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# GLOBE

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2/2021



## Nature + design

Blurring the boundaries between  
the natural and the artificial 14

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EDITORIAL

# INTERVENING IN NATURE



Illustrations: David Padilla (cover page), Oriana Fenwick (editorial)

GLOBE – the magazine for ETH Zurich  
and ETH Alumni

The difference between “natural” and “artificial” may seem obvious, but it’s actually remarkably complex. Ever since humans first walked the earth, we’ve been adapting nature to improve our living conditions. And however much we may lean towards favouring the natural, it’s the artificial remedies that protect us against natural dangers and disease.

Nowadays, we rarely encounter nature in its unaltered state. The array of synthetic substances – in other words, those created by humans – continues to grow by the day. Researchers at ETH Zurich have recently succeeded in building from scratch the first entirely synthetic genome of a bacteria, and AI and robotics are busy creating machines that can perform human tasks. The greater our abilities to change the world, however, the greater our responsibility – making it all the more crucial to carefully weigh the pros and cons of each intervention.

Some may dream of nature, pure and simple – others of some kind of artificial paradise. But the reality of our lives actually lies somewhere in between. This issue of *Globe* will take you on a voyage of discovery through the many gradations of the natural and the artificial. We hope this will spark your interest in our *Scientifica*: Zurich Science Days event on the topic of “natural – artificial”, which will take place on 4 and 5 September 2021.

I hope you enjoy reading this issue, and I look forward to seeing you at *Scientifica*!

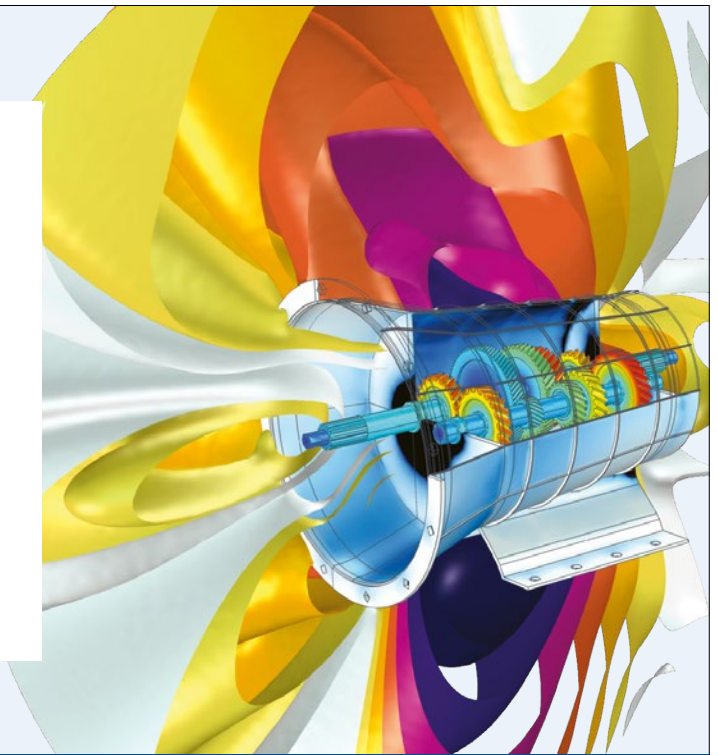
Joël Mesot  
President of ETH Zurich

## SIMULATION CASE STUDY

# How noisy is this gearbox design?

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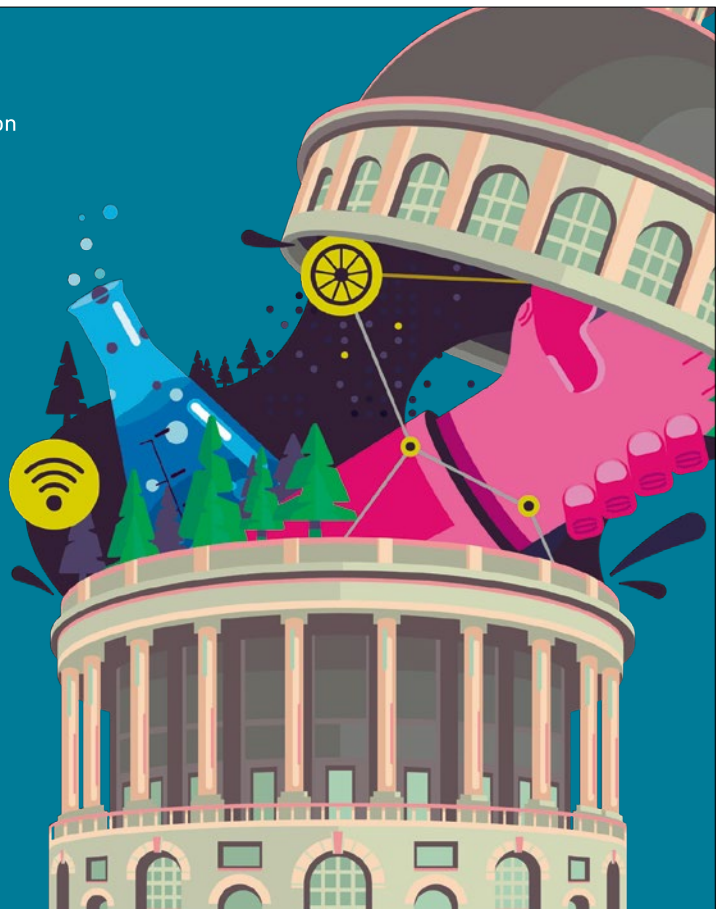
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Images: David Padilla; Daniel Winkler

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# NEW + NOTED



Image: WSL

A look at the lower part of the Illgraben in the canton of Valais.

## AI provides debris flow warnings

Debris avalanches and mudslides often occur during heavy rainfall in steep alpine terrain. Switzerland alone sees several hundred of these events each year – yet warnings often come at the last minute. This is because current alarm systems are based on instruments that typically have to be installed in accessible, low-elevation valley sections. They therefore register debris flows relatively late – a common problem in debris flow detection. Now, however, a team of researchers led by Fabian Walter, ETH Professor of Glacier Seismology, has come up with a new approach.

To carry out their study, the scientists chose the Illgraben catchment in the canton of Valais, where an early-warning system to alert people to debris flows has been in place since 2007. This system is based on various types of sensors located in

the channel bed, but Walter and his team opted for the kind of seismic sensors that are normally used to measure earthquakes. Their new system can detect the vibrations of a debris flow while it is still in higher, inaccessible areas.

The real challenge, however, was to develop a detector that could specifically distinguish between the vibrations of a debris flow and other ground vibrations within a continuous stream of seismic data. This was far from simple, since even herds of cows, distant construction sites, and rail and road traffic can make the earth tremble. To achieve their goal, Walter's team employed machine learning, a branch of artificial intelligence in which a computer learns from training data how to recognise patterns in large data sets. At Illgraben, their new method sounded the alarm at least 20 minutes earlier than existing detection systems. ○

## Climate change and population displacement

Every year, millions of people around the world are forced to flee their homes due to severe weather caused by climate change. According to the International Red Cross and Red Crescent Movement, 10.3 million people were displaced by climate-related events in the last six months alone – four times the number displaced by war and conflict over the same period. One of the main causes of displacement is flooding. An international research team led by the Weather and Climate Risks Group at ETH Zurich recently published a new study that aims to provide a better understanding of future displacement risks due to floods. Their study also evaluates the impact of climate change alongside demographic and socioeconomic factors.

Using a variety of climate, hydrology and population-distribution models, the researchers showed that – were the population to remain at its current level – the risk of displacement related to

floods would increase by more than 50 percent (relative to 2010 levels) with each degree of global warming. However, even if global warming is mitigated, the risk of displacement will still increase significantly if the world's population continues to grow at the current rate. For example, if the world meets the Paris Agreement's goal of limiting global warming to 2 degrees Celsius, the average risk of displacement is still expected to jump by up to 110 percent by the end of this century. Under "business as usual" climate-change conditions, however, and if the gap between rich and poor continues to widen, the risk is projected to increase even more dramatically. In this scenario, the researchers calculated that the risk of displacement due to flooding would be up to 350 percent higher. ○

## Eliminating resistant bacteria with nanoparticles

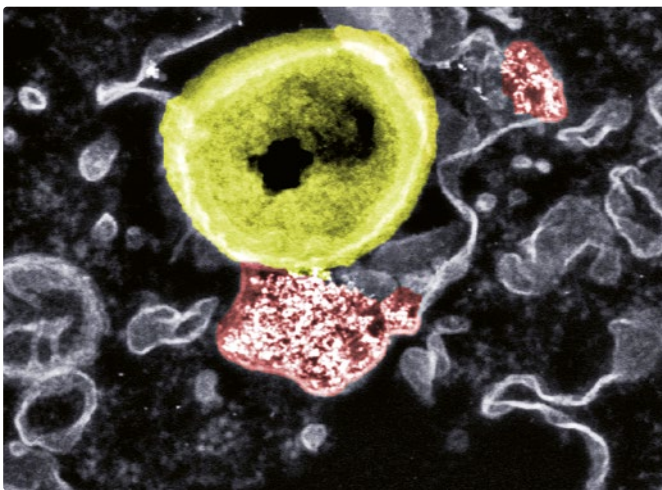


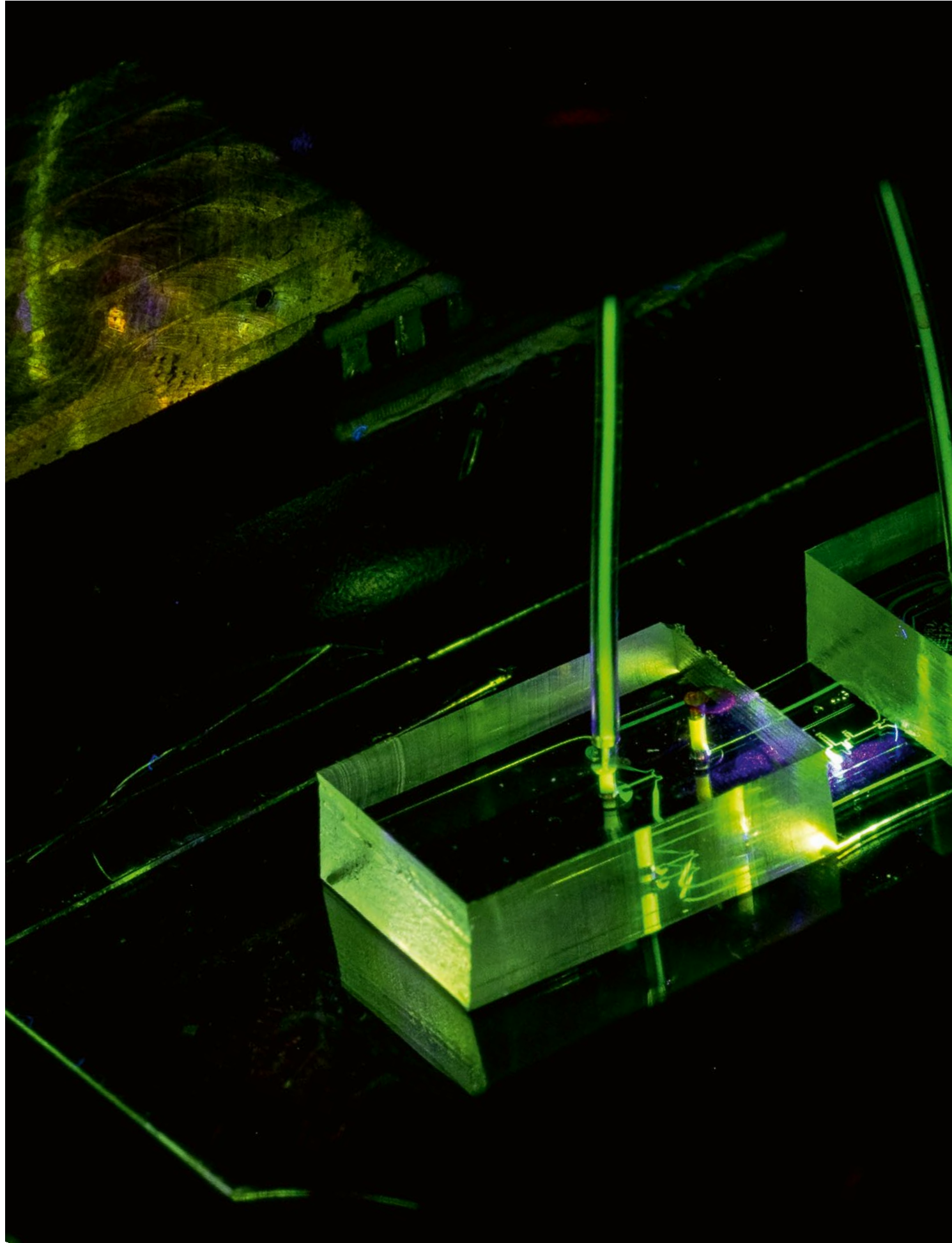
Image: Empa

Nanoparticles (red) attack a resistant bacterium (yellow).

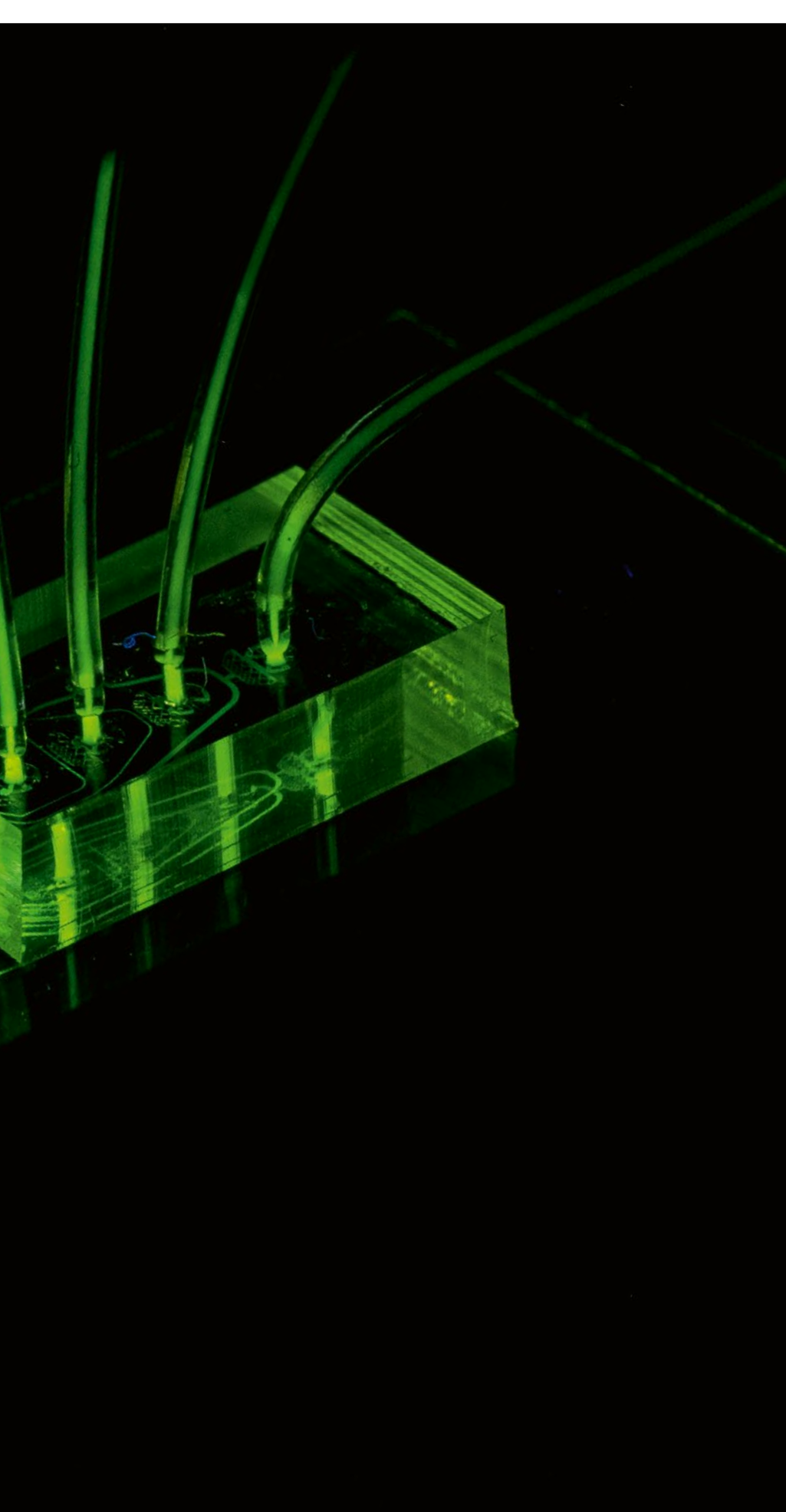
Nanoparticles developed by researchers at ETH Zurich and Empa are able to track down multi-resistant pathogens and eliminate them. A team led by Inge Herrmann, Professor of Nanoparticulate Systems at ETH Zurich and a researcher at Empa in St. Gallen, used cerium oxide, a material with anti-bacterial and anti-inflammatory properties in its nanoparticle form.

The researchers combined cerium oxide with a bioactive ceramic material – a bioglass – and synthesised hybrid nanoparticles from the two materials. When the scientists used the nanoparticles to treat cells infected with bacteria, the bacteria inside the cells began to dissipate. The researchers' goal is to develop an antibacterial agent that is effective in cases where conventional antibiotics do not work. ○









## Lab in miniature

**MICROFLUIDICS** ○ This tiny device made of glass and silicone measures only a few centimetres. It allows researchers to study the rapidly changing properties of biomolecules, such as proteins, at different temperatures, and to explore their potential industrial applications. In short, a light source, usually a laser, illuminates part of the chip and causes a change in signal that can then be measured and investigated.

The experiment belongs to the interdisciplinary field of microfluidics, which deals with the manipulation of fluids on scales as small as a human hair. Microfluidics is known for its low sample consumption, small dimensions, and rapid mixing and heat transfer. It has diverse applications, ranging from inkjet printers to analysing single droplets of blood. ○

→ [demellogroup.ethz.ch](http://demellogroup.ethz.ch)

## Learning to cope with uncertainty

Statistics can't always give us the certainty we want, says mathematician Tanja Stadler in the Zukunftsblog.



**TANJA STADLER** is a Professor in the Department of Biosystems Science and Engineering at ETH Zurich. She will take over the lead of the Swiss National COVID-19 Science Task Force as of summer 2021.



One of the pandemic's key questions is how many other people one infected person will pass the virus onto.

Is the number of COVID-19 cases in Switzerland rising exponentially, or is it falling? How much faster are new variants of the virus spreading? We try to answer these questions using statistical data analysis. Scientists would love to provide clear and unambiguous answers, but that's not always possible. When it comes to people's lives and diseases in the real world, things rarely follow a strict pattern.

When we say, for example, that each person with SARS-CoV-2 infects on average one other person, what this means is that some individuals with the disease will infect several people, while others won't infect anyone. Another good example is the incubation period: the time between contracting the virus and experiencing the first symptoms. On average, this lasts five days, varying between three days for some patients and seven or eight for others. Another key indicator is the number of new daily infections, which also varies from one day to the next.

**THE RANGE MATTERS** My group is estimating the R value of the COVID-19 epidemic in Switzerland. When R is greater than 1, the virus spreads exponentially within the population. Our estimates take into account all sorts of fluctuations and uncertainties, including those mentioned above. That means the estimates we provide are never a single number, but rather a range of values.

So, at a given point in time, we can provide a statistically robust estimate that the R value in Switzerland lies between, say, 0.96 and 1.21. We call this the uncertainty interval. We also report

a single number that lies in the middle of this range: the point estimate. This is the best estimate of a single value, although it's important not to overinterpret it.

**“SIGNIFICANT” STATEMENTS AND TRENDS** If the estimated R value range is not fully above 1 or fully below 1, as in the example above, then we can't say with statistical certainty whether we're in a phase of exponential growth. We can still interpret the data and cautiously suggest some trends, but we can't make a “significant” statement. The less data we analyse, the more prominent the fluctuations and the wider the range of uncertainty.

**IDENTIFYING DYNAMICS** Estimates of R can suggest in which direction the pandemic might be heading, but we must always take the uncertainty interval into account and interpret the data with caution. It's also important to consider other pandemic-related parameters in order to build up a comprehensive assessment. You can't get a full picture of the epidemiological situation with a point estimate alone.

We all want certainty in uncertain times. But that's not something statistics can necessarily provide. We can't eliminate statistical uncertainty because it's a direct consequence of real-world events. We therefore have to accept uncertainty and, as a society, find ways to deal with it. Our team's job is to identify the epidemiological dynamics from the available data, highlight possible scenarios and quantify those scenarios by calculating probabilities. But deciding how to use these scientific insights ultimately comes down to policymakers and society as a whole. ○

Read more blog posts at:  
→ [ethz.ch/zukunftsblog-en](https://ethz.ch/zukunftsblog-en)



## Mitigating global warming



Grab crane at the Hagenholz waste incineration plant, Zurich.

In order to meet global-warming targets, carbon emissions must be reduced or offset. One option is to employ what are known as negative-emissions technologies, which remove CO<sub>2</sub> from the atmosphere and store it in underground repositories. One such technology, known as BECCS, generates bioenergy by burning biomass and combines this with carbon capture and storage. Researchers at ETH Zurich have now analysed the potential of BECCS were it to be deployed in Europe. Their calculations show that if BECCS were fully implemented, this would reduce carbon emissions in Europe by 200 million tonnes per year, the equivalent of 5 percent of European carbon emissions in 2018. However, fully exploiting the calculated potential of BECCS is likely to prove challenging in practice.

BECCS captures carbon at the very source where it is produced from biological material. In Europe, the greatest potential lies in the pulp and paper industry. Other promising sources are waste incineration plants, wood-fired combined heat and power plants, and biogas plants. “The technology for carbon capture is ready to go,” says Marco Mazzotti, Professor at the Institute of Energy and Process Engineering, who led the study. What is lacking, however, are pipelines or other suitable infrastructure for transporting the CO<sub>2</sub> to storage locations. ○



# Smart camera sees surge in interest



The coronavirus crisis has led to an increase in the use of video communications, and Seervision, an ETH Zurich spin-off, is riding this trend. The company develops software that can automate cameras in studios, meaning that one person is able to operate and control several cameras at the same time. The key driver of Seervision's solution is the software, which combines artificial intelligence, image recognition and predictive mathematical models. It can anticipate a person's movements while filming and pan the cameras as if they were

being operated by a cameraperson. The software works with a range of cameras from various manufacturers, which makes the technology versatile to use.

The idea for the start-up dates back a few years, when students at ETH Zurich developed a rather clunky-looking prototype for recording lectures. Seervision co-founder and CEO Nikos Kariotoglou was a doctoral student working on remote-controlled cameras at the time, and he figured a new algorithm might be a good way to improve them. His aim was to get the cameras to react intelligently to a person's movements. Reto Hofmann, who was studying for his Master's degree, took on the challenge of building a smart camera system for this purpose. His bulky prototype was used to record lectures given by the head of the Automatic Control Laboratory, and it went on to form the cornerstone of the spin-off that Kariotoglou and Hofmann founded in 2016. ○

# Using play to combat dementia

Everyone dreads a dementia diagnosis and the gradual loss of brain function it entails. So far, all attempts to find a drug to cure this disease have failed. However, a clinical study carried out in Belgium with the involvement of ETH Zurich researcher Eling de Bruin has now shown that cognitive motor training improves both the cognitive and physical skills of patients with advanced dementia. The study was based around a fitness game and training platform developed by ETH Zurich spin-off Dividat. The system consists of a screen, game software and a platform with four fields that measure steps, weight displacement and balance. Users must attempt to complete a sequence of movements with their feet by following the on-screen instructions, letting them train both physical movement and cognitive function at the same time. ○



Training with the Senso platform.

# *Scientifica*<sup>21</sup>

Zurich Science Days

4 – 5 September 2021

## *Synthetic naturally*

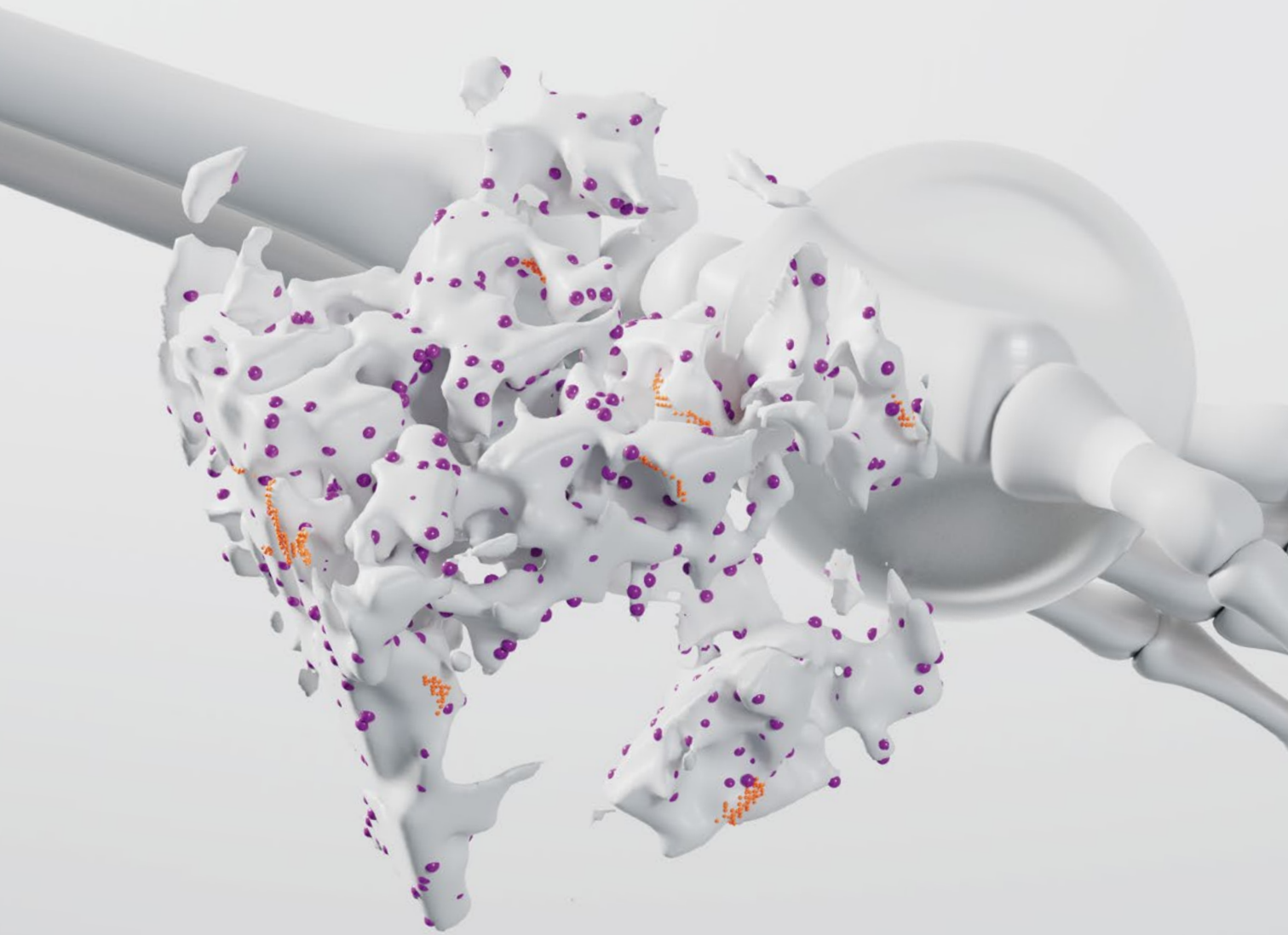
Scientists showcase their latest research at the University of Zurich and ETH Zurich in the main buildings on City Campus and now also at Irchel and at Hönggerberg.

[www.scientifica.ch/en](http://www.scientifica.ch/en)

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# Artificial?

**INSIGHTS INTO BONE PROCESSES** Simulation – that is, creating models of real-life systems – helps us analyse complex processes that we cannot observe directly. The Laboratory for Bone Biomechanics at ETH Zurich is seeking to build computer simulations to replicate all the natural processes that occur in bones. These simulations are used to predict what natural changes bones will undergo in the course of diseases such as osteoporosis as well as during treatment and bone healing.

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



**FOCUS** | Our ability to intervene in nature is growing all the time. Researchers also look to nature as a source of inspiration. This issue of *Globe* explores the relationship between the natural and the artificial – and asks whether we need to abandon the dichotomy altogether.

ILLUSTRATIONS | David Padilla's artwork is inspired by projects that will be showcased at *Scientifica*.

# Natural?



# “Scepticism isn’t a bad thing per se.”

Is natural always good and artificial always bad? We talked to psychologist Angela Bearth and biotechnologist Sven Panke about science, scepticism, misunderstandings and how language influences the way we think.

INTERVIEW Corinne Johannssen and Martina Märki



Image: courtesy of Angela Bearth

**ANGELA BEARTH** is a social scientist. She conducts research into risk perception in the Consumer Behavior Group at the Department of Health Sciences and Technology.

—> [cb.ethz.ch](http://cb.ethz.ch)

**Ms Bearth, based on your research in the Consumer Behavior Group, why do you think people get so emotionally worked up about techniques they see as artificial, such as genetically modified plants or vaccines?**

**ANGELA BEARTH:** The term “artificial” has negative connotations and is often associated with risk. Most people won’t automatically know how an mRNA-based vaccine works, for example. That’s the kind of situation where we tend to rely on so-called heuristics – mental shortcuts or simplified rules of thumb that help us make quick decisions of the type “if it’s artificial, it must be bad”.

**Mr Panke, your area of specialisation is synthetic biology, which sounds pretty artificial...**

**SVEN PANKE:** That term was coined by an MIT and Berkeley working group, and we’ve never been very happy with it! As science branding goes, I would say it hits all the wrong notes, at least in Europe. But, yes, at its core, synthetic biology is about creating genetic circuits that do something useful in a cell. It always involves some kind of manipulation of a biological system – and, of course, that’s another word with negative connotations.

**So language influences our attitudes towards these things?**

**BEARTH:** This is one of the biggest challenges and something I'm also looking at in my work. If I ask you how dangerous you think biotechnology is, then I've already implied that it might be dangerous. A better approach is to start with a broad focus and talk about bigger issues before actually asking for people's opinions.

**Coronavirus and the mRNA-based vaccine are the big issues right now. Mr Panke, you're in charge of a new EU consortium that is examining the therapeutic benefits of mRNA. What are you aiming to achieve?**

**PANKE:** We want to find out if we can leave the realm of chemistry that nature has laid out for us. What possibilities might we unearth by working at a cellular level to manipulate molecules that exist in the same form just about everywhere? Might that enable us to develop new drugs, for example?

**People have always striven to stretch the bounds of possibility. Is what's happening in research today really any different?**

**PANKE:** When we look at nature, we see how certain types of molecules appear again and again in virtually the same form, such as DNA. You could argue that just suggesting we try something different is already pushing back the boundaries.

**So perhaps some scepticism is justified?**

**BEARTH:** Scepticism isn't a bad thing per se. It's actually good to instinctively take a precautionary approach. When we are unsure, we try to protect ourselves on an individual level. But it becomes problematic when decisions on a societal level are based purely on feelings and not on science.

**Does public scepticism affect you, Mr Panke?**

**PANKE:** Absolutely! I couldn't do things that would upset or alienate everyone around me. That's not in my personality. Obviously we're very open to new things at ETH. But that's balanced by a raft of government regulations that give me the framework for my research. I can move within that framework without having to constantly worry that I might be about to do something wrong.

**Ms Bearth, as well as being a researcher at ETH, you're also Vice President of the Forum for Genetic Research at SCNAT. What's your experience of the interaction between science, policymakers and the general public?**

**BEARTH:** For the most part, I find it very constructive. We're witnessing a new generation that grew up with climate activism and sees plenty of

Image: Giulia Marthaler



**SVEN PANKE** is a Professor of Bioprocess Engineering. He conducts research in the field of synthetic biology at the Department of Biosystems Science and Engineering. → [bsse.ethz.ch/bpl](https://bsse.ethz.ch/bpl)

opportunities in new technologies. CRISPR has a better image than traditional genetic research. In addition, the research community is becoming more aware of the issue and is investing more in science communication.

**PANKE:** Those of us working in synthetic biology have certainly tried to engage in dialogue early on, but overall I have a very different impression of the current situation. It seems to me that society has lost a huge amount of trust in scientists since the 1980s. There's a crisis of confidence, and our efforts to remedy this with better information aren't working. People don't believe us any more because we've messed things up too many times in the past.

**BEARTH:** I don't think that's the case. Hardly any studies point to a steady decline in people's trust in science. In reality, the level of trust is pretty much stable, and in some areas it's even increasing. If there is the opposite impression, it might be because people who have lost trust in science are very vocal. Ultimately, they are a minority, but they are well organised. For example, the anti-vaccine movement is a powerful campaigning force. Their message can certainly undermine trust but mostly just makes people feel a little unsettled.

**PANKE:** But what about genetic engineering in plant breeding? Researchers working in that field have tried so hard to get information out to the →



public, but my feeling is that none of their efforts have ever really got anywhere. Why is that?

**BEARTH:** I agree that information is probably not the only solution. We can't all become experts in everything, but people do need to have some basic understanding of the issues. We recently did a study on potato blight where we offered people various solutions. Interestingly, the approach people were most enthusiastic about was gene transfer, which is gene technology. And that was true whether or not we used the term gene technology. People tend to generalise about consumers being against genetic engineering, but I don't think it's as simple as that.

**One of the arguments that's often used to support genetic engineering and CRISPR is that we're doing the same thing that nature does, only faster and in a more targeted way. Is that a fair point?**

**BEARTH:** Obviously those technologies can produce mutations that might also occur in nature. The difference is that genetic engineering involves a specific person with a specific intention, who can then be held responsible for it. This is where consumers might judge differently, whereas a scientist wouldn't necessarily take that issue into account. Basic researchers don't put a big emphasis on which company uses a technology or who profits, but public opinion takes all those kinds of things into consideration.

**Can we always distinguish between what's natural and what's artificial? And does that distinction even make sense?**

**PANKE:** It absolutely makes sense, because we're talking about social codes that are clearly important. Society uses the terms natural and artificial to contrast and compare certain things. As a scientist, I don't have sole power to define those words, and I wouldn't even want to. Instead, I need to focus on what society feels about what I do.

**BEARTH:** I would largely agree with that, but I do think there's a problem when these terms lead to uninformed decisions, especially on a political or societal level. I've done a lot of research into toxicology, and it's a great example of how people

**“We want to find out if we can leave the realm of chemistry that nature has laid out for us.”**

Sven Panke

misunderstand basic concepts. Many people think that the word “chemical” refers to something in a test tube, but not to the air we breathe or the water we drink. And that of course can quickly lead to all sorts of misunderstandings.

**Mr Panke, does it bother you that scientists and lay people interpret the terms differently?**

**PANKE:** No, quite the opposite! Scientists like me and the insights we offer are just part of a broader toolkit. We try to use the means we have at our disposal to help build the society of the future, but we shouldn't see our contribution as some kind of absolute. ○



**AUGMENTED REALITY – A BRIDGE TO UNDERSTANDING** Over the years, many viewers of Hendrick Goltzius's copperplate engraving of the Apollo Belvedere, a celebrated marble sculpture from the classical era, must have wondered what the original looks like in 3D. This is now possible thanks to an augmented reality (AR) platform developed by the Game Technology Center and ETH Zurich's Graphische Sammlung. Museums, galleries and universities can use the platform to create customised AR applications that enrich the experience of artworks through extra information and interactive effects. This new toolkit is known as Artifact and was developed with the support of LGT Private Banking.

—> [gtc.inf.ethz.ch](http://gtc.inf.ethz.ch) and [gs.ethz.ch/en](http://gs.ethz.ch/en)

# Optimising nature

Evolution is constantly and inevitably creating something new. Today humans can do the same. Novel methods mean we can intervene deep into biological processes.

TEXT Michael Keller and Fabio Bergamin

## Breeding the crops of the future

When it comes to food, many people yearn for nature in its most pristine state. The thinking is that natural products are somehow better and healthier. Organic food is marketed through an idealised vision of agriculture in which quasi-natural methods are used to produce natural food, and tools such as genetic engineering are frowned upon as a form of artificial meddling. Yet this romanticised view of nature is deceptive. Very little of what we eat today is produced in ways that could be considered entirely natural. "For the past 12,000 years, we've been modifying plants

by selecting for traits that make them more edible and higher yielding," says Bruno Studer, Professor of Molecular Plant Breeding at ETH Zurich.

**BOOSTING BETTER CROPS** Today's farmers are under pressure to adopt practices that are more environmentally friendly, in particular by reducing the use of pesticides. At the same time, we expect them to deliver consistent, high-quality harvests in an increasingly warmer and drier climate – a task that requires disease-resistant, climate-resilient crop varieties. "We need to make sure our crops are genetically prepared for the challenges that lie ahead," says Studer. Yet traditional cross-breeding is often a slow process – which is why Studer and his team are developing molecular genetic techniques to make plant breeding more efficient. One example is the use of genetic markers that make it quicker to identify plants with the desired traits. The group works closely with Agroscope, the Swiss centre of excellence for agricultural research, and is supported by the fenaco agricultural cooperative.

**PRECISION BREEDING** It's been almost a decade since new plant breeding techniques based on the CRISPR/Cas system paved the way for a powerful method known as genome editing. Commonly referred to as genetic scissors, this tool is much more precise than the "shotgun" genetic engineering techniques used in the 2000s, which involved randomly introducing DNA from other species into plant genomes. Swiss legislation on genetic engineering classifies organisms as genetically modified if their genome has been modified in a way that does not occur in nature through cross-breeding or genetic recombination. A moratorium prohibiting the cultivation of such gene-edited plants has been in place since 2005. Genome editing is different, however. It enables us to make targeted changes to the genome by inserting, editing or switching off individual genes. By adding a resistance gene from a wild relative, for example, or by turning off a gene that suppresses a plant's ability to defend itself against pests, genome editing offers a highly efficient way to create resistant plants – without introducing genetic material from other species.

**A MEANINGFUL DISTINCTION?** In many cases, targeted changes to the genome made using genetic scissors cannot be distinguished from naturally occurring or conventionally induced mutations. This raises the question as to whether gene-edited crops should be considered as genetically modified organisms. "That's how things are right now in Switzerland and Europe, where the cultivation of gene-edited crops is banned. However, if the same mutation occurs in a natural way or as a result of conventional breeding techniques, no strict regulations are applied, even if it is genetically the exact same germplasm," says Studer.

Paradoxically, this also holds true if the mutations in the genome are induced more invasively and at random by chemicals or radiation. "That makes absolutely no sense from the plant breeding perspective. A plant is not 'more artificial' or 'more dangerous' simply because it was created through the CRISPR/Cas system!" says Studer. He argues it would make more sense to assess the risk of new plant varieties based on their traits rather than the techniques used to create them.

**MULTINUTRIENT RICE** Navreet Bhullar, a biotechnologist at the Institute of Molecular Plant Biology, agrees. Bhullar improves food crops by boosting the amount of micronutrients they contain. Over 2 billion people worldwide suffer from mineral and vitamin deficiencies because their diet is based on polished grains of rice that contain virtually no essential trace elements, such as iron. Bhullar's team has developed transgenic rice varieties that not only have increased levels of iron and zinc in the grains, but also produce beta-carotene, a precursor of vitamin A.

The research group and its multi-nutrient rice are at the cutting edge of this field of technology. "We used classic genetic engineering methods to develop it because this is something that conventional breeding simply cannot do," says Bhullar. Although she has not yet worked with CRISPR/Cas, she points out that the combination of traits such as drought tolerance, pest resistance and micronutrients offers enormous potential for sustainable agriculture, which could in turn help to solve global food shortages.

The moratorium on GM crops is set to expire at the end of this year. The Federal Council is keen to extend it by another four years and include genome editing in the complete ban on cultivation. Bhullar and Studer say that so far, the biological risks supposedly posed by older methods of genetic engineering have not proven to be true. "Switzerland shouldn't be closing the door to the potential of new breeding methods," they argue. ○

**BRUNO STUDER** is Professor of Molecular Plant Breeding. His research focuses on molecular biology techniques to improve plant breeding efficiency.

→ [mpb.ethz.ch](http://mpb.ethz.ch)

**NAVREET BHULLAR** is a scientist at the Institute of Molecular Plant Biology. Her research team has developed new rice and wheat varieties with increased levels of micronutrients such as iron and zinc.

→ [impb.ethz.ch/research/research-pb/research-pb/research-nkb](http://impb.ethz.ch/research/research-pb/research-pb/research-nkb)



Image: Andreas Hund

Should Switzerland make use of new plant breeding techniques to make agriculture more sustainable? Pictured: a test field with different wheat varieties.



## Designing an enzyme from scratch

Enzymes are catalysts that dramatically speed up chemical reactions. Engineering natural enzymes in order to optimise them for industrial applications is a well-established field of biotechnology. Such modified enzymes – which are derived from enzymes that occur naturally in animals, plants and microorganisms – are used in laundry detergents as well as for food production and diverse chemical processes. Evolution has given rise to thousands of different enzymes. Yet this pales in comparison with the literally infinite number of theoretically possible chemical reactions that might be of value to industry.

Scientists are therefore keen to boost the ranks of available enzymes by developing synthetic enzymes that might be useful for reactions of interest in the future. “The most common approach is to focus on existing enzymes and then – sometimes with the help of computer modelling – mutate their active sites in such a way that they recognise a different substrate and catalyse a new reaction,” says Peter Kast, honorary professor at the Laboratory of Organic Chemistry.

An alternative approach, however, is to go back to the drawing board and design an entire enzyme from scratch, as ETH emeritus professor Donald Hilvert

recently demonstrated. He began with a peptide scaffold that was not based on any natural model. By making targeted changes and working through multiple rounds of mutation and selection, he developed an enzyme for a specific chemical reaction for which there is no suitable enzyme in nature. Hilvert notes that this work was a proof of concept, and he cautions that concrete applications are still some way off. What’s clear, however, is that biocatalysis with enzymes has distinct advantages over conventional catalysis: it requires neither high process temperatures nor toxic solvents and is extremely efficient and environmentally friendly. ○

Rational design and directed evolution were used to transform a non-natural zinc-binding protein into a highly active catalyst for a Diels–Alder reaction.

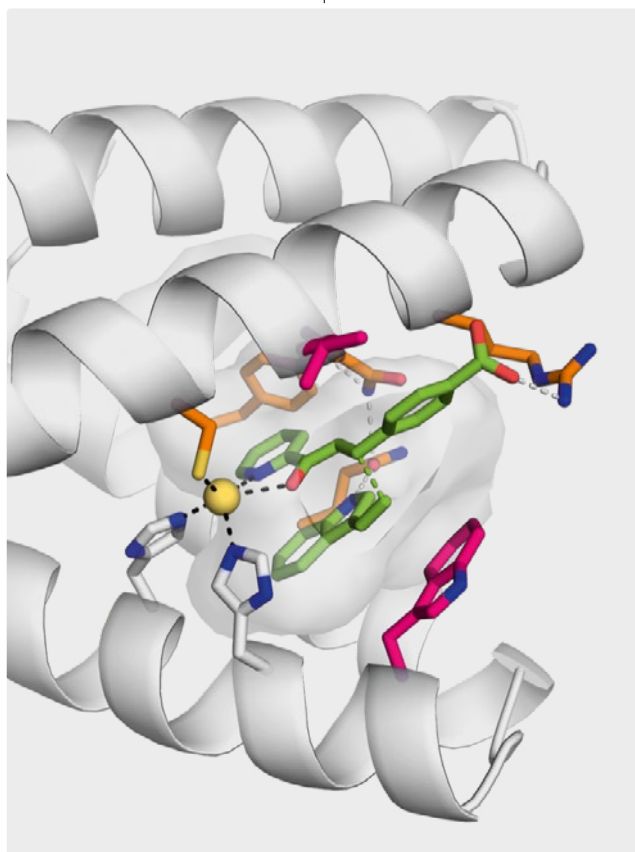


Image: Sophie Basler

**PETER KAST** is an honorary professor at the Laboratory of Organic Chemistry.

**DONALD HILVERT** is Emeritus Professor of Organic Chemistry.

—> [protein.ethz.ch](http://protein.ethz.ch)



Image: ETH Zurich / Agnieszka Wormus

The *Caulobacter ethensis*-2.0 genome was designed on a computer.

## Paving the way for the first synthetic living organism

Beat Christen, Professor of Experimental Systems Biology, has set himself the challenging goal of creating a bacterium with a radically simplified, computer-designed genome. Such organisms can be used by biotechnologists for drug and vaccine production, for cell therapy, and to reduce the carbon footprint of agriculture. “One advantage of a novel engineered organism is that we can specifically equip it with new, beneficial functions,” says Christen. Writing genomes anew also allows us to broaden our understanding of life at the molecular level, he says, because it is only when we succeed in building an organism from scratch that we can claim to have fully understood biology.

Two years ago, Christen completed the first step towards creating a synthetic

bacterium by chemically synthesising an artificial bacterial genome. Now he is working in his lab to progressively introduce this genome into the cells of a related, naturally occurring species of bacteria. This will enable him to verify whether the artificial genome is fully functional. Whenever Christen finds artificial genes that are not yet functioning, it automatically means that he has come across a new secret of biology – recent examples include a previously unknown regulatory mechanism of cellular protein production. It also helps him steadily improve the computer algorithm he uses to write the simplified artificial genome, bringing him one step closer to the goal of a fully functional synthetic bacterium. ○

**BEAT CHRISTEN** is Professor of Experimental Systems Biology at the Department of Biology at ETH Zurich.

→ [imsb.ethz.ch/research/christen](https://imsb.ethz.ch/research/christen)



**SHATTERPROOF CERAMICS** Metamaterials are a class of materials artificially produced to possess properties that do not occur in nature. These properties are the result of careful structural engineering. ETH Zurich's Mechanics and Materials Laboratory develops the architectural design paradigms for, among other things, ceramic metamaterials that display high levels of stiffness and strength thanks to a multitude of curvilinear channels and cavities running through the material. They are arranged in such a way that, when pressure is applied, destructive tensile forces cannot concentrate in one area, thereby preventing the ceramic from shattering.

→ [mm.ethz.ch](http://mm.ethz.ch)



# Robots for comfort and counsel

From robots that offer solace to algorithms that help judges make fact-based decisions, robotics and machine learning are entering new domains that were once the preserve of humans.

TEXT Samuel Schlaefli

Five years ago, while studying in Pennsylvania for a Master's degree in robotics, Alexis E. Block was asked to choose a topic for her thesis. Almost right away, she said she wanted to develop a robot that would hug and comfort her. Block's father had recently passed away, and her mother lived in Wisconsin, a two-and-a-half-hour flight away. With millions of people living far from their loved ones, she figured she wasn't the only one craving physical comfort. Wouldn't it be marvellous, Block thought, if we could at least send a hug to the people we love and miss so much? And it could make a real difference: it is well established that human hugs and physical contact reduce blood pressure, alleviate stress and anxiety, and boost the immune system.

**SIX COMMANDMENTS FOR ROBOT HUGS** Today, Alexis E. Block is a doctoral student at the Max Planck ETH Center for Learning Systems. Dividing her time between Stuttgart and Zurich, she is

continuing to develop and improve her hugging robot, or HuggieBot. "Our work is based on our six design tenets, or 'commandments', for natural and enjoyable robot hugging," says Block. "A hugging robot should be soft, warm and human-sized. It should be able to visually perceive the person it is hugging, adjust its embrace to the user's size and position, and always let go when the person wants to end the hug." Block therefore opted to clad the upper body of her HuggieBot with heating and softening elements, including a custom inflatable torso. Sensors in the torso measure the pressure applied by the person being hugged, detecting when the user starts and stops hugging the robot. Meanwhile, torque sensors in the arm measure how tightly the robot is hugging. Using a 3D printer, Block produced a head with a built-in screen that displays animated faces. This enables the robot to laugh and wink while simultaneously, through a built-in depth-sensing camera, detecting the distance and movements of the person being hugged and responding accordingly.

Robotics is increasingly focusing on the use of soft, organic-like, "bio-inspired" materials. This throws up challenges for other disciplines such as materials science and is also attracting the attention of educators. From February to June of this year, the Competence Center for Materials and Processes organised a series of lectures on soft robotics. Alongside presentations by renowned researchers from Stanford, Yale, Harvard and MIT, there were also talks by experts from the ETH Domain. The Competence Center will be opening a doctoral school this summer, with these kinds of bio-inspired systems as one of its five focal points.

**PARTICULARLY APPEALING TO INTROVERTS** In 2020, Block tested the second version of the robot, HuggieBot 2.0, in the lab. A total of 32 test subjects were hugged by the robot and asked to share their experiences. "It was fascinating," says Block. "Some of the hugs lasted so long that I actually began →





Image: Alexis E. Block

Alexis E. Block and HuggieBot.

to get nervous!" Several subjects told her the firm hug was just what they needed. She noticed that HuggieBot 2.0 offered particular benefits to introverted people because they no longer worried about making an odd impression if they wanted a hug to last longer. Once the experiment was over, she also found that the study participants had a significantly more positive attitude towards robots and their introduction into everyday life.

Block has since developed HuggieBot 3.0, which will be able to detect and classify intra-hug gestures, such as rubs, pats and squeezes, and respond appropriately, and an even more advanced model – HuggieBot 4.0. This should help to gradually make robot hugs more similar to human ones. Block's team is also working on an app which will allow users to remotely "send" hugs via HuggieBot. While passing on a loved one's hug, HuggieBot can simultaneously play video or audio messages from the sender via its digital interface. "I don't believe robot hugs will ever be able to completely replace human hugs, however much progress we make," says Block emphatically. "But what robots can do is alleviate loneliness and perhaps even improve people's mental health in situations where physical contact is made impossible by distance or illness." Block can already see possible applications in hospitals, care homes and, of course, universities.

### COMBATING PREJUDICES WITH ALGORITHMS

Elliott Ash, Assistant Professor at the Department of Humanities, Social and Political Sciences, is similarly cautious about the potential for robotic systems to become a regular part of our daily lives: "Robots will never replace judges in legal proceedings, but they will increasingly be able to support them." Ash develops virtual assistants that make it easier for judges to base their decisions on previous legal rulings and minimise the impact of their prejudices. Studies from the US, for example, show that darker-skinned defendants are typically sentenced to longer prison terms for the same offence and are less likely to be released on bail. In San Francisco, some judges approve almost 90 percent of asylum applications, while others only approve 3 percent. This situation is complicated further by the daunting backlog of court cases. All too often, judges struggle to keep up with their caseload and are too pressed for time to conduct extensive research. A virtual assistant that is able to analyse all the precedents in a matter of seconds and channel those findings into suggestions for the case at hand could greatly improve the quality of judgements. In future, the use of big data, machine learning and decision theory could also enable the inclusion of sound recordings, photographs and surveillance images in the decision-making process. At the same time, Ash is using machine learning to shed light on

the legal system itself. He recently joined forces with the World Bank to investigate whether the under-representation of women and Muslims as judges in Indian courts leads to bias in court rulings. Previous studies had already indicated that judges tend to favour their own gender and religion.

Ash and his colleagues developed a neural network to retrieve female and Muslim names from more than 80 million publicly available court documents filed by over 80,000 judges over the period between 2010 and 2018. They then deployed an algorithm to search for correlations between names and rulings. The researchers found no statistically significant discrimination in sentencing, though Ash is quick to point out that this does not mean India's legal system is free from prejudice. Discrimination can also be applied by police or prosecutors, he says: "Our results will help politicians decide where they can most effectively tackle discrimination." Ash also worked in Brazil, where he used freely available budgets and audit data from hundreds of municipalities to train an algorithm to spot anomalies. Compared to the previous method, in which auditors visited a random selection of municipalities each year, the use of the algorithm led to the detection of twice as many cases of corruption.

Yet as soon as machine learning is introduced into sensitive areas such as law, questions are bound to be asked about the fairness and ethics of the algorithms on which it is based. For example, how do we stop the same prejudices that shape our world from being programmed into an algorithm in exactly the same form? "Algorithms shouldn't be black boxes," says Ash. "They should be accessible to all, not for profit and under democratic control." He envisions a kind of Wikipedia of algorithms that gives everyone an insight into the codes employed in the realm of public administration.

**CAN ROBOTS MAKE US HAPPIER?** Robotics expert Alexis E. Block believes that the COVID-19 pandemic and the need to maintain physical distance has changed our attitudes towards robots. "People used to laugh at me at conferences because they thought HuggieBot was a silly idea," she says. "But now I don't have to explain to anyone why hugs are so important and why we're developing these kinds of systems." She is currently collaborating with a psychologist to prove scientifically whether being hugged by HuggieBot 4.0, the latest model of the hugging robot, can alleviate stress and produce feelings of happiness – just as human hugs do. Under lab conditions, the 52 test subjects are exposed to mild stress and then hugged by a person or a robot, or not hugged at all. Their heart rate is measured and samples are taken of their saliva to measure oxytocin levels, which are correlated with positive emotions like those in social bonding, and

cortisol levels, which indicate stress. Whatever the results, Block will continue to look forward to a hug with HuggieBot at the end of a long day because, as she says, "It just feels fantastic when it hugs me!" ○

**ALEXIS E. BLOCK** is currently a doctoral student at the Center for Learning Systems, a joint programme of the Max Planck Institute for Intelligent Systems and ETH Zurich.

—> [ait.ethz.ch/people/blocka](https://ait.ethz.ch/people/blocka)

**ELLIOTT ASH** is Assistant Professor in the Department of Humanities, Social and Political Sciences and head of the Law, Economics and Data Science Group.

—> [lawecondata.ethz.ch](https://lawecondata.ethz.ch)



**BEATING BIRDS AND INSECTS AT THEIR OWN GAME** Birds and insects are incredibly adept at flying, collecting materials and building nests – but soon they will be facing stiff competition from robots. The omnidirectional micro aerial vehicle (OMAV) from the Autonomous Systems Lab is a flying robot with an impressive array of skills. Here, “omnidirectional” means that in addition to being able to fly in any direction, it can also apply force and torque to its surroundings from any direction. By adding a delta arm and other features, researchers hope to give the flying robot the dexterity it needs to manipulate objects from the air.

—> [asl.ethz.ch](http://asl.ethz.ch)

# Juggling with constant change

A cultural landscape reflects the combined activity of nature and humans. Where has the equilibrium of this union been lost? And how can we restore the balance?

TEXT Stéphanie Hegelbach

Putting on the VR headset, Maya finds herself immersed in a landscape where a dozen wind turbines are busy generating electricity. Whenever she moves, this immediately triggers sounds linked to the virtual image. The noise of the rotors fills Maya's ears as clearly as if she were actually there. Meanwhile, sensors attached to her body measure her heart rate and skin conductance to record her physiological response. "We use the Audio Visual Lab to investigate how people perceive changes to the landscape," says Adrienne Grêt-Regamey, a professor at the Chair of Planning Landscape and Urban Systems (PLUS). People's particular experiences can play an important role here. "In our studies, many individuals exhibit negative emotions when they see interventions in the landscape. But this is dampened if they've had personal experience of such infrastructure landscape," she explains.

Grêt-Regamey applies the same research method in the ERC project GLOBESCAPE, where she is studying our relationship to peri-urban areas –

the transitional zone between the city and the countryside. Interestingly, the results so far show that, when confronted with uniform peri-urban areas, people display a measurable physiological reaction with less stress reduction potential than in other areas. Even in densified spaces such as a village square, the stress reduction potential can be higher. Grêt-Regamey says that a key problem is the lack of engagement on the part of residents. "In many cases, they show little attachment to place and don't get involved in place-making. So what we end up with is dictated by land prices and commercial interests," she explains.

The professor hopes her study will pinpoint what peri-urban areas need to offer in order to encourage residents to build connections to them – the kind of connection that encourages them to get actively involved in changing the landscape. Only then does it become a cultural landscape: a geographic area whose character we perceive as being shaped by the action and interaction of natural and human factors.

**SUSTAINABILITY IS NOT EQUILIBRIUM** So how can we create landscapes that successfully function as an interplay between nature and human activity over the long term? Grêt-Regamey says the key lies in socio-ecological dynamics: she envisages a landscape in which biophysical and social factors interact in such a way that the landscape remains resilient under changing conditions and is able to continue providing its "services" in a sustainable way. "It's always about negotiating the various services provided by an area," she explains. She favours the concept of ecosystem services, →



which are always tied to the landscape and the interests of specific stakeholders. On this basis, she is able to negotiate with stakeholders in a collaborative and iterative process and thereby identify the required uses of the landscape.

A creative twist to this approach is used for the ValPar.CH project, in which Grêt-Regamey evaluates the ecological infrastructure of Swiss parks. Using a facilitated discussion, groups of five or six stakeholders were able to agree on a future vision for each park, which an illustrator then represented in pictorial form. Researchers use these images to identify elements of the landscape that provide ecosystem services or contribute to biodiversity – and to determine which paths might lead to the desired result. Here, however, Grêt-Regamey would like to go one step further: “We need to ask ourselves how we can create new places that are dynamically resilient – especially in built-up areas.”

**21ST-CENTURY GARDEN** Work on one such human-made ecosystem is already underway at the Chair of Being Alive, where a team led by Teresa Galí-Izard is developing a Garden of the XXI Century. The Catalan landscape architect and agronomist has been a professor on the new ETH Master’s degree programme in Landscape Architecture since 2020. “I’m working on a complex productive landscape. It’s less productive than a monoculture, but it regenerates itself thanks to the interactions between all the various factors,” says Galí-Izard. She is already testing this system in Spain and Santiago de Chile and plans to test it in Switzerland in the future. At its core is a herd of around 20 horses that moves to a different pasture each day. Depending on the climate, it takes between 60 and 90 days for the horses to complete a full rotation of the fields and return to the initial pasture. The horses’ faeces and urine fertilise the soil so that it can be used to produce food crops on a four-yearly rotation. “Even the hedges around the fields produce food for people,” says Galí-Izard.

What interests her now is finding out how elements of this regenerative landscape can be tailored to a more urban setting – with the focus firmly on the goal of making run-down places more vibrant. The key thing to recognise, she says, is that we share our planet with other living things, including plants. Yet this is also the biggest hurdle: “We’re no longer exposed to other living creatures frequently enough – and that leaves a big gap in our knowledge of our environment.” Children, says Galí-Izard, should have access to places where they can observe around them the constant changes at different speeds in our environment.

This is the same principle she applies to the Master’s programme: “The first year is all about encouraging students to observe things so that they

can learn to read the landscape and find new beauty in it,” says Galí-Izard. To help visualise the complex relationships between climate, animals, plants and soil, she is developing a pictorial language that her students also learn and apply. “These dynamic diagrams boost our understanding of how things relate to each other and help us make living things such as trees part of the planning process,” she says.

**21ST-CENTURY HUMAN** This contemporary approach to planning means learning about the potentials of sites, which is a key tenet of Galí-Izard’s firm, *Arquitectura agronomia*. This prompted the wait-and-see approach she applied in one of her first projects, a small private garden. She only intervened once every two or three weeks, carefully observing the natural changes in the garden before deciding on the next steps to take. “The way gardeners modify the environment is obviously ‘artificial’. For example, they might water the ground so as to grow a new species of plant,” Galí-Izard explains.



Virtual reality is used to study how people perceive changes in the landscape.

“But what matters is understanding where the limits are – and, in this specific example, also thinking about the place from which this water has been diverted.” The fact that we can alter the environment so radically also increases our responsibility to impose limits on our actions. How far do we want to go? How long should our intervention continue? And what do we really need?

“It’s great to be able to think like an engineer, but technology is so seductive that it can make us forget to set boundaries for ourselves,” says Galí-Izard. The question of whether nature and humanity can occupy their rightful place in the landscape of the future depends, to a large extent, on whether humans are capable of re-educating themselves. Indeed, the key qualities of people in the 21st-century may well be the ability to negotiate, assess, decide, forgo, and prioritise others. ○



**ADRIENNE GRÊT-REGAMEY** is a professor at the Chair of Planning Landscape and Urban Systems. Her research focuses on how the interactions of humans with their environments shape landscapes and vice versa.

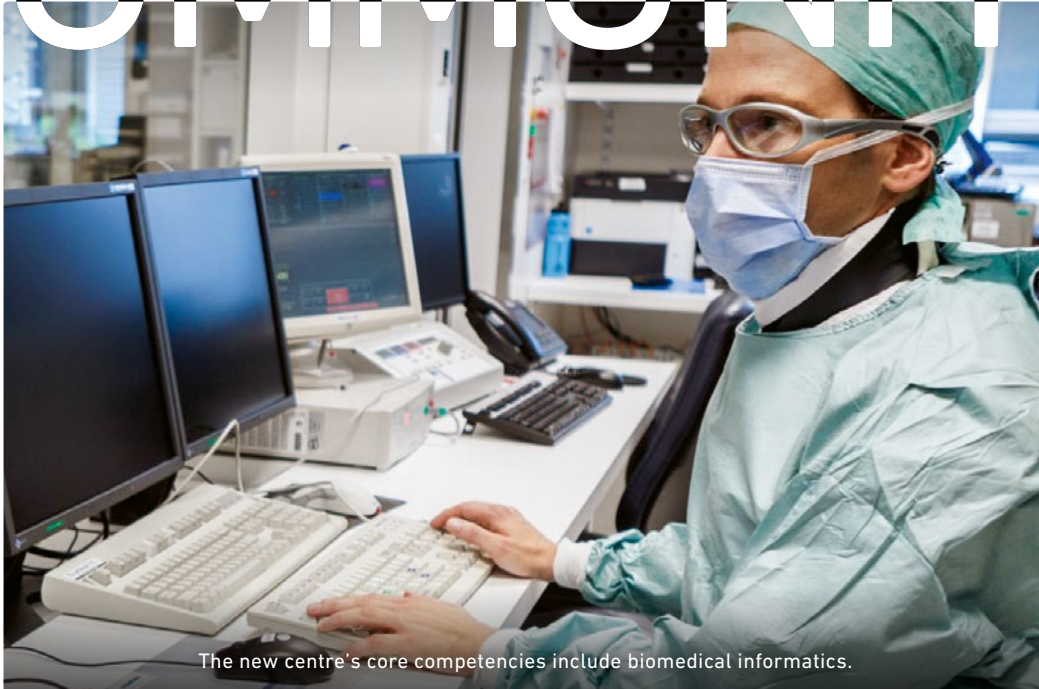
—> [plus.ethz.ch](http://plus.ethz.ch)

**TERESA GALÍ-IZARD** is a professor on the new Master's degree programme in Landscape Architecture at ETH. She would like to see us learn to pay more attention to non-human beings.

—> [mscla.arch.ethz.ch/team/professor-teresa-gali-izard](http://mscla.arch.ethz.ch/team/professor-teresa-gali-izard)

Image: Ralph Sonderegger, PLUS, ETH Zurich (2018)

# COMMUNITY



The new centre's core competencies include biomedical informatics.

Image: courtesy of anonymous

## Targeted therapies thanks to precision medicine

Because every patient is different, the more precise their diagnosis – and the more targeted the therapy – the better their individual needs can be met. This is the goal pursued by The LOOP Zurich, a new translational research centre that aims to improve our basic understanding of diseases in order to develop therapies tailored to individual patients. To this end, it combines basic research in biomedicine and bioinformatics at the University of Zurich (UZH) and ETH Zurich with clinical research from Zurich's university hospitals – the University Hospital Zurich (USZ), the University Children's Hospital Zurich (KiSpi), the University Hospital Balgrist and the University Hospital of Psychiatry Zurich (PUK). Two of the centre's first projects are in the fields of oncology and neurorehabilitation.

Thanks to the four university hospitals' access to patients and the combined research infrastructures at UZH and ETH, The LOOP Zurich enjoys some unique advantages in the Swiss research

system. "We're bringing together some of the best people in biomedical research, clinical research and bioinformatics in order to conduct innovative research," says Beatrice Beck-Schimmer, Vice President Medicine at UZH. Dettel Günther, Vice President for Research at ETH Zurich and chair of the executive board of the University Medicine Zurich initiative, is equally enthusiastic: "By pooling our expertise in basic research and innovative diagnostics and drawing on our specialist knowledge in handling medical data, we can ask and answer some really important research questions." The centre's cooperative approach looks set to bolster Zurich's position as a hub for precision medicine. ○

Support precision medicine:

→ [ethz-foundation.ch/en/precision-medicine](https://ethz-foundation.ch/en/precision-medicine)



## ETH Zurich chooses new Rector

The ETH Board has appointed Günther Dissertori as the new Rector of ETH Zurich. The Professor of Particle Physics will succeed Sarah Springman in February 2022. Dissertori grew up in South Tyrol and studied physics at the University of Innsbruck before moving to CERN in Geneva to work on his doctoral thesis. In 2001 he joined ETH Zurich as an assistant professor, eventually becoming Full Professor of Particle Physics in 2007. He has won several awards for excellence in teaching. Dissertori made a name for himself as a researcher working on the CMS experiment at the LHC accelerator at CERN in Geneva. He held a number of important CMS coordination roles, including deputy spokesperson for a collaborative project involving over 4,000 researchers. ○

## Working together to make things happen

The year 2020 once again saw a major commitment to ETH Zurich on the part of donors and partners. The annual report details donations of 145 million Swiss francs to the ETH Foundation, up from 120 million Swiss francs the previous year. This invaluable assistance also was provided by more than 2,300 private individuals who opted to support ETH either during their lifetimes or through a bequest or legacy. Together, they are helping fund over 140 projects in teaching and research, scholarships, spin-offs and infrastructure. ○

The ETH Foundation's digital annual report offers more insights into the support received by ETH Zurich in 2020:

→ [report.ethz-foundation.ch/en](https://report.ethz-foundation.ch/en)

## Digital planning and construction

A new centre at ETH Zurich has acquired two strategic partners: Basler & Hofmann, an engineering, planning and consultancy firm, and Hexagon, a global leader in sensors, software and autonomous solutions. Each company will be making a generous donation to the ETH Foundation that will be distributed over a period of six years. The Centre for Augmented Computational Design in Architecture, Engineering and Construction, also known as Design++, will develop digital tools and processes to improve design, boost productivity in the construction process, increase the quality of buildings and reduce their environmental impact. The ETH Immersive Design Lab will assist in this task by providing the

necessary research infrastructure for the Design++ centre. The donations from Basler & Hofmann and Hexagon will primarily go towards establishing a new professorship in augmented computational design at the Design++ centre. ○



Visualisation of a virtual collaboration environment for the ETH Immersive Design Lab.

Image: ETH Zurich / Gramazio Kohler Research



# Pritzker Prize awarded to Anne Lacaton

Anne Lacaton, Emeritus Professor of Architecture and Design at ETH Zurich, and her partner, Jean-Philippe Vassal, have received the world's most prestigious architectural award for their sustainable and social approach to building design. Anne Lacaton is only the sixth woman to receive the Pritzker Prize, and the first female ETH professor to win such an internationally renowned award.

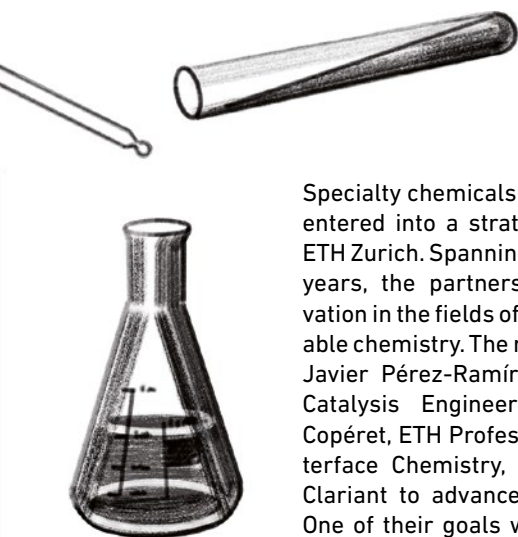
Regarded as the Nobel Prize of the architecture world, the Pritzker Prize has been awarded every year since 1979 to an architect whose work offers a new perspective on the built environment. Previous recipients include architecture greats such as Zaha Hadid, Peter Zumthor, Rem Koolhaas and the ETH professors Jacques Herzog and Pierre de Meuron. ○



Image: Laurent Chalet

Anne Lacaton and Jean-Philippe Vassal.

## Clariant drives innovation in catalysis



Specialty chemicals company Clariant has entered into a strategic partnership with ETH Zurich. Spanning an initial period of 10 years, the partnership will foster innovation in the fields of catalysis and sustainable chemistry. The research groups led by Javier Pérez-Ramírez, ETH Professor of Catalysis Engineering, and Christophe Copéret, ETH Professor of Surface and Interface Chemistry, will be working with Clariant to advance catalysis innovation. One of their goals will be to improve our understanding of catalyst properties – from the nano level to the macro level – and their performance. In addition, Clariant will

collaborate with ETH on projects in basic chemical research and fund these via the ETH Foundation so as to support talented researchers and students at ETH.

“This partnership highlights our commitment to fostering innovation. That, in turn, will enable us to develop groundbreaking products and solutions that benefit people, industry and the environment,” says Hans Bohnen, member of Clariant’s executive committee. Detlef Günther, Vice President for Research at ETH Zurich, shares his enthusiasm: “Our new research collaboration with Clariant offers fantastic opportunities for our scientists and students to broaden their knowledge of catalysis and benefit from first-hand expertise in the industrial application of novel technologies.” ○

Illustration: Nadja Häflliger

# TRANSFER

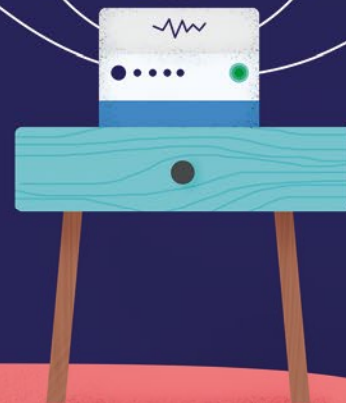
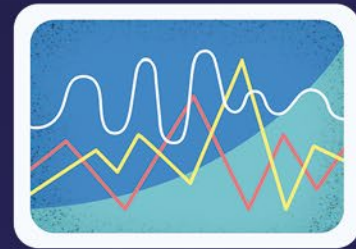
## Overnight diagnosis

Being continually roused during deep sleep can have serious consequences for a person's well-being and health. One of the most common causes of this is sleep apnoea – a momentary suspension of respiration during sleep. Many sufferers, however, are unaware that they have this condition. To enable a firm diagnosis, they must first be hooked up to monitoring equipment before going to sleep or even spend a night in a sleep laboratory.

An ETH spin-off by the name of Sleepiz has now developed a contactless system that uses weak electromagnetic waves to measure key sleep parameters. Positioned on the bedside table, this compact device monitors a person's breathing rate, heart rate and body movement even when they are wearing pyjamas and tucked in beneath the sheets. These data are transferred in real time to a cloud platform, where automatic evaluation occurs. The findings from this evaluation help the doctor reach a diagnosis.

The fledgling company is currently conducting clinical validation studies in cooperation with clinics and sleep laboratories. ○

Sleepiz: ETH spin-off company  
 established in 2018  
 Product: Contactless, wireless  
 sleep monitoring device  
 → [sleepiz.com](http://sleepiz.com)



# The impact of science on agriculture

The Division of Agriculture was established at ETH Zurich in 1871. A look back at the past 150 years shows how far the agricultural sciences have come since then.

TEXT Franziska Schmid

Switzerland would remain an agrarian society until well into the 19th century, with over 80 percent of the population involved in farming. Yet it was at universities abroad that the agricultural sciences first became an established discipline. Back home, teaching focused on providing empirical knowledge and practical skills, with little or no systematic research. That all changed in 1871, when ETH Zurich set up a Division of Agriculture.

**GREAT STUDENT-FACULTY RATIO** The first three professors were appointed: Adolf Kraemer for animal husbandry, Anton Nowacki for agronomy and crop cultivation, and Ernst Schulze – who later became Kraemer’s son-in-law – for agricultural chemistry. All three were men – and foreigners to boot. For the posts in question, there were simply no Swiss or female candidates with the relevant expertise. The three professors had a grand total of five students under their supervision. Over the next four years, only 37 people enrolled for the course. Yet it wasn’t long before the first woman signed up, Russian-born Maria Kovalik. She graduated in 1877, becoming the first woman to be awarded a degree by the Polytechnic Institute. The first Swiss woman to graduate in agricultural sciences was Lilly Leuthold in 1925. Another 67 years would pass before Silvia Dorn was appointed the first female Full Professor of Agricultural and Food Sciences in 1992.

In 1909, ETH was granted the right to confer doctoral degrees. The first doctorate in agricultural sciences was awarded in 1913 for a thesis on the “Physical Properties of Equine Hoof Horn”.



In the past, the priority was to ensure sufficient production, while today’s education and research focus on multifunctional agriculture and sustainable agroecosystems.

**BROAD RANGE OF SUBJECTS** Despite this slow start, the Division of Agriculture was soon going from strength to strength. Over the years, it underwent a series of organisational reforms. Known today as the Institute of Agricultural Sciences, the faculty’s longest-serving members are Michael Kreuzer, Professor of Animal Nutrition, and Emmanuel Frossard, Professor of Plant Nutrition. Kreuzer emphasises the importance of the 2010 fusion of the animal and plant sciences into one institute. Two years later, in 2012, the Institute of Agricultural Science was incorporated in the new Department of Environmental Systems Science. Today, the institute has a total of 12 full and 8 associate professorships. While there is still an emphasis on plant and animal sciences, these two disciplines have now been joined by agricultural economics, sustainable agroecosystems and computational ecosystems science. “In the past, the priority was to ensure sufficient production,” Frossard explains. “Now, it’s all about optimising a multifunctional type of agriculture that helps protect the environment.”

**INTERNATIONAL REPUTATION** Following a slump in student intake in the early 2000s, numbers have picked up once again. Each year, some 70 undergraduates – around half of whom are women –





Image montage: ETH Zurich

enrol for the Bachelor's programme in agricultural sciences. ETH Zurich currently holds sixth place in the Agriculture & Forestry category of the international QS World University Rankings. This also reflects a sustained reputation for research excellence. Back in 1993, ETH agricultural scientists started the world's first ever open-air experiment to study the effects of increased CO<sub>2</sub> concentration on grassland.

As for the future, Kreuzer is confident that systemic thinking will continue: "We need to take a much closer look at which parts of agriculture are genuinely relevant to the system as a whole." Climate change remains a major concern, and digitalisation is becoming ever more important. ETH is now conducting intensive research into smart farming. This includes the use of robots for targeted weed control, thereby reducing the need for herbicides. It therefore makes perfect sense for the institute's latest professorship to be in the field of environmental robotics. After all, agricultural sciences at ETH intend to be perfectly placed to take on the challenges of the coming 150 years. ○

#### ANNIVERSARY OF AGRICULTURAL SCIENCES

The Department of Environmental Systems Science (D-USYS) has organised a range of events to mark the 150th anniversary of the agricultural sciences at ETH. The anniversary website shows a timeline of historical milestones and a selection of stories from the past 150 years.

—> [agri150.ethz.ch/en](http://agri150.ethz.ch/en)

## PHILANTHROPY

BY  
Donald Tillman



### The real winners

There was good news in May for the team at the ETH Foundation. We were delighted to receive the 2021 DACH University Fundraising Prize, which is awarded by the German Association of University Professors and Lecturers. In reality, though, we know that it's you, the donors to ETH Zurich, who earned this award! Philanthropy is a voluntary commitment, and you have all made a conscious decision to get involved in our activities. You may well have different reasons for doing so, yet you all share the desire to achieve as much as is humanly possible.

The new edition of *Uplift* magazine, included here as a supplement, examines the impact of philanthropy. It is thanks to the support of companies, foundations and private individuals that ETH is able to actively foster ambitious, entrepreneurial talent from within its own ranks. For example, the Pioneer Fellows from Digit Soil are now helping to improve soil quality, thereby supporting the sustainable production of food.

Further examples of enterprising ETH students and researchers can be found in *Uplift*. If that encourages you or any new donors to offer their support, that would delight me more than any prize!

—> [ethz-foundation.ch/en](http://ethz-foundation.ch/en)





Image: ETH AI Center

Recently inaugurated: the ETH AI Center.

## Forty years of computer science

It was back in 1981 that ETH Zurich first offered a degree programme in computer science, thereby laying the foundations for today's Department of Computer Science. Over the past 40 years, the subject has developed – and, with it, the department itself. Having started out with five professors for few more than 100 students, the Department of Computer Science has since grown into a world-class institution with some 1,400 Bachelor's and 800 Master's students, 300 doctoral candidates, 110 postdoctoral and senior researchers, and over 40 high-ranking professors. ○

An anniversary website takes an inside look at the history of computer science at ETH:  
—> [inf.ethz.ch](http://inf.ethz.ch)

## New Quantum Computing Hub

ETH Zurich and the Paul Scherrer Institute (PSI) are set to establish a joint centre for the development of quantum computers. Its purpose will be to advance the design and build of quantum computers based on ion traps and superconducting components. Under the leadership of ETH professors Andreas Wallraff and Jonathan Home, a team of around 30 researchers will investigate these two fields of technology. ETH Zurich is providing 32 million Swiss francs for the new hub. At present, researchers at ETH Zurich have access to quantum computers with a capacity of up to 17 quantum bits, also known as qubits. Yet unleashing the full potential of quantum computing will ultimately require computers with a capacity of thousands, if not hundreds of thousands, of qubits. The next step will be to develop a quantum computer with a capacity of over 100 qubits. ○

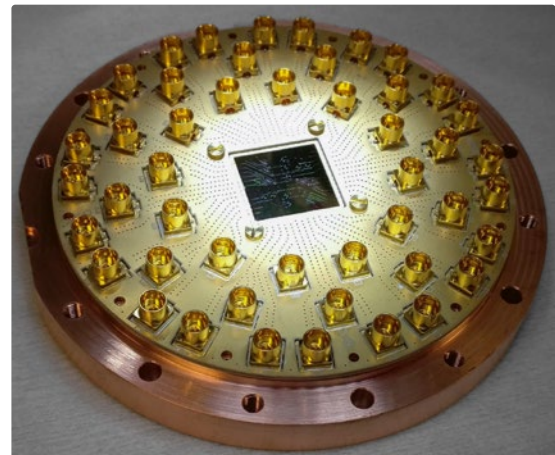


Image: Quantum Device Lab

Superconducting 17-qubit quantum chip.

## IN PERSON



**ATHINA ANASTASAKI**  
 joined ETH Zurich in 2019.  
 Her research focuses  
 on the next generation  
 of polymers and recycling  
 processes for these.

TEXT Karin Köchle

**ATHINA ANASTASAKI** is Assistant Professor for Polymeric Materials at the Department of Materials.  
 —> [polymeric.mat.ethz.ch](http://polymeric.mat.ethz.ch)

### **Your roots are in Crete. What connects you with the island?**

We always associate places with people. For me, Crete is linked with my grandparents and family, so everything there feels special. The light, the land, the water – they are all unique. I still feel like I am part of the island, even though I don't live there anymore.

### **You deal with polymers, the main components of plastics. What's your goal?**

In our lab, we synthesise polymers with enhanced properties and functions. But we're also interested in breaking them apart – a process called depolymerisation. We want to make sure that after a polymer does the job it's designed to do, we can break it apart and retrieve the starting materials, returning them to the circular economy.

### **Is there a recycling idea behind this?**

The concept of depolymerisation is broader than recycling. In traditional recycling, the polymer is melted and reshaped into a new material, usually of lower quality than the starting one. However, in an ideal depolymerisation, all the starting materials, such as monomers or catalysts, are fully recovered and can then be reused to render either the initial polymers or an entirely new material tailored to a different application.

### **What makes polymers so fascinating?**

The word polymer comes from Greek: poly, meaning "many" and mer, meaning "part" – so, many parts come together to form long molecules. One hundred years ago, few scientists believed that polymers existed. Today, almost everything around us is made of polymers, such as clothes, paints, and computer parts. We simply can't live without them!

### **You're active on Twitter. How is social media important for your academic career?**

Social media helps you keep in touch with your scientific community, especially at such a challenging time. It's also a great place for professors to show their human side. If we share our cooking or express emotions, it goes down well with the students and brings us closer. ○





# SILENT WITNESSES

TEXT Corinne Johannssen  
IMAGES Daniel Winkler

**REPORT** | Once only of interest to collectors, ETH Zurich's Entomological Collection now offers researchers a treasure trove of hidden knowledge.

Four tightly closed doors protect the Entomological Collection of ETH Zurich from heat and daylight. The cold, dry air is the perfect environment for the two million insects that call these specimen drawers home – although it's not particularly comfortable for their human keepers. On a trolley in one of the aisles is a small brown box filled with fruit flies. Upon their return from the Czech Republic, they were first placed in a four-week quarantine at minus 20 degrees Celsius. All insects must undergo this process after shipping in order to keep out pests such as the dreaded museum beetle. While the staff here may love their job, not every kind of insect is welcome.

Sending specimens to researchers all over the world is all part of a day's work for Michael Greeff, who manages the Entomological Collection. But there's something rather unusual about this particular box from the Czech Republic, namely the fact that the researcher took a full 27 years to return it, despite repeated reminders. Greeff is sanguine, however: "The insects may be rather mildewed, but they did a great job of classifying them!"

ETH Zurich's Entomological Collection is one of the most significant collections of insects in central Europe, particularly for Swiss fauna. It all started with a donation from a man who did not share his father's passion for entomology. Alfred Escher inherited the insect collection from his father Heinrich upon his death in 1853 and promptly donated it to ETH Zurich in its entirety – a remarkable gift that included not only 66,000 specimens of 22,000 species but also a large, heavy book. "It's a ledger in which Heinrich Escher recorded his stock of insects. He kept detailed notes and dates for each transaction, describing which insects he swapped or traded with whom," says Greeff. He carefully closes the book to protect its fragile, yellowed pages against further disintegration.

**OPEN TO VISITORS** If it weren't for the coronavirus pandemic, this unique ETH collection would be receiving visits from a multitude of students,

researchers and enthusiasts on a daily basis. Today, however, its only visitors are Martin C. Fischer and Gabriel Ulrich, who both work at the Chair of Plant Ecological Genetics under Professor Alex Widmer. They have come to see *Melitaea diamina*, the false heath fritillary, more than 300 specimens of which are held in the collection. Opening the cabinets, they pull out one drawer after another of neatly arranged brownish-orange butterflies.

The false heath fritillary is one of five species selected for a pilot study to monitor genetic diversity in Switzerland, which also includes the natterjack toad, the yellowhammer, the Carthusian pink, and hare's-tail cottongrass. ETH Zurich was commissioned to carry out this study by the Swiss Federal Office for the Environment (FOEN), with support from the Swiss Federal Institute for Forest, Snow and Landscape Research (WSL). Genetic diversity is one of the three components of biodiversity, along with habitat and species diversity. Environmental scientist Martin C. Fischer is heading up the study: "Our main goals are to understand and document how genetic diversity within certain species changes over time and, as far as possible, to draw conclusions on their ability to adapt to a changing environment in the future." Habitats are →



1  
The Entomological Collection at ETH Zurich is known for its beetles.

2  
His passion is insects: Michael Greeff, collection manager.



changing, primarily as a result of fragmentation and climate change, but greater genetic diversity gives animals and plants more opportunities to adapt.

The researchers are busy collecting ten contemporary specimens of each of the five species at 30 locations across Switzerland. Back in the lab, they will then analyse the entire genome of each individual. "That will generate a huge amount of data," says Fischer, "But fortunately we can handle it thanks to ETH's excellent infrastructure!"

In addition to collecting specimens in the field, doctoral student Gabriel Ulrich is also keen to perform a retrospective analysis of genetic diversity, hence his visit here today. He, Fischer and Greeff are debating the least invasive way to obtain genetic material from the butterflies, some of which are over a century old. "We can't do a genetic analysis of our chosen butterflies without cutting off a leg," says Ulrich. Fischer sees this as a reasonable compromise: "Most of the false heath fritillaries in the collection will remain in pristine condition – and the others will still have five intact legs."

Michael Greeff says it's a matter of considering the pros and cons: "Ultimately, we have to weigh the damage to the collection against the knowledge we might gain." A key question, he argues, is whether the body part is relevant to identifying the species or not. He also points out that the collection will benefit in return – and that the value of new specimens acquired through monitoring projects shouldn't be underestimated in the current climate: "Young people are no longer interested in collecting insects, and traditional collectors are a dying breed."

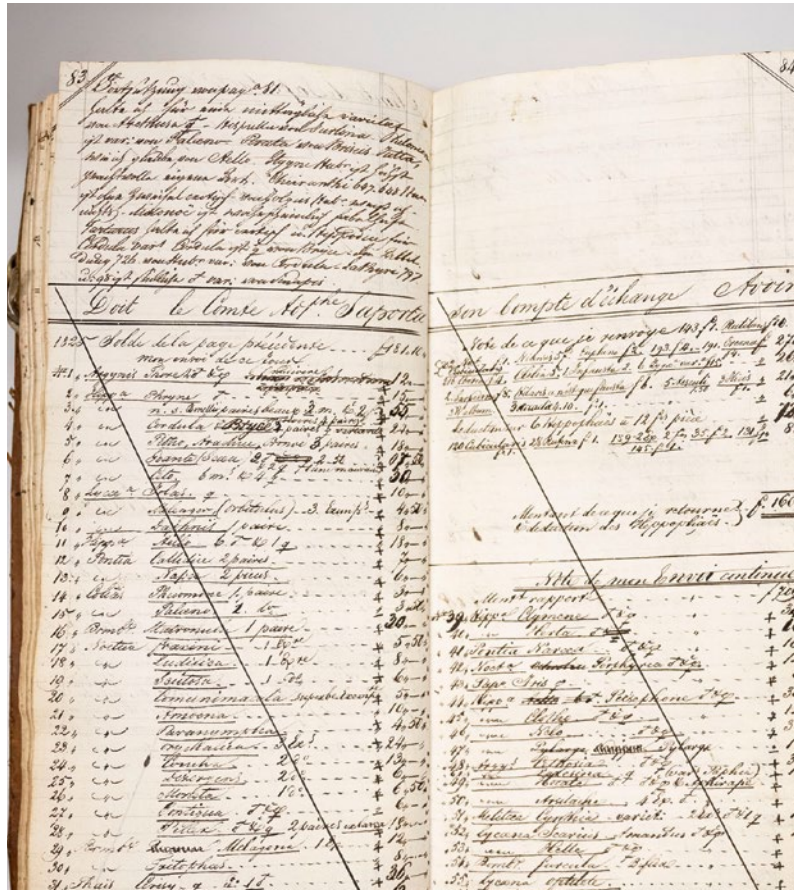
For today, at least, Martin C. Fischer's and Gabriel Ulrich's work in the collection is done. But they are already planning to return – and when they do, they will be wearing white protective suits to make sure they don't contaminate the samples with their own DNA while removing the butterfly legs.

**RENEWED INTEREST** When the collection was first established, nobody could have imagined that it would eventually be used for genetic analyses. Its early years coincided with the famous experimental work on pea plants by the Augustinian monk Gregor Mendel – but this was long before the discovery of the DNA molecule. Initially, the collection's primary purpose was to map which species were found where. The famines of the First World War shifted the focus to pest control, however, with ETH entomologists among those working on the development of pesticides. From the 1950s onwards, biological pest control and insect systematics were key topics of interest.

The centrepiece is the collection of type specimens, which has grown steadily over the years and now numbers over 5,000. A type is a specimen on which the description of a new species is based.

3  
Martin Fischer (left) and Gabriel Ulrich examine the false heath fritillary.

4  
Heinrich Escher recorded his barter deals with insects in detail. His estate is the beginning of the Entomological Collection at ETH Zurich.





3

“Think of a prototype metre: a type is a bit like that, but for entomologists,” says Greeff. “The type is what we turn to when we’re unsure about certain characteristics, because it allows us to check them against the original physical specimen. Types help ensure that scientists all over the world use the same standardised terms to describe biodiversity.”

These type specimens are clearly irreplaceable, yet the rest of the collection also offers an important framework for interpreting the world around us. Hence the Swiss government’s decision to fund a multistage project to bring the collection up to date and capture specimen data in an online database. “The work we’re doing now on collecting and documenting specimens will bear fruit in future research projects. But obviously we have no idea what methods will be available 100 years from now and what issues might be relevant,” says Greeff. “When people look back in 100 or 200 years, let’s hope they say we got our priorities right!”

Greeff is also preoccupied with another question. To date, only around 20 percent of the world’s insect species have been identified. Estimates put the number of undiscovered species at around four million. Most of these are in the tropics, and many are likely to become extinct before they are ever described. “As entomologists, shouldn’t we be putting all our other projects on hold and documenting this diversity while it’s still there?” He leaves this question hanging in the cool, dry air as they leave, carefully closing the doors behind them. ○

Entomological Collection of ETH Zurich:

—> [biocommunication.ethz.ch/entomological-collection](https://biocommunication.ethz.ch/entomological-collection)

Pilot study to monitor genetic diversity in Switzerland:

—> [gendiv.ethz.ch](https://gendiv.ethz.ch)



4

#### BIODEX BUTTERFLY APP

The Entomological Collection collaborated with Barry Sunderland from the ETH Library Lab to develop an app for identifying butterflies. The app uses artificial intelligence to enable staff with no entomological training to carry out curatorial work in the collection.





“YOU CAN'T CUT  
CORNERS”

# PROFILE | Elena Roos had a tough start in the world of professional sport, but her perseverance took her to the top of the international orienteering rankings. Even a global pandemic can't stop this ETH alumna.

TEXT Leo Herrmann  
PHOTOGRAPHY Daniel Winkler

"Building recovery time into my training schedule isn't one of my strong points," Elena Roos confesses with a grin. An elite athlete with an ETH Master's degree in Health Sciences and Technology, she fully appreciates the importance of regeneration, yet part of her stubbornly refuses to accept it: "Somehow I always think that more is better. If it was up to me, I would always do one more round of training." Fortunately, her long-time coach, Simone Niggli-Luder, is on hand to help her take a more objective view – and Roos's recent achievements suggest she has the balance just about right. In 2018, the Ticino native became world and European champion in two different relay disciplines. One year later, she went on to take fifth place in the overall World Cup.

These successes are the reward for a strenuous daily regime of power and endurance training. Roos has loved sport since she was a child, but she is the first to admit that it comes with its ups and downs: "Sometimes, when my whole body is aching, I force myself to imagine that feeling of being on the starting line of a major event. Those are the moments that give me the motivation I need." Elena first discovered orienteering by chance when she was 10 years old: "I was often homesick as a child, so my parents sent me to a summer camp to make me more independent. And they just happened to choose an orienteering training camp for kids."

She was immediately hooked. From that moment on, Roos went on regular runs through the forests on the Magadino plain with her local club, Orientisti 92. It wasn't long before she was entering her first competitions and regularly landing in the

top three. At 14, she gained a place in the Ticino junior squad; at 16, she was picked to compete in the European Youth Championships in Slovenia, followed by World Youth Championships in Sweden and then Italy. "The whole atmosphere got more and more serious and competitive," Roos says. "But it didn't put me off at all. Quite the opposite, in fact! All that pressure and the sense of responsibility made me work even harder."

**TURBULENT TIMES – AND A MOVE TO ETH** When Roos was 20, the logical next step would have been to move from the junior squad to the elite team. But the sheer joy and pleasure of those early days had been overshadowed by inner conflict. "I suddenly found myself making huge technical errors because I wasn't properly focused," says Roos. She admits that her early success made things even tougher. "When you're young and starting out, you just go for it and end up surprising yourself. But then I began setting the bar too high and striving too hard for success," she says.

At the same time as trying to deal with this rocky period in her sporting life, Roos was also laying the foundations for her future career. Being a sports teacher had long been a goal, but she was also interested in biology and medicine. Ultimately, it was the recently launched Master of Science ETH in Health Sciences and Technology that gave her the push she needed to leave her home in Cugnasco and head to Zurich. But that wasn't the only factor that led her to make the move: "Zurich appealed to me as a city – it never even occurred to me to study anywhere else."

It turned out to be the right decision for her sporting career as well. Zurich is home to one of Switzerland's two elite orienteering centres, so it was easy to maintain contact to the upper echelons of the sport. Even though she wasn't initially a member, she was accepted to train with the best squad in Switzerland. "I kept at it and could see I was getting pretty close," says Roos. But without official squad membership, personal supervision from →

**ELENA ROOS** A professional orienteer with a Master's degree in Health Sciences and Technology from ETH, Roos's greatest sporting achievements include one world and two European titles. She also works in performance diagnostics and as an athletics coach. Roos was raised in Cugnasco in the canton of Ticino and now lives in Zurich.



a trainer and proper training camps, she had to shoulder much of the responsibility herself – all while tackling a challenging degree programme.

She admits it was a tricky balancing act: “It was all about staying organised and disciplined – you can’t cut corners. But I still found time to enjoy student life!” She benefited from ETH’s policy of helping students who are professional athletes to combine their studies and sporting activities – including the option of postponing exams. “Knowing that ETH would be flexible and understanding with any scheduling clashes was a big help,” says Roos.

**A FRUSTRATING HIATUS** As time passed, Roos notched up steady progress in her sports and studies. Her physical performance continued to improve, and sports psychology helped to alleviate some of the pressure she felt. Her dry spell finally came to an end in 2014 when she got the opportunity to compete in the European Orienteering Championships in the Portuguese town of Palmela on the Atlantic coast. She came 26th in the middle distance event, which gave her the boost she needed: “It was plain sailing from then on. Each good result gave me the confidence I needed to tackle the next event.”



Then the world was hit by coronavirus – and her string of successes came to an abrupt end. The pandemic derailed almost the entire 2020 season, apart from a month or so of the national championships in the autumn. It was frustrating not being able to put her abilities to the test after a winter of intense training – and not knowing how long it would be before she could compete again. Alongside her sporting activities, Roos also fits in a couple of part-time jobs, working in performance diagnostics at a sports centre and giving athletics training to up-and-coming tennis players. But these, too, were brought to a sudden halt by the pandemic.

**A CRISIS – AND A TIME TO REFLECT** During this period, Roos says she spent a lot of time reflecting on her situation and thinking about her plans for the years ahead. To expand her career options, she also put the time into successfully completing her teaching diploma in sport at ETH. The age of peak performance in orienteering is higher than in other sports, with many athletes enjoying significant success in their 30s. So, if the pandemic permits, there is nothing to stop Roos racking up more international achievements in the future.

She is particularly looking forward to the 2023 World Orienteering Championships in the Swiss canton of Graubünden. “After that, I’ll just have to see,” she says. One decision she needs to make is whether to stay in Zurich for the long term. “Life here is pretty competitive,” she says. That suits her right now, she admits, but she could also imagine returning to Ticino at a later date: “The weather’s better, and the lifestyle is more relaxed.”

Even so, Roos still finds time to unwind in Zurich, especially with friends. “Meeting up for coffee is my favourite hobby!” she says with a smile. A café is her venue of choice, though she does enjoy soaking up the view from the balcony of her flat on the Zürichberg. She also loves reading, and her favourite books come from the home of orienteering: a Scandinavian crime novel is the book most likely to be on her bedside table.

But it’s her love of sport that dominates her leisure time. From mountain biking and cross-country skiing to beach volleyball, sport offers balance all year round – though the boundary between fun and competitiveness sometimes gets blurred: “When I go biking or cross-country skiing, I still push myself hard whenever I get the chance!” ○

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## ETH zürich



## The Feminine Side of Science.



The ETH Zurich Tours app takes you all around the Hönggerberg campus, and introduces you to pioneering women at ETH. Download it now!



Available on the App Store and Google Play

Due to the coronavirus, events may be cancelled or postponed at short notice. Please check the organiser's website.

# AGENDA

## DISCOVER

○ Until 8 August 2021

### Realms of Knowledge

Where is knowledge produced, organised, stored and disseminated? And what influence do architectonic factors have in shaping the knowledge a society believes to possess about itself and the world? This exhibition takes a look at encyclopedias, archives and universities and their role in the creation of systems of knowledge.

ETH Zurich Zentrum,  
Graphische Sammlung

→ [gs.ethz.ch/en](https://gs.ethz.ch/en)



Image: ETH Tours

○ 3 August 2021, 6.15 – 7.15 p.m.

### Herds and high-tech

This public tour takes you on a journey of discovery across the Hönggerberg campus and to some of the latest landmarks in cutting-edge research.

ETH Zurich, Hönggerberg campus  
HIL building, Campus Info entrance

Sign up and find out more about this and other tours:

→ [tours.ethz.ch](https://tours.ethz.ch)



Image: Nelly Rodriguez

○ Until 10 December 2021,  
Monday to Friday, 10 a.m. to 6 p.m.

### The Power of Mushrooms

Throughout the year, an exhibition at the Institute for the History and Theory of Architecture (gta) will be looking at Berta Rahm, one of Switzerland's first female architects, and the recently rescued pavilion she built for Saffa 58, the Schweizerische Ausstellung für Frauenarbeit (Swiss Exhibition for Women's Work) of 1958. In her professional capacity, she designed and built single-family holiday homes and oversaw numerous building conversions as well as creating the aluminium-clad pavilion for Saffa 58. As a committed feminist, she fought for many years to find a voice in the field of architecture but ultimately abandoned the profession to set up Ala, a Zurich publishing house specialising in feminist authors and subjects.

ETH Zurich, Hönggerberg campus,  
Institute for the History and Theory of  
Architecture (gta)

→ [gta.arch.ethz.ch](https://gta.arch.ethz.ch)



## FOR YOUNG ADULTS

○ From 13 to 16 July 2021

### Summer camp

Dive into the world of robotics, medical technology and product development. Discover the secrets of exoskeletons and learn how modern technology connects us. At this year's summer camp, ambassadors from CYBATHLON@school will also be on hand with handy tips and tricks to help young adults learn what inclusion really means. At the end of the week, camp attendees will have the opportunity to put their own self-programmed creations to the test in a competition.

Details and registration:

→ [mintpepper.ch/stories/camps2021](https://mintpepper.ch/stories/camps2021)



Image: Cybathlon@school

○ From 16 to 20 August 2021

### CreativeLabZ

The plant workshop at CreativeLabZ is a great place to start learning about the climate and sustainability. Build a solar greenhouse for micro-greens, design your very own upcycled clothing or accessories, and learn how to repair and reuse electrical devices. The workshop also offers info on sustainable projects as well as exciting excursions. Prepare to meet the future!

Find out more at:

→ [creativelabz.ch/sommerkurs-2021](https://creativelabz.ch/sommerkurs-2021)

## MUSIC AND BOOKS

### GESStebuch

The multilingual podcast "GESStebuch. Livre d'or. Libro degli ospiti" provides a platform each semester for visiting professors at the Department of Humanities, Social and Political Sciences to discuss current academic and cultural topics. Each podcast episode also features a review of a book or a piece of work.

BOOK

Author: Kettly Mars

Mercure de France

ISBN 978-2-7152-4695-9



Image: Mercure de France

In the second episode, Haitian writer Kettly Mars shares the story of her writing along with her hopes and fears about the political situation in Haiti. She also reads an extract from her latest hit, the thriller *L'ange du patriarche* (Angel of the Patriarch), and talks about her upcoming literary projects.

PODCAST

→ [francais.ethz.ch/fr/podcast-livre-d-or](https://francais.ethz.ch/fr/podcast-livre-d-or)

(In French)

Don't miss our other exciting podcasts:

→ [ethz.ch/podcast](https://ethz.ch/podcast) (In English)



# OUT OF FOCUS

Illustration: Michael Meister



“Natural – artificial” as visualised by Michael Meister

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# Inspiration doesn't come from a blank sheet of paper

## Robin Phillips, Director of SpaceLab

Every space project is different and demands creative solutions. That's why our SpaceLab Director Robin collects unusual components from motors and gearheads to get inspiration. This is how he came up with the key idea for the brushless drive that is used in the Perseverance rover. This and other motors will handle the valuable samples of Martian soil that are intended to be brought back to Earth by a later mission. Our curiosity drives us to excel.

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