ETH Zurich receives major donation 36 Bridging the gap with policy fellow Regina Witter 40 Profile of alumna Martina Pfeiffer 45

GLOBE

NO.
1/2024

FOCUS

The Basel connection

ETH zürich

Dear readers,

The life sciences and data-driven engineering are two of ETH Zurich's major strengths – and the Department of Biosystems Science and Engineering is where these two disciplines meet. Basel has been home to this academic department ever since it was founded in 2007. The choice of location is hard to beat: the Basel region is a hotspot for the pharmaceutical industry and other top-notch partners, making it an ideal setting for interdisciplinary research. This favourable situation has spawned a number of notable projects. Right now, our researchers are working together with Roche to develop new ways of treating pancreatic cancer with the aid of mini-organs. Meanwhile, the Basel Research Centre for Child Health, whose partner institutions include ETH, is looking to combat malnutrition among children in the Global South. These two research projects have something in common: both use cutting-edge bioengineering to target key medical challenges.

A watershed in the department's evolution will be this year's inauguration of the state-of-the-art BSS research and teaching building on the Schällemätteli Life Sciences Campus, just a stone's throw from the University of Basel's Biozentrum, the University Hospital Basel and the University Children's Hospital Basel. Being part of this scientific community is a unique opportunity for ETH Zurich, which is why I'm delighted to see the spotlight fall on Basel in this issue of our magazine. I'm sure we'll be seeing many more successful partnerships in the future!

I hope you find this issue of *Globe* an inspiring read.

Joël Mesot,
President of ETH Zurich

Globe – the magazine for ETH Zurich and ETH Alumni

Images: Alessandro Della Bella (cover); Alexandra Compain-Tissier (editorial)

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NEW + NOTED

FOCUS

Images: Michel Büchel; Désirée Good

COMMUNITY

REPORT

PROFILE

COVER Photographer Alessandro Della Bella has captured ETH Zurich's stunning new research and teaching building in Basel.

NEW + NOTED

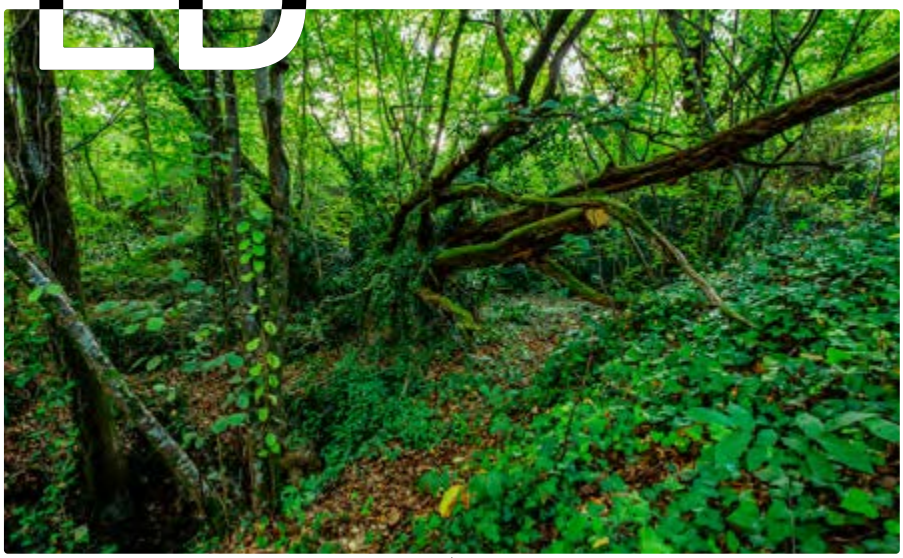


Image: Adobe Stock

Diverse natural forests have massive carbon storage potential – but we still need to cut emissions.

Forests as carbon sinks

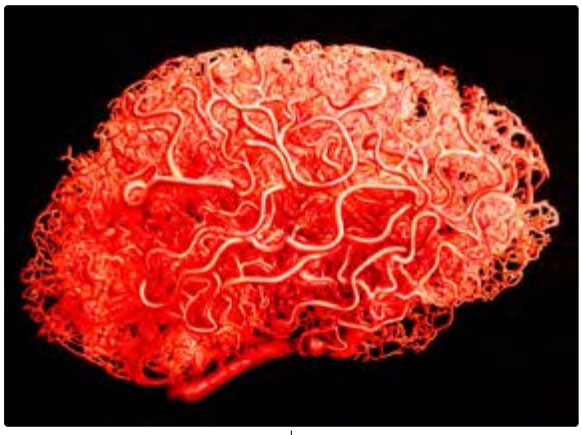
Nature's role in combatting climate change is an issue that provokes heated debate. Thorny issues include the carbon-capturing potential of forests, which ETH professor Tom Crowther has now re-assessed with the help of an international team. The researchers used a wide range of approaches, including the collection of extensive data on the ground and via satellite.

As a result of relentless deforestation, the world's forests now absorb 328 gigatonnes of carbon less than they would if left in their natural state. If forests outside urban and agricultural areas were allowed to recover, say the researchers, they would capture 226 gigatonnes of carbon from the atmosphere. This storage potential could be achieved in two ways: by protecting existing forests and allowing them to reach old-growth maturity, and by reconnecting fragmented patches of forest and promoting a sustainable restoration and management of related ecosystems.

The study highlights the crucial importance of diverse natural forests, which have the potential to draw down up to 30 percent of carbon emissions created by humans. Nonetheless, forest restoration measures should not be seen as a substitute for cutting fossil fuel emissions. If emissions keep rising, the study warns, then prolonged droughts, fires and global warming will continue to threaten forests and significantly reduce their capacity to absorb carbon. ○

Microvehicles guided by ultrasound

Illustration: Science Photo Library / Francis Leroy



Microbots could be used to deliver medication to specific locations in the brain.

Brain tumours and other neurological conditions are often hard to treat with medication. Even when effective drugs are available, they can often cause severe side effects. This is because they circulate throughout the brain rather than being confined to the area under treatment. The scientific community is therefore pinning its hopes on the use of tiny transport vehicles made from gas-filled microbubbles, which will deliver drugs to specific locations in the brain with pinpoint precision.

Led by ETH professor Daniel Ahmed, researchers at ETH Zurich, the University of Zurich and the University Hospital Zurich have now, for the first time, managed to navigate ultrasound-guided microbubbles through blood vessels in the brain of an animal. They hope that this will one day provide the basis for developing new courses of treatment. ○

Feathery inspiration

The eastern bluebird is a remarkable bird with brilliant blue feathers. This colouration, however, is not the result of pigmentation; instead, it is due to the special structure of the feathers. When examined under a microscope, the bird's feathers reveal a network of channels, each just a few hundred nanometres across. The bold blue hue of the eastern bluebird also attracted the attention of ETH Zurich researchers from the Laboratory of Soft and Living Materials, led by former ETH professor Eric Dufresne. He and his team set about replicating this material in their lab. Using a new method, they were able to develop a material with the same structure as the eastern bluebird's wing feathers. With its network of nanochannels, this new material may well prove suitable for applications that foster sustainability, such as longer-lasting batteries and more efficient water filters. ○

Image: Adobe Stock

Bright blue top feathers are a striking feature of the eastern bluebird's plumage.


Eberhard

Image: ETH Zurich / Marc Schneider

Autonomous excavator

Building drystone walls is expensive and time-consuming. A team of robotics experts and architects from ETH Zurich has come up with a new approach. As part of a project supported by the NCCR Digital Fabrication, a Swiss National Centre of Competence in Research, researchers developed a walking excavator that can construct a six-metre-high drystone wall from boulders and demolition rubble. The excavator starts by creating a 3D map of the construction site. Once it has identified suitable on-site materials, it scans these potential building blocks to determine their approximate weight and their centre of gravity. An algorithm then pinpoints the best position for each stone, and the excavator grabs each one in turn and slots it into place with millimetre precision. The excavator can independently landscape an entire site using stones of almost any shape. By making use of on-site boulders and rubble, which contain little embodied energy, this approach reduces carbon emissions and energy consumption – an excellent example of how harnessing resource-efficient principles can help the construction industry transition towards a circular economy. ○

Video: Autonomous excavator
⟶ youtu.be/P7wmotyKgXc

NCCR Digital Fabrication:
⟶ dfab.ch

Enhancing trust and value

Digital responsibility should not be seen merely as a duty to comply with regulations but also as an activity that generates value, says Tomoko Yokoi.

TOMOKO YOKOI is a doctoral student at the Chair of Technology and Innovation Management at ETH Zurich and an expert in digital transformation.

In an era marked by growing mistrust, businesses face significant challenges in maintaining stakeholder confidence. Recent years have seen a proliferation of concerns about the misuse of customer data and questionable digital practices, along with a corresponding erosion of confidence.

Last summer, for example, an attack on Swiss IT service provider Xplain, in which hackers stole sensitive data from the Federal Administration and published some of it on the darknet, threw a spotlight on a sometimes lax approach to cybersecurity and data protection. Switzerland has since followed the example of other countries in tightening its regulatory environment, and in September 2023, it aligned its data protection standards more closely with EU regulations, raising the bar for Swiss companies.

Research shows that people have greater trust in businesses with robust data-protection systems and strong cybersecurity defences. As people come to expect and demand a more responsible use of digital technologies, firms that promote better practices will have a distinct advantage.

In my view, strengthening digital responsibility is not only an ethical obligation but also a driver of value creation. Brands that are regarded as responsible enjoy higher levels of trust and loyalty among their customers, employees and partners. This, in turn, translates into increased sales and enhanced recruitment opportunities.

TRANSLATE YOUR VALUES Yet many businesses have not fully grasped the importance of digital responsibility, and some are simply overwhelmed by the number of regulatory requirements in the EU's General Data Protection Regulation and Switzerland's new Federal Act on Data Protection. In many cases, compliance has become their primary focus, which leads to a short-sighted approach to digital responsibility.

Furthermore, the allure of new technologies often blinds businesses to the risks involved. Artificial intelligence and data analytics hold out the promise of smarter and faster decision-making, but the risks of biased data and unsuitable modelling are often overlooked, leading to poor-quality results.

To enhance digital responsibility, organisations should be translating their existing values into the digital realm rather than reinventing them. Following the lead of the pharmaceutical industry, which has long employed ethics committees to ensure balanced decision-making,

today's companies are establishing digital ethics advisory panels to guide them in the use of AI and big data and to safeguard integrity.

MORE THAN JUST COMPLIANCE The path to digital responsibility should be based on a company's values. At the same time, organisations need to assess the specific risks they face as they embrace digital transformation. Finally, a shift in focus from risks to opportunities is crucial: businesses need to decide how to position themselves in the marketplace as responsible partners that deserve stakeholders' trust.

I believe digital responsibility is fast becoming an imperative for today's organisations. Yet success in this sphere is by no means guaranteed. If businesses are prepared to go beyond mere compliance, they can boost their credentials in areas such as cybersecurity, data protection and privacy. This way, they will not only enhance trust and resilience but also move one step closer to reaching their commercial goals. ○

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

An ethical approach to digitalisation can enhance trust in organisations.

Images: Courtesy of anonymous; Adobe Stock

Getting rid of carbon

Image: Carbfix

Captured CO_2 is injected underground at the geothermal power plant in Hellisheiði, Iceland.

Switzerland has announced its intention to reduce its greenhouse gas emissions to net zero by 2050. Yet despite the growth in renewable energy and a steady reduction in emissions, large quantities of CO_2 will continue to be generated by sources such as waste incineration plants. In a pilot project carried out on behalf of the Swiss government, a consortium from science and industry led by ETH Zurich has examined ways of permanently removing CO_2 from the atmosphere. The researchers explored two solutions for permanent carbon storage: mineralisation in recycled concrete, and subsurface mineralisation in Iceland. ETH professor and project coordinator Marco Mazzotti and his team were able to demonstrate that both pathways are technically feasible and have a positive climate impact. The ratio of carbon removed from the atmosphere to any new emissions generated during the storage process is 90 percent for carbon stored in concrete, and 80 percent for carbon injected into Icelandic rock. Most of the new emissions arise through the transport of CO_2 by rail and sea, some of which is still fuelled by energy from fossil fuels and coal-fired power stations. In other words, the storage efficiency ratio is likely to improve over time. ○

Measuring snow depth with satellites and AI

Current snow monitoring techniques primarily rely on data from meteorological stations. But with only 400 such stations across the whole of Switzerland, obtaining accurate information for some locations is a challenge. To plug these gaps, a team of ETH researchers led by ETH professor Konrad Schindler joined forces with Swiss company ExoLabs, a University of Zurich spin-off, to develop a technique that could provide a faster and more accurate assessment of snow depth.

The scientists trained an AI system to derive snow depth from satellite data and maps of the relevant terrain. The resulting snow maps were then improved by incorporating data from meteorological stations on the ground. The AI-assisted snow monitoring system has already been successfully tested, and the researchers hope it will set a new standard for measuring snow depth across Switzerland. ○

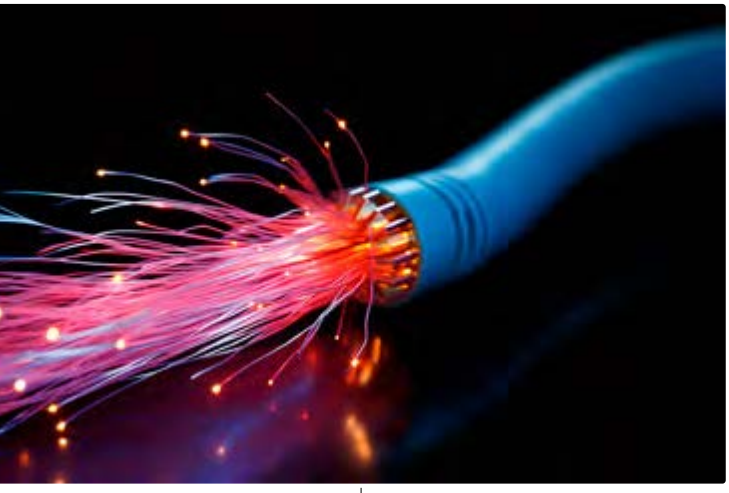
Image: Keystone

In the future, skiers will benefit from more accurate information on snow depth, thanks to an AI-assisted measuring system.

Using fibre optics to detect earthquakes

Geophysicists at ETH Zurich have harnessed a feature of existing fibre optic networks to record vibrations such as earthquakes. In collaboration with the Swiss Federal Institute of Metrology (METAS), a team of researchers led by ETH Zurich professor Andreas Fichtner was able to obtain vibration data from the active noise-suppression system that is used to increase signal accuracy in optical data communication. All the scientists needed to do was store and evaluate the noise suppression data; no additional devices or expensive infrastructure were required. This method could be used to build comprehensive, low-cost early-warning systems for earthquakes and tsunamis – even on the ocean floor or in less developed countries. ○

Image: Adobe Stock / AI-generated



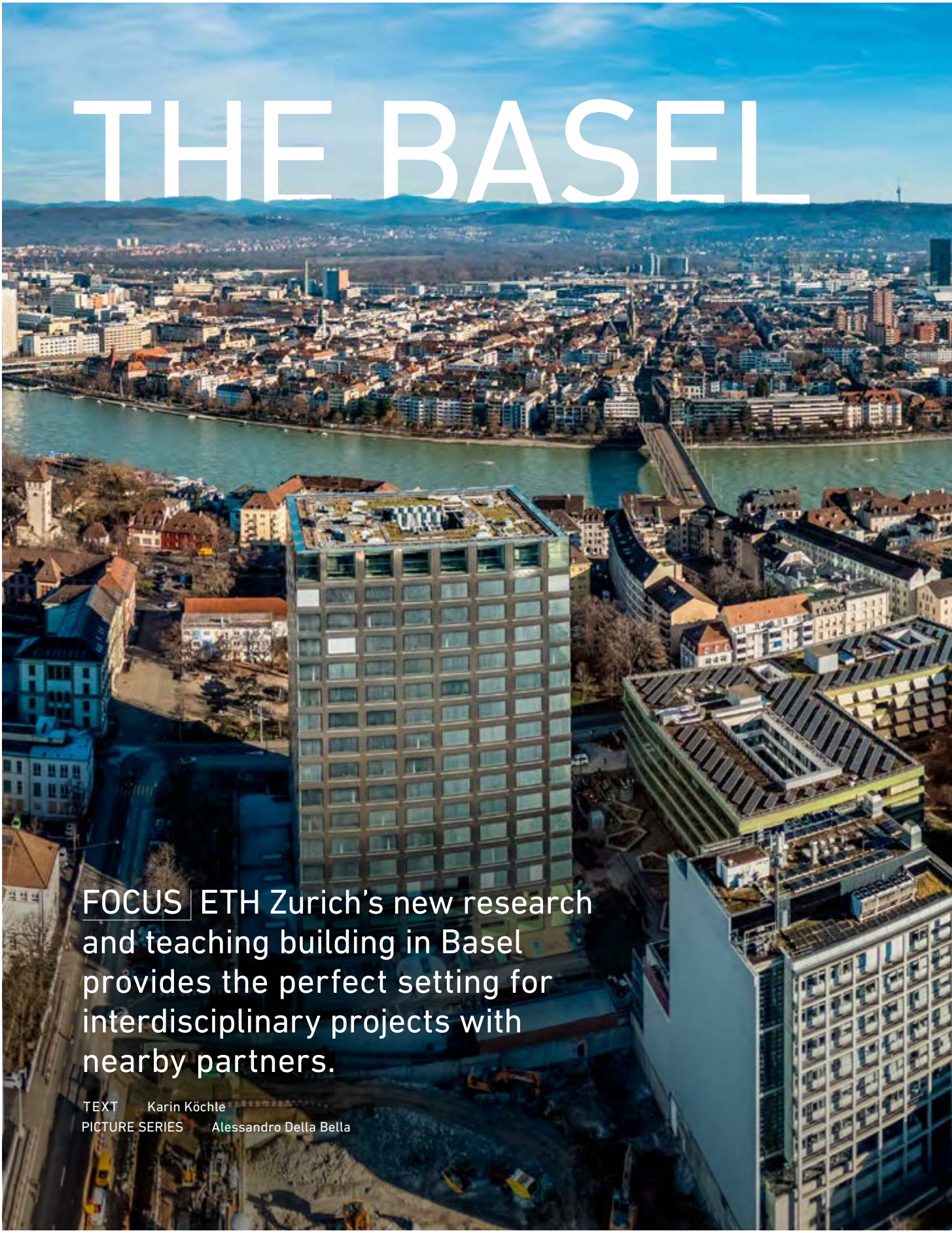
Fibre optic networks offer an inexpensive way of detecting even the smallest vibrations – independently of seismic stations.

Harnessing AI expertise for the common good

ETH Zurich and EPFL have launched the Swiss AI Initiative, a joint endeavour that aims to develop and train new and transparent large language models that deliver clearly comprehensible results while upholding legal, ethical and scientific standards. The initiative will make use of the new Alps supercomputer at the Swiss National Supercomputing Centre (CSCS), which is operated by ETH Zurich and is one of the world's most powerful computers for AI applications. Access to this infrastructure enables Swiss scientists to keep pace with the largest tech firms in the world in the race for computing power.

The Swiss AI Initiative seeks to make existing AI expertise more accessible to society. This goal is shared by the International Computation and AI Network (ICAIN), which ETH Zurich launched in conjunction with the Swiss Federal Department of Foreign Affairs (FDFA) and other partners. ICAIN's mission is to facilitate international research projects that benefit society as a whole and that promote the United Nations Sustainable Development Goals (SDGs). ICAIN is already collaborating with Data Science Africa (DSA) on a pilot project that aims to use AI to make agriculture more resilient to the negative effects of climate change. ○

THE BASEL

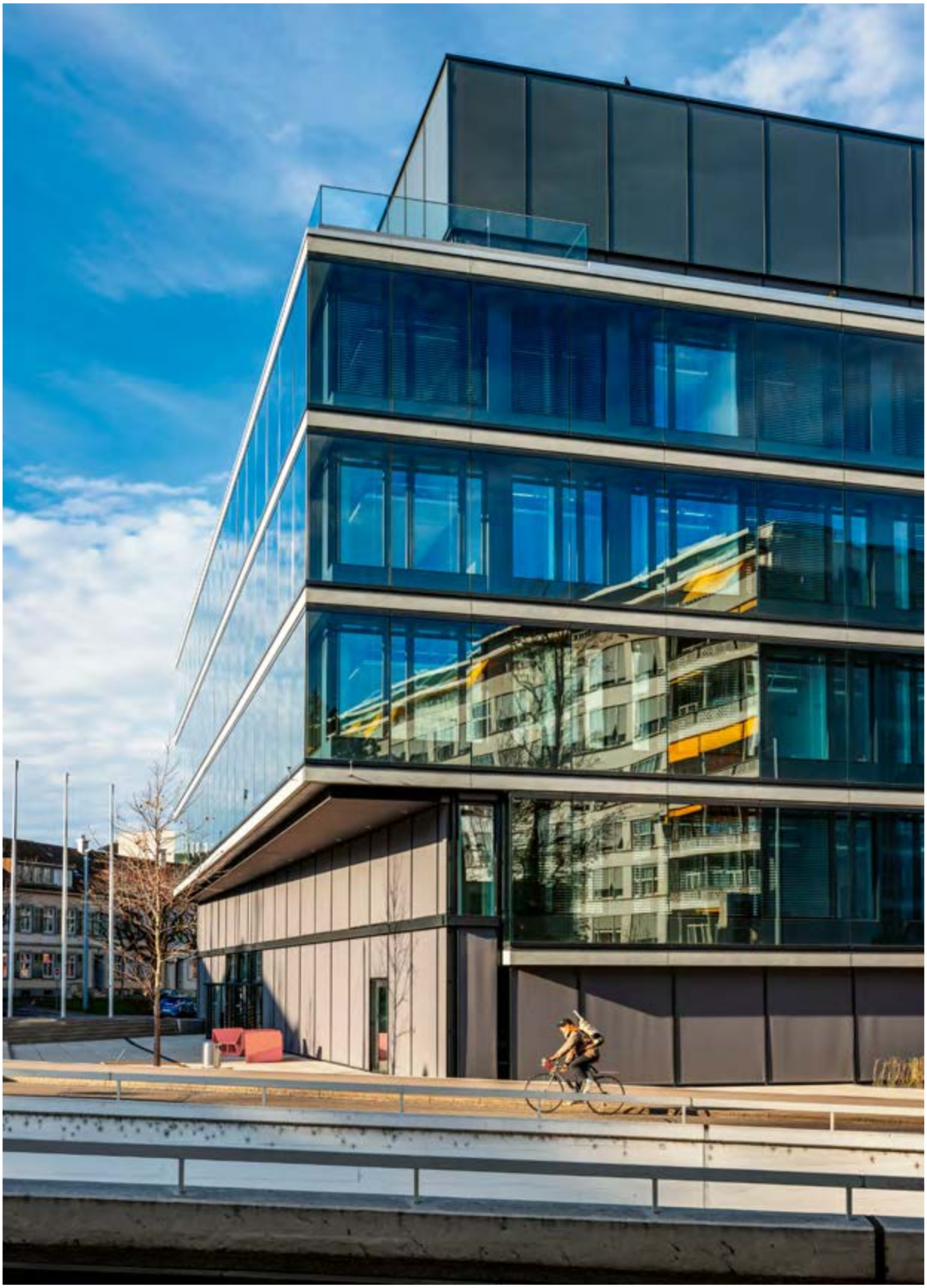


FOCUS | ETH Zurich's new research and teaching building in Basel provides the perfect setting for interdisciplinary projects with nearby partners.

TEXT Karin Köchle
PICTURE SERIES Alessandro Della Bella

CONNECTION

NEW BSS BUILDING The pentagonal building with a glass-domed atrium is the new home of the ETH Department of Biosystems Science and Engineering in Basel. It is situated close to the University of Basel's Biozentrum, the University Hospital Basel and the University Children's Hospital Basel.



▲ **MIRROR FINISH** Designed by architects Nickl & Partner, the ETH BSS building features transparent walls both inside and out. Neighbouring buildings such as the University Hospital Basel are reflected in the facade.

► **FLOODED WITH LIGHT** Daylight pours into the spacious atrium through a glass and steel dome.

▲ **MAKING CONNECTIONS** Spectacular helical staircases link different storeys. State-of-the-art research facilities are also housed on the lower floors.

◄ **INTERDISCIPLINARITY IN ACTION** Each floor houses a mix of different research groups. The goal is to foster interaction and interdisciplinarity.

SPACE TO SHARE Open-plan areas offer plenty of opportunities for students and staff to swap ideas. Several parts of the building are accessible to the public, including the bistro on the basement level, the rooftop restaurant and terrace on the top floor, and the conference and seminar rooms.

Designed for bold visions

The idea of ETH Zurich establishing a Department of Biosystems in Basel once seemed unachievable. Today, the department occupies a new building where the dividing lines between biology, computer science and engineering are blurred – and researchers increasingly focus on medical applications.

TEXT Florian Meyer

An impressive sight awaits first-time visitors to the new BSS building. Immediately beyond the reception area, they plunge into a surprisingly bright and airy space, a towering atrium flooded with light and topped by a transparent glass roof. At the end of this huge concourse, a helical staircase winds its way up to the floors above. The impression is one of countless connecting lines, a deliberate ploy on the part of the architects to foster communication and interaction between research groups. Right now, the atrium is bustling with backpack-toting students, some descending the curving path to the welcoming bistro. Researchers waiting for the lift pause for a quick chat before heading up to their workspaces.

Standing in the centre of the atrium are Renato Paro and Sven Panke. Paro, now an emeritus professor of molecular biology, is still visibly taken by the concept. "When I walk through the BSS building and see all these offices, labs and joint research platforms, it makes all the time and effort we invested in creating our department seem worthwhile," he says. Appointed as the inaugural director of the fledgling Center of Biosystems Science and Engineering (C-BSSE) in 2006, Paro went on to become one of the driving forces behind the creation of the ETH Department of Biosystems Science and Engineering (D-BSSE). "For me, this building represents the culmination of an amazing journey," he says.

"Right from the planning stage, our goal was to create a building in which all the various components encourage interaction and scientific exchange," he continues. Panke, who takes over the reins of the department this year, nods in agreement, noting how all the professors have steadily built upon this original concept: "We decided that each floor should have a mix of research groups rather than organising them by subject area."

INTERDISCIPLINARITY IN ACTION The department is divided into three main areas – experimental biology, computational theoretical biology and bioengineering – with each floor of the building hosting a mix of experimental biologists, bioinformaticians and bioengineers working in adjacent offices and laboratories. "We saw early on that one of the main benefits of D-BSSE was getting all three of these research areas under one umbrella to encourage the groups to communicate with each other. And now that we're all under the same roof, it's even easier to mingle and interact," says Panke. "This is interdisciplinarity in action – and it's attracting researchers from all over the world." D-BSSE currently employs researchers from 42 different countries.

Panke's own bioprocess laboratory, for example, is on the same floor as the group led by Niko Beerenwinkel. Both are typical of the special →

mission of the department, which seeks to combine basic research in life science with a mathematical and computer science approach while also incorporating a technological, engineering component. Panke specialises in miniaturisation techniques for bioprocess engineering that can be used to discover and synthetically control enhanced cell variants. Beerenwinkel, meanwhile, unites mathematics, computer science and artificial intelligence with biology and medicine. Applications of his computational methods include the ability to characterise and describe viral illnesses at a molecular level. His models proved a highly useful tool during the coronavirus pandemic. Together with Tanja Stadler, Professor of Computational Evolution at D-BSSE and president of the Swiss Science Advisory Panel for COVID-19, Beerenwinkel played an important role in efforts to detect new variants of the coronavirus and to track their evolution and spread.

The work of D-BSSE researchers builds on the foundation of systems biology. Its aim is to generate a holistic understanding of how cells, organs and organisms function and of the temporal and biochemical processes that keep them alive. To study how they work, researchers typically employ large data sets, generated by high-throughput technologies such as DNA sequencers, as well as mathematical models and computer simulations. Systems biology also plays a role in the second strand of D-BSSE's research work, synthetic biology – the main goal of which is to produce cells, organoids and microorganisms with new properties that are not found in nature, many of which offer potential medical benefits.

BLAZING A TRAIL IN BASEL D-BSSE's work in the field of bioengineering, which uses DNA to regulate cells and organisms, has an equally practical focus. Concrete outputs of this research include vaccines and antibodies for synthetic immunology, as well as cellular implants that can help combat metabolic disorders, and miniaturised platforms such as lab-on-chip technologies. "Two of the pioneering areas of work at our department in Basel are bioengineering and computational data science," says Panke, who has been part of D-BSSE since 2009. "It is only logical that we also show our students the benefits of bringing these two components together."

The idea of establishing an ETH bioscience research institute in Basel began to germinate in the year 2000. Looking back, it is clear just how bold this vision was. Equally astute was ETH Zurich's decision to turn D-BSSE into a separate department in Basel in 2007 and to provide it with secure long-term funding. Of course, D-BSSE's evolution wasn't always plain sailing: in 2003, for example, the *Neue Zürcher Zeitung* declared that the plan to establish an ETH outpost in Basel had run into difficulties. The newspaper expressed astonishment at ETH Zurich's plans to create a fully fledged department of bioengineering or biomedical engineering in Basel: "Such a grandiose idea seems almost unachievable." Yet their scepticism proved unfounded.

The next stage in D-BSSE's development came when it moved from the Rosental site into the BSS building on the Schällemätteli Life Sciences Campus. As systems biology and synthetic biology gain traction and knowledge in these areas continues to advance, more and more emphasis is now

2003
ETH Zurich first puts forward the idea of establishing its own research institute in Basel.

2005
Founding of the Center of Biosystems Science and Engineering (C-BSSE).

2007
Founding of the Department of Biosystems Science and Engineering (D-BSSE).

2009
D-BSSE building opens on Rosental site.

2014
Launch of the NCCR Molecular Systems Engineering, headed by D-BSSE and the University of Basel.

Munich-based architects Nickl & Partner win competition to design a new building on the Schällemätteli campus.

2018
Botnar Research Centre for Child Health (BRCCH) inaugurated by partner institutions including ETH Zurich and the University of Basel (now known as the Basel Research Centre for Child Health).

Foundation stone of new BSS building laid on Schällemätteli campus.

2023
Launch of Next-gen Bioengineers, a research and education partnership between ETH Zurich and Roche.

New BSS building completed and handed over to ETH Zurich by general contractor.

2024
Inauguration of new BSS building.

Image: ETH Zurich / Alessandro Della Bella

Synthetic biology is a key area of research at ETH's department in Basel.

being placed on translating the findings of basic research into medical applications. "Today, systems biology often has such a profound understanding of how a cell works that it can provide most information for controlling key processes within the cell," says Paro. "By harnessing this expertise, synthetic biologists can then reprogramme a cell to perform a new task. In future, these reprogrammed cells may well be used for therapeutic purposes."

TRANSLATIONAL RESEARCH But such cells can only be used in patients if they are produced in compliance with the strictest pharmacological standards. Prior to its move, D-BSSE lacked the infrastructure required for this purpose – but the new BSS building came equipped with a GMP facility (see box). "This means we can now progress to the translational phase of our research," says Paro. "Working under GMP conditions, we can enhance reprogrammed cells and purify them so that they can be used in clinical trials."

This evolution toward translational research has also been eased by the D-BSSE's new location on the Schällemätteli Life Sciences Campus, which lies in the immediate vicinity of the University Hospital Basel, the University Children's Hospital Basel and the University of Basel's Biozentrum. Basel University's Department of Biomedicine and the Basel Research Centre for Child Health are also planning to build new premises nearby. This proximity is likely to further accelerate the translation of biological research into medical applications. ○

SVEN PANKE is Professor of Bioprocess Engineering at the Department of Biosystems Science and Engineering.
—〉 bsse.ethz.ch/bpl

RENATO PARO is Professor Emeritus of Molecular Biology at the Department of Biosystems Science and Engineering.

INFRASTRUCTURE FOR MEDICAL APPLICATIONS The new Good Manufacturing Practice (GMP) facility is run by ETH Zurich in collaboration with the University of Basel and University Hospital Basel. It provides researchers with a strictly controlled, ultra-clean environment for producing gene, cell and tissue-therapy products that comply with regulatory requirements for human clinical trials.

—〉 bsse.ethz.ch/gmp-facility

Cutting-edge research from Basel

From new tests and therapies to the fundamental principles of biology: five compelling examples of the benefits of new bioengineering technologies.

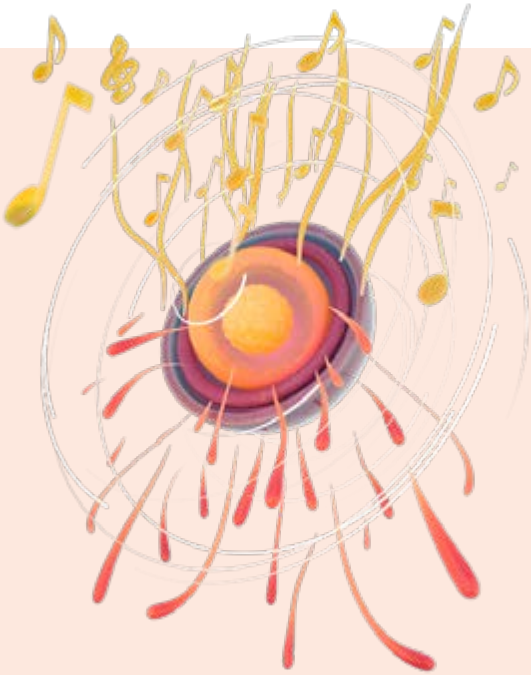
ILLUSTRATIONS Francesco Schito TEXT Karin Köchle

REGULATING GENE ACTIVITY WITH LIGHT
Transcription is the process by which the genetic information contained within DNA is transferred into RNA. A team led by ETH professor Mustafa Khammash has developed a method that uses blue light to control and study specific aspects of this biological process. As transcription proceeds slightly differently in each cell, this new approach also offers a way of exploring this variability. The method could also be used to control synthetic gene circuits, paving the way for innovative biomedical research and medicine in areas such as tissue engineering and stem cell research.

Control Theory and Systems Biology Laboratory
⟶ bsse.ethz.ch/ctsb

BETTER CANCER THERAPIES
Certain immune cells can attack tumours – but cells derived from donor blood can pose a risk to recipients. Now, a group of researchers led by ETH professor Sai Reddy has managed to modify the immune cells of donor blood to make them safe to administer. This could improve cancer patients' chances of recovery. The aim is to create a standardised, user-friendly commercial product to benefit cancer patients. A patent application for the new technology has been filed.

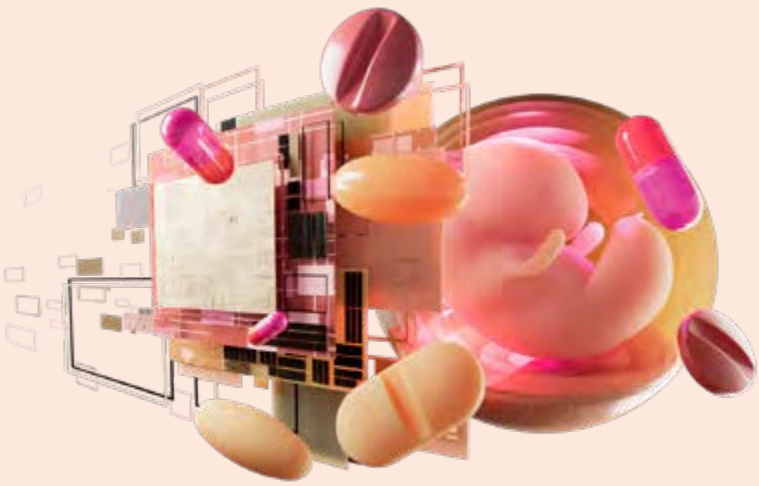
Laboratory for Systems and Synthetic Immunology
⟶ bsse.ethz.ch/lsi



CELLS WITH AN EAR FOR MUSIC

To control their blood sugar levels, diabetics have to inject insulin or use an insulin pump. Now, a team of researchers led by ETH professor Martin Fussenegger has discovered a solution that would allow diabetics to produce and administer this hormone in their own body. Their method involves enclosing insulin-producing designer cells in capsules, which are then implanted in the body. The cells contain a gene switch that enables the release of insulin to be controlled from outside the body. In a research first, the team has used music to trigger this process – a novel way to administer insulin.

Biotechnology and Bioengineering Group
—〉 bsse.ethz.ch/bbg



A NEW TEST TO PROTECT EMBRYOS

Drugs prescribed for pregnant mothers must also be safe for the unborn child. A research group led by ETH professor Andreas Hierlemann has now developed a lab test that provides a better assessment of embryotoxicity. The test takes into account how a drug interacts with the mother's body tissue – determining, for example, whether the medication is modified when passing through the placenta. The core component of the new test is a chip that combines mouse embryonic stem cell lines and human placental cells.

Bio Engineering Laboratory
—〉 bsse.ethz.ch/bel

LIFE IN THE BALANCE

For the first time, a team of researchers led by ETH professor Daniel Müller has developed a highly sensitive weighing device that can measure the mass of a single cell, the fundamental unit of life. The research was carried out in collaboration with the University of Basel. This groundbreaking technique can also be used for the real-time analysis of changes in cell mass caused by drugs or disease, such as infection with a flu virus.

Biophysics Group
—〉 bsse.ethz.ch/biophysics

Mini-organs with big potential

Organoids grown from human stem cells can help provide answers to important medical questions. In a partnership that looks set to profit both sides, ETH professor Barbara Treutlein has teamed up with pharma giant Roche to advance research in this area.

TEXT Corinne Johannssen

The clumps of cells are modest in size, ranging from just a few millimetres to a couple of centimetres – yet their impact on medical research could be huge. Known as organoids, they are the focus of much of the research carried out by Barbara Treutlein, Professor of Quantitative Developmental Biology at ETH. These organ-like systems are made up of different cell types arranged in complex tissue structures, essentially making them the 3D extension of 2D cell cultures. All the specimens in Treutlein's lab are grown from human tissue. "Organoids help us tackle questions in various fields of medicine," says Treutlein.

One of these questions concerns the possible causes of autism spectrum disorders. Analysis of patient data has already identified a link between certain genes and autism. To find out how exactly these genes influence brain development, researchers grew a brain organoid by turning stem cells into neurons. They then switched off certain genes in the organoid using the "genetic scissors" of the CRISPR-Cas method. This experiment was performed by colleagues from the Austrian Academy of Sciences and picked up by Treutlein's research group, which deployed the cutting-edge bioinformatics tools required to analyse the vast quantities of data obtained from single-cell analysis. "We eventually succeeded in pinpointing the effects of inactivating those genes. We are interested in whether there are mechanisms that affect all genes, and whether some mechanisms are specific to certain genes," Treutlein says. "By taking this approach, we can try to gain a better understanding of a disease." In this case, the researchers discovered which gene networks in which type of brain cell are responsible for the development of autism.

As well as studying abnormalities in brain development, Treutlein's laboratory is also working on the Human Cell Atlas, a project that aims to draw up a map of every cell type in the human body, from development to adulthood. Researchers around the globe are putting immense effort into creating this reference atlas.

The main contribution from Treutlein's research group is data obtained from characterising the cells of the nervous system. In their experiments, the team analyse more than 20,000 genes per cell, repeating this process for thousands of cells. This generates vast quantities of data, which the scientists interpret with the help of machine learning. "The algorithms spot patterns within this huge volume of data," says Treutlein. This information is then added to the reference atlas, which researchers worldwide can use for experiments.

CELLS FROM PATIENTS Some of the organoids in Treutlein's lab are derived from embryonic stem cells (ESCs), which international organisations have been preserving as stem-cell lines for decades. Because ESCs emerge very early on in the development of the embryo, they can be used to produce any type of cell – given the right environment – and thus any type of organoid.

The research group also generates its own stem cells from adult tissue. Known as induced stem cells, these are produced from body cells such as skin cells or white blood cells. By introducing the right factors into these body cells, they can be turned back into stem cells, which can then be used to grow a new organoid. "We can isolate cells from patients, transform them into stem cells and then generate an organoid," says Treutlein. "What makes this approach so exciting is that we're essentially mimicking organ development on the level of the individual patient." Using this method, researchers can model how a disease develops in a Petri dish and try to understand the mechanisms involved.

Periventricular heterotopia is one such disorder that is currently being studied by a doctoral student in Treutlein's research group. This is a condition in which the neurons fail to migrate properly during the initial development of the cerebrum. Epilepsy can be one of its manifestations. Scientists know that 21 genes are affected. When they switch off these genes in the brain organoid, this creates an imbalance in the different cell types. For now, these are still just the preliminary findings from initial experiments. "But if we can improve our understanding of the mechanisms involved, that could lay the foundations for new therapies," says Treutlein.

MORE THAN ONE CELL TYPE Treutlein's research group has analysed the individual cells of the tumouroids. Unlike analysis under the microscope, which merely permits a generalised pronouncement as to whether the tumour tissue is dying or not, Treutlein's single-cell technology yields much more precise conclusions. "Organoids are complex structures," she says. "That's why it's important to analyse them in detail." By analysing genes and proteins at the single-cell level, scientists can determine how efficiently a cancer therapy works on a tumouroid. ⟶

TRAINING THE NEXT GENERATION OF BIOMEDICAL RESEARCHERS ETH Zurich has partnered with Roche to launch two new research and training programmes. Their focus is on the development and application of new bioengineering techniques and of novel cell- and gene-based human model systems. ETH Zurich and Roche plan to enrol up to 20 doctoral students and up to 20 postdoctoral fellows over the next three to four years. This collaboration will be based primarily in Basel, home not only to ETH Zurich's Department of Biosystems Science and Engineering but also to Roche's Pharma Research and Early Development unit and its new Institute of Human Biology.

⟶ next-gen-bioengineers.ethz.ch

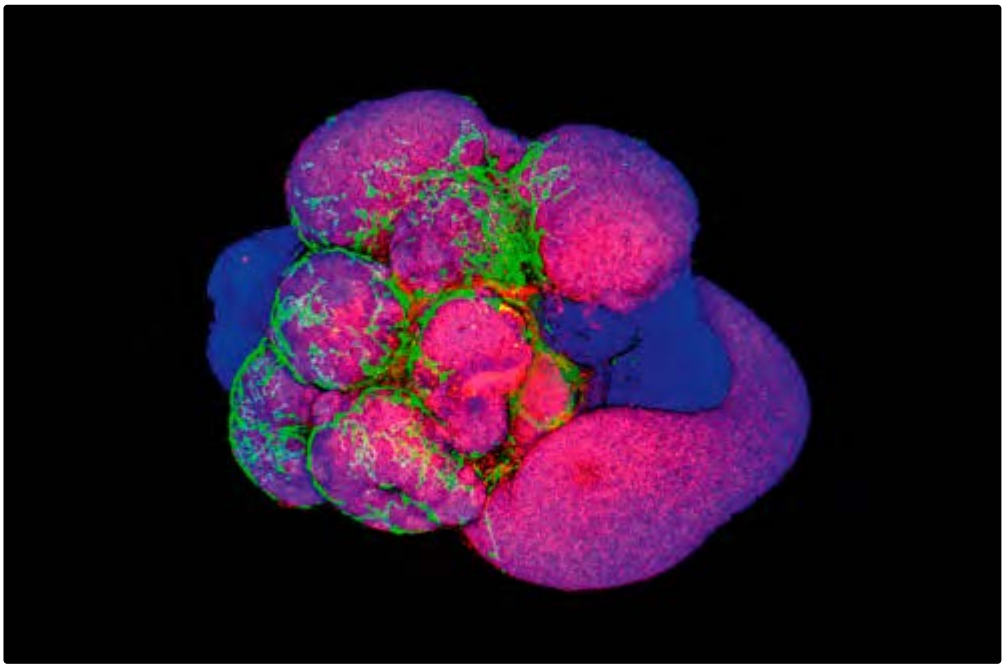


Bild: ETH Zurich / Treutlein Lab

A brain organoid (blue/magenta) with vascular structures (green) created by cell programming.

"This project highlights why our partnership with the IHB at Roche is so beneficial," says Treutlein. This sentiment is echoed by Matthias Lütolf, head of the IHB and Professor of Bioengineering at EPFL: "ETH Zurich is one of the world's leading universities, which makes them the perfect partner for the IHB. They have outstanding doctoral students and researchers – and that's a big reason why our joint research activities are doing so well." Treutlein believes this success primarily comes down to the difference in focus between academia and the pharma industry: "As a university, it's easier for us to take on longer-term projects, which are, of course, more risky. At the same time, we benefit from the private sector's practical focus, which is required to advance real-world applications."

ETH Zurich and Roche have also launched a joint programme for doctoral students, and Treutlein's laboratory will soon be welcoming a doctoral student from the IHB. Both she and Lütolf see major benefits in the decision to locate ETH Zurich's Department of Biosystems Science and Engineering in Basel. "Our joint students need easy access to both partners' labs and the ability to move quickly from one institute to the next," he explains. "It's this kind of personal contact that I believe is the key to successful research." ○

BARBARA TREUTLEIN is Professor of Quantitative Developmental Biology in the Department of Biosystems Science and Engineering at ETH Zurich in Basel.
⟶ bsse.ethz.ch/qdb

Combatting infant malnutrition

Bioengineer Randall Platt engineers bacteria that can assess the state of our guts. It is hoped this non-invasive technique could eventually be used to develop more effective interventions against malnutrition among children in the Global South.

TEXT Samuel Schlaefli

According to the World Health Organisation (WHO), 148 million children under five suffer from developmental delay due to malnutrition and are therefore unlikely to reach their full potential as adults. Malnutrition is caused by an insufficient intake of food or an inadequate absorption of nutrients such as proteins, vitamins and minerals. This, in turn, stunts growth and weakens the immune system. Infant malnutrition is a problem chiefly in Africa and Asia.

In Zimbabwe, decades of political and economic turmoil have had a profound impact on health. Outbreaks of typhus, measles and cholera are common – and children are the worst affected. UNICEF estimates that some 2 million children in Zimbabwe were dependent on humanitarian aid in 2023. "Many of the mothers I work with have access to running water for only three hours a day," says Kerina Duri, a professor of immunology at the University of Zimbabwe. "And a fifth of these women live on less than one US dollar a day."

THE ROLE OF GUT FLORA Five years ago, Duri established a cohort of 1,200 mother-child dyads and launched a research study that is still ongoing today. The mothers live in densely populated areas of Zimbabwe's capital Harare. Many of them are infected with AIDS, and malnourishment is common among their children. One of Duri's main goals is to understand why newborns who are exposed to HIV during pregnancy and the breastfeeding period, yet remain uninfected, are nevertheless at a higher risk of dying young. "There's a lot of evidence to suggest that the answer might lie in the newborn's gut flora," says Duri. "If a mother takes antiretroviral medications to suppress AIDS, her baby's gut flora will be exposed to these drugs during breastfeeding – and that could have a negative impact on the child's physical, neurocognitive and social development."

Gut flora, also known as gut microbiota, are the microorganisms that reside in the digestive tract – and Duri notes that Zimbabwe still lags far behind when it comes to research and expertise in this area. She is therefore pinning her hopes on a joint project with the Basel Research Centre for Child Health (BRCCH). Founded by ETH Zurich in collaboration with the University of Basel and charity group Fondation Botnar, the BRCCH aims to develop effective medical interventions for children in the Global South. Since 2020, Duri has been working with colleagues at the University of Bern, the University of Basel and ETH Zurich as part of a project funded by the BRCCH. Their goal is to improve diagnostic methods of assessing gut flora in infants.

SENSOR BACTERIA At the helm of the five-year project is 36-year-old Randall Platt, Associate Professor of Biological Engineering at ETH Zurich. Last October, his research group moved into the new building of the Department of Biosystems Science and Engineering in Basel, where light floods through the windows of his office. "We still don't have any simple methods of reliably measuring ⟶

inflammation, infection and diet-related gut disorders, even though we know that gut microbiota are central to human health," says Platt. The bacteria in our intestines influence almost all organs, including the brain, he adds, and they play an important role in the immune system and metabolism.

Currently, the standard method of assessing gut composition and health is by means of a colonoscopy. This is not an entirely straightforward procedure, and it is very unpleasant for patients – especially since the bowels need to be completely emptied beforehand. Moreover, the results are merely a snapshot of the manipulated colon at a given moment, with no measurement of changes over time. These drawbacks prompted Platt to come up with a more elegant alternative. His technique is non-invasive and does not disturb normal intestinal function, yet it still provides insights into changes in the gut environment. "It's a huge technological leap – a bit like switching from photography to film," says Platt.

> "We were able to track in real time whether the level of nutrients in a diet was sufficient for gut health."
>
> Randall Platt

The recording tools used by Platt and his team are just a few micrometres in size. They consist of *E. coli* bacteria modified using the CRISPR-Cas system in such a way that they can identify and record changes in their biological environment. "The cells of these bacteria adapt to their environment as they pass through the intestine. They react to changes in pH as well as to nutrients and chemicals," Platt explains – and these reactions can be measured. At the genetic level, the researchers capture RNA molecules in living *E. coli* to determine the genes expressed by the bacteria in response to the gut environment. The researchers encode this collection of gene expression events like a digital video camera, storing them on a kind of bacterial memory card. To do this, they isolate bacterial DNA from a faecal sample and analyse it using high-throughput DNA sequencing. They then perform a bioinformatic evaluation to determine which genes were active during the bacterium's journey through the gut. At the same time, they can identify what molecular and microbial environment the bacterium encountered and whether the nutritional composition of the intestine is sufficient to promote health.

In a study published in 2022 in the journal *Science, Platt* and his team described the function of these data-logging bacteria in a mouse model. In their experiment, the bacteria remained active in the mouse intestine and continued collecting data for between one and seven days. "We were able to show that our technique can be used to capture important biological information in every region of the gut," explains Platt – a clear advantage over endoscopy. The researchers also succeeded in tracking the effects of diet on gut flora. To do this, they fed three groups of mice with different diets: one with lots of nutrients, one with lots of fat and one with lots of starch. The sequenced sensor bacteria exhibited a characteristic gene expression that varied according to the type of diet. "We were able to track – practically in real time – whether the level of nutrients of a diet was sufficient for gut health," says Platt.

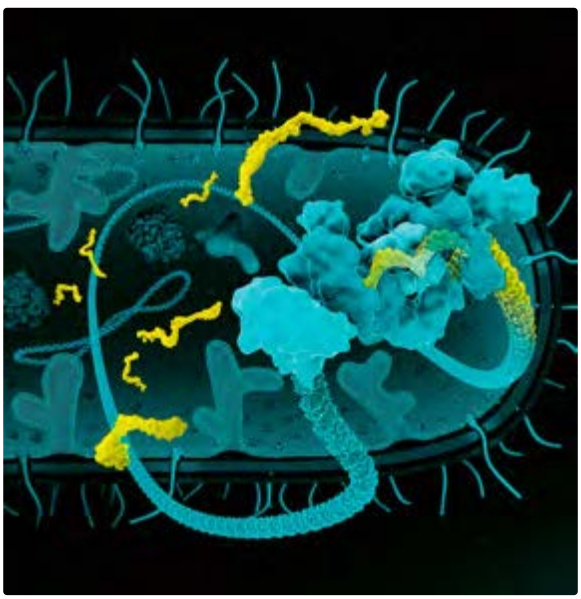


Image: Science animated / Bara Krautz

Genetically modified *E. coli* bacteria can detect and record changes in the intestine.

> "Our goal is to create a centre of excellence for gut flora research in Zimbabwe."
>
> Kerina Duri

TARGETING DEFICIENCIES The researchers hope this kind of diagnostics platform could pave the way for a more personalised and targeted approach to treating children suffering from malnutrition or other deficiencies. In the meantime, however, a better understanding is needed of the connection between changes in gut microbiota and certain disease manifestations. To tackle this aspect of the project, Platt is working closely with experts both inside and outside ETH. Among them is Uwe Sauer, ETH Professor of Systems Biology, who conducts research into microbial metabolism and the interactions between host and microbes. Platt also works with Andrew Macpherson, Professor of Medicine and Director of Gastroenterology at the University Hospital of Bern, who has established his own mother-child cohort in Switzerland for the project. By working with Kerina Duri in Zimbabwe to compare the two cohorts, he hopes to gain a better understanding of the changes that take place in infants' gut flora under different conditions. The final member of the team is Dirk Bumann, Professor of Infection Biology at the Biozentrum of the University of Basel, who joined the group to study the role of pathogens in gut flora. These pathogens are commonly encountered in contaminated water or as a result of poor hygiene practices. They can cause intestinal infections and exacerbate the effects of malnutrition.

The research team now aims to test the diagnostic potential of the bacteria in human clinical trials, though Platt cautions that the use of CRISPR-Cas technology will require them to clear some significant regulatory hurdles. He estimates that the first clinical trials could begin sometime in the next five years.

Kerina Duri, his colleague in Zimbabwe, hopes to continue working with Swiss partners after the BRCCH project finishes at the end of this year. "Our goal is to create a centre of excellence for gut flora research in Zimbabwe," she says. Such a centre would benefit mothers and children nationwide, and the African region at large. "But we can only build the necessary capacity through third-party funding and joint projects such as the one with ETH Zurich," says Duri. ○

RANDALL PLATT is Associate Professor of Biological Engineering in the Department of Biosystems Science and Engineering at ETH Zurich and in the Department of Chemistry at the University of Basel.
⟶ bsse.ethz.ch/platt

BASEL RESEARCH CENTRE FOR CHILD HEALTH
Last year, Fondation Botnar donated an additional 50 million Swiss francs to the University of Basel and ETH Zurich to expand the activities of the Basel Research Centre for Child Health (BRCCH). This funding will support the establishment of six new professorships in the field of paediatric digital health. Founded in 2019 as a joint venture between the University of Basel and ETH Zurich, the BRCCH works to improve the health of young people. To achieve the centre's goals, the two co-founders work closely with the University Children's Hospital Basel and the Swiss Tropical and Public Health Institute.

⟶ brc.ch

A new direction for cancer research

In collaboration with University Hospital Basel, researchers from ETH are investigating the early stages of bladder cancer. Their findings show that future research should also focus on mechanical changes in tumour tissue.

TEXT Fabio Bergamin

Dagmar Iber is Professor of Computational Biology at ETH's Department of Biosystems Science and Engineering in Basel. Her research group uses a combination of lab experiments and computer modelling to investigate how cells organise themselves into organs and other complex, three-dimensional tissue structures based on the genetic information they contain. Until recently, their work did not touch on cancer research. But that all changed when the ETH Board issued a call for research proposals combining basic and medical research on new topics in health-related fields.

In response, Iber teamed up with two professors from the University Hospital Basel, urologist Cyrill Rentsch and pathologist Lukas Bubendorf. They were seeking to understand what governs the direction in which bladder tumours grow. As it turns out, their collaboration may well have provided cancer research with a major new lead.

TUMOUR TYPE IS KEY The direction in which a bladder tumour grows can play a key role in whether it proves malignant or benign. In turn, this also determines the course of treatment and the patient's chances of survival.

One of the most common forms of bladder cancer is a papillary tumour. This has a slender, branch-like structure and grows from the bladder wall into the bladder cavity. It is a relatively benign form of bladder cancer that can be effectively treated in a minimally invasive procedure that involves scraping the tumour off the bladder wall.

Harder to treat is what doctors refer to as muscle-invasive bladder cancer, where the tumour grows not into the bladder cavity but rather into the deeper layers of the bladder wall. Access to blood and lymphatic vessels in those deeper layers facilitates the formation of metastases that can then spread through the body. In this case, the prognosis is much less favourable; frequently, the entire bladder must be surgically removed.

It is known that these two forms of cancer differ genetically. However, these differences do not explain why one cancer type would grow into the inner layers of the bladder wall and the other grow out into the bladder cavity.

The team's initial inspiration came from their work on lung development. "The tree-like ramification of the papillary bladder tumours have some likeness to the minute branches of the bronchioles in the lungs," Iber explains. This led them to wonder whether similar molecular mechanisms might be responsible for creating both these structures. Yet subsequent research showed this not to be the case. "It turns out that the molecular drivers in the formation of lung tissue are quite different to those in the development of bladder cancer," says Iber.

MECHANICAL, NOT BIOCHEMICAL When it comes to lung tissue, a biochemical mechanism defines the position of new branches. In bladder cancer,

however, the emergence of papilla appears to be influenced by mechanical rather than biochemical factors. In support of this theory, the Basel-based researchers have now published a study in the form of a preprint – a full draft of a research paper that is shared publicly before peer review.

To understand their theory, it helps to visualise the structure of the bladder wall. This wall is flexible and has numerous folds that enable the bladder to expand and contract depending on the amount of urine it has to hold. Three layers of tissue play an important role here. Together, they make up the innermost layers of the bladder wall, like an onion: first, a soft epithelial layer on the inside of the bladder wall; next, a substantially stiffer membrane, which provides mechanical stability; and, beyond that, a somewhat softer layer of connective tissue.

> "Cancer research needs to focus more closely on biomechanics and the chemical signalling pathways that affect it."
>
> Dagmar Iber

Based on computer models, biopsies from tumour patients and tissue samples harvested from experiments with mice, the researchers' theory posits that cancerous growth is accompanied by changes in the relative stiffness of the different layers of the bladder wall. Depending on the degree of these changes, different forms of cancer develop. If there is only a minimal change in the stiffness of the layers relative to one another, blunt protrusions may grow from the bladder wall into the cavity of the bladder. These can then form the basis for papillary tumours. By contrast, if changes in relative stiffness are more significant, the surface of the bladder mucosa remains smooth. Instead, the membrane that separates the epithelium from the surrounding layer of connective tissue forms fine wrinkles and narrow folds. The researchers posit that this can result in tissue damage that encourages the growth of a malignant tumour into the inner layers of the bladder wall.

FOCUS ON THE EARLY STAGES "Pathologists have described changes in bladder wall stiffness in patients with advanced bladder cancer," explains Franziska Lampart, a doctoral student in Iber's group. The Basel researchers now used an animal model to investigate the early stage of bladder cancer. In collaboration with the group led by Daniel Müller, Professor of Biophysics at the ETH Department of Biosystems Science and Engineering, atomic force microscopy revealed localised softening of the membrane layer even at this early stage. "This supports our idea that local changes in the relative stiffness of individual bladder wall layers play an important role in the development of bladder cancer," says Lampart.

These findings may well take cancer research in a new direction. At present, much of this work focuses on inhibiting the growth of cancer cells or killing them. "But our research shows once again that tissue mechanics is important, too," Iber notes. Cells secrete protein fibres and enzymes that influence and modify the extracellular matrix that surrounds them. "Cancer research needs to focus more closely on biomechanics and the chemical signalling pathways that affect it," Iber says. "But this line of investigation is still very much in its infancy."

Besides the enjoyment of constructive collaboration with clinicians from University Hospital Basel, this cancer research project has brought Iber new insights. These may well prove invaluable back on her home territory of developmental biology, where tissue mechanics also play a role. ○

DAGMAR IBER is Professor of Computational Biology at the Department of Biosystems Science and Engineering and President of the University Assembly.
—〉 bsse.ethz.ch/cobi

Image: ETH Alumni Association

Daniel Naeff (left), ETH Alumni board member and head of the Knowledge Network project, and Marc Vontobel, CEO of Starmind.

New knowledge network for alumni

The newly launched ETH Alumni Knowledge Network brings people together by providing a platform for community members to connect and interact with one another. Operated by Starmind, its patented AI system offers a kind of intelligent matchmaking service. Users pose questions that are then analysed by the AI system in order to identify the four to ten members of the community most qualified to answer them. This ensures that the answers undergo a form of peer review, thereby delivering an accuracy rate of 95 percent. The answers are also stored in the Knowledge Network for future reference.

Daniel Naeff, ETH Alumni board member, sees a number of benefits to this approach: "It gives members a more direct way to access alumni from different backgrounds and generations, allowing them to share experiences and ask questions to which they wouldn't easily get answers elsewhere." Marc Vontobel, CEO of Starmind, agrees: "I never cease to be amazed by the vast reservoir of knowledge that exists in people's heads – in the form of experience, expertise and tacit knowledge."

The Knowledge Network encourages alumni not only to seek answers but also to make their own contributions, thereby fostering a dynamic and continually updated flow of knowledge. This will ensure that the Knowledge Network remains a durable resource. ○

ETH Alumni Association:
—〉 alumni.ethz.ch/en/

Challenge accepted

The planned Centre for Students and Entrepreneurs on the Hönggerberg campus will create a meeting place for science and industry. Funding of the project is already at an advanced stage thanks to partnerships with organisations such as UBS as well as donations from private individuals. In addition to their generous contribution, the Geneva-based ALCEA Foundation also launched a challenge: any money raised by ETH alumni, staff and students would be matched by the foundation. The target amount was duly raised in a mere eight months, and in January of this year, doubled by the Alcea Foundation to a sum of two million Swiss francs. Special thanks go to the over 1,600 donors – including Severin Hacker, Jost Allmeling, Plexim, Heer and Co. AG, the Werner Steiger Stiftung and the ETH juniors – whose donations helped get the challenge over the finishing line. ○

Find out more at:
⟶ hic.ethz-foundation.ch/en/challenge

Strengthening bonds

The League of European Research Universities (LERU) is committed to promoting basic research at European universities. Its aim is to raise awareness among political decision-makers and opinion leaders about the important role that research universities play. On 1 January 2024, ETH Zurich took up an invitation to join LERU, becoming its 24th member. In response, LERU chair Linda Doyle said: "I am delighted that the leading research university ETH Zurich is joining the LERU network." ETH Zurich is joining at a time when the university remains excluded from the Horizon Europe research programme, making it all the more important that ETH join forces with partner universities in Europe. ○

New spin-off record

The past year saw the establishment of 43 spin-offs at ETH Zurich, a new record. Most were created in the areas of biotechnology and pharmaceuticals. Twelve of the new spin-offs have a clear link to AI. The proportion of female founders is also up from the previous year, with the number of ETH spin-offs founded or co-founded by women rising to 11. Vanessa Wood, Vice President for Knowledge Transfer and Corporate Relations at ETH Zurich, is delighted: "The fact we have managed to encourage more and more women to become entrepreneurs is not only very satisfying for me personally but also important for Switzerland's economy and society." It was also an outstanding year for grants: a total of 47 million Swiss francs was received by ETH spin-offs in 2023, without any dilution of the existing shareholdings of current owners. There were also major funding rounds, with the five spin-offs GetYourGuide, ANYbotics, Verity, Wingtra and Memo Therapeutics alone raising a combined total of more than 200 million Swiss francs. ○

Image: ETH Zurich

The ETH weeding robot from spin-off Caterra promises to save many hours of manual labour and to enable scalable organic farming without the use of chemicals.

Towards responsible digital transformation

ETH Zurich has received a major donation from the Dieter Schwarz Foundation. It plans to invest the money in a new teaching and research centre to pave the way for a smooth digital transformation in Germany.

TEXT Corporate Communications

Society today faces a raft of truly global challenges – climate change, geopolitical instability, the energy crisis, disruption to supply chains, cyberattacks and big changes in the world of work. "One of the keys to solving such problems lies in digital transformation. We need to muster all our strength," says ETH President Joël Mesot. "And scientists and universities have a particular responsibility to play their part."

At the end of last year, the not-for-profit Dieter Schwarz Foundation and ETH Zurich signed a wide-ranging letter of intent outlining their commitment to a responsible implementation of digital transformation. Over the next 30 years, some 20 professorships will be established successively with grants from the foundation.

"Our partnership with the Dieter Schwarz Foundation will enable ETH Zurich to further develop its research and teaching, particularly in the field of artificial intelligence, to an extent not possible with the regular funding and structures in place at ETH," says Mesot. This marks the start of a collaboration of pan-European significance, he adds. The additional professorships will enable ETH Zurich to expand strongly in the strategic field of digital transformation and data science.

Image: ETH Zurich / Valeriano Di Domenico

ETH President Joël Mesot (left) and Reinhold Geilsdörfer, Managing Director of the Dieter Schwarz Foundation, sign the joint letter of intent.

The first fruit of the partnership will be the creation of two new professorships in Zurich, one in computer science and the other in data science. This will be flanked by a further expansion of the Zurich Information Security and Privacy Center (ZISC). In addition, an endowment fund will be set up at the ETH Foundation to secure the partnership over the long term and to invest in infrastructure in Zurich.

Over half of the remaining professorships will be established at the Dieter Schwarz Foundation's teaching campus in Heilbronn, where ETH Zurich plans to open a new teaching and research centre.

INTERNATIONAL COLLABORATION The partnership will focus on topics including artificial intelligence, cybersecurity, bioinformatics and the circular economy. "These areas rely more than ever on international collaboration," says Mesot, emphasising that the teaching campus in Heilbronn will aim to foster precisely this kind of cooperation. At the same time, ETH Zurich will be able to draw on its positive experiences in Singapore, where it has been operating a research centre with close links to world-leading universities since 2010.

"With the renowned Technical University of Munich already on board, we're now delighted to welcome ETH Zurich as another top international university to strengthen the ecosystem in Heilbronn. It's crucial that we bring together the very best scientific institutions," says Reinhold Geilsdörfer, managing director of the Dieter Schwarz Foundation.

The Dieter Schwarz Foundation is working to attract further professors from other premier universities to work at the teaching campus in Heilbronn. Both the Technical University of Munich (TUM) and the Fraunhofer-Gesellschaft already have an on-campus presence. The Dieter Schwarz Foundation has also forged strategic partnerships with the University of Oxford, Stanford University, HEC Paris, the Hebrew University of Jerusalem and Nanyang Technological University of Singapore.

Currently, ETH is planning the exact configuration of its centre in Heilbronn. Questions include the thrust of research and teaching activities there and the precise nature of the collaboration between ETH Zurich and Heilbronn. If everything goes according to plan, the Dieter Schwarz Foundation and ETH Zurich will sign a further agreement this year, paving the way for the appointment of the first five professorships at the Heilbronn teaching campus. ○

PHILANTHROPY

DONALD TILLMAN
Managing Director of the ETH Foundation

From Zurich to Murray Hill

When Frank W. Sinden attended ETH Zurich in the 1950s, he was among the first pioneering group of Americans to study at the university. Today, ETH is an international institution through and through, with 200 students from the US alone, plus another 120-odd nationalities among its talented intake. Back in Sinden's day, ETH – like the rest of the world – was far less globalised. But it was still an exciting time to be a student at our university. Sinden's professors included Paul Scherrer, who in 1954 helped found CERN and would later give his name to the Paul Scherrer Institute, and his doctoral studies were supervised by Eduard Stiefel, who developed one of the first computers in Europe. Even now, aged 96, Sinden cites his ETH doctorate as the reason he was offered a position at the prestigious Bell Labs in Murray Hill, New Jersey, where he worked for some 40 years. He remains grateful to his alma mater to this day, which is why he continues to be a loyal benefactor of the ETH Foundation. Thank you very much, Dr Sinden – we appreciate it!

→ ethz-foundation.ch/en/eth-foundation-usa

Image: Hannes Heinzer

Awards for diversity and inclusion

The Academic Association of Scientific Staff at ETH Zurich (AVETH) and ETH Diversity recently announced the winners of the third edition of the Diversity Award, which honours individuals and organisations committed to the principles of diversity and inclusion. Of a total of 30 nominees, the following individuals and groups were recognised: Valentina Gasser, Fabienne Jaquet, Katharina Kolatzki, the association Hochschul-Pride Zürich (HoPZ), the NADEL Center for Development and Cooperation and the Society for Women in Natural Sciences (WiNS). ○

Watt d'Or for enhanced power grid management

The Swiss Federal Office of Energy has once again presented Switzerland's Watt d'Or energy prize. Among the winners of the 17th edition of this award was ETH Zurich, which took the top spot in the Energy Technologies category in partnership with AEW Energie AG. ETH researchers Lukas Ortmann and Saverio Bolognani from the group led by ETH professor Florian Dörfler received the Watt d'Or for developing an algorithm that helps solve a power management problem in the grid. Implemented within the real-world environment of the AEW Energie power grid, their algorithm means that photovoltaic systems not only supply renewable electricity but also contribute towards the control of reactive power in the grid. ○

New honorary councillors appointed

On ETH Day, ETH Zurich traditionally awards the title of honorary councillor to select individuals. At the celebration to mark ETH Day 2023, Wera Hotz Kowner, the first woman to complete a degree in electrical engineering at ETH Zurich, was named an honorary councillor in recognition of her outstanding services in the promotion of young talent. Franz von Meyenburg received the same honour for his visionary promotion of Zurich as a centre of academia and medicine, and for strengthening the collaboration between medicine and technology in the service of society. ○

Image: Frame Photography

Honorary councillor Franz K. von Meyenburg.

Image: Courtesy of anonymous

Honorary councillor Wera Hotz Kowner.

IN PERSON

Artist Rosa Barba is constantly seeking new perspectives. At ETH, she works to bring art together with architecture, science and engineering.

ROSA BARBA is Professor of Art in Space and Time at the Department of Architecture, ETH Zurich.
⟶ barba.arch.ethz.ch

Where does architecture end and art begin?

Art can be understood as a transitional architecture in its own right, one that supports a spatial and temporal projection into the past and into the future. At its best, art creates a secure space for thought – a place from where different perspectives can be explored.

Is the ability to think and act creatively a prerequisite for architecture?

Critical and creative thinking are important elements of architecture, and interdisciplinary approaches are also key. Our chair brings artists together with the community of architects, scientists and engineers at ETH. We take a fresh look at technological, social and sustainability issues, with a view to engaging with the wider community on the civic and societal level.

What do you hope to impart to architecture students?

My aim is to give students a sense of how multifaceted the world is. We're an international team of artists and researchers. Our areas of interest are diverse and multidisciplinary, ranging from urban anthropology to artistic practices such as film, sculpture, sound and performance. These encompass or intersect with issues such as language, political discourse and diverse explorations of the human world.

You've participated in artist-in-residence programmes in Europe and the US. What does it mean to work in different geographical locations?

It's important to tune into different cultures, to understand their landscapes, and explore new perspectives arising from that. We're all connected, and grasping the bigger picture involves drawing knowledge from various locations.

You've said that history is like a sculpture. How will our descendants interpret today's architecture?

When I say history is like a sculpture, I mean the underlying spatial and temporal lines in a poetics of distance. It's a balancing act in unstable surroundings that we continually re-read and understand anew. I'd like to think that our buildings will say a lot about a shared future without ever losing sight of the past. ○

TEXT Karin Köchle

Image: Courtesy of anonymous

BRIDGING THE GAP WITH POLICY REGINA WITTER

REPORT | The new ETH Policy Fellowship aims to foster greater understanding between government and the academic world. Regina Witter from the Federal Office for Spatial Development was among the first cohort to take part.

TEXT Christoph Elhardt
IMAGES Michel Büchel

Battery or hydrogen power? Which one will drive the trucks and buses of the future? This question is more than just academic for Regina Witter. As deputy head of the Agglomeration Transport programme at the Swiss Federal Office for Spatial Development (ARE), she helps decide which projects benefit from CHF 1.6 billion of federal funds to promote sustainable spatial and transport planning. "We recently discussed an idea put forward by an agglomeration to convert public bus transport to hydrogen power," Witter recalls. But does this approach really make technological sense? This was just one of many questions on Witter's mind when she visited ETH Zurich last autumn.

ETH professors Tobias Schmidt and Russell McKenna are currently investigating the pros and cons of various energy systems. Both agree that battery power, rather than hydrogen, offers the best option for passenger transport. "If you consider the total vehicle costs over its full service life, batteries are significantly cheaper and more efficient," says Schmidt, who has published a major study on the subject. Regina Witter held one-on-one meetings with both Schmidt and McKenna, delving deep into this topic over the course of several hours. "I was struck by how vehemently both of them argued against the use of hydrogen power for passenger transport," she explains. "That level of conviction is not something we've heard in our department before, and it throws into question whether hydrogen is the right choice for public transport."

Helping to promote closer consultation between the Federal Administration and the academic world is a new pilot project at ETH Zurich: the ETH Policy Fellowship. Last year, from September to November, three officials from the Swiss Federal Administration spent ten days at ETH. One of them was Regina Witter, who has a doctorate in spatial and transport planning. She took part in workshops, gave a lecture, bounced ideas around with students and met up with a total of 13 experts in the fields of spatial planning, energy and transportation. She describes it as a "rewarding experience that I can heartily recommend to middle-ranking officials at the Federal Administration". ⟶

FELLOW

TWO-WAY TRAFFIC In early 2020, as the SARS-CoV-2 coronavirus began to take hold in Switzerland, the federal government and administration quickly turned to the scientific community for advice on how to handle this complex new situation. Initial efforts at cooperation were bumpy, however, with little mutual understanding of the other's needs or ways of working. A key lesson of the Covid-19 pandemic has been that communication between government and the scientific community needs to be ongoing rather than merely an ad hoc measure in times of crisis.

It is this problem that the ETH Policy Fellowship is designed to address. "Our aim is to create a network between Federal Administration officials and ETH researchers that is based on mutual understanding and trust," explains Benedikt Knüsel, ETH liaison officer for the Federal Administration.

The policy fellowships are about facilitating a two-way transfer of knowledge between the Federal Administration and the scientific community. "The idea is that both sides should benefit," says Knüsel. As well as learning about relevant research, administration officials can develop new ideas in discussion with ETH academic staff and find out where to get information on specific topics. In turn, they bring valuable knowledge and experience that can help researchers at ETH to better understand how the administration works and what its needs are.

WHAT THE PUBLIC WANTS During her time at ETH, Witter was attached to the research group of David Kaufmann, Professor of Spatial Development and Urban Policy. Both Witter and Kaufmann are interested in how and where best to encourage inward urban development – i.e., densification – in Switzerland. Both are convinced that the answer to this question can only lie in an integrated approach to spatial and transport planning.

One of Witter's roles at the ARE is to promote sustainable transport projects that also encourage densification. Kaufmann, meanwhile, is interested in finding out just what kind of densification the Swiss would prefer. In a large-scale survey, he and his team have shown that urban dwellers are certainly not opposed to further densification. "But they also want to see the creation of affordable housing and of green spaces," he says.

For Witter, these insights are invaluable: "They help us to assess more accurately what people want from future spatial and transport planning."

TRANSPORT HUBS Another of Kaufmann's research projects has a direct bearing on Witter's field of work: the conversion of stations into transport hubs. As Witter explained in a presentation to students and researchers at ETH Zurich, the point of

these hubs is "to enable people to switch as smoothly as possible between car, bike, train and bus". ARE runs a dedicated programme – led by Witter – to promote this policy. In tandem with federal government, Swiss cities and cantons are looking to create transport hubs to improve connectivity between urban and rural areas and relieve pressure on the road network.

Improved transport links also make hubs a magnet for new residential projects. "From a spatial planning point of view, it really makes sense to densify where the transport infrastructure is already in place," Witter says. For Kaufmann, however, this is only half the story. He has gathered extensive data showing that this kind of development can also have negative consequences. "New housing in areas with good transport is expensive – too expensive for people on lower incomes," he explains. "They can't afford it and get squeezed out by younger, higher-income households." What's more, he argues, the Swiss expect more from a transport hub than smooth connectivity between different types of transport and a bit of shopping on the side. "There's also a strong perception of stations as public spaces that help define a neighbourhood's identity," Kaufmann says.

For Witter, such findings are a key input for the consultation process on transport hubs back at the Federal Administration. "We also have to factor in the displacement effects of densification and the need for public space," she explains. As a result, she will now pay more heed to the station layout for the projects in which she is involved. For example, are there enough attractive spaces that can be used by the public without the requirement to consume? ⟶

Regina Witter in discussion with ETH professor Francesco Corman. During her time at ETH, she met up with a total of 13 experts for one-on-one sessions.

Image: ETH Zurich

The three Policy Fellows with their hosts (left to right): Daniel Naeff, Head of Innovation & Entrepreneurship at the ETH Zurich AI Center; Policy Fellow Katharina Frey; ETH professor Guillaume Habert; Policy Fellows Vera Kämpfen and Regina Witter; ETH professor David Kaufmann; Benedikt Knüsel, Head of Science-Policy Interface at ETH Zurich; and Cédric Bolli, Programme Manager for Science & Policy at ETH Zurich.

Kaufmann is also benefiting from his newfound contact with Witter. For example, it has enabled him to substantially build his network at the ARE – not least in middle management, where many programmes get drafted and implemented. What's more, he has also been able to get Witter on board for a joint seminar: "It's going to be so exciting for our students to see first-hand how spatial and transport planning works in practice!"

LOOKING AHEAD Many of the one-on-one discussions that Witter held at ETH Zurich covered not only spatial planning but also the field of transport planning. Professor Kay Axhausen, since retired, showed her a visualisation of what Zurich's streets might look like if half the road network were reserved for bicycles and e-bikes. And Professor Emilio Frazzoli talked with Witter about self-driving cars and buses. According to Frazzoli, it is highly unlikely that this technology will become widespread over the next ten years, as there are still too many safety concerns. That said, they were in agreement that autonomous vehicles could complement public transport, especially in regions with a less well-developed transport infrastructure. Meanwhile, Witter's discussions with Professor Francesco Corman addressed the use of digital twins to model future traffic scenarios. This can serve, for example, to analyse city traffic flows and simulate various planning options. "For me, these discussions were like opening a window on the future of transport policy," Witter says.

Her stay ended on a decidedly practical note – with a workshop on the relationship in Switzerland between government and science. Here, she explained to up-and-coming researchers how they can contribute to the political process and what they need to bear in mind when communicating with the administration. With her inside knowledge, Witter had plenty of valuable advice to offer. ○

Regina Witter explains to students and researchers at ETH how spatial planning works in practice.

A THIRST FOR ADVENTURE

TEXT Andres Eberhard
IMAGES Désirée Good

Sport and an interest in healthy eating took Martina Pfeiffer first to ETH Zurich and then to Swiss beverage producer Rivella. Her active lifestyle has always kept her at the top of her game.

Martina Pfeiffer is in good spirits as she ushers us into a meeting room above the shop floor at the headquarters of Rivella in Rothrist. Earlier today, she and her team raised a glass to a new variety of the soft drink Rivella. Due to hit the shelves a few weeks from now, the details of the launch are still strictly under wraps. But this morning's tasting session was an opportunity for Pfeiffer and her colleagues to toast the success of their new product – in small tasting glasses rather than the plastic bottles that will soon be rolling off the production line.

It's moments like these that Pfeiffer loves about her job. "I always used to see my work in terms of management methods and technical skills," she explains. "But now I've got more scope to shape the business. I like achieving things as part of a team."

Forty-seven-year-old Pfeiffer has worked at Rivella AG for six years, first as production manager and then as head of the company's supply chain, a position she has held for just over a year. With around 100 people reporting to her, she is responsible for every step along the value chain, from procurement, planning and production to maintenance, quality assurance, logistics and customer service. Development and engineering also fall within her remit, and her position on the board means she has to tackle strategic questions on the company's future: Which new products should Rivella develop? Where should they focus investment? Which areas of business could benefit from digitalisation? And how can they reduce their environmental footprint?

Pfeiffer takes a sip from a bottle of blueberry-and-rhubarb-flavoured "Focuswater". This line of vitamin water products is part of the Rivella Group's portfolio, along with the Michel brand of fruit juice products that are currently being bottled on the shop floor below. "When I go shopping, I certainly spend longer in the drinks section than I used to!" says Pfeiffer with a smile. "I like to take a look at what the competition is up to – and how we measure up."

FASCINATED BY SPORTS NUTRITION Pfeiffer's interest in beverages and food in general goes back many years. She was a keen athlete in her youth, competing in swimming events and later in triathlons. She has always been interested in the beneficial effects of a well-balanced diet. Inspired by her interest in science subjects and what she describes as her practical nature, she enrolled at ETH and completed a degree in Food Science.

Eager to take us on a quick tour of the plant, Pfeiffer dons a hairnet and work coat. She also pulls on a pair of steel-toed safety boots. Then we're off to the production hall, where bottles are filled and packed – a huge space full of automated machinery and relatively few workers, who are responsible for monitoring production. "Quality is never an accident" says a sign in the anteroom, where Pfeiffer washes and disinfects her hands.

On the shop floor, she pauses in front of a machine packaging bottles into six-packs and tells us about the dissertation she wrote at ETH, which required her to investigate the omega-3 fatty acid content of fish and explore its relevance for human nutrition. "The things I learned at ETH are useful for the discussions we have here at work on ingredients and other issues," she says. After completing her degree, Pfeiffer obtained a doctorate in nutritional science from the ETH Department of Agricultural and Food Science. Her doctoral project also dealt with the topic of nutrition, this time in the context of exercise and human metabolism.

When colleagues ask her for tips on sports nutrition, she strikes a reassuring note: "A balanced diet will take you a long way." Equally pragmatic is her advice on healthy eating: "Nutrition should always be viewed in relation to physical exercise. The more you move, the less you have to worry about what you eat."

MARTINA PFEIFFER is a member of the Rivella Group management board and head of the company's supply chain activities. After studying Food Science at ETH Zurich, she obtained a doctorate in Nutritional Science from the ETH Department of Agricultural and Food Science. Pfeiffer lives with her partner in Staufen in the Swiss canton of Aargau.

GIANT SCREEN FOR TEAM MEETINGS Pfeiffer continues to keep active. She regularly spends her lunch break jogging along the bank of the River Aare towards Boningen or as far as Aarburg, which is a 7-kilometre, 40-minute round trip from Rivella's headquarters in Rothrist. But she no longer tackles the Olympic distances she used to cover in triathlons, nor the 1,000-step hiking trail up to the top of Born mountain, which has a punishing 300-metre elevation gain. "You have to be crazy to do that!" she says with a laugh.

When Pfeiffer took up her new post at Rivella, the management team made a short video to present her to the workforce. It shows her kitted out with hiking gear and a rucksack on top of a mountain, rock climbing with helmet, ropes and carabiners, and riding a mountain bike. "For me, exercise is all about nature, fresh air and, hopefully, a little bit of sun!" she says. Recently, however, she also took a shine to yoga. "It's great to keep learning new things," she says.

Having completed our tour of the production hall, Pfeiffer heads up the stairs to the office wing on the third floor. In the corridor, she stops in front of a giant screen that offers a view over the shop floor. Tapping her fingers on the screen, she scrolls through production schedules, error messages, consumption data and downtime figures. Staff can enter this data in the system directly from their company smartphones.

At 7.30 a.m. each morning, the team gathers in front of the screen, joined by Pfeiffer. "Getting everyone together is a great way to improve communication," she says. The meeting is based on the concept of shop floor management, which takes management to the front lines and brings all levels of the hierarchy together to promote a culture of continuous improvement. Pfeiffer also lectures on this subject at various universities as an industry guest speaker.

After completing her studies at ETH, Pfeiffer spent a year working at Coca Cola in Brüttisellen before heading into the mountains for six years, where she held various positions at mineral water bottler Valser Mineralquellen. "It felt a bit like emigrating, but without actually leaving Switzerland!" says Pfeiffer, who grew up on Lake Zurich and had spent most of her life in the city. This was followed by a brief stint at Swiss bakery JOWA before she finally joined Rivella.

CHILDHOOD MEMORIES When she was a kid, Pfeiffer says, everyone drank Rivella in the ski huts, and she has always had a soft spot for the brand. In fact, Rivella – which was founded in 1952 by student Robert Barth – is regarded in Switzerland as a kind of national beverage. Its close ties to the dairy industry certainly help – Rivella contains whey, the liquid that remains when the protein and fat are removed from milk.

The Swiss drink, on average, 9 litres of Rivella a year per head, according to the company's figures. A few years ago, the beverage was officially recognised as part of Switzerland's culinary heritage. Pfeiffer says working for a well-known brand is a big motivation. The company, which has 231 full-time employees, is still owned by the founder's family. This has fostered a close-knit corporate culture, says Pfeiffer, with the workforce referring to themselves as "Rivellaners".

Back in her office, Pfeiffer takes off her hairnet and coat, but leaves her safety boots on. There's just time to ask about her goals for the future. "To stay healthy. And active!" she says. And how about the ambition that has driven her to so many sporting heights? Still very much intact, it seems. "I want to achieve what's best for me," she says, referring not to traditional career aspirations, but rather activities that bring her fulfilment. "I'm not someone who gives up easily!" ○

"I like achieving things as part of a team."

Martina Pfeiffer

○ Bimonthly event

Nachtaktiv – scientainment for teens

An evening get-together with a party groove that combines science, art and entertainment. Targeted at a teen audience, it provides a showcase for researchers and start-ups from ETH and UZH to give a hands-on introduction to their latest projects and products – to the backing of a DJ set and drinks from the bar. The host museum also offers snap tours. Topics vary to match the exhibition currently on show.

Held every two months on a Thursday, 7.00 – 10.30 p.m., in the Zurich-Basel Plant Science Center and other Zurich museums

Information and dates:
⟶ nachtaktiv.ethz.ch

Image: Bolthauser Architekten

○ Open day

Tour of GLC building

ETH Zurich's new GLC building on Gloriastrasse in the Zurich City University District is a state-of-the-art lab and development facility situated at the interface between the health sciences and medical engineering. This open day offers the chance to tour the labs and learn more about the building's architecture.

6 June 2024, from 4.30 p.m.
GLC building, Gloriastrasse

More information at:
⟶ ethz.ch/glc-event-en

Image: ETH Library, University Archives, ref. 1995 VSETH

A caricature in the Studentischer Wochenkalender (22 June 1971) shows the ETH President expelling, in absolutist fashion, three guest lecturers from ETH Zurich.

○ Public tours

"L'ETH, c'est moi!"

Stories from the ETH archives

A collection of fascinating, surprising, humorous and sometimes tragic stories lie slumbering in the University Archives. Original papers from both the ETH administration and private estates of former academic staff tell of major events and curious incidents in the history of ETH Zurich.

A public tour to mark the 25th anniversary of the University Archives turns the spotlight on a choice selection from this vast array of materials and delves into the stories behind. As the "Memory of ETH Zurich", the archive is open to researchers and any other interested parties. Its purpose is to conserve, catalogue and make available all papers and documents of long-term interest to ETH Zurich.

23 April 2024, 6.15 – 7.15 p.m.
ETH Zurich, Zentrum campus

Sign up for this and other tours:
⟶ tours.ethz.ch/en

○ Music

Piano recital

Konstantin Scherbakov is an internationally renowned pianist who occupies a distinguished place within the pantheon of modern piano music. He boasts a large and demanding repertoire comprising technically complex works as well as performances of great interpretative sensitivity. The evening recital features works by Scarlatti, Respighi, Godowsky and Brahms.

17 May 2024, 7.30–9.30 p.m.
Auditorium of the University of Zurich

Programme and tickets:
—〉 musicaldiscovery.ch

Image: Jen-Pin

○ ETH app tours

Unearthing the power of agriculture

The latest app tour takes in the rich field of nutrition research at ETH Zurich. Discover how the agricultural sciences first came to ETH and the role that this research now plays in helping to feed the world. Follow the app tour on the Zentrum campus for a wealth of facts and fascinating insights on topics such as plant genetics, biocommunication and phytopathology.

Simply download the ETH Zurich tours app – and you're ready to go!
—〉 tours.ethz.ch/en

○ Recommended reading

Historical roots to modern problems

Lecture at ETH Zurich in 1985

A rousing return to the 1980s, this new publication reminds us that plenty of yesterday's problems are still with us today.

In the summer semester of 1985, Paul Feyerabend gave a lecture at ETH Zurich arguing that many of the challenges of the modern era are better understood when traced back to their roots in the intellectual world of ancient Greece. His audience – the majority from a scientific background – enjoyed an unabashedly anti-professorial performance laced with brilliant provocation and anecdotal wit, firmly underscoring the huge depth of Feyerabend's erudition. Once again, the philosophy of science's enfant terrible had delivered a resounding critique of Western rationalism!

Suhrkamp Verlag
ISBN: 978-3-518-58805-5

Image: Suhrkamp Verlag

Image: ETH Zurich / Nicole Davidson

Estelle Clerc and her start-up CellX are investigating the use of deep-sea bacteria as a sustainable solution for breaking down pollutants.

Allies from the deep

TEXT/VIDEO Karin Köchle / Nicole Davidson

Chemical waste from industrial processes can pose a threat to biodiversity and people's health. Yet current methods of dealing with pollution are expensive and sidestep the problem – for example by incinerating the waste – rather than solve it. Estelle Clerc, a postdoctoral researcher at ETH Zurich, is forging a different path with her start-up CellX: she searches remote waters such as the deep ocean for bacteria that can degrade specific pollutants such as microplastics, pharmaceuticals and pesticides. These bacterial strains can be cultivated in large quantities in the lab, the goal being one day to turn them into commercial products that can degrade specific pollutants. Sustainable, efficient and cost-effective, this new technology might also be used in the future to upcycle pollutants and other waste. ○

STUDENT PROJECT HOUSE This creative thinkspace and makerspace is open to ETH students from any discipline. The support they receive in developing and implementing their own project ideas helps the students learn about the different stages of the innovation process.
—› sph.ethz.ch

Video: CellX
—› youtu.be/pvgyVnu__uw

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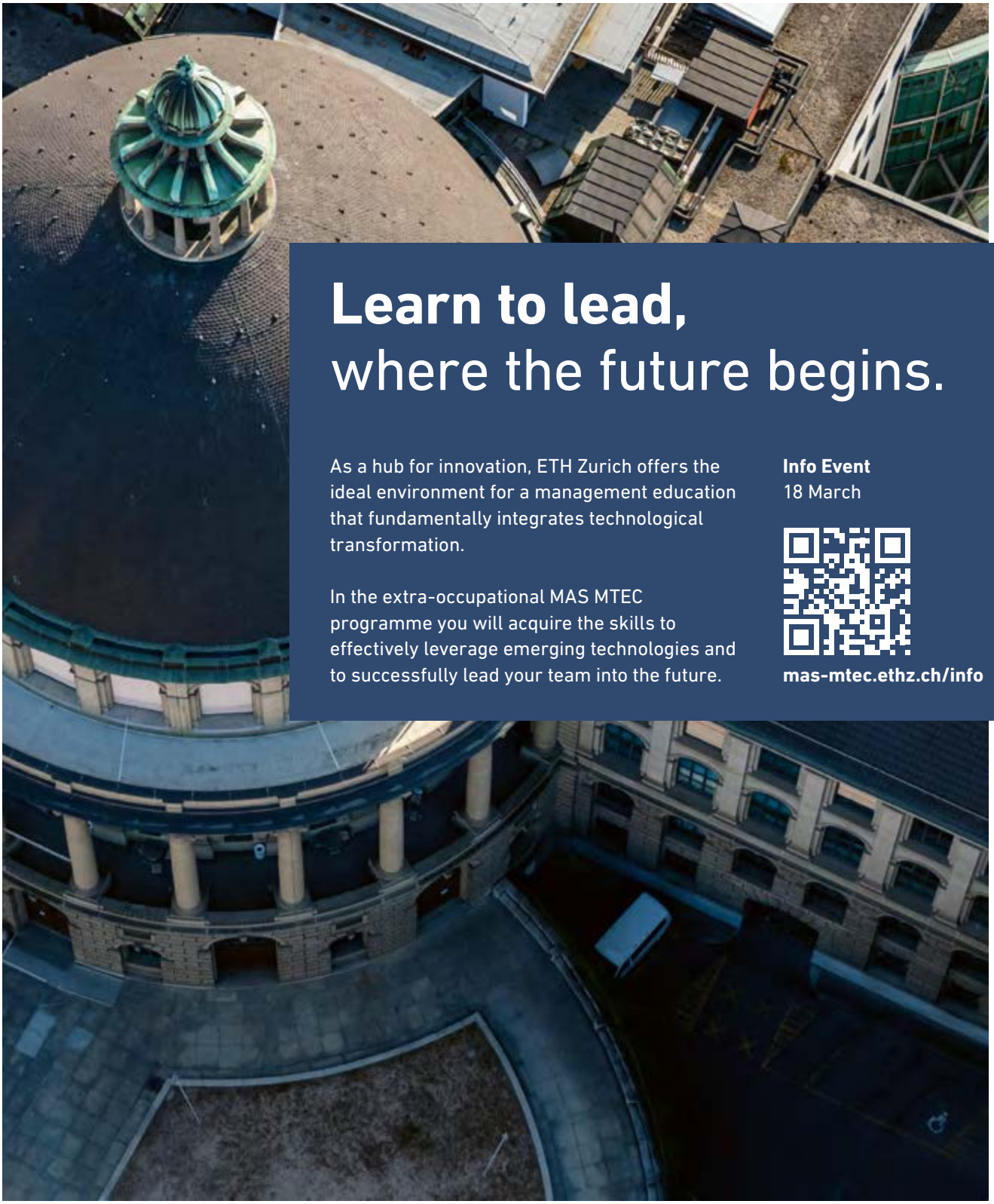

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