

Off the BENCH

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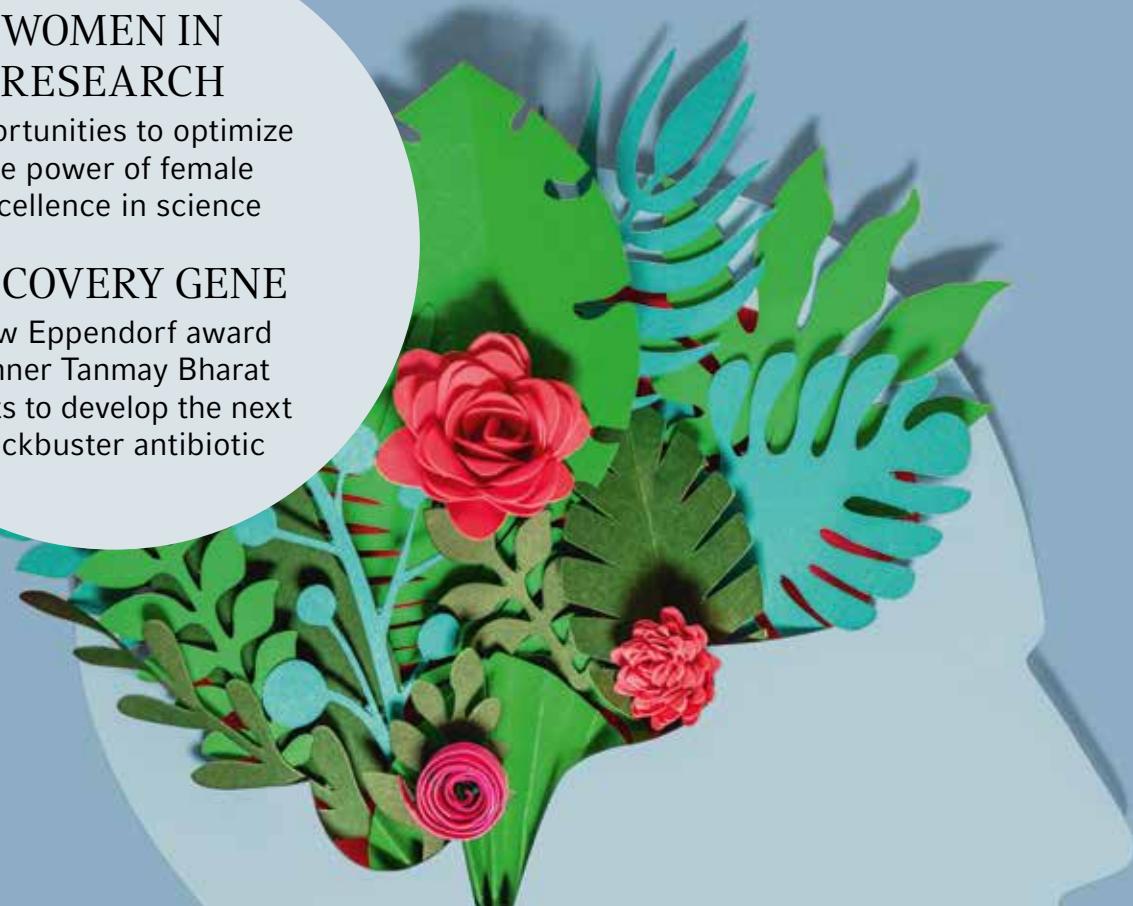
The Eppendorf – LifeScienceStyle Magazine

WOMEN IN RESEARCH

Opportunities to optimize the power of female excellence in science

DISCOVERY GENE

How Eppendorf award winner Tanmay Bharat wants to develop the next blockbuster antibiotic



Dossier In Harmony with Nature

presented by
eppendorf



INSPIRING SCIENCE

- 4 Science News
News from the world of research
- 6 Ready to Erupt
Scientists across the globe monitor them closely: a portrait of four fiery mountains
- 10 The Miracle of Suction
How plants remove heavy metals from the soil
- 12 Supporting Female Scientists
When it comes to higher positions in science, women continue to be underrepresented. Why?
- 14 The Power of Touch
Physical contact is elementary for us humans. Researchers now want to better understand touch

DOSSIER

- 16 Taking Care of Nature
Many animal and plant species are in real distress, from which only man can rescue them. It is time!

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We look forward to your feedback, which will tell us whether we have indeed achieved our goal with this issue. We invite you to submit your suggestions for improvement:

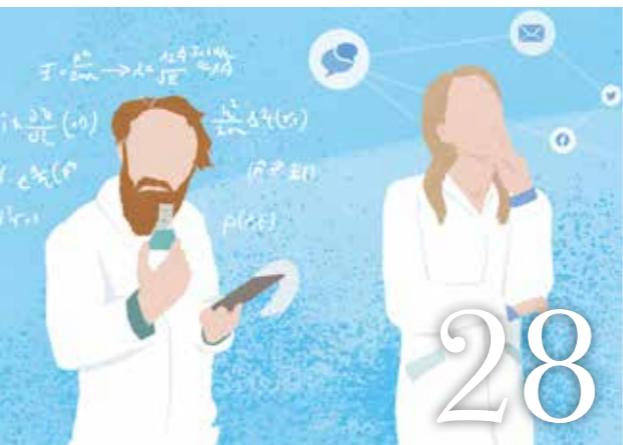
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36



14



28

- 20 Joyful Outdoors
Connected with nature, life is happier and healthier. What each individual can do for themselves
- 24 Expanding Knowledge
Two books and an app for nature aficionados

INSIDE EPPENDORF

- 26 Anniversary with a Future
60 years of Eppendorf pipettes: the art of reinvention
- 28 More Than Laboratory Products
What you need to keep your daily laboratory routine well managed: Eppendorf benefits at a glance
- 30 Lab Lifestyle
Be inspired – and win!
- 32 Up to Date!
News from the company

BRIGHT MINDS

- 33 Cornering Resistant Pathogens
How molecular biologist Tanmay Bharat intends to render bacteria more susceptible to antibiotics

i

Dear Reader,

"To improve human living conditions" – with this mission statement, Eppendorf refers not only to those people who benefit from innovative research. As a global company, we feel a great responsibility towards society and the environment overall. Our professional actions as a company are therefore oriented entirely along the four guiding principles of our sustainability initiative: Climate Change, the Utilization of Natural Resource, Social Compliance and Social Well-being.



The international community has now given the protection of our environment a clearly defined goal: by 2050, humanity has to find its way back to a "life in harmony with nature". The dossier in this issue of "Off the Bench" highlights the steps which are necessary to reach this goal. The initiative is not entirely selfless: it has been proven that nature makes us happy and healthy. This dossier provides practical and inspiring tips for everyday life.

These days, many societal topics are the subject of lively discussion – for example, how to handle disinformation; fair treatment and professional support of women in the workplace, including research; as well the fundamental question: how do we want to work moving forward? In his new book, anthropologist and author James Suzman introduces several – at times provocative – new hypotheses.

One thing is certain: the world of work is undergoing constant change, which we must help shape as a responsible employer. Eppendorf is working intensively on the topic of New Work and the growing need of people to want to learn throughout their lives. In our new career blog (more on page 31), colleagues talk about their work and careers at Eppendorf, about working together and about what makes our corporate culture tick.

We hope you will enjoy the read,

Eva van Pelt

Eva van Pelt
Co-CEO

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Moving Research



Good Plastic

In terms of environmental protection, doing without plastic is by far the most effective course of action. At the same time, however, science is pursuing a further approach: developing a plastic that is as environmentally friendly as possible! In this vein, material scientist Ting Xu and her team at the University of California, Berkeley, have developed a plastic that is compostable. This is made possible by embedded enzyme particles which, when exposed to heat and water, will degrade the plastic almost entirely down to its components. The team published these prom-

ising results in the journal "Nature". Eppendorf is also working intensively on the possibility of using biodegradable plastics in its laboratory consumables. However, it has not yet been possible to create a material that retains its properties for the typical shelf life of a laboratory consumable. Global research on compostable plastics is promising, but the material properties of such developments are unfortunately not yet suitable for use in consumable products for the demanding work in the laboratory and thus for the specific needs of researchers.



Criminals Beware!

The year 1897 saw the first criminal conviction worldwide based on fingerprints. In 1987 came the first arrest of a murderer thanks to DNA analysis of his trace evidence. The next step in this process is the consideration whether the biological material of the perpetrator, such as hair or blood, may soon no longer be necessary for DNA detection. For the first time, researchers at Queen Mary University of London were able to establish that living organisms such as plants and animals, but also humans, emit DNA into the environment. The researchers state that the material isolated from samples of air could potentially be used for the identification of individuals. The application of this technology may also prove useful in the fields of forensics, anthropology, and even medicine.



Living Longer

It is a well-known fact that humans are living ever longer – however, our maximum life span could be even longer than it presently is. A team of researchers based in Singapore, Russia and the US has discovered that under ideal circumstances, the life expectancy of humans could reach 120 to 150 years – a quite dramatic difference to the currently close to 80 years reached in most countries. Such are the scientific conclusions following repeated analyses of blood-based data. Indicators of health include the rapid recovery of blood values following stress, mobility and disturbances. This resilience decreases with advancing age; past 150 years, recovery is no longer expected.



1.6 billion

Sparrows exist worldwide. This number makes the species one of only four bird species with more than one billion individuals. This fact was discovered by researchers at the University of New South Wales who conducted a study on global bird populations. The counts revealed drastic differences: the Kiwi bird family, for example, comprises only 3,000 individuals worldwide.

Cooling White

Scientists at Purdue University in the US have developed the world's whitest white. This wall paint reflects a total of 98.1 percent of the incoming sunlight and is thus capable of cooling objects by up to 4.5 degrees below ambient temperature. The cooling effect is made possible by the main ingredient of the paint – barium sulfate – which, due to its broad spectral scatter, displays exceptionally high reflective powers. The leading researchers expect that this ultra-white paint will eventually be able to replace climate-damaging air conditioning units and thus help mitigate global warming.



Giants with Explosive Powers

Volcanoes exist all over the world, and since even inactive volcanoes may once again choose to breathe fire, their continued scientific study is crucial. Four fiery mountains – four superlatives.



! The Most Powerful of Its Kind

Mauna Loa ("Long Mountain") rests inconspicuously on the horizon behind the volcanic cone of Mauna Kea ("White Mountain"), which appears more violent. Measured from the seafloor, Mauna Kea is the highest mountain on Earth, but nevertheless inactive as a volcano. Mauna Loa in turn, hardly smaller, rises four kilometers above the Pacific Ocean and, with an area of over five square kilometers, is one of the largest active volcanoes on Earth. Since 1984,

Hawaii has been quiet, except for minor Earth tremors, but the New York School of Marine and Atmospheric Sciences is alarmed: satellite data and GPS stations prove that the peak of the sleeping giant rose by about six centimeters a year between 2014 and 2020. The reason is an underground magma flow. However, an eruption is not expected soon, but the Hawaiian Volcano Observatory wants to keep a close eye on the mighty volcano.

! Iceland's Spring Spectacle

For almost 800 years, the volcano Fagradalsfjall, located in Iceland's southwest, kept its peace, before 50,000 smaller earthquakes within the span of three weeks announced its eruption. In the evening of March 19, 2021, the spectacle came to a grand finale. A spectacle indeed – the eruption on the Reykjanes peninsula turned out to be moderate and did not pose a threat to surrounding cities; the closest city, Nátthagiakríki, was located almost 10 kilometers away. The

natural wonder attracted thousands of onlookers – the images and movies of the glowing viscous mass, captured by the people of Iceland, allowed audiences from around the world to take part, and international research teams took advantage of the good geological location for their studies. One thing is evident: due to the massive seismic energy that was released, additional, stronger eruptions are to be expected. The timing, however, is a secret held by Fagradalsfjall alone.





! Fascinating Beauty of Ice and Snow

"Very high" – such is the official hazard potential of Mount St. Helens in Washington State, USA. This active stratovolcano made history on May 18, 1980, when a magnitude 5+ earthquake triggered a series of severe subsequent events: at 8:32 am local time, a massive landslide of rubble tore the top 400 meters of the volcano all the way to the bottom. Shortly thereafter followed the actual Plinian eruption – an explosion with a pillar

of smoke 24 kilometers high. 540 million tons of ash were carried eastward across the United States by the wind, darkening the skies. 57 people died – making this volcanic eruption the deadliest in the history of the US. What was left behind was a crater; its ever-growing Godzilla Hole, a glacier cave, continues to attract researchers who climb down inside to study the fascinating life forms therein.

! Along the Ring of Fire

Powerful tsunamis, destructive earthquakes, red-hot clouds of smoke and streams of lava originating from volcanoes – the Pacific Ring of Fire constitutes the geologically most active region on Earth. At least 450 active or temporarily dormant volcanoes make up the 40,000 kilometer-long belt which circumscribes the Pacific Ocean. The subduction process, during which one tectonic plate pushes underneath another, causes the creation of enormous pressure in some regions. Eventually, this pressure will

be released in the form of earthquakes and volcanic eruptions. One country that is particularly affected is Indonesia: its volcano Bromo, on the island of Java, most recently spewed white-gray clouds of ash in May 2021. The 2,329 meter-high stratovolcano, named after the Hindu god Brahma, is located, along with three other volcanoes, in the Tengger Caldera – an 820,000 year-old collapsed crater. Together, they form an unusual landscape – which might as well be on another planet.



Some Like It Toxic

Certain plants are capable of extracting heavy metals from contaminated soil while at the same time supplying important raw materials. This process is known as phytomining, and it is considered to be both sustainable and forward-looking.

The father of modern botany, Carl Linnaeus, favored the twinflower (*Linnaea borealis*), whereas the founder of evolutionary theory, Charles Darwin, adored orchids. Plant expert Antony van der Ent, on the other hand, prefers *Phyllanthus rufuschaneyi*, because "it is the most successful metal-absorbing plant we know", says the biogeochemist who is based at The University of Queensland in Australia.

Plants Hoover up the Poisons

Phyllanthus rufuschaneyi belongs to a genus of herbaceous plants with leaves that are either spiral-shaped or arranged in two rows, and whose 900 species grow predominantly in the tropical and subtropical regions of our planet. It was discovered in Malaysia in 2013, near Kinabalu National Park in the state of Sabah. Its special feature: growing in nickel-rich soil, the plant is able to absorb this heavy metal, which is toxic at high concentrations, and store it – thus engaging in phytomining. "A sustainable method of mining metals, with a low impact on the environment", says van der

Ent. "Phyllanthus rufuschaneyi, by the way, was named after the researcher Dr. Rufus Chaney who is considered one of the scientists who discovered phytomining as early as 40 years ago."

Soils all over the world contain metals such as lead, nickel or germanium. Their presence can sometimes be traced back to the formation process, as the source material of these soils is the rock that slowly disintegrated through erosion and weathering, and which has been stripped down to its components. The largest offender when it comes to contamination, however, is man. Fine toxic dust from industry and traffic is deposited in the environment to the same extent that pesticides and fertilizers are used in agriculture. The consequence: the soil is no longer able to filter water, bind carbon or serve as home to living things. Foods are increasingly contaminated; for example, rice is contaminated by arsenic. Scientists worldwide are searching for options for removing heavy metals from the soil.

Phytomining for metal recovery

And this is where phytomining comes in. As a hyperaccumulator plant, *Phyllanthus rufuschaneyi* thrives in soil with high concentrations of metal ions which the plant takes up through its roots. It does not fall ill from the overdose; in fact, it stores the heavy metals in special hollow spaces in the outer layer of its leaves – far away from the chlorophyll inside the leaf, which is crucial for photosynthesis. If the plants which accumulate the toxins are harvested on a regular basis, the toxic metals can then be removed from the

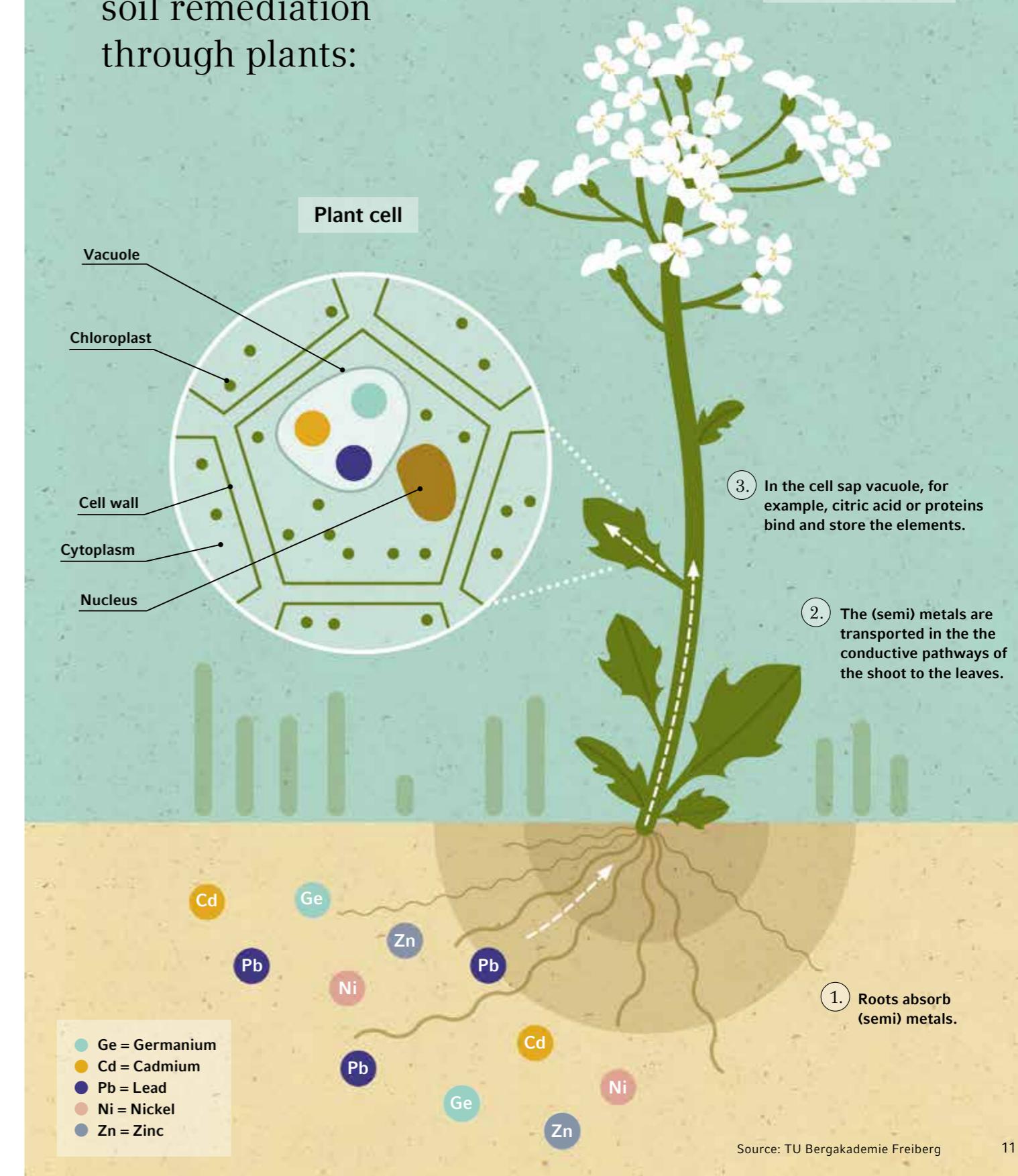
ground. A close relative of *Phyllanthus rufuschaneyi*, *Arabidopsis halleri*, for example, grows in a region of the Sauerland in Germany which had been subject to lead mining since Roman times. This area harbors some of the most contaminated soils in Europe, and the plant with the white flowers is capable of taking up and storing lead, zinc and cadmium in its leaves. This unique faculty helps it render the soil of former industrial sites serviceable once again.

A gentle alternative for the environment
These super-plants with their vacuuming-like qualities may also be planted in a more targeted fashion in order to actually mine valuable metals. Nickel, for example, is used during the dyeing process in glass factories. While it can be mined by industrial methods, traditional nickel mining uses immense amounts of water while leaching toxins into the environment. In these cases, phytomining would definitely present a gentler alternative.

Antony van der Ent is conducting studies on the Pacific island of New Caledonia – the place which harbors the greatest nickel reserves on Earth. These were mercilessly exploited for decades, and now hyperaccumulators are employed in order to detoxify the soil. He and his team founded a metal farm in Malaysia in order to demonstrate "that phytomining really works". While the mining industry is showing a strong interest in phytomining, thus far, the plants have not been used across large areas of land for the purpose of extracting heavy metals. "At this time, we are waiting for investment from the industry to establish metal farming globally." ■

How it works,
phytomining and
soil remediation
through plants:

Cruciferous plant



Lost Excellence?

Women continue to be in the minority when it comes to senior positions in science and research. Why is this? An attempt at finding explanations, with recommendations for action.

When, in the first year of university, an equal number of male and female students populate the lecture halls, the problem is still invisible. But then, shortly thereafter, we lose our promising female researchers and scientists. What happened? "I thought that if I just persisted and performed well, I would reach my goal. I now ask myself: if I had been a man, would it have taken me less time to arrive at where I am today?" Professor Borna Relja has achieved her goal. Today, she is head of the Department of Experimental Radiology at the University Hospital in Magdeburg, Germany, and she holds the position of Deputy Director of Research, Technology and Equal Opportunities at Otto von Guericke University in Magdeburg. She enjoyed research, and it continually motivated her. "However, the assumption that we women only need to be strong enough to be able to persist in this male-dominated environment is only partly correct. While performance is definitely important, women need to do more than simply prove that they are as good as their male colleagues – in many cases, they must be better."

This inequality between the sexes in the context of research is difficult to resolve. According to a survey by the Federal

Ministry of Education and Research in Germany, the gap opens up at the time of habilitation: in 2018, only 31.6 percent of those qualified to lecture at universities were women. No sufficient data exist which may allow conclusions to be drawn on the international level – not all countries collect the relevant data, and there are limits to the way in which academic titles may be compared. According to the UNESCO Science Report 2021, however, Germany falls behind the European average: in 2018, women constituted close to 40 percent of female professors in Europe.

Initial difficulties and hurdles

It is a fact: one has to be able to afford a scientific career – both on an economic as well as a social level. For prospective female researchers from nonacademic homes, the bar is set even higher, knows Silke Tölle-Pusch. She spearheads the national coordination for university cooperation within the nonprofit organization ArbeiterKind.de (working-class child), and she is familiar with the challenges of those women who are the first in their families to attend university: real and perceived financial concerns, the absence of family support, a lack of knowledge about university procedures,



Strong enough?
Women in research often have to do more than their male colleagues in order to make a career for themselves

and careers in science in particular. "These are aspects which may render a precarious career in science unattractive", she says.

Once a career in science has been chosen, new obstacles await: "The foundation of a scientific career is laid between the age of 30 and 40. This is the time when most people will decide in favor or against a family – a certain need for security sets in. This is when female researchers turn down temporary appointments and inflexible work models", states Professor Relja. The consequence: many female researchers decide against employment that promises an uncertain future.

In 2018, only 24.7 percent of full professors in Germany were women, and across Europe, only 11 percent of top academic positions were held by women. This imbalance continues in the realm of research: globally, 33.3 percent of researchers are women – across Europe, this number is 33.8 percent; however, these numbers continue to rise, and an upward trend is noticeable. In some countries, the proportion of women is significantly higher: 75 percent in Myanmar and 62 percent in Venezuela. When will Europe come around?

Role models are important for the system as a whole

In order to spark enthusiasm for science and research in more women, it will take a variety of measures which will need to take hold early. In cooperation with scientific institutions, more women who have built successful scientific careers should be engaged in visits to schools where they can speak about their paths, explains Ms. Tölle-Pusch. "By serving as a role model, they can present perspectives. This is particularly critical for students who experience little educational support at home." Initiatives such as the "International Day of Women and Girls in Science", initiated by UNESCO and UN Women, are successful in increasing visibility – and thus staying relevant: during the previous action day, women

were introduced who had contributed significantly to fighting the COVID-19 pandemic.

To further the task of inspiring women to pursue careers in research, structures will need to be established to help retain prospective female researchers. The recently founded network "Equal Opportunity & Diversity" at the University of Magdeburg combines different areas – one of the most crucial pillars, according to Professor Relja. "If the front wheels turn while the back wheels are blocked, we will go nowhere. This is why, in addition to gender equality, our network also considers other areas such as the family." This collaboration would enable the formation of sustainable alliances and support flexible working hours, digital work models and part-time careers – which will, of course, will also benefit men.

Creating more room for strength

Networks of this kind make exchange possible – hot topics included. "My position allows me to address deficits", says Professor Relja, who leads the network. "But for a graduate student or postdoc, who is in a dependent working relationship, speaking up requires a lot of courage. It is risky to take a stand." In addition to structured programs at universities, protected spaces of trust are needed. Ms. Tölle-Pusch confirms: "We know that experiencing stigmatization within one's own university can prevent people from pursuing good offers."

The question of whether the effort is worth it should no longer be asked. "Not tapping into diversity borders on arrogance. The world is a dynamic place – research, thinking and technology all continue to evolve", says Professor Relja. "It is my duty to pave the way for future generations of researchers." Ms. Tölle-Pusch agrees that a lack of diversity is especially problematic for the scientific community: "Different perspectives introduce fresh ideas and research strategies, which are needed to drive science forward." ■

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Not tapping into diversity borders on arrogance. The world is a dynamic place – research, thinking and technology all continue to evolve."

Professor Borna Relja

LISTEN AND VIEW



Podcast "LAB GAP"

To this day, research potential continues to be wasted because not enough highly qualified women work in research. In her podcast Lab Gap, moderator Victoria Müller interviews leading female scientists from Germany.

Podcast "Talk Nerdy"

Cara Santa Maria is a science correspondent for the popular National Geographic TV show Brain Games, and she is also the founder of the weekly science podcast Talk Nerdy.

Film "Picture A Scientist"

This film tells the story of Professor Nancy Hopkins and her colleagues at the Massachusetts Institute of Technology (MIT): in 1994, they published a report which proved that preference was given to male colleagues; they were in possession of indisputable scientific evidence.

The Power of Touch

Interpersonal touch is essential for the survival of our species. Touch influences the biochemistry of our bodies – an area of study full of potential.

What was taken for granted prior to the pandemic has now been missing from our daily lives for the past year and a half: no salutary handshake, no hugs on parting, no pat on the shoulder to signal encouragement. Whether in the professional or the personal realm – touching has become taboo. “This is not exactly healthy”, says Professor Martin Grunwald, founder of the haptics laboratory at the Leipzig University. “Humans are relationship creatures, and belonging, for example, is communicated through touch”, as the perceptual psychologist well knows. Physical contact influences how we perceive stress or pain as well as whom we trust. How does it work? “Our skin is quite literally physically deformed”, explains Grunwald. Signals are then transmitted to the brain where they are processed, followed by the secretion of hormones that are distributed throughout the entire body via the bloodstream.

“No other sense is connected to our emotional and cognitive development like our sense of touch. We have an easier time understanding and remembering things that we can touch”, explains the haptics expert. His area of research – the scientific study of the interaction between nerve fibers, the spinal cord and the brain – “is practically in its infancy”, reveals Grunwald. This is surprising, as touch is crucial for survival within the human species. “This is bordering on biology. An organism that cannot feel is sentenced to death, or it will not even begin to live. All growth processes of altricial mammals – those mammals that are underdeveloped

at birth and which include cats, dogs, mice, and humans – are dependent on physical contact”, clarifies Grunwald.

Of Homo hapticus ...

The enthusiasm of the 55-year-old for his discipline is palpable. In 2018, he was awarded the Austrian Science Book Prize for his book “Homo Hapticus” – a prize that is awarded annually by the Austrian

Ministry for Education, Science and Research. The founder of “haptic design” receives many requests for support from companies, including those within the packaging and car industries. “The spectrum ranges from tissues to the cockpit of an airplane”, says Grunwald with a smile. “We deal with everything that people can touch or that they can step or sit on.”

In April of 2020, BBC Radio 4 published the results of a survey of more than 46,000 people from 237 countries on the topic of touch. 72 percent of participants perceived touch as generally positive. 43 percent of respondents to this survey, which had been conducted prior to the major lockdowns, were of the opinion that our societies did not facilitate touch to a sufficient extent. Would machines be able to fill the gap? Haptics expert Grunwald considers this question carefully. “Humans are most likely the best option in this case. Studies with other mammals, i.e., dogs and cats, do show that physical contact with animals will ensure a higher level of the happiness or cuddling hormone oxytocin in humans, among other effects. Studies of human-machine interactions have thus far not yielded data to allow drawing accurate conclusions”, says Grunwald.

... and of touching robots

Professor Laura Hoffmann, junior professor for Human Centered Design for Socio-Digital Systems at the Ruhr University Bochum (RUB) in Germany,

is one scientist who is engaged in research in this field. Together with her colleague Professor Nicole Krämer, professor for Social Psychology - Media and Communication at the University Duisburg-Essen, she analyzed test subjects as they interacted with a humanized robot. It appeared that during the course of the conversation, the robot spontaneously and briefly touched the hands of some test subjects, all of whom responded in a positive manner: most smiled or laughed – nobody withdrew their hand. The willingness to follow the advice of a robot was higher in those test subjects who had experienced the touch than in those who had not been touched.

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No other sense is connected to our emotional and cognitive development like our sense of touch.”

Professor Martin Grunwald,
Leipzig University

Hoffmann had identified a gap in the research: numerous studies had been conducted to elucidate the effect of touch initiated by humans; in contrast, investigating touch by robots had thus far been limited to functional reasons – for example, to washing a patient. “Direct touch by a robot within the context of a conversation had not been considered”, reveals Hoffmann. The results of her studies involving 48 test subjects may, for example, aid in the design of the workplace of the future. “We are interested in gaining an understanding of how robots must be designed if they were to work side by side with humans”, illustrates the scientist. At the same time, she does not believe that this scenario will become reality anytime soon. “This is a complex issue – not only ethically but also technically!” ■



Elixir of life
If touch is prevented, emotional and cognitive development suffer



Back to Nature!

The global community is declaring war on the extinction of species. The goal: by 2050, humans are to find their way back to a “life in harmony with nature”. Will it be attainable?

For centuries, it had a bad reputation: not only lambs, but small children, would be carried away to the underworld by the bearded vulture. This massive bird with a wingspan of close to three meters frightened humans to the extent that more than 100 years ago, this last “giant of the air” was driven to extinction in Germany.

Soon, however, the formerly extinct bearded vulture will once again soar above the German Alps – thanks to an international species protection project. The Klausbach Valley in Berchtesgaden National Park, is to become home to two young bearded vultures. Together with eight other chicks, they hatched in the mountains of Andalusia – a minor miracle. “Despite difficult conditions in the breeding program, we are pleased to be able to provide two bearded vultures to Berchtesgaden for the purpose of reintroduction into the wild”, says Dr. Alex Llopis Dell, director and coordinator of the Bearded Vulture Breeding Program in the Spanish breeding center at Guadeltín.

This reintroduction project is not based on nostalgia – other alpine countries already reintroduced the first specimen to their native habitats in the 1980s. After all, the bearded vulture plays a significant role within the ecosystem of the Alps. As a scavenger whose favorite food is bones,

the bearded vulture removes the remains of dead animals, and thus prevents transmission of disease from animals to humans.

One-quarter of all species in peril

The bearded vulture was lucky. Thanks to engaged conservationists, this majestic bird of prey has been able to regain its alpine habitat. In contrast, many endangered animal and plant species face a much darker future, as climate change, and the destruction of nature, threaten biodiversity more than ever before.

According to reports published by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), which serves as scientific advisor to policy makers on the subject of biodiversity and ecosystem performance, approximately one quarter of all plant and animal species worldwide are under threat of extinction. This means that the extinction of species is progressing ten to a hundred times faster than it did on average during the past ten million years. Intensification of agriculture, deforestation and pollution contribute to the disappearance of species, and the growing human population, increasing consumption, and climate change magnify these effects. ▶

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Global environmental awareness is on the rise

The good news: an analysis commissioned by the environmental organization World Wide Fund for Nature (WWF) determined that environmental awareness is, in fact, on the rise. For example, the number of Google searches, tweets and news on the topic of nature loss have increased dramatically in recent times. "Concern about nature loss and ecosystem degradation is shared by people all over the world, and many are already feeling more acutely the impacts of deforestation, unsustainable fishing, species extinction and the decline of ecosystems", says Sabien Leemans, biodiversity expert with the WWF European Policy Office.

What people experience globally has since been proven by science: nature conservation and the diversity of species, as well as climate protection, are crucial to human survival. Nature provides food, drinking water, fresh air and medicine; its condition will decide our future on Earth. Scientists are explicit about the fact that nature conservation cannot be achieved without concession. Professor Josef Settele of the Helmholtz-Center for Environmental Research, and one of the co-authors of the IPBES report, frames it in a positive light: "It is not about foregoing quality of life. On the contrary, it is about foregoing a negative, polluted environment and poisoned bodies of water. This, in reality, does not mean going without – it is, in fact, a huge gain."

Decade on ecosystem restoration

The global community appears to have recognized the dramatic situation in which we find ourselves – and it is intent on attempting an about-face. The optimistic message: by 2050, the world is to find its way back to a "life in harmony with nature". To this end, the United Nations declared the upcoming decade the UN decade on Ecosystem Restoration. Within the new agreement on biodiversity, the member countries of the convention have agreed on the expansion of protected areas to 30 percent of land and water surface; the restoration of degraded soils; as well as the reduction of the use of fertilizers and pesticides, and the generation of plastic waste.

Technology – certainly not a cure-all

The ways in which the world intends to move in the direction of a sustainable future are subject to discussion. According to scientists, conservation cannot be achieved by technological means alone,

It is not about foregoing quality of life. On the contrary, it is about foregoing a negative, polluted environment and poisoned bodies of water. This, in reality, does not mean going without – it is, in fact, a huge gain."

Professor Josef Settele

but instead it presents a societal challenge which requires accountability similar to that outlined in the Paris Agreement. "The answer is not more technology, innovation and investment, but a shift in focus. Evolved regulatory regimes would boost technologies that meet human needs while also benefiting climate, wildlife, soils, water and broader ecosystems", explains Dr. Kai Chan, professor at the Institute for Resources, Environment and Sustainability at the University of British Columbia.

Certain successes already justify optimism: at this time, protected areas constitute more than 17 percent of the land surface and ten percent of the ocean surface. Rewilding, i.e., the reintroduction of animals formerly native to a region, has also shown remarkable success. Since, for example, the wolf was returned to Yellowstone National Park in the 1990s, the ecosystem has recovered surprisingly fast. The reason: these predators keep the elk population in check. Their numbers declined as the numbers of wolves increased, allowing the vegetation to recover. Almost completely extinct tree species, such as poplar and willow, and also beaver and grizzly, have returned to Yellowstone. Where terrain had formerly experienced

desertification, colorful new vegetation is now thriving. This example shows that all the species on Earth are important for a complete and functioning system.

Every one of us is needed

At the end of the day, according to IPBES, the world will only be able to halt the extinction of species through fundamental, transformative change which will transcend technological, economic and social factors – and with the help of broad societal support. It will be down to every one of us. Laura Pereira of the Centre for Complex Systems in Transition at Stellenbosch University in South Africa, emphasizes: "Building a better future requires everyone's buy-in. The scientific community is starting to realize how important it is to listen to voices from the ground. Without these voices, targets for the planet will remain out of reach." ■

AT A GLANCE

Goals of the global strategy on biodiversity by 2050:

- Improvement of the condition of ecosystems. Support for healthy populations of all species as well as reduction in the proportion of endangered species
- Improvements in ecosystem performance, i.e., nature's capacity to benefit humans
- Assurance of the fair and equal use of genetic resources
- Provision of sufficient funds for the implementation of the strategy



The forest calls
Just two hours a
week in nature is
enough to benefit
mentally and physically

A Flourishing Life

Nature provides us with health and happiness; it has been hailed as a teacher and healer for millennia by peoples all over world. The chirping of birds, a hike in the mountains and the power of trees can make all the difference.

! Fit? Naturally!

Small effort, huge effect: British scientists have discovered that those who spend two hours per week in nature will improve their health and well-being. The effects described by Mathew P. White and his co-authors from the University of Exeter in the scientific journal "Nature" are impressive: time spent in nature will ameliorate depression and anxiety; it lowers blood pressure and the risk of other illnesses. In addition, nature fosters creativity and cognitive function. The good news for the non-athlete: one can reap these health benefits regardless of whether one lies under a tree or runs through the park.

The surroundings alone bring about the relaxation, and two consecutive hours are just as effective as several shorter exposures. For the purpose of this study, the researchers analyzed a survey of 20,000 respondents. Those who spent a minimum of two hours per week outside were much more likely to feel healthy and well than the couch potatoes.

1





! Houseplants Provide Distraction

Lots of green at home helps us handle stress better, as suggested by the study conducted by an international research group and published in the professional journal "Urban Forestry & Urban Greening". During the first phase of the COVID lockdowns – specifically, the months between March and June 2020 – the team interviewed more than 4,200 people from 46 countries with respect to their living situations. During this time, people were very restricted in their movements and allowed to leave their homes to a limited extent only. The result: "Having indoor plants was correlated with more positive emotions, and confined inhabitants allocated more time for plant maintenance", write the scientists. In contrast, more negative emotions were reported by participants who lived in small apartments with minimal daylight and without plants. Plants are simply good for you!



3

! Birds Chirping Against Stress

The song of the skylark, the gentle splashing of the waves or a soft breeze in the leaves – the sounds of nature are not only pleasant, they promote health. According to a new American survey study, published in "Proceedings of the National Academy of Sciences of the United States of America" (PNAS), humans feel less pain and stress if they are surrounded by natural sounds. Indeed, even their mood and cognitive performance improved. The chirping of birds, the study has shown, is the best remedy against stress and upset. The sounds of water, on the other hand, have positive effects on blood pressure as well as pain perception. Scientists feel that evolution may be able to explain these positive effects. They write that "natural acoustic surroundings provide signals of safety and security – an ordered world without danger, which, in turn, allows control over one's psychological state, as well as the amelioration of stress-induced behavior and mental recovery."

2

! Hiking – the Miracle Cure

Several studies on the impact of walking in nature have demonstrated the healing effects of hiking. According to the study "Evaluation of Hiking for Health", conducted in 2014 at the Martin Luther University of Halle-Wittenberg, more than 60 percent of respondents felt less stressed following a hike, and 73 percent adopted a more optimistic outlook on life. The fact that hiking in the mountains may even act as a fountain of youth on the body was proven by scientists at the University of Colorado and their research project "AltitudeOmics". According to this study, a two-week-long stay at high altitude led to lasting changes in the metabolism of red blood cells (erythrocytes). In fact, this adjustment effect persisted long past the actual stay at elevated altitudes, and participants reported feeling fitter during later hikes in the mountains.

4

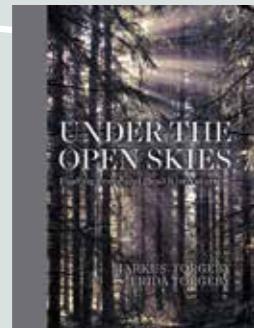


! Strong As a Tree

The Japanese people have long sworn by "forest bathing" and its associated medicinal benefits. They credit terpenes with the power of healing – these are signal molecules which trees employ to communicate with each other. Researchers at the University of Sheffield and Flinders University in Adelaide have recently discovered that the "filter effect" of trees may be able to protect humans from pathogenic bacteria. As Jake M. Robinson and his colleagues report in "Nature", the air sampled from the forested areas of a city park near Adelaide contains more species of bacteria with fewer potential human pathogens than the air above nearby playing fields. Trees appear to filter the microbial communities in a certain air space and thus lower the risk of exposure to microbes that cause disease. At the same time, trees also appear to increase microbial diversity in the air. The scientists' conclusion: more trees within cities could strengthen people's immune systems – and thus substantially benefit our health.

5

Under the Open Skies



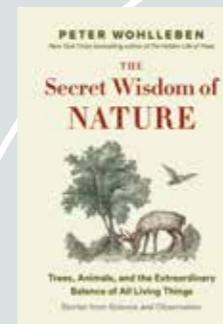
A guide for a life in nature

Be free: out in nature, life is easier. Markus Torgeby has made this experience. He turned his back on civilization and lived alone in the forest for four years. He perceived the loss of thousands of opportunities as enrichment. His book encourages people to escape from everyday life with its thousands of possibilities and spend more time outdoors.

Markus Torgeby, 192 pages, 78 colored Illustrations, Simon & Schuster Ltd., approximately €24

Off to the Outdoors!

Nature as a guide: these authors remind us of nature's intelligence - and why it's worth preserving.



The Secret Wisdom of Nature

Astonishing insights into the seven senses of humans, the heartbeat of trees and whether plants have a consciousness

With all senses: It has been scientifically proven that spending time in the forest has a relaxing effect. Just as nature appeals to all the senses, plants also respond to human touch. Peter Wohlleben invites us to explore our own senses and creates new awareness of the strong connection between humans and the forest.

Peter Wohlleben, 272 pages, Greystone Books, approximately €22



iNaturalist

Be in the moment: when observing, you forget about everyday life. The nature app "iNaturalist" is an initiative of the California Academy of Sciences and the National Geographic Society and invites people to observe and document their own surroundings. The data is made available to researchers and helps to preserve biodiversity.

Available for iOS and Android

INSIDE Eppendorf

Tradition with a future: 60 years of Eppendorf pipettes.
Plus: a medley of benefits that Eppendorf offers in addition to its products.
The prize: an engraved anniversary pipette!





Happy Birthday, Pipette!

60 years ago, Eppendorf launched the world's first industrially manufactured piston-stroke pipette, changing laboratory work forever.

Marburg Pipette was the name of Eppendorf's first pipette in 1961, a completely new instrument for handling liquids in the laboratory at that time. The novelty already had the same basic elements that characterize modern piston-stroke pipettes: a spring-loaded piston that stops exactly at a set volume level, and a removable pipette tip made of plastic. Only this innovation made it possible to pipette liquids in the microliter range easily, reliably and safely. Together with the first Eppendorf Tube® ("Eppi®") reaction tube, a microliter centrifuge and a thermomixer, the Marburg pipette

formed the Eppendorf microliter system, a revolutionary set of instruments that paved the way for modern clinical analysis and molecular biology research.

But the story goes on: over the past 60 years, ever-improving solutions from Eppendorf for liquid handling have led again and again to innovative designs that have made working in the laboratory ever more efficient, safer and better.

Today, Eppendorf customers can choose from a wide range of instruments, consumables and services to meet their liquid handling needs and further advance their research work.

66
We would like to thank all our customers who have accompanied us in the development of our pipettes, and we are looking forward to the future of liquid handling."

Dr. Christian Eggert,
Head of Division Liquid Handling

The image consists of four separate panels arranged horizontally. Each panel depicts a different scene related to science and technology. The first panel shows two scientists in lab coats, one writing in a notebook, with lightbulbs and gears floating around them. The second panel shows three scientists in a lab setting, with a large syringe and molecular structures in the background. The third panel shows two scientists standing and talking, with a large syringe and a blue circular diagram in the background. The fourth panel shows two scientists looking at a tablet, with a digital thermometer and molecular structures in the background.

Suction: that no longer pulls

Until the 1950s, scientists pipetted liquids by aspirating them into thin glass tubes by mouth – an unreliable and sometimes even dangerous technique. Frustrated by the inadequacies of mouth pipetting, German physician Heinrich Schnitger constructed a “device for the rapid and accurate pipetting of small quantities of liquid” using a converted tuberculin syringe and applied for a patent in 1958. Eppendorf was the first to recognize its importance and further developed it into the “Marburg Pipette” by 1961.

Ready, set, pipette!

The global dissemination of pipettes picked up speed between 1961 and the 1980s, bringing with it new challenges and new developments. For example, the microplate gradually gained acceptance for various assays and analyses, and the single-channel pipette proved to be a bottleneck for efficient dispensing. The solution: multi-channel pipettes, such as the Titerman pipette launched by Eppendorf in 1993. With the ability to dispense up to 12 reagents simultaneously, the Titerman was the optimal complement to the microplate.

Ready, set, pipette!

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Think of your thumbs: the ergonomics of pipettes

Eppendorf was already thinking about intelligent ergonomic design in the 1970s and always had the user in mind when developing new products. With the introduction of the Eppendorf PhysioCare Concept® in 2003, the company anchored a holistic ergonomics concept in product development. A result of this time are also the first electronic pipettes, which contribute to safer working with revolutionary speed, accuracy and precision.

The future of pipettes is now

Demand for innovative laboratory designs is increasing as the fast and reliable processing of high workloads becomes more and more important. One example is high-throughput analysis, where automated pipetting systems such as Eppendorf's epMotion® systems are used. Another component is the increasing digitalization of laboratories, where networked pipettes will play an important role in saving more time, reducing repetitive tasks and providing more accurate results.





Those Certain Extras

Have you ever asked yourself what all the things are that Eppendorf offers you? Of course – lots of great laboratory products. But your experience within the Eppendorf world goes far beyond that.

F

or all of us in Science" is the motto of the new Eppendorf campaign. Eppendorf respects and appreciates all its customers, independent of their gender or the color of their skin, or whether they work in the laboratory or in an office. Whether they are huge fans of our pipettes, or whether they are more interested in our latest digital solutions – for example, the VisioNize® Lab Suite. We are all unified in science – each with our own personality and with different needs when it comes to the Eppendorf experience. In order for you to find your way around and easily obtain what you need for your specific laboratory routine, we have compiled the following information:

Did you know ...

... that you can register your products simply and effortlessly online? Did you know about the epPoints® bonus program? Or that we provide a whole lot of helpful

information and entertaining literature, such as Application Notes, White Papers and scientific articles, which are ready for you to download?

At www.eppendorf.com/customer-loyalty, you now have the opportunity to discover the custom benefits of the Eppendorf world that are available to you.

By the way: those who register their products and share with us why they are the proud owner of an Eppendorf product will have a chance to win an engraved pipette for their own laboratory. Jenny, for example, told us: "I first came across a pipette during a school field trip to the University of Bremen. After holding this pipette in my hand for the first time, I knew that I wanted to pursue a career in the laboratory. I have now nearly completed the second year of my schooling as a biological laboratory assistant, and I am very close to fulfilling my dream." ■

Personality test: do you recognize yourself in one of the personalities below?

With our online test (on the right), you will quickly and easily find out which laboratory type you are. Curious? You can take a peek below right now and see what your result could be.



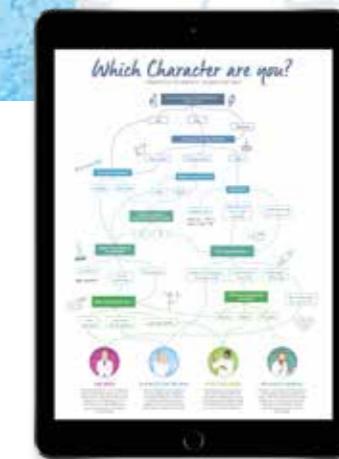
Research Maniac

You are proactive, and you need access to all relevant information now. Being able to touch an instrument and test its functionalities helps you with your decision-making. Your job is demanding; the rest should be as easy and straightforward as possible.



Scientist on the Rise

You are a digital native, and you are not afraid of new media. You navigate the digital world, and you love to see content that is perfect for you, and which provides you with tips and tricks for your new job in the laboratory.



For the full test and more on the new Eppendorf "For All of Us in Science" campaign, visit: www.eppendorf.com/customer-loyalty



Pipetting Ninja

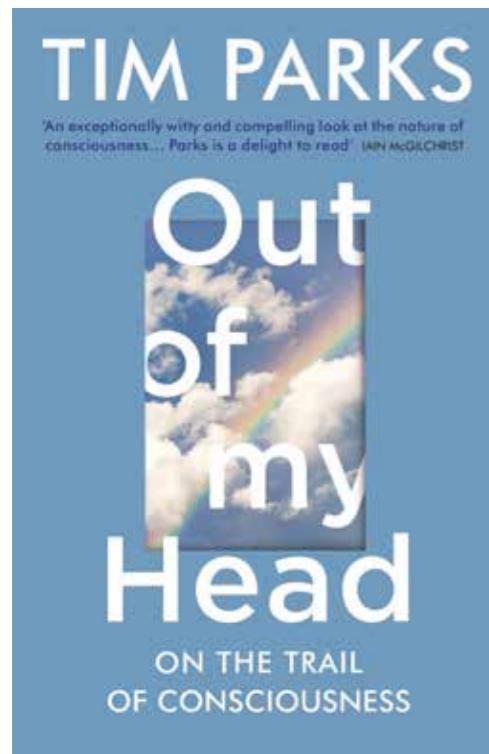
Your laboratory is your playground. Nobody is faster or more accurate than you when it comes to pipetting. It is important to keep up with the latest laboratory trends in order for you to be able to continually improve.



Admin Hero

Quickly and efficiently – this is the way you like to work. Your laboratory space must be organized to perfection, and you never miss a calibration date. Naturally, cost efficiency is one major factor when you order new instruments for the lab. You strive to get the most out of everything.

Lab Lifestyle



1



2



3

1

Do Computers Have a Consciousness?

When neuroscientists study our brains, all they find are billions of neurons exchanging electrical impulses and releasing chemical substances. Is that all there is to it? Tim Parks, in his book "Out of my Head" explores the question of whether computers might have a consciousness after all, or whether this is a unique characteristic of humans. A compelling, often funny story of a paradigm shift. 320 pages, New York Review Books, approx. €25

<https://bit.ly/3lttM0X>

2

New Eppendorf Career Blog

What is it like to work at Eppendorf? Find out on the Eppendorf career website: career.eppendorf.com. Completely relaunched, it makes our employer brand "Collaborate on new ideas" visible.

"The website is the central point of contact for potential employees and one of the most important components of our employer branding," says Anneke Wiskemann, Global Strategic HR Development at Eppendorf. Tip: The career

website has been expanded to include a career blog (**corporate.eppendorf.com/en/career/blog**), which gives potential applicants a genuine insight into the company and everyday working life at Eppendorf. The stories cover topics such as "digitalization", "careers of former trainees" and "diversity". It goes without saying that the focus is on Eppendorf employees – for an authentic picture of what it is like to work at Eppendorf.

3 The World of Medicine in Comics

A picture is often worth a thousand words and is also well suited to explaining complex issues clearly. A pinch of humor also helps – even when topics are fraught with crisis. For several years now, the field of "graphic medicine" has been establishing itself, doing just that: getting to the heart of what needs to be understood. A recommendation for Internet-savvy and research-interested comic friends is the website of the "Graphic Medicine International Collective". Here you can follow what is being published by comic artists on Corona and COVID-19 on a daily basis. Humorous cartoons lend a little lightness to the heavy topic.

graphicmedicine.org

① Personalize Your Pipette!

Now 60 years ago, the "Marburg Pipette", the first pipette from Eppendorf, was a real sensation for laboratory scientists. Today, an Eppendorf pipette is probably part of the standard repertoire of every laboratory. It becomes a rarity when it bears the name of its user.

Would you like to win a laser-engraved pipette? Eppendorf is giving away a personalized Eppendorf Research® plus pipette to all "Off the Bench" readers. Answer the following question correctly:

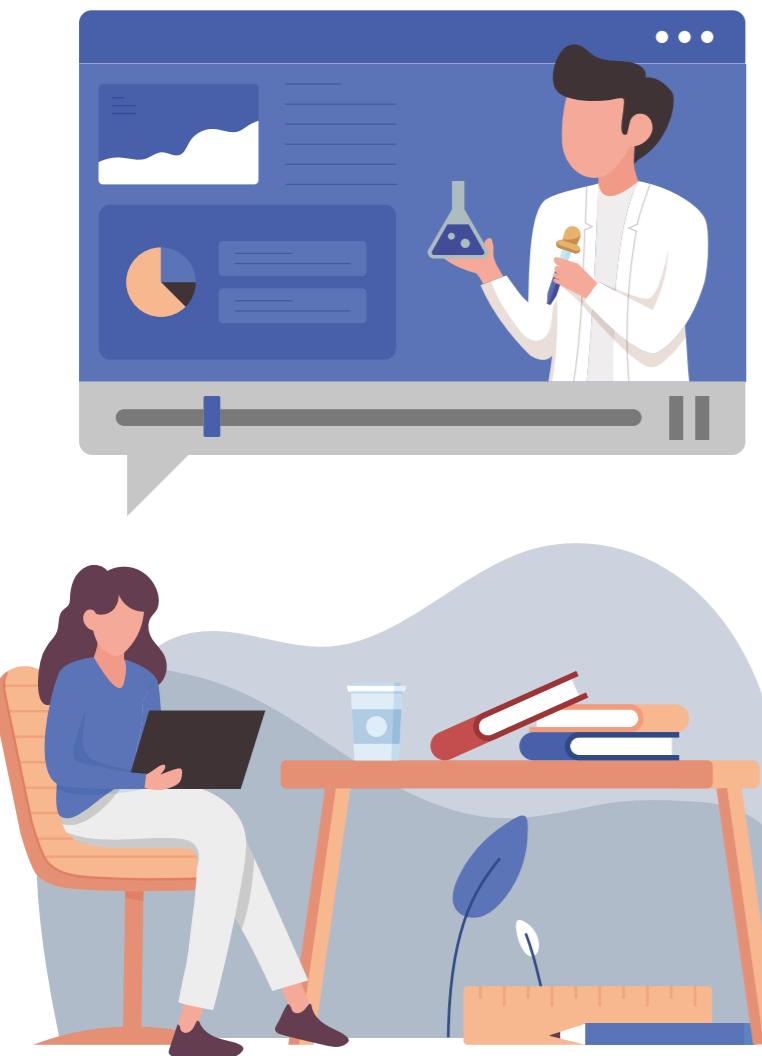
What were the basic elements of the "Marburg Pipette" that was launched 60 years ago?
Hint: You will find the answer on pages 26/27.

The closing date for entries is January 31, 2022. Send us an e-mail to magazine@eppendorf.com, or register as a subscriber and leave a message with the keyword "Personalized pipette". You can find the rules of entry here:

www.eppendorf.com/otb

Made by Eppendorf

The future is digital: acquiring new knowledge through online seminars and virtual formats – and finding smarter ways to monitor laboratory processes.



Experts. Knowledge. Live.

Homeschooling, online training as well as virtual conferences and webinars are no longer foreign words since 2020 at the latest. At Eppendorf, too, a lot has happened with virtual reality: in order to remain in lively exchange with its customers and to share its expert knowledge, Eppendorf has established a new virtual format:

Eppendorf Lab Channel!

The Eppendorf Lab Channel is a virtual platform where everyone can watch live and on-demand webinars for free, but also – and this is new – product and application demonstrations. Dare to look over the shoulders of Eppendorf experts and let the details and camera work conjure up the lab world. Participants are encouraged to ask questions, interact with the experts, and get up close and live to gain new experiences. Is your interest aroused?

Then register easily and free of charge at:

[Event.eppendorf.com/
labchannel](http://Event.eppendorf.com/labchannel)

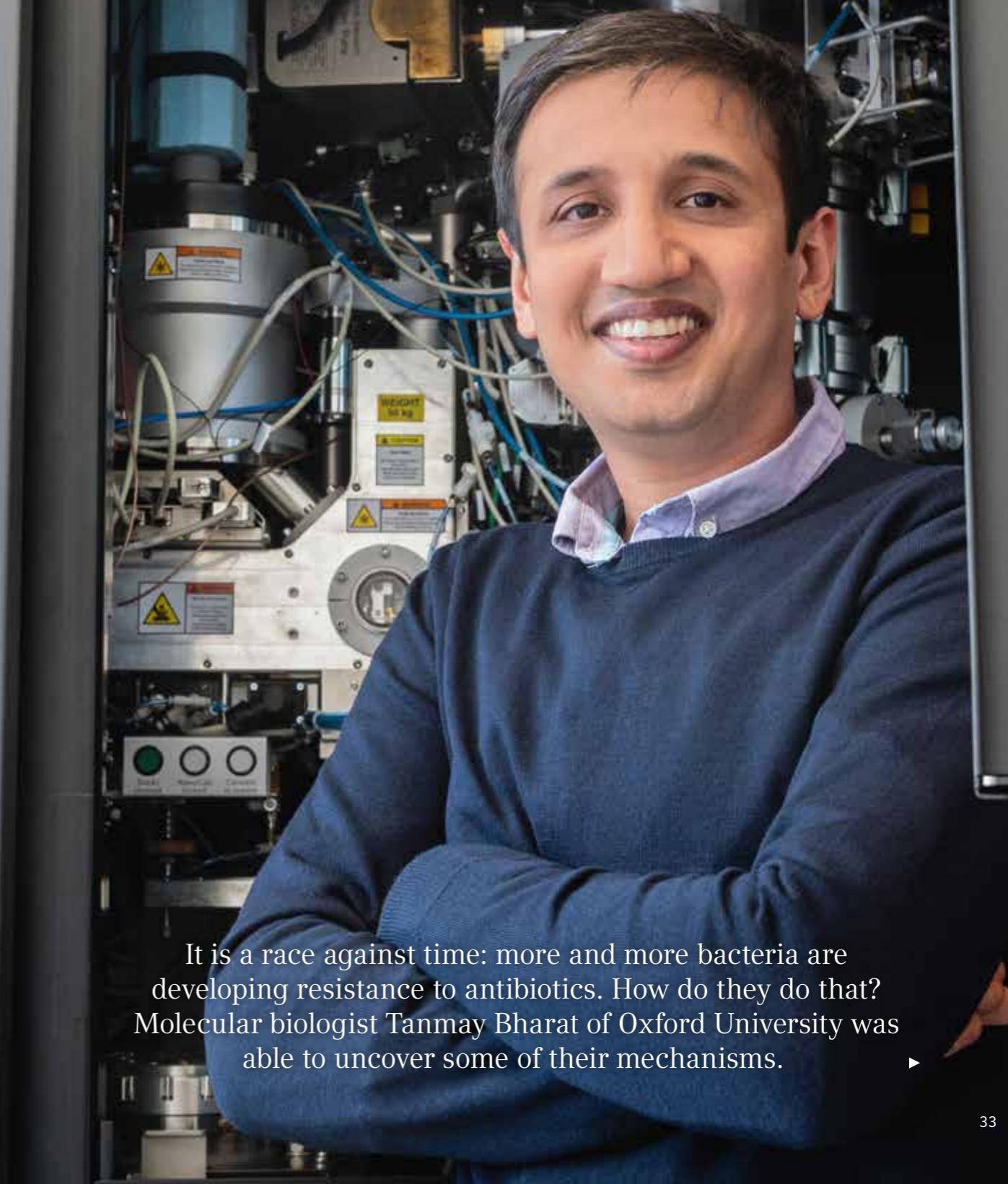


Experiment Management VisioNize® Lab Suite

Are you suffering from time-consuming documentation and results that cannot be reproduced? If this is the case, plan your next experiment using a tool; allow yourself to be guided through the procedures, and benefit from pre-programming of the connected laboratory instruments. Retain complete control over your experiments and streamline your laboratory processes. The next iteration of services for the VisioNize Lab Suite offers all the function options mentioned above. To help you improve productivity and comfort, as well as reproducibility, in your laboratory, the service-add-on experiment management guides the user through their laboratory workflow – from design to optimization – by utilizing contextualized data from networked instruments. Learn more about the VisioNize Lab Suite and how you can digitalize your experiments:

www.eppendorf.com/vnls-experiment-management

A Dangerous Game of Hide-and-Seek



It is a race against time: more and more bacteria are developing resistance to antibiotics. How do they do that? Molecular biologist Tanmay Bharat of Oxford University was able to uncover some of their mechanisms.

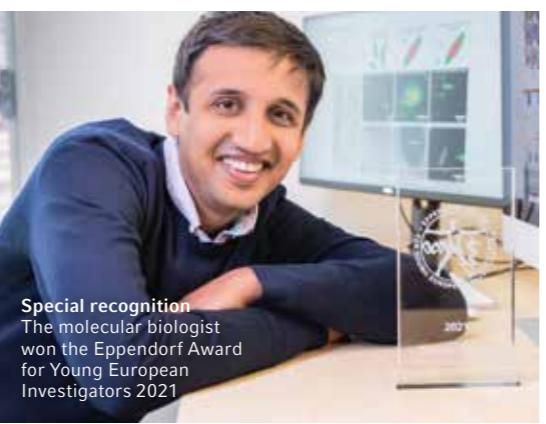


Are bacteria actually living organisms? Bacteria comprise a single cell; they do not possess a nucleus, and yet, they have at their disposal all the necessities of life: genetic material as well as proteins which provide the food for their metabolism. And, of course, they are capable of procreation by cell division. Even though they do quite well on their own, they prefer the company of other bacteria. Most bacteria collaborate, thereby setting in motion the processes that cause illness in humans. Throughout, they tend to resort to cunning methods; they play hide-and-seek with possible adversaries such as antibiotic medications.

Pathogen specialist

Tanmay Bharat specializes in the study of these microscopic organisms. The molecular biologist observes bacterial cultures in detail. Born in New Delhi, the 36-year-old came to Oxford on a scholarship to support the completion of his biology degree. He subsequently moved to the European Molecular Biology Laboratory (EMBL) in Heidelberg for his PhD in order to study viruses – namely Ebola and HIV – which are 100 times smaller than bacteria. As a postdoc, he started out in Cambridge and shortly thereafter moved to the Sir William Dunn School of Pathology on the Oxford University campus. For the past four years, the young scientist has headed his own laboratory with 14 members (before the pandemic). COVID-measures have reduced his lab to ten members.

During our conversation, he refers to both current and historic context. It was at this very university that an academic laboratory, in collaboration with a pharmaceutical company, developed the COVID vaccine Astra Zeneca in record time. Likewise, prior to the second world war, penicillin, the first antibiotic ever, was launched in Oxford and subsequently distributed across the world, which, according to Bharat, "significantly changed human history." The ambitious researcher is inspired by his professional surroundings, and he considers his work as a molecular biologist to be an absolute dream job. It is therefore not surprising that the ambitions of the soon-to-be father of two aim high. His goal: offering the next big blockbuster antibiotic to the world. And how does he relax? "Once you are dealing with children and changing diapers it's hard to think of antibiotics", he says with a smile.



Antibiotic resistance – a "slow pandemic"
His drive is not fueled solely by the spirit of his inspiring academic environment, but it is also of a personal nature. "My work is directly related to my biography", emphasizes Tanmay Bharat. As a child in India, he contracted a bone infection – a disease that continues to cause him problems: he needs to undergo repeated surgeries, the most recent of which occurred shortly after starting his laboratory in Oxford. "I hope this will be the end of it."

This bridge between illness and his studies is reminiscent of a natural race against time; at the same time, his personal affliction makes up only a part of his motivation. Tanmay Bharat considers the bigger picture. He places science in a direct relationship with society; throughout his scientific career, he has continuously taken up the most relevant topics. The latest: the fight against AIDS and Ebola. He considers the growing resistance to antibiotics a "threatening pandemic" which is simply unfolding at a slower pace than the COVID-19 catastrophe. "When antibiotics cease to be effective, our medical system will be catapulted back into the Middle Ages."



The mechanisms we discovered could be one way to make bacteria more susceptible to antibiotics and thus kill them efficiently."

Tanmay Bharat

Together with his team, Bharat has been able to shine a light on the many aspects of bacteria, and he promises: "Our fundamental research will contribute to the development of strategies for the therapeutic intervention against bacterial infections." This is one of the reasons why he is excited to be awarded the Eppendorf Award for Young European Investigators 2021, worth 20,000 euros. This is a "very prestigious prize" in Europe, which elevates his research into the spotlight. The most difficult hurdle that young researchers face is to be noticed among the crowd.

Bacteria build biofilms

According to the jury, Bharat was awarded the prize for "his groundbreaking research in the field of antibiotic resistance". What did he discover? Put simply, he observed how certain bacteria collaborate and how it is possible to block their deadly deed. Since bacteria are tiny – between 0.0001 and 0.8 millimeters in diameter – specialists operate in dimensions that are all but inconceivable to the layperson. State-of-the-art laboratories are equipped with electron microscopes; resolution achieved with these microscopes for

biological specimens is now approaching 0.1 nm, which means one billionth of a meter. "Even from a technological perspective, these are incredibly exciting times", says Tanmay Bharat. It was only high-resolution imaging technology that was capable of providing answers about bacterial cell biology. The researchers were now observing bacteria in their natural habitats – as if through a keyhole.

Enjoying eureka moments

They could see how communities of bacteria form biofilms and embed themselves in a kind of protective matrix. Bharat illustrates that the bacteria secrete certain molecules and deposit them in their vicinity. What looks like a slimy string turns out to be a protective barrier against antibiotics. This biofilm lifestyle allows the bacteria to enter a metabolically inactive state during which they power down their metabolism to such an extent that they internalize hardly any antibiotic molecules. The medication cannot do them any harm. Bharat's team, however, has been able to successfully generate antibodies which block the protective effect provided by the slime barrier, and block biofilm formation. "When bacteria return to the single-cell state, they are susceptible to killing by antibiotics." This can easily be achieved with the current generation of antibiotics.

He enjoys such "eureka-moments", but also the process itself. "This, to me, is not work – it is more of a hobby, no, my life", says Tanmay Bharat, whose best ideas come to him during conversations with colleagues. The only thing that is needed now before clinical trials can begin, and thus for society to enjoy a practical benefit as soon as possible, is a pharmaceutical collaborator. After all, the COVID-19 pandemic has shown that "where there is a need, things can move very quickly." Within a year from now, it might be possible – he pauses briefly – no, it will most likely take a little longer ... ■

LEARN MORE?



Click here for the website:

<http://bharat.path.ox.ac.uk>

Rethinking Work

In order to understand our essence and our very nature, as well as our relationship with work, anthropologist James Suzman has returned to the origins of humankind. Four theses from his book “Work – A History of How We Spend Our Time” inspire both thought and change.

1 Boredom – The Key to Creativity

For roughly 30,000 years, our ancestors lived in hunter-gatherer communities. They spent a mere 15 hours per week collecting food – what we call “work” – explains Suzman. His conclusion: humans are not, in fact, workaholics. “One thing that sets us apart from many other species is our strong desire to turn boredom into creativity”, he writes. Our ancestors most likely used the remaining time satisfying their curiosity and engaging in creative pursuits: even Newton’s, Einstein’s and Descartes’ significant discoveries can be attributed to boredom. Therefore, in order to design a new future, we will need more freedom.

Use Energy More Wisely 3

Despite increasing automation, structures were built with the goal of employing – ideally – every single adult. Anthropologist David Graeber divided occupations into useful professions and “bullshit jobs”. While, according to Suzman, this kind of categorization is of course subjective, surveys show that more and more people are dissatisfied with their work. If we were all to work in “meaningful occupations” – in hospitals, schools or agriculture – each individual worker would have to work and accomplish less on average. The newfound energy thus liberated could then be used to design the future. In order to make this possible, we will have to free ourselves from wanting ever more, as well as from the traditional ideas of which jobs deserve special recognition.

The Economic System is Flexible 2

Anthropologists agree that the agricultural revolution was a major step in the evolution of humankind. Whereas hunter-gatherers were content acquiring the things that satisfied their immediate needs, the worry of “not having enough” only took hold once humans had settled down. Today, humankind is producing more than it can consume. Suzman considers the “economy of scarcity” the greatest misconception in history – and it continues to this day. We could end this race for more by realizing that we already have enough, and we could learn to need less. Furthermore, the energy of our planet is finite. Suzman advocates for more mindfulness in the ways that we use this energy.

4 The Time for Change is Right Now!

History shows us how adaptable our species really is. “We are capable of quickly becoming accustomed to new, completely unfamiliar ways of thinking and acting and incorporating new habits within a short period of time”, says Suzman. The challenges posed by climate change require us to rethink and find new solutions. The pandemic, too, has created a momentum and posed questions which we had never before asked ourselves: which jobs are, in fact, “meaningful and valuable”? Why do we not reward those people the most whose work is significant? How do we want to work in the future? Suzman believes that questions such as these can become catalysts for change.



“We can dare to be courageous.”

Dr. Suzman, how far away are we from an identity crisis?

James Suzman: Ever since the industrial revolution, the rapidly changing nature of work has sparked identity crises; certain highly qualified professions and trades, and thus people within these communities, have been made redundant by automation. This continues to be the case today, especially since fewer and fewer people pursue a “job for life”. The pandemic allowed a large number of people to work from home. Perhaps this is a sign that in the future we may find an increased sense of community and feeling of

belonging among the people with whom we live, rather than among those with whom we work.

What are the responsibilities of companies during this process?

There are companies that are prepared to experiment with the configuration of our working lives by introducing flexible working hours, by trying out the four-day-week or by making sure that even the lowest paid employees receive more than minimum wage. The actual driver of change, however, must have a broader base and address the economic institutions which shape our working life.

What could be a first step in the right direction?

Now is the time to experiment and be courageous. We have learned from the pandemic that we do, in fact, possess plenty of resources which will allow us to dare and be ambitious when it comes to experimentation. The experiment that I would like to see is a real and universal basic income – on a national level and, importantly, one that includes everyone, rich and poor. I believe this would the right way, morally – and not only in the short term. This approach would also harbor the potential to recalibrate our relationship with work and with endless economic growth.



Wish fulfillment
James Suzman says, “Now is the time to experiment and be bold”



Detect lies
According to John Cook,
misinformation can
ultimately only be
detected with education

Debunking Disinformation

While it is challenging to fight disinformation, it is relatively easy to uncover. John Cook has compiled a list of the most common manipulation strategies using his concept of FLICC.

Those who aim to deny, manipulate and disinform will always find a way, or even more than one. Whether it concerns the existence of a COVID-19 illness, the moon landing or man-made climate change: the strategies employed by deniers are manifold – and always the same. Australian cognitive psychologist John Cook is one person who studies this phenomenon in depth; he has dedicated his career to this topic, and he is currently conducting research at the Climate Change Communication Research Hub at Monash University in Melbourne, Australia.

In 2013, his “97 Percent Consensus”, published in “Environmental Research Letters”, received global attention. For this publication, Cook had reviewed approximately 12,000 relevant scientific articles from the field of climate science. He discovered: 97.1 percent of all authors agreed that global warming was man-made. This level of concurrence proves that within the discipline, this question is no longer up for debate.

Disinformation strategies

Some people, however, consistently deny such facts. The arguments that are presented follow certain patterns and myths; John Cook lists close to 200 of these on his website skepticalscience.com, and he has

summarized the five most common strategies in his concept of FLICC.

The F stands for Fake Experts, the technique referring to alleged experts whose opinion reflects one's own worldview – no matter whether or not they are actually qualified to speak on the subject at hand. For example, a physics professor may be a renowned scientist, but he will not necessarily possess any knowledge about epidemiology. If he then proceeds to publish incorrect facts on the COVID-19 pandemic, his credentials will nevertheless lend weight to his word in the eyes of certain circles.

The L refers to Logical Fallacies. Disinformers frequently use arguments that sound logical at first but will not withstand closer scrutiny. Confusing comparisons, faulty analogies or the omission of certain aspects are used to confirm one's own theory. Oversimplification is a further attribute of this strategy; for example, when one assumes that complex events have but a

single root cause. On the topic of climate change, for example, it is frequently argued that the climate has always been subject to change due to natural causes, and that therefore, this continues to be the case. The fact that industrially generated CO₂ did not exist in human history until very recently will be ignored.

The I in FLICC concerns the topic of Impossible Expectations. Deniers make demands on scientific research that simply cannot be met. Either because the earthly laws do not give them or because research often takes a long time and does not always produce clear results. If, for example, disinformers accept that ocean levels are in fact rising, they will go on to demand an even higher standard of proof – perhaps information on the speed at which this scenario will unfold. Since a rise in sea levels can only be measured across an extended period of time, science may not be able to provide an answer just yet. This is then readily interpreted as incompetence.

The first C stands for Cherry-Picking – the process of selective reporting of data that strengthen one's own position. All contradictory evidence is ignored.

The final C represents Conspiracy Theories, i.e., imaginary secret powers that control the world in accordance with their own interests and which intentionally misinform the public. The most perfidious aspect: attempts at presenting factual arguments are then perceived as confirmation of the conspiracy.

The handling is trainable

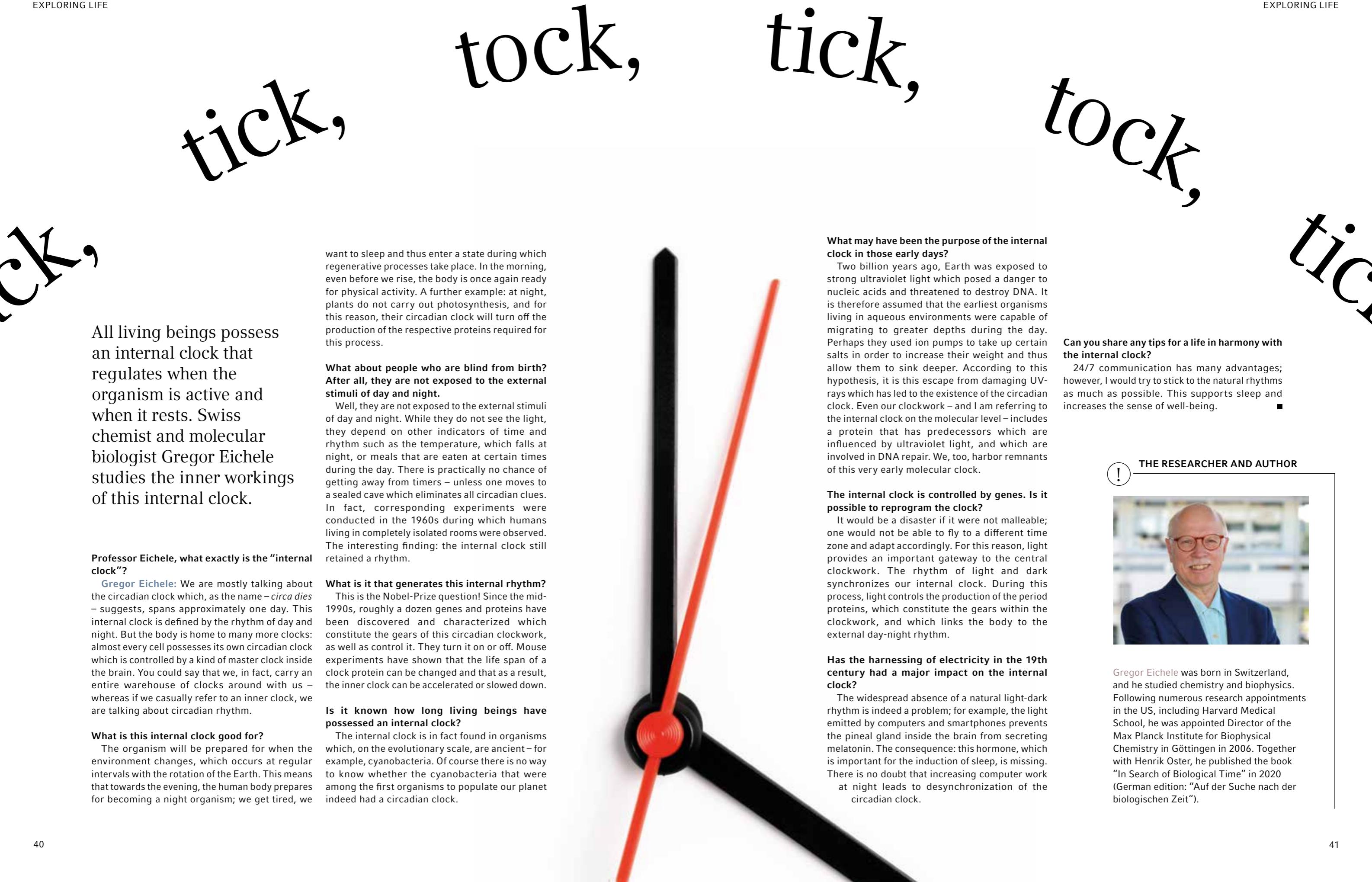
But: is it sufficient to recognize these strategies in order to counter the deniers? “Not always”, sighs John Cook – this is incredibly difficult and requires immense quick-wittedness and breadth of argumentation. He himself frequently despairs. Tireless as he is, he dedicates his enthusiasm to the tool which promises the greatest potential for success on a

larger scale: education. To make it more accessible and add humor, he invented the app “Cranky Uncle”. With the help of a cranky uncle with crude theories, one can train one's own resistance to disinformation – and thus detect it ever more readily. ■

SHORT PROFILE



John Cook completed his PhD in the discipline of cognitive psychology at the School of Psychology at the University of Western Australia in 2016. As early as 2007, he founded skepticalscience.com for the purpose of providing information about the denial of science. He is currently a post-doctoral research fellow at the Climate Change Communication Research Hub at Monash University. His paper “Quantifying the consensus on anthropogenic global warming in the scientific literature” (2013) has thus far been cited more than 1,600 times.



All living beings possess an internal clock that regulates when the organism is active and when it rests. Swiss chemist and molecular biologist Gregor Eichele studies the inner workings of this internal clock.

Professor Eichele, what exactly is the "internal clock"?

Gregor Eichele: We are mostly talking about the circadian clock which, as the name – *circa dies* – suggests, spans approximately one day. This internal clock is defined by the rhythm of day and night. But the body is home to many more clocks: almost every cell possesses its own circadian clock which is controlled by a kind of master clock inside the brain. You could say that we, in fact, carry an entire warehouse of clocks around with us – whereas if we casually refer to an inner clock, we are talking about circadian rhythm.

What is this internal clock good for?

The organism will be prepared for when the environment changes, which occurs at regular intervals with the rotation of the Earth. This means that towards the evening, the human body prepares for becoming a night organism; we get tired, we

want to sleep and thus enter a state during which regenerative processes take place. In the morning, even before we rise, the body is once again ready for physical activity. A further example: at night, plants do not carry out photosynthesis, and for this reason, their circadian clock will turn off the production of the respective proteins required for this process.

What about people who are blind from birth? After all, they are not exposed to the external stimuli of day and night.

Well, they are not exposed to the external stimuli of day and night. While they do not see the light, they depend on other indicators of time and rhythm such as the temperature, which falls at night, or meals that are eaten at certain times during the day. There is practically no chance of getting away from timers – unless one moves to a sealed cave which eliminates all circadian clues. In fact, corresponding experiments were conducted in the 1960s during which humans living in completely isolated rooms were observed. The interesting finding: the internal clock still retained a rhythm.

What is it that generates this internal rhythm?

This is the Nobel-Prize question! Since the mid-1990s, roughly a dozen genes and proteins have been discovered and characterized which constitute the gears of this circadian clockwork, as well as control it. They turn it on or off. Mouse experiments have shown that the life span of a clock protein can be changed and that as a result, the inner clock can be accelerated or slowed down.

Is it known how long living beings have possessed an internal clock?

The internal clock is in fact found in organisms which, on the evolutionary scale, are ancient – for example, cyanobacteria. Of course there is no way to know whether the cyanobacteria that were among the first organisms to populate our planet indeed had a circadian clock.

What may have been the purpose of the internal clock in those early days?

Two billion years ago, Earth was exposed to strong ultraviolet light which posed a danger to nucleic acids and threatened to destroy DNA. It is therefore assumed that the earliest organisms living in aqueous environments were capable of migrating to greater depths during the day. Perhaps they used ion pumps to take up certain salts in order to increase their weight and thus allow them to sink deeper. According to this hypothesis, it is this escape from damaging UV-rays which has led to the existence of the circadian clock. Even our clockwork – and I am referring to the internal clock on the molecular level – includes a protein that has predecessors which are influenced by ultraviolet light, and which are involved in DNA repair. We, too, harbor remnants of this very early molecular clock.

The internal clock is controlled by genes. Is it possible to reprogram the clock?

It would be a disaster if it were not malleable; one would not be able to fly to a different time zone and adapt accordingly. For this reason, light provides an important gateway to the central clockwork. The rhythm of light and dark synchronizes our internal clock. During this process, light controls the production of the period proteins, which constitute the gears within the clockwork, and which links the body to the external day-night rhythm.

Has the harnessing of electricity in the 19th century had a major impact on the internal clock?

The widespread absence of a natural light-dark rhythm is indeed a problem; for example, the light emitted by computers and smartphones prevents the pineal gland inside the brain from secreting melatonin. The consequence: this hormone, which is important for the induction of sleep, is missing. There is no doubt that increasing computer work at night leads to desynchronization of the circadian clock.

Can you share any tips for a life in harmony with the internal clock?

24/7 communication has many advantages; however, I would try to stick to the natural rhythms as much as possible. This supports sleep and increases the sense of well-being. ■

THE RESEARCHER AND AUTHOR



Gregor Eichele was born in Switzerland, and he studied chemistry and biophysics. Following numerous research appointments in the US, including Harvard Medical School, he was appointed Director of the Max Planck Institute for Biophysical Chemistry in Göttingen in 2006. Together with Henrik Oster, he published the book "In Search of Biological Time" in 2020 (German edition: "Auf der Suche nach der biologischen Zeit").

L

Leipzig Riverside Forest: the search begins! Zammy directs his moist black nose into the air and eagerly awaits the sign from his companion. Biologist Annegret Grimm-Seyfarth lifts her arm and points to a small parcel of forest. Instantly, the border collie darts off and begins to search through the grass, branches and leaves. He stops abruptly before a piece of dead wood - Zammy has picked up a scent. He then merely stares at his prey - a tiny trace of feces from a crested newt.

This is one of the YouTube videos that biologist Grimm-Seyfarth of the Helmholtz Centre for Environmental Research in Leipzig (UFZ) regularly uploads to her channel "Monitoring Dogs". It shows how dogs can become useful assistants in the conservation effort by tracking down minute traces of endangered species - traces that humans would have to search for in painstaking ways, using binoculars or camera traps.

Ten years ago, during a practicum, Grimm-Seyfarth had the idea of training her cattle dog Foxy to locate endangered otters - a cumbersome task. According to genetic analysis, 30 percent of the feces collected by humans was prone to error. Once trained on the otter scent, Foxy's work proved to be much more thorough and accurate. Even during the search for crested newts - amphibians barely the size of a finger - her current border collie Zammy is quick, reliable and extremely accurate.

1,220 publications from 60 countries

Animal assistants like Zammy are becoming increasingly important in the global fight against the loss of species; today, one million animal and plant species are in danger of extinction. "In order to be able to protect their habitats and implement measures, we must first know where they can still be found", says Grimm-Seyfarth. It is therefore an important goal of field biologists to advance the effective search for their traces.

In order to be able to better assess the potential of species tracking using sniffer dogs, Grimm-Seyfarth and her UFZ colleague Wiebke Harms, together with Dr. Anne Berger of the Leibniz Institute for Zoo and Wildlife Research in Berlin, conducted extensive research and found 1,220 scientific publications employing dogs in the search for species from a total of 60 countries.

They discovered that the use of dogs has been a common approach for decades - mainly in the United States, New Zealand and Australia. In fact, many university research groups keep their own tracking dog teams. In their overview study they show that to date, dogs have helped track down 400 different species - mostly cat, dog, bear or marten, but also 42 plant species, 26 fungal species and six bacterial species were listed on the global list of species detected by scent. The animal

detectives found up to 4.7 times more black bears, fishers (*Marten pennanti*) and bobcats than camera traps.

Grimm-Seyfarth suspects that dogs were first enlisted in conservation efforts in New Zealand in the 1890s. At that time, conservationists trained hunting dogs to search for the nocturnal kiwi. The population of these flightless birds was severely threatened by rats, marten and foxes which had been introduced to the islands by humans. In order to save these rare birds, preservationists collected the kiwis and brought them to an island that had not yet been invaded by their predators.

Dogs are smart

Herding dogs, in particular, are well suited to conservation work - they like to cooperate with humans, and they possess up to 300 million olfactory receptors which allow them to detect minute concentrations of scent molecules. In addition, cognitive

scientist Juliane Bräuer demonstrated that dogs construct an exact internal image when they follow a scent. They therefore actively and effectively contribute to conservation. Moreover, when Grimm-Seyfarth's five-year-old male border collie searches for otters and crested newts in the Leipzig Riverside Forest, his involvement is considered "non-invasive" as his quests constitute only a minimal interference with nature.

Nowadays, dogs are also employed by planning and advisory offices in their search for birds and bats injured or killed by wind turbines, or when burrows of field hamsters or nests of the rare dormouse need to be located on agricultural land. "The German railway company Deutsche Bahn is currently determining whether the deployment of trained dog squadrons could possibly replace the existing external consultants for the detection of endangered animal species near railway tracks", says Dr. Anne Berger, biologist and co-author of the UFZ overview study. ■

The researchers are presently experiencing a high demand for the project "Igamon Dogs", a collaboration between the German Federal Ministry of Education and Research and the UFZ. This project enlists the help of private dog owners from the states of Saxony, Saxony-Anhalt or Berlin who, along with their companions are interested in joining the search for traces of endangered species. "We are looking for animals who are highly motivated by toys or food", states the advertisement. Once selected, the dog owners will be responsible for monitoring, i.e., they will go into the field perform documentation. The results will then be scientifically analyzed. The project aims to test the extent to which the "citizen scientists" may be able to help expedite the conservation of species. ■

The Right Nose



Dogs possess up to 300 million olfactory receptors. Dogs' sensitive noses can assist biologists in the conservation of species, as they are much better at detecting traces of otter, crested newt or hedgehog than humans - or even technology.

Moscow Underground

Saint Basil's Cathedral with its onion-shaped spires; treasures from the tsarist era and the Novodevichy Convent: Russia's capital is replete with sights – even below ground.



Magnificent design
Novoslobodskaya Metro station, put into operation in 1952, is located 40 meters underground. It is considered one of the most architecturally outstanding Moscow subway stations

The evening, with the sky descending over Moscow in a gentle hue of blue, is the most beautiful time of day. The expansive pleasure gardens of Gorki Park fall quiet, and the rainbows of its fountains fade. Those who cross the Krymsky Bridge, a steel suspension bridge which spans the Moskva River, will arrive at a small white temple – the subway station Park Kultury – and thus the entrance to the Moskovskoe Metro, Moscow's Metro, which resembles a museum dedicated to the history of the former Soviet Union.

The Moscow Metro was established in 1935 as the first subway of the former USSR, and it was considered a favorite project of Josef Stalin. It was his goal to create the most beautiful subway system in the world, and many people flooded to the stations to attend its opening. While the people themselves lived in dark cottages, they marveled at the mirroring walls of marble, the sparkling chandeliers and moving stairs beneath the ground.

Palaces for the people
On its way underground, the escalator hums quietly, and the air begins to feel cooler. Then, at a depth of 40 meters, one finds oneself, a 70-cent ticket in hand, at the Station Park Kultury, on a bright white center platform with gray granite tiles and marble columns. Circular, gold-rimmed wall reliefs depict young athletes. These are the pleasant pastimes one can discover in Gorki Park, a park established in 1928 as the first cultural park of the Soviet Union. It served as an example for more than 2,000 other parks throughout the country.

The Station Park Kultury belongs to the Koltsevaya line, also known as line 5, which leads in a circle around the city center. All the other 14 lines, spanning a network of 400 kilometers beneath Russia's capital, branch off it. The Koltsevaya connects what are considered the most magnificent stations of Moscow, with Komsomolskaya, built in 1952 and six stops from Park Kultury, the most beautiful of all. Travelers are initially greeted by a hall framed by marble arcades, with a ceiling as yellow as the sun and adorned with stucco. Colorful mosaics of precious stones tell of Russian generals as well as Lenin addressing the people in the Red Square. Moscow's main attraction by the Kremlin is a mere 15-minute ride from the Komsomolskaya. ▶



EPPENDORF IN MOSCOW

The Eppendorf Russia office is located in the heart of Moscow: on the Moskva river quay called "Derbenevskaya". From here, Eppendorf Russia provides user support, promotes its products in the Russian Federation, participates in exhibitions and conferences, displays Eppendorf products in the office showroom and holds seminars. Derbenevskaya is known for its characteristic business centers – successors to factories from pre-revolutionary times, such as the cotton printing plant founded in 1823. Across the river, the 530-year-old Novospassky Monastery can be seen.

LET'S GO!

Moscow by water, air and land

Discovering the city by bike is a beautiful alternative to the Metro. Fortunately, the city features multiple **city bike stations** close to the Metro stations and parks where one can rent bicycles or e-bikes. One can either drift or follow a route that can easily be researched online – for example, nine kilometers through the city center, starting at Pushkin Square, and enjoying a lemonade when arriving at the Hermitage Garden. Renting a bike requires registration on a bikesharing-website.

<https://velobike.ru/en/>



2

The **Moskva** meanders through the center of the Russian capital, and those who wish to explore Moscow from a boat or river cruiser, will pass by the most important sights. From the water, the Kremlin, Novodevichy Convent, the Cathedral of Christ the Saviour or the

Moscow State University may be enjoyed through full, unobstructed views and without the crowds that often congregate by attractions. It is recommended to book the tour in advance and select a custom package.

<https://bit.ly/2VrA4np>

The approximately 374-meter-high **Federation Tower** in Moscow City is Moscow's highest building in the business district. The viewing platform Panorama 360 offers a spectacular view across this city of 12 million people. The top floor of the Swissôtel Krasnye Holmy will also lift you among the clouds: the City Space Bar on the 34th floor invites you to enjoy a sunset dinner while the red sun sets over the Moskva. The menu includes shrimp with wasabi and chocolate biscuit cakes.

<http://cityspacebar.com/>



3

Afraid to Fail? Reach Out

Many years ago, a trusted professor suggested I make a radical change in my academic path and pursue a doctorate in psychology. That sounded impossible! I was interested in the subject matter, but my training was in English and philosophy. I was petrified that seeking a science PhD would bring rejection and failure. For months, I looked into programs, only to get cold feet and back away – until my curiosity spurred me down the road again. Now, years after successfully completing my doctorate, I realize that I was actually facing two distinct fears during that tortured time. And I realize that I could have eased my path by seeking outside perspectives.

One fear was simply that, in trying to make a dramatic career change, I would fail. Given my training and connections in the humanities, who could write letters recommending me for a science program? Who would mentor me along the way? What could I point to as evidence that I was a credible candidate? Even if I were accepted, did I really believe that I could succeed? The risk seemed overwhelming. I thought I would suffer for years, if not my entire life, if I didn't get into a program or was unprepared and had to leave.

My other fear was that such a bold move would disappoint important people in my life. This fear is not unique to academia, but university culture can make it hit particularly hard. Many advisers see students as academic progeny, and when we make career choices that don't match our advisers' ideas of what we should do, we may feel we are

betraying them. When I told one of my humanities professors that I was serious about applying to doctoral programs in psychology, he expressed grave concern that I was making the wrong choice (although, to his credit, he wrote a wonderful letter of recommendation).

Beyond academic colleagues, it was difficult to face the prospect of disappointing family and friends who had supported me – emotionally and in some cases financially – during the ups and downs of my studies. I worried that if I pursued what might appear to be a pipe dream, they would feel I was turning my back on all they had done. Or they might conclude

Science
AAAS

i THE SOURCE

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that all my efforts up to that point had been a failure. When I talked with my parents about making the leap to psychology, they questioned whether it was the right choice and wondered when I would be settled.

Now, though, I realize that I probably exaggerated the strength of others'

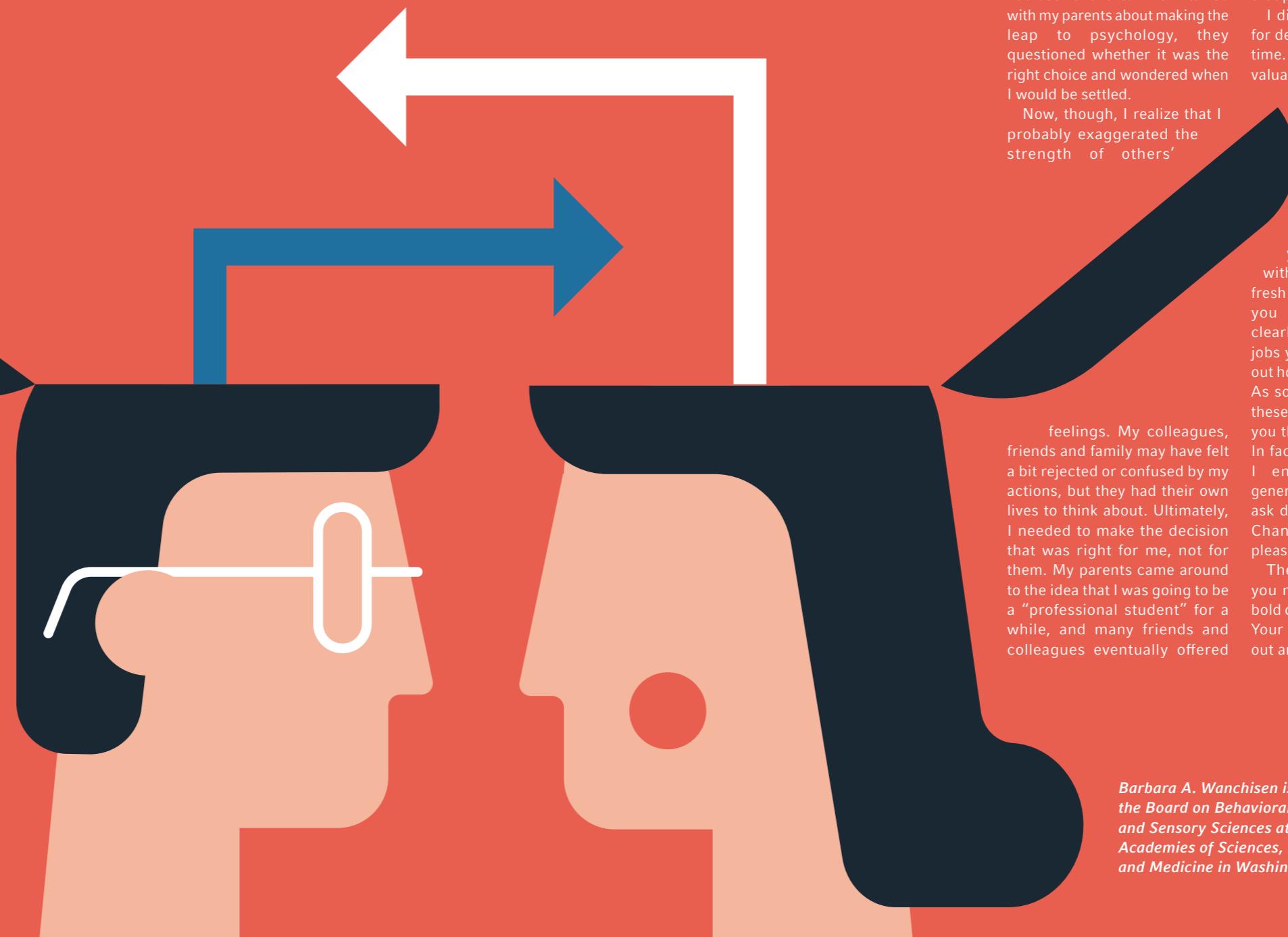
support, though I lost touch with that professor.

I didn't have a good strategy for dealing with my fears at that time. But I have since learned a valuable approach that I wish I had known then: reach out to people beyond your immediate circle for input and advice.

People who have no skin in the game – your neighbors, your hair stylist, even strangers you strike up conversations with at the airport – can offer fresh perspectives that may help you see your options more clearly. Reach out to people in jobs you're interested in to find out how they got where they are.

As someone who now receives these types of inquiries, I can tell you that it's not a burden at all. In fact, it's a compliment – plus I enjoy helping the next generation. If the first person you ask doesn't respond, try again. Chances are you will be pleasantly surprised.

There are more people than you may think who have made bold career moves. Talk to them. Your future is your own. Reach out and see what happens. ■



Barbara A. Wanchisen is the director of the Board on Behavioral, Cognitive, and Sensory Sciences at the National Academies of Sciences, Engineering, and Medicine in Washington, D.C.



For the Love of Detail

Rendering the flavors of herbs visible – in his long-term project, Martin Oeggerli employs macro photography to grant us entirely new and unique insights.

Basil, rosemary, saffron – the flavors of herbs and spices add a special note to many a dish. You may be able to easily smell them – but it is thanks to Martin Oeggerli that these flavors are now actually visible. With his electron microscope and its up to 10,000-fold magnification, the photographer and scientist produces images of herbs and spices, highlighting those areas in color which harbor the chemicals that are responsible for flavor and scent.

Surreal, detail-rich landscapes become visible – appearing as though they might originate from foreign, as yet undiscovered planets. “I find this exciting – and not solely from a scientific perspective. Especially when we consider how well we think we know our herbs – and then find out how different they actually look”, describes Oeggerli about his long-term project. “Suddenly, details come to light that one did not think were possible, and this will be exactly where the flavor is located – what we immediately associate with the herb.”

This surprise effect also teaches us something else: “We should take more time to look closely instead of jumping to foregone conclusions on all kinds of subjects”, reports Oeggerli about his own personal “lesson”, as he calls it. Additional macro images of the herbs, as well as background information and projects, may be viewed on Martin Oeggerli’s website:

www.micronaut.ch



Fascinating world of surfaces
1) “King” – that’s what basil means in Greek. The culinary herb contains different essential oils, depending on the variety. For example, the strong clove scent of sweet basil comes from eugenol, the same chemical that real cloves have. If you add basil at the last moment of cooking, you preserve the concise flavor!

2) Greatly enlarged, the leaves and buds of the cannabis plant look as if they are covered by a sticky blanket of frost. What we are dealing with here are large accumulations of so-called trichomes, or tiny hairs, as it were.

3) Hairs and glands line the surface of a tomato leaf. They protect the plant from predators and reduce water loss through evaporation. Also visible here are small gray-blue colored pores that are responsible for gas exchange.



MASTHEAD

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