficulties she was facing," says Hasler. This was the "empathising" part of the design-thinking approach that Hasler favours. In June 2022, he went to see Rigling at the Swiss Championships in Steinmauer, near Zurich. This was his first opportunity to see how she held the handlebars, and he quickly understood what had to be done: "It's really difficult for Flurina to hold the handlebars with one finger, so she clearly needed custom hand-rests that would enable her to ride her bike safely, comfortably and aerodynamically."



2

GETTING IN SHAPE Based on this information, the conventional approach would have been to design, produce and test the handlebars on a computer. That wasn't an option in this case, however, because Hasler still had no idea what the hand-rests should look like. He needed to develop a method of defining, testing and optimising the hand-rest design as quickly, simply and cheaply as possible.

The breakthrough came when he visited the rehabilitation clinic in Bellikon. There, he met Rigling's orthopaedic technician, who suggested using a thermoplastic, which can be moulded into different shapes once it reaches a certain temperature. This proved to be the perfect solution to roughly model the structure of Rigling's hands.

Replicating the delicate contours of her hands, however, proved a tougher challenge that required a more flexible material. Once again, the ETH student drew inspiration from orthopaedic technology, opting for a fast-curing silicone moulding putty, which is also used for finger prostheses. Equipped with these two materials and numerous other tools, Hasler headed to the racing cyclist's family home one hot day last summer.

3
The new handlebars help Rigling feel safer and more comfortable on the track.

4
Mechanical engineering student Luca Hasler optimises the handlebars between two test rides.

The Rigling family's farm in Hedingen is surrounded by woods and meadows. The day is still young, but Hasler and Rigling are already hard at work trying to come up with the best design for the new handlebar hand-rests. Hasler starts by moulding the soft thermoplastic to Rigling's hands to define the length and width of the hand-rests. Next, he smears on silicone putty and attaches them to a set of test handlebars mounted on Rigling's racing bike. As she rides, the para-athlete presses her hands into the putty, leaving an impression of their shape and position. The duo now have their first prototype – the first of many they will create that day.

Hasler and Rigling continue experimenting with different variations until late that evening, gradually working their way towards a hand-rest design that Rigling feels comfortable with. It's a classic example of rapid prototyping, and Rigling is impressed by Hasler's systematic approach. "I feel really fortunate. From the first day I met Luca, I knew we would be a great team," she recalls.

The next job is to work out how to produce such a complex design. Back at ETH, Hasler creates a digital model of the two hand-rests using a 3D scanner. Now he can prepare them for production and run onscreen simulations under different ⟶

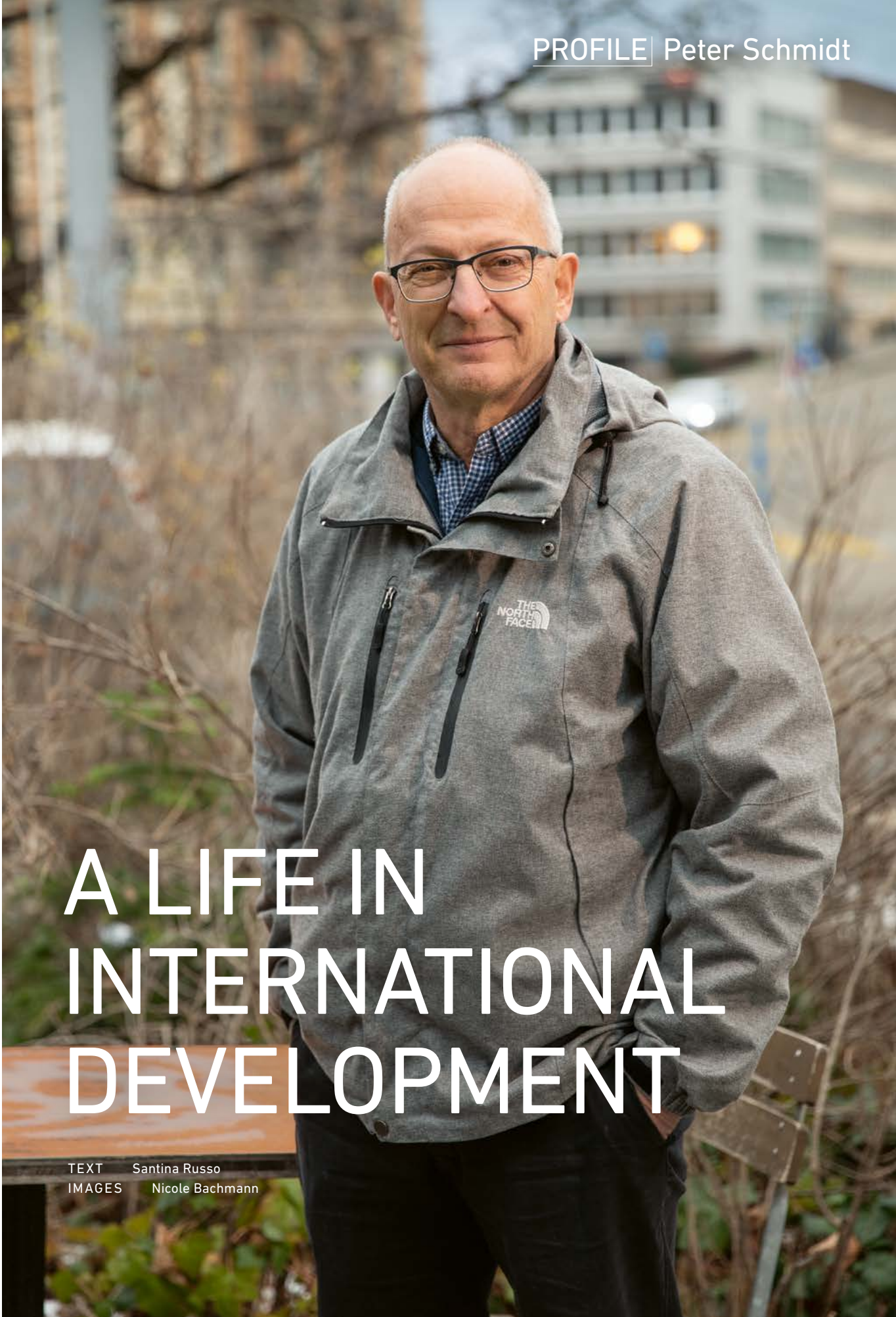
loads. He also comes up with a way to attach the new hand-rests to Rigling's old handlebars. "That allows Flurina to try out the new hand-rests without us having to go through the expensive process of producing a whole new set of handlebars," he says.

Between July and December, Rigling and Hasler are in touch on a regular basis as they strive to optimise the hand-rests and mount them on the handlebars in a way that will allow Rigling to adopt the most aerodynamic position on the bike. The only way Hasler can get the necessary feedback he needs to tailor the handlebars to Rigling's hands is by testing the new design in as many situations as possible – a time-consuming process that requires immense patience. "Luckily we get along really well! That made it much easier for me to get constant feedback and make the corresponding changes," says Hasler.

PARALYMPIC DREAMS But the real test of whether their efforts have paid off comes on the track. After a solid hour racing around the Tissot Velodrome with the new handlebars mounted on her bike, Rigling rolls over the finish line one last time. She has put in the same effort as when she was using the old handlebars – but the clock shows she covered the distance six percent faster. "That's a huge improvement for a cyclist. It's probably because I was able to adopt a more compact riding position," says Rigling. And there's more good news: the new hand-rests distribute the pressure over a wider area, which makes the whole riding experience safer and more comfortable.

Hasler is delighted when he sees the results come up on the screen: "I'm absolutely thrilled that all our work has paid off!" He and Rigling have become firm friends over the past few months. They plan to work together in future to adapt the new handlebars to Rigling's time-trial bike and to develop a new hydration system. Rigling's big goal is to qualify for the 2024 Paralympics in Paris. "If I make it that far, Luca will join me as my technical assistant," she says. ○

Luca Hasler and Flurina Rigling have become firm friends and plan to continue working together in the future.



A LIFE IN INTERNATIONAL DEVELOPMENT

TEXT Santina Russo
IMAGES Nicole Bachmann

Peter Schmidt has been working in development aid for over 30 years, constantly seeking ways to help people help themselves. His first visit to India left him in shock for three days – but ended up shaping the rest of his life.

At first glance, you wouldn't think Peter Schmidt had led such a well-travelled life. With his white cropped hair, checked shirt, tailored trousers and soft voice, he hardly seems like the adventurous type. But ask him about his time in India, Kyrgyzstan and Myanmar, and his eyes light up. A life filled with memorable experiences has made him a fulfilled and happy man.

THE SOUND OF POVERTY The turning point in Schmidt's life came on his first visit to India, as part of an extended internship for the agricultural science degree programme at ETH Zurich. He and his fellow students had already completed an initial stint on Swiss farms, and now they were expected to spend a few weeks in a very different environment. The year was 1986, and Schmidt's destination was the state of Kerala in southern India – but his arrival in the regional capital of Trivandrum (now Thiruvananthapuram) left him in a state of shock. He took refuge in a Swiss colleague's house and didn't emerge for three days. "That's how long it took me to process the flood of new impressions," he recalls. From that moment on, he would forever associate poverty with one specific sound: "It was the clanging of hammers wielded by hundreds of Indian women sitting by the roadside. They were smashing up rocks to build roads – the kind of work I would have expected a gravel works to do." He was overwhelmed by the huge crowds and the overpowering odours of cooking, spices and excrement.

Just 26 at the time, Schmidt felt completely out of his depth – but the experience was to shape his life. During this first visit, he worked on a livestock farming project for the international development organisation Intercooperation. "We visited various villages, spending some time in each talking to the locals and helping them with their work," he says. He provided advice on animal husbandry to farmers and their families and carried out some basic field trials of feed crops. Like his hosts, he slept in a bare room, using a bucket for a shower and a hole in the yard as a toilet. Schmidt soon realised that the farmers' main handicap was a lack of vocational training – and that development aid is a complex business. He also realised that he had found his calling.

SHORT HIATUS Schmidt returned to Switzerland to complete his degree programme, but he was soon on his way back to India for another Intercooperation project. His destination this time was Orissa, now Odisha, one of the country's poorest regions. With him was his wife, Käthi Hüssy, and their one year-old daughter, Zarah. "Our town had 100,000 inhabitants, but apart from my boss, his wife and an English nurse, we were the only foreigners," says Schmidt. He and his wife threw themselves into learning the local language, Oriya, but getting to know the locals was far from easy.

"Professionally, though, it was an incredibly enriching experience," he says. "We looked at what farmers needed and came up with projects to help them." Milk production was one area where their help was particularly useful. The locals keep cows primarily to provide manure for their crops, but it only took a few simple tweaks – such as feeding them the right diet – to get them producing more milk. "Of course, that means you immediately need a cold chain and distribution system," adds Schmidt. "Those were the kind of things we provided support with as we became more attuned to the farmers' needs."

After three years in India, the family returned to Switzerland. They quickly settled back in and found their daughter a place at nursery. Schmidt became a trainer in agricultural extension, educating farmers to apply scientific research to agricultural practices – including on short trips to Albania and Zimbabwe. But it wasn't long before he and his ethnologist wife were heading off again, this time to Kyrgyzstan. "We were itching to experience another culture and broaden our horizons," he recalls. The family moved into a small house in Kyrgyzstan's capital, Bishkek, and sent Zarah to a private school, where the main language was Russian. Schmidt acknowledges that their daughter found the new language challenging at first, but her Russian skills would eventually pave the way to her current position as a diplomat. "It was a great time for us as a family. We had a high quality of life and close ties to the expat community," he says. Schmidt was also doing well career-wise: as part of a Helvetas project, he established an

agricultural advisory service similar to Switzerland's cantonal extension services. This provided much-needed development support to the country following the collapse of the Soviet Union.

Three years later, it was time to return to Winterthur. "We wanted our kids to spend their teenage years in Switzerland," says Schmidt. The children had friends in Bishkek, he says, but couldn't see them unless he or his wife were willing to drive them halfway across the city. "Life in Switzerland gave our kids more freedom and independence," he adds. He spent the next 14 years working for Helvetas in a number of roles, including as Regional Coordinator with a liaison role between donors and aid-receiving countries, as Co-Director of the International Programmes Department and as Co-Director of Advisory Services. "I really enjoyed what I did, and it never got boring!" says Schmidt. His work would eventually take him to some 30 countries on four continents.

FROM DEMOCRACY TO COUP Nonetheless, he and his wife were becoming increasingly eager to embark on a new adventure, this time to Myanmar. In January 2017, they arrived in a country that was finally on the road to democracy after decades of military rule. "It was a fantastic time to be there," says Schmidt. The country was entering a new era. Schmidt was in charge of a young, motivated, 50-strong team, and he was soon busy launching new projects – some aimed at fostering the fledgling democracy – and travelling back and forth across Myanmar.

Then came COVID-19 and a strict lockdown, followed swiftly by a military coup on 1 February 2021. Schmidt first heard about the coup in a phone call from his son in Switzerland. "Twenty minutes later, they cut off all the phone and Internet access," he says. For two days, the country was in a state of shock, and then people took to the streets in their hundreds of thousands. "I'd never seen such huge protests," recalls Schmidt, shaking his head. For a few days, the military let the demonstrations continue; then, they brutally suppressed them. "I'm still incredibly sad for everyone who lives there, for all my former colleagues. They had to watch their futures being obliterated in front of their eyes," says Schmidt. The terror campaign unleashed by the military junta has so far claimed almost 3,000 lives, and many thousands more have been imprisoned and tortured.

Schmidt and his wife returned to Switzerland in July 2021 as planned, but this time they found it harder to settle in and meet people. "It all just happened automatically when we had kids because we had to find school places and get everything organised," says Schmidt. But things gradually improved, and he now works in Helvetas' modern open-plan office in Zurich, where he is currently preparing a feasibility study on producing rice with lower methane emissions in Peru. Nowadays, he avoids flying for environmental reasons. But his belief that people should be empowered to seize opportunities remains unchanged, and he is currently helping two Afghan migrants find apprenticeships. ○

PETER SCHMIDT studied Agricultural Sciences at ETH and went on to obtain a Master's degree in rural sociology. He subsequently became a consultant at Intercooperation, which merged with Helvetas in 2011. Over the course of his 30-year career in development aid, Schmidt spent long periods living with his family in India, Kyrgyzstan and Myanmar, where he set up and led a variety of projects. He also worked as a consultant in around 30 other countries in Asia, Africa, Europe and Latin America. He is currently employed at the Helvetas office in Zurich, where he is responsible for various projects on socially just and ecologically sustainable value chains in agriculture.

DISCOVER

○ 9 May 2023, 6.15 – 7.15 p.m.

Dogs in space

ANYmal is a quadrupedal robot built by ETH Zurich that might one day join a mission to the moon. Designed to navigate rough terrain and equipped with various instruments to analyse rock samples, scientists hope it could help track down valuable resources at the lunar south pole. In the meantime, visitors to the Robotic Systems Lab can get a taste of the canine robot in action.

Free registration plus info on other tours at:
⟶ tours.ethz.ch

Image: ETH Zurich

○ 27 March – 1 April 2023

Computer Science Day

Organised by the Department of Computer Science and ETH Zurich's IT Services, this year's programme caters to all ages and levels of expertise. Young and old will have the chance to pick up some basic coding skills, dive into virtual worlds, take a tour of a data centre or even attend a Disney Research lecture.

Parents and kids can join forces to program a self-propelling robot, and teenagers can try their hand at the latest games. They can also get to know about the Swiss Olympiad in Informatics and discover the latest on artificial intelligence from the ETH AI Center.

Find out more at:
⟶ informatiktage.ch/eth

Image: rhz Reisehochschule

Behind the church spires of Stepantsminda towers the 5,047-metre Mount Kazbek.

○ 7–17 October 2023

Green mountain pastures

Alumni trip to Georgia

Despite its turbulent history, Georgia has been able to preserve its cultural identity, including a varied cuisine and age-old winemaking tradition. Surrounded by spectacular mountains, the Caucasian republic boasts a rich heritage, with medieval towns, frescoed churches and cave monasteries.

In Tbilisi, Georgia's vibrant capital, the labyrinthine old city sits cheek by jowl with innovative modern architecture. The mining town of Chiatura, an industrial heritage site, is famous for its extensive system of cable cars, originally numbering over 50. Led by Lorenzo Amberg, former Swiss Ambassador in Tbilisi, this fascinating trip will end on the Black Sea shores in Batumi.

Find out more and book your place:
⟶ alumni.ethz.ch/events

○ Open Sunday: 19 March and 2 April 2023

Treffpunkt Science City

Image: Shutterstock

Gaze up in wonder at the vast expanses of the night-time sky: Is there life out there? What makes up the universe and how was it created? Will we one day fly to Mars and even colonise other planets? Featuring a combination of tours, lectures and demonstrations for young and old, Open Sunday at Treffpunkt Science City will help illuminate these and many other mysteries of the universe.

For more information and to sign up, please visit:
—〉 treffpunkt.ethz.ch

AUDIO

○ ETH podcast

How ETH shaped my life

In the ETH podcast, two former students describe how their time at ETH helped make them what they are today. In retrospect, they realise that almost anything was possible. The important thing, they say, was to take one step at a time.

Find out more about this and other ETH podcasts at:
—〉 podcast.ethz.ch

BOOKS

Slow Pandemics

How lifestyle diseases will bring a redefinition of the quality of life

A combination of medical progress and increasing prosperity has helped us live longer while still remaining healthy. Yet the downsides are beginning to show. The next pandemic will be one of lifestyle diseases – and in contrast to COVID-19, it will spread slowly, far away from the media spotlight.

Diseases caused by modern lifestyles will be part of the "new normal", fuelled by more fast food, less exercise, greater pressure and stress, increasing loneliness and a morbid reliance on digital aids.

ISBN: 978-3-907396-13-1

These "slow pandemics" will emerge almost imperceptibly, in the midst of everyday life, and will be untreatable by hospitalization or medication. Instead, they will require a new type of health system – one that focuses on the way we live and includes all the factors, public and private, that impact our surroundings and behaviour. A focus on healthier lifestyles will open up new markets in preventive care. In return, we will be expected to show greater responsibility towards society, to participate in data-based healthcare systems and to accept a redefinition of the quality of life.

Image: NZZ LIBRO

OUT OF FOCUS

Illustration: Michael Meister

Emotions – as seen through the eyes of illustrator Michael Meister

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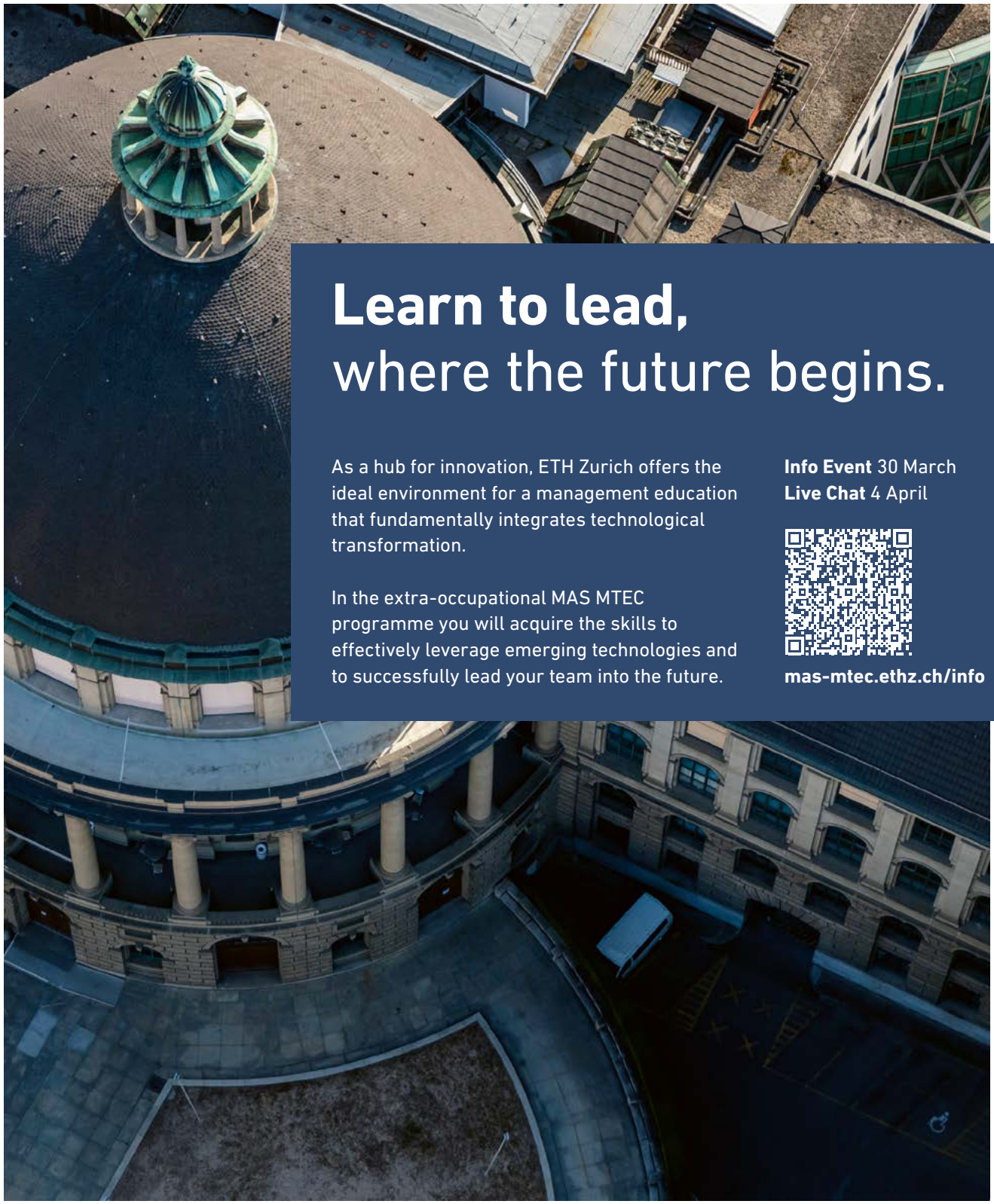

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