ETH Zürich Foundation

Uplift

The impact of giving №10

On course to find a cure for blood diseases
Young entrepreneur Mandy Boontanrart

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Funding focus

Personalised medicine

ETH Foundation

No ivory tower in sight!

ETH Zurich / Markus Bertschi

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EDITORIAL

Around 30 percent of all ETH professors are already working in medical-related areas, and ETH is now boosting its commitment to health. A hot topic among researchers is personalised medicine. Doctors have always wanted to be able to give patients the most effective treatment for their individual case. Thanks to progress made in data-driven technologies and analytical processes, they are becoming increasingly better equipped to do so. Besides genetic disposition and clinical data, research now looks at factors like lifestyle, age and sex. The data is particularly valuable when it leads to a better understanding of the underlying causes of a disease.

For further results in as many diseases as possible, researchers must have closer contact with the patient. An excellent example is Professor Catherine Jutzeler. Embedded in the Schulthess Klinik, she is seeking new insights that will lead to more precise diagnoses and treatments of bone marrow injuries. Read on for more fascinating stories on the medicine of the future!

Hoping to heal

With her start-up Ariya Bio, Mandy Boontanrart aims to develop a therapy for severe blood diseases. Thanks to ground-breaking discoveries in genetic research, she may not be far from making her vision come true.

Scientists can often tell a personal story when it comes to their field of research. Molecular biologist Mandy Boontanrart is no exception. At the beginning of her doctoral studies in 2015, she came across the lab led by Professor Jacob Corn, located then at the University of California, Berkeley. His research focuses on how the new CRISPR/Cas9 method for genome editing can be used in treatments for sickle cell disease, a severe genetic blood disease. The CRISPR/Cas9 method was discovered in 2012 by Jennifer Doudna and Emmanuelle Charpentier and earned them the 2020 Chemistry Nobel Prize. By enabling scientists to alter individual DNA building blocks in the genetic material, the method opens up new avenues in the treatment of hereditary diseases, such as haemoglobinopathies, which are found all over the world.

It was immediately clear to Mandy Boontanrart that she wanted to delve deeper into this field. Through a routine blood test at the age of 14, the American with Thai origins discovered that she was a carrier of thalassaemia, a haemoglobinopathy from the same group as sickle cell disease. The condition disturbs the formation of red blood cells. Depending on the severity, patients develop severe anaemia in the womb and need blood transfusions for the rest of their lives. Fortunately, Mandy Boontanrart lives without symptoms. “The doctor explained to me at the time that thalassaemia is very common among people with Southeast Asian roots and could only be treated by donor stem cell transplantation. Jacob Corn’s research challenged this, and I was determined to find out more about the CRISPR/Cas9 method.”

“The Pioneer Fellowship programme enables me to further develop my research into an effective therapy. ”
Mandy Boontanrart

From the lab to the patient

For her doctorate, Mandy Boontanrart researched ways of treating the blood disease. Her approach involves taking the patient’s own stem cells, editing the genetic material using the CRISPR/Cas9 method and transplanting the altered cells back into the patient's bone marrow. The modified cells can then multiply in the body. Because germ cells are not changed, the modification is not passed on to future generations. Mandy Boontanrart is currently conducting her research with Jacob Corn and his team at ETH Zurich. When she heard about the Pioneer Fellowship programme, she jumped at the chance: “With my start-up Ariya Bio, I can focus on working to achieve my goal which is to make this

Mandy Boontanrart and her team are looking to bring a therapy for haemoglobinopathies to market based on genome editing.

highly personalised therapy available to patients and play a part in curing the disease." With the support from the Pioneer Fellowship, she has taken the leap to become an entrepreneur and learned to think from a more business-oriented perspective. "My mentor helps me to set goals aligned with my business and I'm making lots of useful contacts."

Joint efforts to find new treatments

Mandy Boontanrart is still starting out with Ariya Bio. Together with two students, she is working on feasibility studies. If all goes to plan, in vivo studies are due to start at the end of 2022 and she's looking for investments for clinical trials in 2023. These will also take several years. The possibility that someone else could develop an approved therapy for haemoglobinopathies before her does not worry her. "First and foremost, I'd like to see an effective therapy. Besides, there's room for different approaches to a cure," Mandy Boontanrart says. It's noticeable during the conversation how the researcher focuses on positive aspects. She sees her unparalleled optimism, coupled with her determination, as important resources for her business plans: "As a researcher and a young entrepreneur, I have to be able to deal with setbacks, not to take mistakes personally and to always keep my goal in mind, which is to improve the lives of patients in the long term."

More on the programme at:
www.ethz-foundation.ch/en/pioneer-fellowships

Empowered by partners

The Pioneer Fellowships are funded by numerous foundations and companies, and over 200 private individuals. With mentoring, seed capital and access to labs, the programme supports outstanding researchers with high entrepreneurial ambitions on their journey towards creating a market-ready product. ETH Zurich is seeking to expand this important programme so that technologies with the potential to help shape the future of many areas of society will reach the market more swiftly.

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Mediating between medicine and data science

The research conducted by ETH professor Catherine Jutzeler is paving the way for patients with bone marrow injuries to be given treatments tailored to their specific needs.

I'm meeting you in the Zurich Schulthess Klinik – why is your workplace here and not at ETH?
CATHERINE JUTZELER – I analyse data from patients with spinal cord injuries: data on their health, age, blood values, previous illnesses, medication treatment and so on. This involves working together with doctors, therapists and statisticians, and the clinic provides the perfect venue for this interdisciplinary research. Theoretical models often don't work when you apply them to medical data, as this real-life data may be incomplete or contain biases, for example. To do my job well, I need to understand why the data looks as it does. The models can then be improved but, to be effective, proximity to the clinical world is essential. This is where you realise that it can make a difference to the data whether it's been compiled by a junior doctor or a doctor higher up the hierarchy, for example. It could be that a doctor with more experience may take a patient's temperature less often, making the data less complete than that of an inexperienced colleague. First and foremost, a doctor is there for the patients and not to generate ideal data sets for us researchers. Another factor is that my presence allows me to build trusting relationships. This creates acceptance for the fact that I'm using the clinical data to generate knowledge that can support clinical decision-making.

In concrete terms, how does your research improve the treatment of patients?
Let me give you an example: many people suffer from back pain often caused by increasing wear and tear of the intervertebral discs and joints of the spine. Infiltration is a non-surgical pain therapy used to treat the condition in which a mixture of painkillers and anaesthetics is injected into the epidural space in the spine. A large number of patients respond, but some do not. But why do certain patients respond and others not? What is the difference between the two groups? This is what I'm hoping to find out in a project with Zina-Mary Manjaly, a neurology consultant at the Schulthess Klinik. The aim is to be able to better predict the effectiveness of this treatment in the future. To do this, I'm looking for patterns in the data that will help us distinguish between the groups. Much of my work consists of preparing data and getting it into a format that we can then use for our analyses. For the latter, we use statistical methods – and machine learning too.

"I'd like to help people better understand why sharing medical data is important."
Catherine Jutzeler

Meetings made easy: Catherine Jutzeler works closely with Zina-Mary Manjaly, a neurology consultant at the Schulthess Klinik.

Why do you think talking to the patients is so important?
We researchers sometimes find one particular goal – such as getting people to walk again – to be particularly worth pursuing. But if you speak with the patients, you realise that their priorities are different: being able to go to the toilet without difficulty, or being relieved of pain, is far more important to many. I therefore ask them quite specifically: "What would help you most?" This is only fair, in fact, as the data I work with doesn't belong to the clinic, nor to research, but to the patients themselves. During my postdoc in Vancouver, I came across a format that I'd like to set up here too: a café scientifique. This is a place where research results are shared with those who provided the underlying data. Overall, I'd like to help people not only better understand why sharing medical data is important but also all the things we do to protect this data.

Which is?
Firstly, we work on secure platforms that are specifically designed for highly sensitive data. My staff and I regularly undergo further training on legal requirements and ethical standards. In addition, my projects are assessed by the Cantonal Ethics Committee. Since there are comparatively few patients with spinal cord injuries in Switzerland, the committee also checks factors like whether people can be identified. If identification is possible, we're not allowed to publish the information for data protection reasons. The privacy and protection of the patient or study participant is of the greatest priority.

Are there other research groups that operate similarly to yours?
Researchers acting at the interface of medicine and data science and taking on the function of a mediator is a recent phenomenon. With my unconventional career path, which led from studying pharmacy to a doctorate at Balgrist University Hospital to diving into machine learning with ETH professor Karsten Borgwardt in Basel, I understand enough about all the disciplines to be able to fulfil this function. The ETH research group led by Diego Paez Granados at the Swiss Paraplegic Centre in Nottwil works in a similar way.

What are the next steps on the journey towards a perfect form of personalised treatment?
Initially, treatments will become increasingly better adapted to certain subgroups: to women with a certain genetic basis, for example. In contrast to other research fields – such as cancer research – the journey for neurological diseases is still long. But we're making progress every day.

Find out more about ETH's Rehab Initiative: www.ethz-foundation.ch/en/rehab-initiative

Introducing

Catherine Jutzeler (*1985) grew up in Fricktal (AG) and is now a Tenure Track Assistant Professor of Biomedical Data Science in the Department of Health Sciences and Technology at ETH Zurich. The professorship is funded by the Wilhelm Schulthess Foundation. The researcher lives in Binningen (BS) and is married to a neuro-urologist.

FUNDED RESEARCH

More precise diagnoses and tailored therapies

The way we get sick and recover again varies from person to person. The natural sciences and technology offer exciting opportunities to fill these gaps: researchers at ETH Zurich are working on technologies, treatment options and medicines that are better tailored to the individual. Progress in this field is also being funded by donors.

Spectroplast: the award-winning ETH spin-off set up by Pioneer Fellows Manuel Schaffner and Petar Stefanov offers customised, high-precision 3D-printed silicone parts that can be used as implants, for example.

CustomSurg: operations after complex bone fractures are challenging. The team led by ETH Pioneer Fellow Thomas Zumbrunn focusses on personalised surgery. 3D simulations and augmented reality provide optimal support to surgeons in planning and performing operations, and in rehabilitation.

The Pioneer Fellowships are funded by numerous foundations, companies and over 200 private individuals. The programme supports talented ETH researchers with entrepreneurial ambitions on their journey towards creating a market-ready product.

The LOOP Zurich: the research centre combines the basic biomedical research and bioinformatics of ETH Zurich and the University of Zurich with the clinical research of four university hospitals – allowing patients to obtain maximum benefit from progress in precision medicine.

Tumor Profiler Center: the globally unique project aims to ensure that cancer patients will be recommended therapies optimally adapted to their individual case. More on page 15.

Already funded by philanthropically engaged private individuals

Alizée Pace: her doctorate is dedicated to methods that predict the chances of success of a treatment and thereby assist clinicians in decision-making.

Alice Bizeul: her doctorate is dedicated to better understanding clinical data and thereby improving medical diagnostics as well as addressing privacy related concerns often raised in the field of artificial intelligence.

At the ETH AI Center, highly talented doctoral and post-doctoral students conduct research through a scholarship programme funded by philanthropically engaged private individuals, the Heidi Ras Stiftung, the Asuera Stiftung and Google.

Professorship in Biomedical Data Science:

Catherine Jutzeler analyses data from individuals with spinal cord injuries and compares it to the clinical course of their recovery. The goal is to identify patterns that enable more effective treatments.

Funded by the Wilhelm Schulthess Foundation

Professorship in Computational Systems Biology:

Pedro Beltrao focuses on the cellular consequences of genetic variation and its impact on health and disease.

Funded by the Helmut Horten Stiftung

Professorship in Systems and Synthetic Immunology:

Sai Reddy studies the molecular and genetic basis of the immune system. His research results present unprecedented possibilities for the development of personalised and precise vaccines and immunotherapies.

Funded by the Misrock-Stiftung

Professorship in Genome Biology:

Jacob Corn is researching how genetic diseases can be cured using genome-editing technologies. More on a researcher from his group on page 4.

Funded by the NOMIS Foundation and the Lotte und Adolf Hotz-Sprenger Stiftung

Professorship in Medical Immunology:

Federica Sallusto's work has greatly enhanced our current understanding of human immunology: with investigations of human T cells for vaccination studies or their role in autoimmune diseases, for example.

Funded by the Helmut Horten Stiftung

Professorship in Molecular Systems Biology:

The technologies developed by protein researcher Paola Picotti expand our understanding of fundamental processes in human health, such as biochemical processes that lead to diseases like cancer or Alzheimer's.

Funded by the Rössler Prize from ETH alumnus Max Rössler

The thrill of pushing boundaries

From pharmacist to internationally sought-after manager and consultant: André Dahinden's history in a nutshell. This background also shapes his view of ETH, which he now supports as a donor.

What is important to you in life?
ANDRÉ DAHINDEN – To test my limits and find out what I am capable of, whether it's in sport, studies, or my work. I don't follow this urge quite as stubbornly as I used to, but I still like to see how far I can get.

In 2019, after a career of almost twenty years in the pharmaceutical industry, you set up your own business. Today, you are Managing Director at Accenture management consultancy – what personal boundaries have you pushed with these changes?
One of the factors linked to setting up my own business was to face my fears and see if I could 'reinvent' myself. My family encouraged me to take this step – that was important. It was an astounding realisation for me that I could still be successful without things like a prestigious title or a large staff. However, I soon realised that it was too early for this step. I wanted to embark on another high-energy adventure in a large organisation. With Accenture's diverse mix of talented people, I have an incredible amount to learn here, but also to give.

Last year you also completed your training as a helicopter pilot.
Doing a lot of mountain sports, I've always been fascinated by the helicopter pilots flying for Rega and Air Zermatt. I wanted to find out whether I had enough discipline, desire and talent for this.

How do you remember your student days?
I almost glorify that period of my life. The studies themselves weren't particularly taxing for me. I mainly remember good times during the seminar weeks, lunches together and fitness training at the ASVZ. It was a time of lots of opportunities and freedom and little responsibility.

"If every graduate doing well donates a little, the result is huge."
André Dahinden

You donate to the ETH Excellence Scholarships – why?
In my opinion, we in Switzerland don't show enough pride in our institutions compared to other countries. ETH has given me a lot. For me, donating an amount every year is a way of expressing pride. If every graduate doing well donates a little, the result is huge.

When you look at ETH in your role as a business and strategy consultant, what do you advise your alma mater?
Don't let anything stop you from striving for world class! Of course, ETH forms part of the Swiss educational landscape and therefore the federalist system too. However, I believe everyone is best served if we see ETH as a beacon institution and cultivate it as such. To achieve ambitions of gaining global relevance, we sometimes need to raise our heads higher than we're used to in Switzerland and cheer confidently: yes, we're world leaders too!

Learn more about the Excellence Scholarships: www.ethz-foundation.ch/en/excellence-scholarships

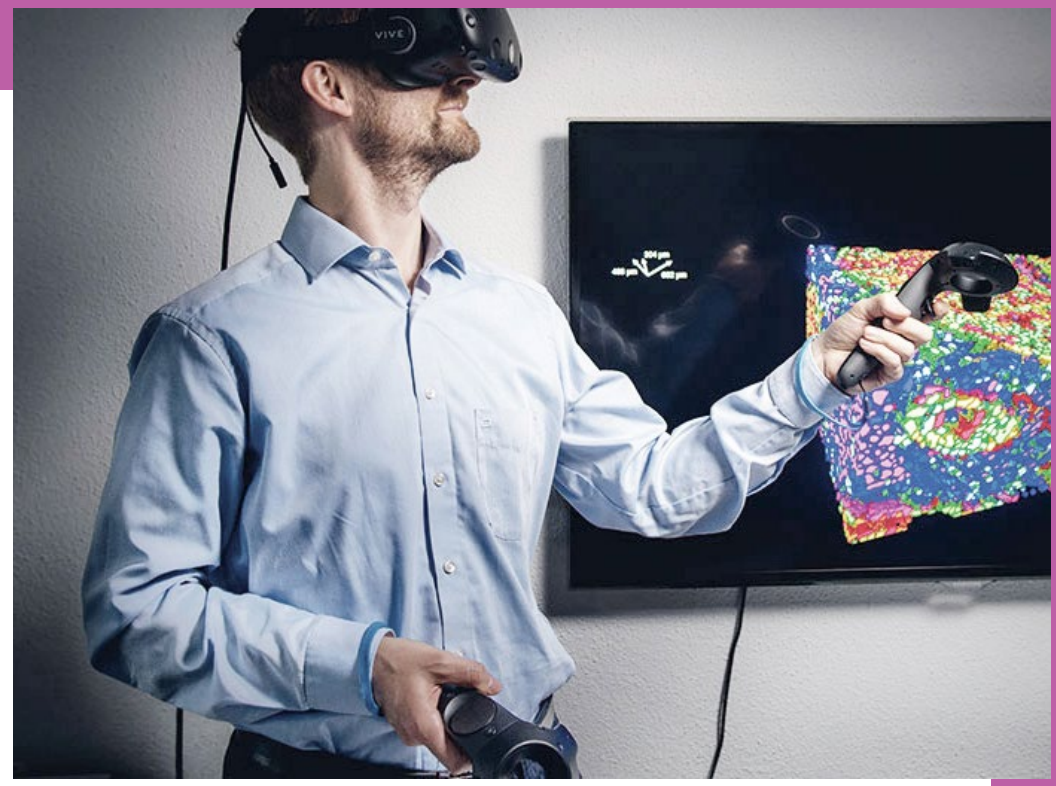
Alongside Hugo Tschirky, who unfortunately passed away, Gerd Folkers was your doctoral supervisor. You describe him as a mentor.
Gerd has always inspired me even back in my student days. He is a visionary. During my career in industry, he kept telling me that I could also do something completely different and that I shouldn't let my success tie me down: at every stage of your life you can always become someone else! As an emeritus ETH professor and former chair of Collegium Helveticum, he is currently doing an apprenticeship as a bookbinder. Today, Gerd is a father-like friend to me.

Introducing

André Dahinden (*1975) studied pharmacy at ETH Zurich and holds a doctorate in management sciences. Before working as a consultant, one of his roles was General Manager at the biotechnology company Amgen, first in Switzerland and then in Italy. André Dahinden and his Valais-born wife have a son in baccalaureate school. The family lives with Ino the cat in Cham (ZG).

Leveraging big data for targeted cancer therapies

Cancer is the second most frequent cause of death in Switzerland. With new opportunities for research enabled by precision medicine, a globally unique project aims to provide therapies optimally designed to target each patient's needs.



Quantitative biologist Bernd Bodenmiller generates spatial images of tumour tissue to analyse the interaction of the different cells in diseased tissue.

Switzerland alone records over 42,000 new cancer patients every year. And each year sees 17,00 deaths. The particularly knotty medical challenge is that each tumour is unique and develops according to its own pattern. Scientists today look on cancer as a singular ecosystem in which a myriad of molecules and cells act in competition with the protective mechanisms of the human body, including the immune system. In the pioneering Tumor Profiler Center, researchers are now deriving from cancer patients the specific molecular profile of this individual ecosystem on which the effectiveness of cancer drugs depends. Not only are several of the methods used new: also new is the fact that the molecular and functional characteristics of tumours are being investigated with a variety of complementary methods. The aim is to gain new insights from their combination. In conjunction with a better understanding of the molecular basis of cancer, this will mean significant benefits for patients in the foreseeable future.

Data science is a powerful tool

The studies include analyses of the genome, biochemistry, function and condition of different tumour cell types and their responses to therapies. With investigations at the single cell level, researchers also record the cellular diversity in a tumour, which includes not only tumour cells but also cells of the immune system. This results in huge amounts of data per patient that is then processed and analysed using the latest data science methods. Information from medical imaging and other sources of patient data is also incorporated. The tumour profiling findings are then made available to doctors, who discuss them at interdisciplinary tumour board meetings. This allows the medical staff responsible for treatment to offer personalised – and therefore potentially greatly improved – therapy recommendations. Over 200 cancer patients have already benefited. The long-term goals of the tumour profiler project are: to improve clinical decisions made by pathologists thanks to

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Using virtual reality representation, researchers can walk through the tumour models.

computer models that integrate the large, multi-layered datasets; and to transform cancer from what is often a fatal disease into a treatable one. Building upon the results gained so far, clinical studies on ovarian cancer and melanoma (black skin cancer) are also planned.

Top expertise in action

Bernd Bodenmiller, Professor of Quantitative Biomedicine at ETH Zurich, is leading the entire project in collaboration with Viola Heinzelmann-Schwarz, Head of Gynaecological Oncology at the University Hospital Basel, and Andreas Wicki, Professor of Oncology at the University of Zurich and Head of Oncology at the University Hospital Zurich. In total, more than 60 experts from the fields of oncology, pathology, dermatology, molecular systems biology, biomedical informatics, quantitative and computational biology, genomics, proteomics and translational medicine are working together to give cancer research a new boost. The Tumor Profiler Center builds upon ground-breaking technological advances achieved in the last ten years at the component research institutions. The aim is to become a national centre for precision oncology by 2025. The collaboration of institutions with expertise between them ranging from basic research to technology and clinical practice ensures that technological and biological innovations are transferred to clinics more swiftly. Such collaboration provides the ideal background for a project positioned at the interface of medicine and technology and creates excellent conditions for making significant headway in the search for more effective cancer therapies.

Support cancer research:
www.ethz-foundation.ch/en/tumor-profiler-center

“Our vision for the Bosch Health Campus is to have successfully met the major challenges facing the healthcare system – demographic change, digitalisation, climate change and technical innovations – by the end of the decade. We see ourselves as visible pioneers and role models for the changes that are needed. And we can only do this in collaboration with partners, which is why we want to work with the best – such as ETH Zurich!”

Dr Ingrid Wünning Tschol, Director Robert Bosch Centre for Innovative Health and Senior Vice President Health Bosch Health Campus, Stuttgart, Member of the Board of Trustees of ETH Foundation Germany

ETH Zurich / Scanderbeg Sauer Photography

Your contribution to our future

Science and technological innovation are more important today than ever. We need answers to global challenges that affect us all: from climate change to our health. The keys to success are exceptional talent, excellent research and teaching, strong partners – and you. **Help support research in tailored cancer therapy!**

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For example, “ethzf30” to donate CHF 30 (maximum donation CHF 100).

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