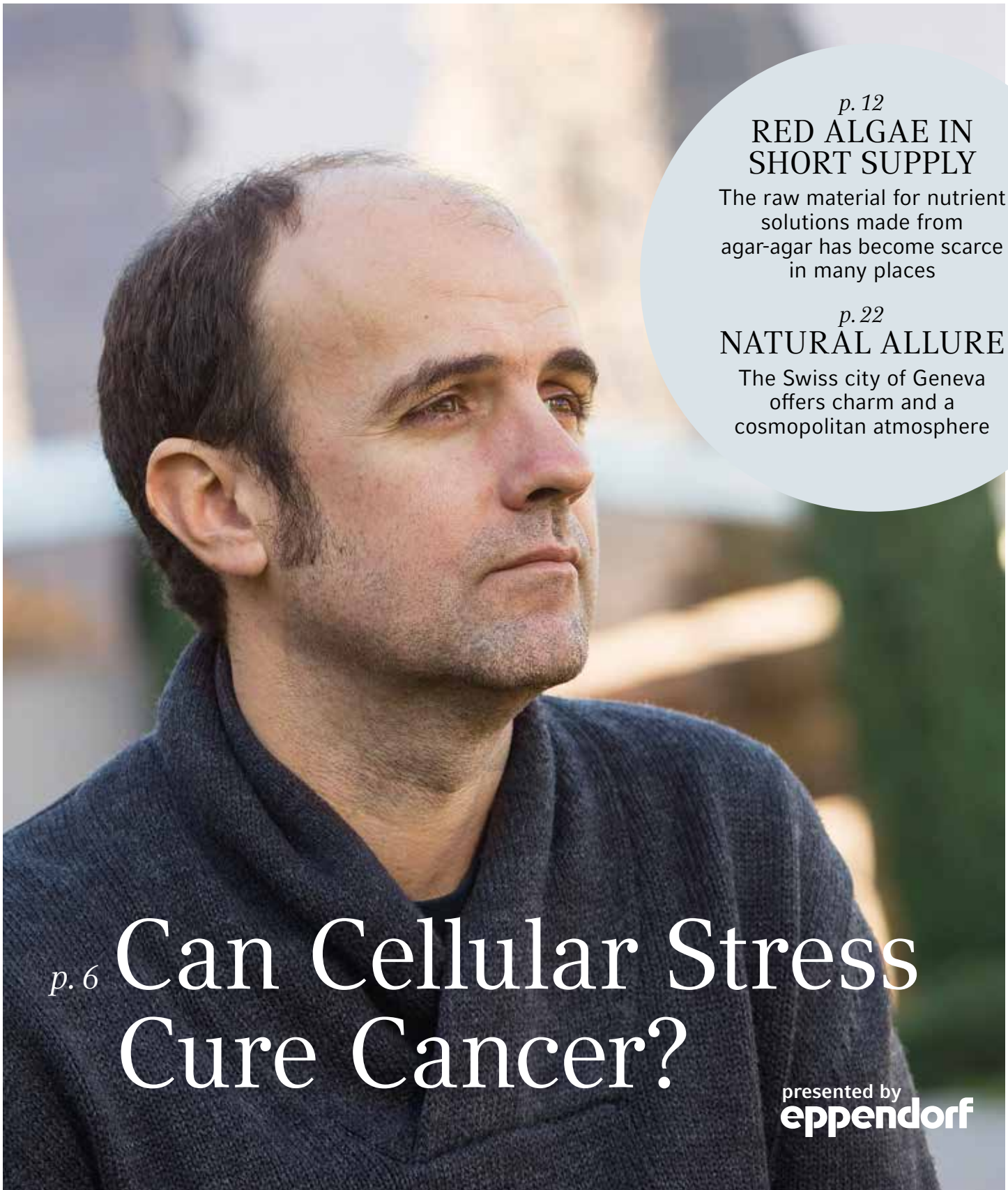
Off the BENCH

01
17

The Eppendorf – LifeScienceStyle Magazine



presented by eppendorf

Contents

magazine@eppendorf.com

SUBSCRIPTION AND FEEDBACK
You want to make sure that you will continue to receive future issues? Please send us a brief note.

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.

Have a look on our website!
www.eppendorf.com/OTB

MASTHEAD

Published by: Eppendorf AG, Barkhausenweg 1, 22339 Hamburg, Germany, e-mail: magazine@eppendorf.com

Editorial team: Julie Brahms, Florian Defren, Dr. Oliver Franz, Susanne Janenz, Dr. Kay Körner, Irina Schner, Svenja Sterneberg, Frank Thormählen

Proofreading: Editorial team

Publisher:
TEMPUS CORPORATE GmbH
Helmut-Schmidt-Haus, Buceriusstraße, Eingang Speersort 1, 20095 Hamburg, Germany

Management: Jan Hawerkamp, Chris Höfner (dep.)

Project lead: Jasmin Kistner

Chief Editor: Hauke Burmann

Authors: Ursula Barth-Modreker, Susan Junghans-Knoll, Jeffrey J. McDonnell, Janina Otto, Ulrike Otto, Esther Sambale

Art Director: Karin Mantel

Layout: Alina Sawallisch

Graphic editor: Beatrice Jansen

Printed by: Dräger & Wullenwever print + media Lübeck GmbH & Co. KG

Image references: Coverphoto, p. 2, 7, 9 Montse Verlando /Focus; p. 2 Fotolia/margo555, Plainpicture/Johner/Vince Reichardt, Getty Images/stevegeer; p.3 Eppendorf AG; p. 4 Getty Images/Dorling Kindersley, Getty Images/Manjurul Haque/EyeEm, iStock/quantum orange; p. 5 iStock/ivkuzmin, hmhco; p. 6 Getty Images/Steve Gschmeissner; p. 9 iStock/vitanovski, Wurzbach; p. 10-11 Stocksy/HEX, Stocksy/Wizemark, Stocksy/Lawren Lu, Eppendorf AG, Fotolia/corabelli, Getty Images/Science Photo Library – ZEPHYR, fotolia/rost9; p. 12-13 Plainpicture//Johner/Vince Reichardt, Getty Images/Kristopher Grunert/Corbis/VCG; p.14 Fotolia/mas0380, Plainpicture/Johner/Vince Reichardt; p. 15 Fotolia/koosen, Fotolia/govindji, Fotolia/weseetheworld, Fotolia/emuck (3), Fotolia/Valentina R.; p. 16 iStock/VvoeVale; p.17 Getty Images/AFP; p. 18-19 Plainpicture/Jasmin Sander, Fotolia/Nenov Brothers; p. 20-21 Niki Lazaridou (7), Eppendorf AG (2), Dreamstime/Antonlunkov; p. 22-23 iStock/antares71, Getty Images/Katarina Stefanovic; p. 24-25 mauritius images/david pearson/Alamy, Getty Images/westend61, Getty Images/Brett Stevens, mauritius images /imageBROKER/Bernard Jaubert, Getty Images/Christian Kober, Getty Images/Greg Dale, mauritius images/age fotostock/Bernard Jaubert; p. 26-27 Eppendorf AG; p. 28 Eppendorf AG, Eppendorf-TECHNOBEAT; p. 29 Tami Steindorf; p. 30-31 iStock/johavel; p. 32-33 Robert Sommer; p. 34-35 Pradyuman Samantha

Editorial

Dear Readers,

We are very pleased to present to you the second issue of "Off the Bench". But first, we would like to thank you for the encouraging and inspiring feedback to our first issue. The positive responses have shown us that the new magazine appeals to your taste. We continue to look forward to your ideas on how to develop our LifeScienceStyle magazine even further. After all, besides entertainment, our topics also aim to offer you real added value.

One of the highlights in this issue of "Off the Bench" is an article that is published with the kind permission of the journal Science; author Jeffrey J. McDonnell explains what writers of scientific texts can learn from Hollywood directors. Furthermore, our title story introduces the cancer researcher Óscar Fernández-Capetillo. The Spanish biochemist studies the connection between DNA damage, replicative cellular stress and the emergence of cancer at the National Cancer Research Center (CNIO) in Madrid.

We also take a critical look at the genome editing process CRISPR. The use of "gene scissors", with which the genome may be altered with unprecedented ease, raises many hopes – but also ethical concerns.

The global extinction of certain species of red algae is an urgent cause for concern to cell researchers. Red algae are the source of agar-agar, which is a crucial component of nutrient solutions. Since the coveted raw material is rapidly becoming scarcer worldwide, and therefore more expensive, scientists are increasing their efforts to identify alternative gelling agents.

The Geneva trade exhibition ESHRE® of the European Society of Human Reproduction and Embryology, too, revolves around the topic of cell biology. Visit us in the Exhibition and Congress Center Palexpo and then take the time to discover the reasons why the Swiss metropolis is considered one of the most attractive cities in the world.

Enjoy reading,

Thomas Bachmann
President & Chief Executive Officer

Devils, Mosquitos and Bats

Hope for the Tasmanian Devil?

For the longest time, it looked as though nothing would be able to save the Tasmanian Devil from extinction. An aggressive type of cancer, Devil Facial Tumour Disease (DFTD), had already decimated the number of these marsupials, which lead an isolated life on the island of Tasmania, located on the southern coast of Australia, by 80 percent over the past 20 years. Of particular concern: the cancer is contagious. The deadly illness is the focus of research for many scientists including Elizabeth Murchison, winner of the 2012 Eppendorf Award for Young European Investigators *(www.tcg.vet.cam.ac.uk/).* It can be passed rapidly from one individual to another as these nervous animals are easily provoked and often bite each other's faces. At this time, infected animals transmit living cancer cells via their saliva. These then cause malignant tumors on the head that often grow so large that infected devils are rendered unable to feed and finally die from starvation, infections or organ failure.

The animals usually die within a few months with no evidence of antibody or immune cell responses against the DFTD allograft. This lack of anti-tumour immunity is attributed to an absence of cell surface major histocompatibility (MHC)-I molecule expression. While the endangerment of the devil population precludes experimentation on large experimental groups, those examined in a recent study indicated that immunisation and immunotherapy with DFTD cells expressing surface MHC-I corresponded with effective anti-tumour responses. Although the sample sizes were small, the results are promising. So, if successfully vaccinated, perhaps there would be hope for the Tasmanian Devil after all.

Zika Virus – Closing in on Treatment

For ten months of the past year, the Zika epidemic caused a global health emergency. Tropical and subtropical countries in particular witnessed the rapid spread of the pathogen which is mainly transmitted by the Asian and Egyptian tiger mosquito, also known as the yellow fever mosquito. Even after the global state of emergency has been declared over, the virus is expected to continue to be "an extremely serious long term problem", explained David Heymann, chairman of the emergency committee of the World Health Organization (WHO). In approximately 20 percent of infected people, Zika causes flu-like symptoms and is therefore largely harmless. On the other hand, pregnant women can transmit the virus to their unborn children.

Zika mainly targets stem cells and glial cells

According to a study by the US Centers for Disease Control and Prevention, the risk of congenital deformities, such as microcephaly, in the case of illness of the mother during pregnancy, is estimated to be around 6 percent. A group of researchers around the biochemist Joseph DeRisi *(www.ncbi.nlm.nih.gov/pubmed/27911847)* at the University of California, San Francisco discovered that Zika does not primarily infect the actual neurons, but that instead it mainly targets neuronal stem cells as well as different types of glial cells, which, in their role of supporting neurons, perform important functions in the brain.

DeRisi and his team have conducted successful experiments which considerably reduced the Zika infection of these glial cells. To achieve this, they first switched off the AXL receptor of these cells by using antibodies, or by overwriting the genetic code for the receptor in the cell's genome. They then employed the well-known antibiotic azithromycin to reduce virus replication inside the brain. Since this method has so far only been tested in brain tissue cultured in the laboratory, additional tests will have to show how successful the approach will be in infected humans.

Language development:

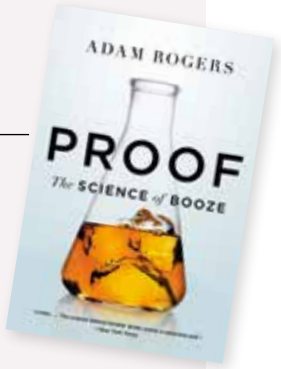
How much BATMAN Is in Us?

The New York Stem Cell Foundation (NYSCF) has awarded the neurobiologist Michael Yartsev with a NYSCF-Robertson Neuroscience Investigator Award. The organization committed itself to supporting the work of the laureate from Israel with a total of 1.5 million dollars over a period of five years. The money will serve the continued development and expansion of the NeuroBat Lab which Yartsev founded in 2015 in collaboration with the Department of Bioengineering at the University of California, Berkeley. This is where, together with his team, Yartsev studies the neurobiological mechanisms which are relevant to language learning in mammals. As evident from the name of the laboratory, the work of the researchers focuses on bats.

Bats, alongside humans, elephants, whales and dolphins, are considered the only living beings capable of learning a complex language. While studying the behavior of bats, the researchers hope to unlock essential basic principles in the area of brain function which are common among all these organisms. The core question: what is unique about the brains of these species that enables them to speak? The NeuroBat builds on innovative technologies such as wireless neural recording, optogenetics, imaging and anatomical mapping. Yartsev, the 2013 winner of the Eppendorf prize for Neurobiology, wants to use his studies to gain knowledge beyond the field of zoology: "Language development disorders are a major problem in human societies. We can really impact the welfare of children, and society in general, by deciphering the underlying neural mechanisms of these disorders. Cracking this complex problem can assist children and adults worldwide since after all, language is a crucial part of the life of humans across all societies."

> "Language development disorders are a major problem in human societies"

BOOK TIP



Intoxicating Literature

Some of us may have asked ourselves why the rising bubbles in freshly drafted beer will form a perfect head whereas the bubbles in champagne will not. The American journalist and author Adam Rogers set out to get to the bottom of this and other scientific questions surrounding the topic of alcohol. For his book "Proof: The Science of Booze" he visited numerous distilleries and spirits factories and spoke with a large number of experts. As such, he visited a small distillery in New York where loud dance music is played at night in order to entice the molecules in the liquids to oscillate with the vibrations emanating from the bass. Rogers also met liquor distillers who have their barrels cross the oceans in ships for many years so that the gentle motion of the waves may help the liquor develop its full aroma.

History and Sociology

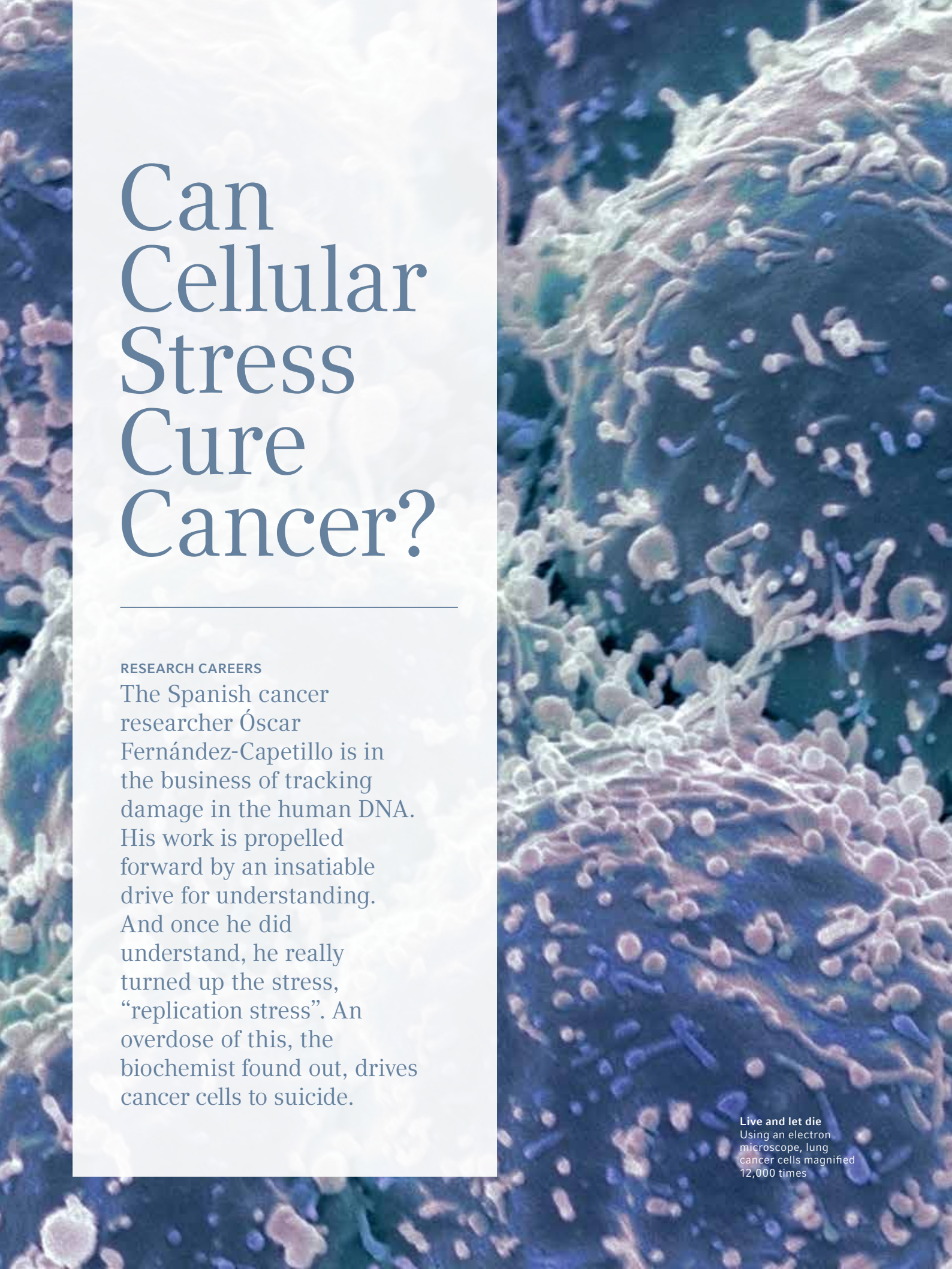
In addition to the history of the origins of alcohol production, which includes the hard facts of biochemistry, Rogers also addresses the psychological aspects of alcohol consumption. The author further touches on the fields of history and sociology: some scientists propose that it was indeed alcohol which precipitated the transition from a nomadic existence to a farming life style. It is therefore possible that our ancestors settled down mainly to plant grain for beer, grape vines for wine and fruit trees for liquor.

"Proof: The Science of Booze" (272 pages) by Adam Rogers was named a Best Science Book by Amazon.

Can Cellular Stress Cure Cancer?

RESEARCH CAREERS

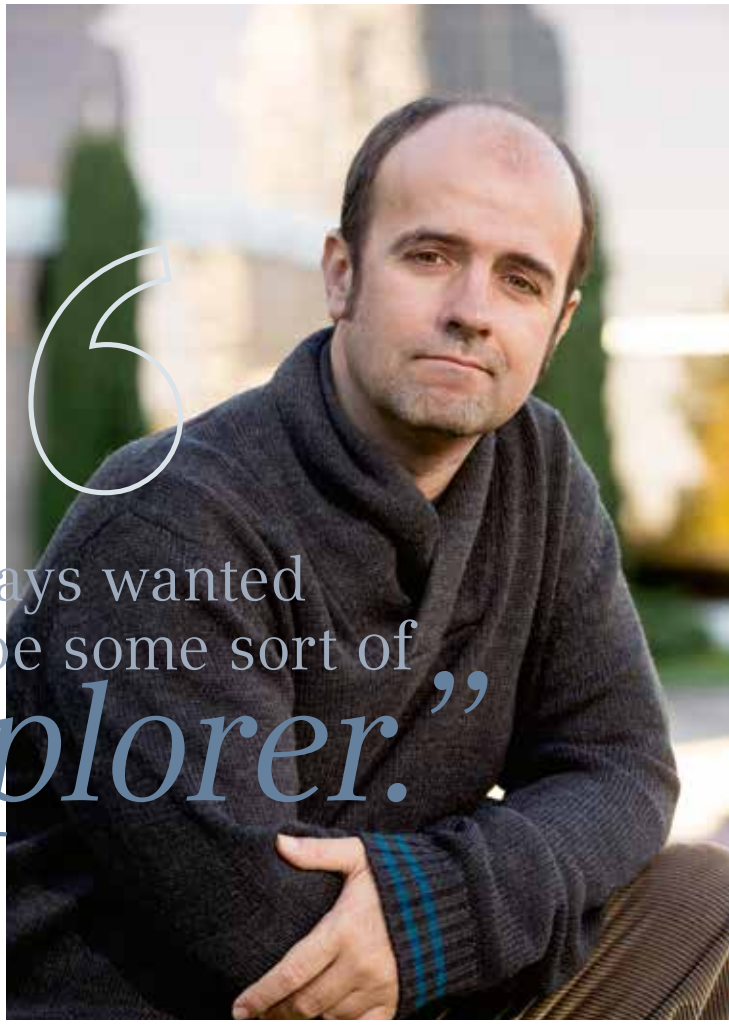
The Spanish cancer researcher Óscar Fernández-Capetillo is in the business of tracking damage in the human DNA. His work is propelled forward by an insatiable drive for understanding. And once he did understand, he really turned up the stress, "replication stress". An overdose of this, the biochemist found out, drives cancer cells to suicide.



Live and let die
Using an electron microscope, lung cancer cells magnified 12,000 times

Óscar Fernández-Capetillo almost became a stock market analyst. Computer Science was also an option, at a time when he was almost ready to leave science. Good thing, though, that men occasionally listen to their wives, as otherwise the 42 year old biochemist would not have gone on to become Spain's leading cancer researcher. "My wife rescued me for the case, and I owe her what I am today", the scientist says with a smile. In fact, he is the man of the hour when specialists around the world gather to discuss the influence of endogenous factors on the formation of cancer and the ageing process.

The focus of Capetillo's scientific curiosity is a microscopic nucleus. Deep inside the human cell, it is the genome within, that not only dictates height, appearance, athletic prowess and artistic talents, but it also determines what makes us human. It plays its part in deciding whether a person is ailing or healthy, and whether they will die young or live to a ripe old age.



"I always wanted to be some sort of explorer."

Insatiable curiosity

As far as Óscar Fernández-Capetillo is concerned, it is safe to assume that his genes may have equipped him with a predisposition: even as a child in northern Spain, he dissected prawns on the Atlantic coast, only to put them back together again like so many pieces of a puzzle. It was good practice! "I always wanted to be some sort of explorer", says the Spaniard and adds, laughing, "I have an insatiable curiosity to understand things!"

It is therefore not surprising that Capetillo's path led directly into research. After earning his doctorate in biochemistry at the University of the Basque Country in the Spanish city of Leioa, he completed a three year postdoc with André Nussenzweig at the National Cancer Institute in Bethesda, Maryland (USA). This is where he discovered his great passion for genetics research and DNA damage. "I was fascinated by understanding the key role that DNA damage plays in why we age or why we suffer cancer."

Back in Spain, and still interested in DNA damage, Capetillo deepened his knowledge at the National Cancer Research Center (CNIO) in Madrid. As director of the "Genomic Instability Group", he was looking for a new challenge, a niche in cancer research. He found it when he accidentally came across a journal article which hinted at the possibility of a connection between replicative stress and the development of cancer. Replicative stress? Capetillo's curiosity was ignited. He was "burning" for the subject which, he found, had been ignored by the scientific community far too long. "Even though it is clear that DNA damage drives cancer and ageing, the sources of endogenous DNA damage in mammals are not as well understood", regrets the biochemist.

Indeed, up to that point the focus of most cancer research had been directed towards exogenous factors, such as, for example, how toxic substances from the environment or UV and ionizing radiation lead our cells ►

to mutate, thus triggering a variety of cancers.

Replicative stress, Capetillo's area of research, originates during cell division and is capable of damaging DNA. "We have discovered that a type of DNA damage accelerates ageing in mammals". This is where the research comes in to develop new strategies against cancer. The basic premise: if stress during cell division will activate ageing, why not harness its destructive power and drive the mutated cells to an early death? Capetillo explains: "Regarding cancer, we have explored the idea of creating an 'overdose' of replication stress in cancer cells as a means to kill them."

The drive comes from the heart

First successes verify the conclusions of the team, which has already moved beyond the basic research phase. "We have moved to the development of actual drugs that have already shown antitumoral efficacy in preclinical models". The Spaniard is happy: a German pharmaceutical company has already licensed the therapy to bring the new agent to market. Capetillo is thus one big step closer to his goal of making a significant contribution to the fight against cancer. "In any case, it would feel great if I have contributed significantly to improve the treatment of some incurable desease", he describes his researcher's dream.

Capetillo is a cool analyst when he is in the laboratory, but the drive behind his achievements comes from the heart. This becomes evident when he talks about his Uncle Carlos who died young and who was his great inspiration. While he had completed his studies of Mathematics and graduated first in his class, he could not imagine spending his life with columns of numbers. So he pursued an additional degree in Psychology and went on to work with underprivileged children. A clear message for Capetillo: "One has to do what is right."

And Capetillo must discover things. For him, that is the most important aspect of his profession. Despite fame and numerous awards, such as, for example, the Eppendorf Young Investigator Award, the EMBO Young Investigator Award, the ERC Starting Grant and many more, the scientist has remained modest.

An optimistic soul

Capetillo is a team player. He loves the scientific discussions with colleagues who drive him to new heights with constructive criticism and new ideas: "Creative, impulsive people, that is who moves the world!" Above all, Capetillo likes tolerant, generous people with a good sense of humor. "And humble and accessible people", he adds. Asked about his greatest scientific successes, he answers modestly: "I do not see this business as a competition. There are several things that we have contributed that I find really exciting, for example, the discovery that embryonic stress can exert its influence later in adulthood, or the development of a new type of antitumor chemotherapy." Even on the topic of failure he remains calm: "Just do many things. Hence, if one fails, well, you just move on to another!" He is not easily derailed – he is an "optimistic soul".

Full of curiosity

That is true. In every respect: The father of four is happy to watch his children grow up, and when he is able to spend two weeks of vacation "at one stretch" with his wife and children. Despite the intensive research, Capetillo takes the time for a variety of hobbies: "To name a few: reading, fishing, mushroom picking, poker, stargazing – and a lot more. In addition, I am a very social person. I particularly enjoy being with my funniest friends!"

What does the future hold? It will definitely be filled with curiosity and scientific drive and the sensation of being just a little lost. Lost? Capetillo laughs: "Yes! If you feel a bit lost, and feel like you do not understand many things about your work, this means you are in the right place!" ■

"Regarding cancer, we have explored the idea of creating an 'overdose' of replication stress in cancer cells as a means to kill them."

THERE'S MORE:
Visit the website of the Howard Hughes Medical Institute:

www.hhmi.org/scientists/oscar-fernandez-capetillo

Microcosm
Cancer cells on their paths, vividly displayed using 3D software

New frontiers
On an expedition in his lab: Óscar Fernández-Capetillo, a passionate researcher

Diseases
Using CRISPR, researchers hope to eradicate ZIKA or malaria.

Food
Genome editing is designed to grow plants faster and protect them from droughts, storms and climate change

How Safe Are Gene Scissors?

The genome editing method CRISPR is currently a worldwide topic of discussion. Never before has it been so easy to alter the genome of bacteria, plants, animals and humans. The method raises high hopes – but also ethical concerns.

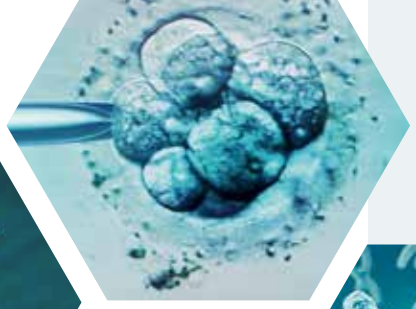
Since 2012, CRISPR has evolved from innovation to standard procedure for targeted processing of genetic information (gene editing). Enlisting the help of the enzyme Cas9 as "molecular scissors," the genomes of viruses and living things may now be altered without the need for introduction of external DNA. Up until now, this process has been employed mainly within the confines of basic research.

Meanwhile, the method is raising hopes of eliminating antibiotic resistance and controlling dangerous diseases such as cancer, ZIKA, AIDS or malaria. Even the causes of Alzheimer or diabetes may one day be unlocked. Furthermore, Chinese scientists report of their success in rewriting the genome of pigs in such a way that their organs will be suitable for human transplant without eliciting rejection reactions. In addition, research in mice has successfully switched off the faulty parts of the gene which causes the hereditary disease cystic fibrosis.

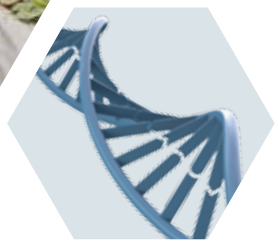
Many unanswered questions

For plant research, too, genome editing equals a leap in technology. Many producers of seeds hope to be able to alter the properties of crop plants much faster, as well as to be able to identify strains with increased resistance to droughts, storms and climate fluctuations. "CRISPR is meant to facilitate research for biologists," says Emmanuelle Charpentier. The French scientist is the Director of the Max Planck Institute for Infection Biology, and she is one of the discoverers of the CRISPR/Cas9 system in bacteria.

Even though many ethical questions still await an answer at this time, some scientists are venturing into initial studies using human genetic material. In China, for example, embryonic cells were genetically altered for the purpose of research. Recently, the method saw its first use in a living human. The man, who suffered from lung cancer, was the recipient of genetically



Genomes
Interventions especially in human chromosomes raise ethical questions



modified T cells. The tumor specialist Lu You of Szechuan University injected him with the modified T cells in order to be able to fight the tumor cells in his body more effectively. US researchers, too, are ready: Carl June of the University of Pennsylvania also wants to treat cancer patients with CRISPR therapy: "Before, we were kind of flying in the dark when we were making gene changes. With CRISPR, I came to the conclusion that this technology needs to be tested in humans." It will, however, take a few years until the effectiveness of the new treatment method may become evident.

"This technology needs to be tested in humans."

More research needed

While gene scissors are raising the hopes of seriously ill patients around the world, critics like the German Theologist Wolfgang Huber demand an international ban on genome editing in humans. The reason: any tampering with the human gene line, the genetic connection between the generations, will be passed on to subsequent generations and thus pose severe long-term consequences. Karen Yeung, a law professor at King's College in London states: "We've identified human reproductive applications as an area that demands urgent ethical scrutiny and we must consider carefully how we respond to this possibility now well before it becomes a practical choice." Physicians like Karl Welte, a member of the National Academy of Sciences Leopoldina in Halle, Germany, advocates the continued use of current methods such as stem cell therapy or pre-implantation diagnostics as long as CRISPR has not been sufficiently researched. Even in the case of animals, the use of this method is controversial: if scientists were to modify the genome of a species such as the Anopheles mosquito in order to eradicate malaria, this will inevitably interfere with the ecosystem on a massive scale.

Higher accuracy

In addition, researchers are still in the process of improving the accuracy of gene scissors. CRISPR may achieve higher accuracy than all laboratory tools before it; however, in rare cases the molecular scalpel will alter genes that were not the intended target. The consequence: unintended mutations. "Knocking out a gene is a lot simpler than knocking in a gene and correcting a mutation", says Cynthia Dunbar, president-elect of the American Society of Gene & Cell Therapy. The human geneticist Boris Fehse of the University Clinic Eppendorf in Hamburg, Germany, agrees and warns that the human immune system may mount a defense against CRISPR/Cas9 treatment. "After all, the system originates in bacteria." Oncologists have voiced additional concerns that genetically modified T cells may escalate out of control and go on to attack not only cancer cells but also healthy tissue. Enormous potential may be offset by risks which are difficult to gauge. ■

INFOBOX

i

INVISIBLE CHANGES

The fight against global hunger is one of the big challenges of mankind as droughts and other climate catastrophes pose increasing threats to food production for a growing population. The CRISPR process has the potential of becoming a miracle weapon.

Gene scissors enable vastly quicker and easier generation of new strains of plants than is currently possible using conventional hybridization techniques. Experts therefore predict that the new method represents the next step in the artificial development of agricultural crops.

In contrast to conventional gene technology, no foreign DNA can be detected in the plant genome following the CRISPR procedure. This is why some Biotech companies use the term "nature identical" plants. Jochen Flasbarth, State Secretary at the Federal Ministry for the Environment, disagrees. The fact that it will later be impossible to discern which plants have been genetically manipulated "can not mean that they are to be considered conventional." Even changes to the genome introduced by CRISPR have serious consequences. This is why it is important to continue to apply the same strict conditions for market approval which are in place for any conventional gene technology.

Endangered Species
Red algae require a rocky ocean floor as well as cold, current-rich waters with plenty of oxygen

Red Algae for Pure Cultures

Agar-agar, the basic substance for nutrient solutions, has long been established as an indispensable material in the field of microbiology. However, certain species of red algae, the raw material for bacteriologic agar-agar, is now threatened with extinction. Laboratories are increasingly forced to look for alternatives.

On March 24, 1882 Robert Koch of Berlin University announced a scientific sensation. The bacteriologist was the first researcher to identify the causative agent of the menacing tuberculosis epidemic which was raging at the time: the rod-shaped bacterium Mycobacterium tuberculosis. This discovery laid the foundation for Koch's subsequent world-wide fame, and it earned him the Nobel Prize for Medicine and Physiology in 1905.

This discovery laid the foundation for Koch's subsequent world-wide fame

The ideal gelling agent

One substance that made a significant contribution to the medical breakthrough in tuberculosis research was completely new to the laboratory at the time: agar-agar (short: agar). In order to be able to study the causative agent of the "white plague", Koch had to isolate the bacterium and grow it as a pure culture in a petri dish. He initially used nutrient solutions from meat broth that were solidified with gelatin. The problem was that this mixture would melt between 26 and 30 degrees Celsius. To make matters worse, gelatin is degraded and liquefied by a number of bacterial enzymes. For this reason, agar is now, as it was then, the alternative of choice in the laboratory: the complex polysaccharide (sugar polymer) which is extracted from the cell walls of certain red algae cannot be degraded by bacteria. In addition, agar does not melt until it reaches 100 degrees Celsius and remains liquid while cooling down to a temperature of approximately 45 degrees Celsius. At room temperature, it forms a semi-solid, translucent gel. Organisms are immobilized on the surface or inside the mass, leaving them to form colonies on or inside the gelled nutrient. In this way, pure cultures may be generated in order to obtain small amounts of microorganisms for subsequent studies.

From pudding to petri dish

The idea to use agar in the laboratory setting, however, did not originate with Robert Koch himself but rather with the German-American Fanny Hesse. She was married to the physician and microbiologist Walther Hesse, a colleague of Koch's. When she was a young woman in New York, a neighbor who hailed from Indonesia first mentioned to her the special properties of the substance. Fanny Hesse subsequently used agar for her puddings that now remained firm even at warmer temperatures. This was what later inspired her husband in Germany to use this substance obtained from red algae for his nutrient broths.

The purely plant-based agar had long been established as a thickener in Asia. The name originates from the Malayan language family and translates into something along the lines of "gelling food from algae". The substance is especially suitable as a sauce thickener in warmer regions as well as for solidifying jams, cake glazes, fruit sauces, ice creams, puddings and also fruit puddings (for vegan agar alternatives, please see page 15).

Shrinking algae populations

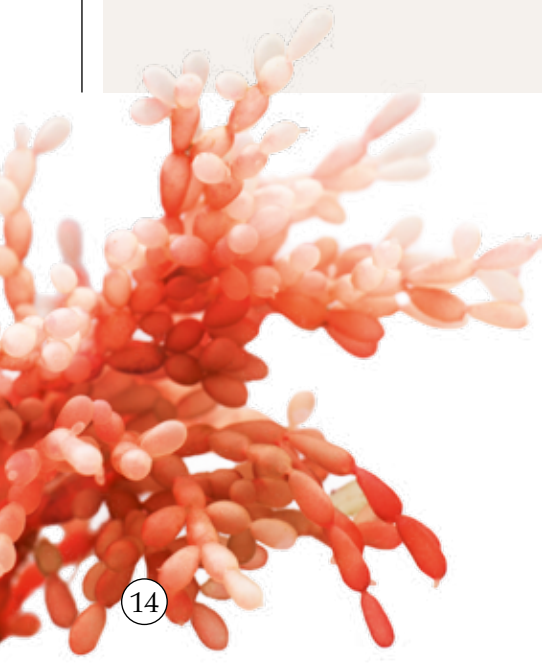
Besides Japan, where agar has been known since the 17th century, red algae are now primarily harvested in Chile, Spain and Morocco. Together, these countries yield two thirds of all globally traded raw agar. In former times, the algae from which agar is purified were simply collected from beaches at low tide, but today, many areas no longer harbor sufficient wild red algae. With population growth and increasing demand for vegetarian foods, the coveted material is experiencing increasing scarcity worldwide. In addition, pilot experiments are under way which explore the future use of agar as a fully biodegradable substitute for plastic. ▸

Breeding ground Proteus bacteria thrive in soil, water and the intestines of creatures – and in a petri dish on Agar-agar

INFOBOX

Typically, highly pure bacteriological agar is the gelling agent of choice for nutrient media used in the laboratory. As a rule, it originates from the red algae species Gelidium sesquipedalis. Agar extracted from this plant yields an especially transparent gel which, in contrast to other strains, does not contain any trace metals such as calcium or magnesium or carbohydrates or other substances which may interact with the petri dish in the lab or which may compromise bacterial growth. Furthermore, the laboratory agar features an especially low gelling temperature and solidifies at 34 to 36 degrees Celsius. This minimizes the risk of damage to biological samples by heat.

Commonly available food agar – the food additive E406 – is also extracted from red algae, but not necessarily from the species Gelidium sesquipedalis. Gelidium gracilaria, or the genus Gelidiella, may also serve as sources of raw agar. In contrast to bacteriological agar, which features gel strength of more than 800 g/cm², this value varies between only 300 and 500 g/cm² for E406. The gelling temperature is also different: it ranges between 40 and 44 degrees Celsius for food agar.



Scarce Commodity
Four countries harvest two-thirds of the world's red algae: Japan, Morocco, Spain and, with 1,800 tons a year, Chile

1,800 tons

Since the natural resources no longer meet today's global demand, fewer of the coveted red algae are now harvested from the wild, but are cultivated instead. This, however, does not work well for all species of the plant. An especially sensitive example is the red algae species Gelidium sesquipedale, the source of the highly purified agar used in the laboratory. This unique species of red algae not only features excellent properties (see information box), but it also places high demands on its natural environment: in order to grow, it requires a rocky ocean floor as well as cold, current-rich waters with plenty of oxygen. This is why, so far, all attempts at growing this particular species of red algae in aquacultures have failed.

"The natural populations have almost completely vanished"

Threatened with extinction

In Chile, which exports roughly 1,800 tons of raw agar annually, red algae are actually facing extinction. "The natural populations have almost completely vanished", says Alejandro Buschmann, Director of the Oceanographic Research Institute in the Southern Chilean city of Puerto Montt. Instead of simply collecting the algae from the coast, as was the traditional practice, the plants now need to be seeded on the beach in order to be harvested later, in strictly regulated amounts. In Morocco, too, the naturally occurring red algae populations are acutely endangered.

This is the reason the North African country enforced drastic export restrictions in late 2015. As a result, prices have skyrocketed. The scarce supply has further led to the consequence that some manufacturers of laboratory products have been unable to deliver certain agar products. As a result, some laboratories have turned to alternative gelling agents, such as guar gum, tragacanth or ground psyllium husks. Steve Petrovski and Daniel Tillet of La Trobe University in Melbourne were also searching for an affordable solution and decided on common agar, the food additive known as E406. It is also extracted from red algae, but in comparison with bacteriological agar supplied by laboratory vendors, it is much more reasonably priced.

The two Australian microbiologists cultivated 50 species of bacteria on the high quality agar as well as on the significantly cheaper food agar. The result: in terms of shape and structure, as well as in terms of growth rates and vitality of the colonies, no differences could be detected between the nutrient media.

For this reason, Petrovski and Tillet have switched entirely to food agar for their routine experiments and were able to reduce the cost for nutrient media by 80 percent. ■

Alternatives to Agar

For those who prefer vegan gelling agents for cooking or baking, it may not be necessary to reach for agar. Agar originates from red algae, many of which are already threatened with extinction (see left page). If you are looking for an alternative, you will find a variety of plant-based thickeners in the supermarket that are not derived from algae. Here is an overview of the most important products:

1

SAGO

Sago is another agent which is based on plant starch. It is extracted from the pulp or the tubers of different plant species. These include the Sago palm, but also potatoes. The thickener is available in the granulated form and is also known as pearl sago. It is especially suitable for thickening of puddings, fruit puddings or soups.

2

GUAR GUM

The ground seeds of the guar bean constitute the basis for guar gum. Among other features, guar gum prevents the formation of ice crystals within ice cream and gives it its creamy consistency. Beyond ice cream, it is employed in jams and also puddings. Using guar gum in combination with carob flour will enhance the gelling action.

3

TAPIOCA

The dried manioc root, too, is a source of pearls of starch. Its trade name is tapioca, which is used predominantly in desserts, jellies, jams, fruit puddings and cakes as well as for the purpose of thickening sauces. Tapioca is also available as a powder. It belongs to the category of arrow root flours that may also be produced from other tropical plants, such as Maranta.

4

CAROB FLOUR

The fruit seeds of the carob tree, too, are ground and processed to carob flour. Due to its special swelling properties, even a very small amount will transform a liquid into a gel-like substance. Carob flour is a good choice when it comes to thickening soups and sauces, but also baking and dessert preparation will benefit from this flour. Similar to guar gum, it gives ice cream a creamy consistency and be produced from other tropical plants, such as Maranta.

5

POTATO STARCH OR CORN STARCH

Potato starch and corn starch are suitable thickeners for cake glazes, puddings, creams and soups, where corn starch is also available in organic quality. Unfortunately, they cannot be used for the preparation of cold desserts, as both starches require heat in order to thicken.

6

PECTIN

Fruits such as apples, lemons, raspberries, currants or quinces, but also sugar beets, are good sources of pectin. Pectin is available in powdered form or as a liquid, and it is well suited for the production of jams, jellies, ice cream or cake glazes.

7

KUZU

Kuzu is considered the richest and best of all binding agents. It is obtained from the starchy tubers of the Kuzu plant, which is also highly regarded as a healing plant in Japan. The complexity of the kuzu extraction process may be reflected in its price, but its enormous gelling power, ideal for thickening sauces, soups or desserts, may well justify it. Puddings, milk-based dishes or glazes for fruit cakes also turn out very well with kuzu.

Honey
Stored cool, dark and dry, it is still consumable over millennia

Good Forever

According to estimates by the EU Commission, approximately 100 million metric tons of food end up in European landfills each year – even though food is often edible long past its sell by date. Some foods are even good forever.

Can I still use my icing sugar? Even after an extended search, the packaging will not reveal a best before date. The reason: sugar does not go bad. This is why, per EU law, it is not required to carry a best before date.

Even when such information is displayed, the consumer is often confused. Out of fear of food poisoning, many expired products are discarded without further evaluation. According to information provided by the Ministry for Consumer Affairs, each year approximately 82 kg of food per German citizen will end up in the garbage – even though about two thirds of this food would still be fit to eat. This amounts to approximately 940 Euros, wasted each year by a family of four. 84 percent are discarded based on a best before date. This date, however, is not equal to an expiry date but it represents a recommended date of consumption. The USA has the highest level of food waste according to a study conducted by the environmental organization Natural Resources Defense Council (NRDC), and up to 40 percent of all food ends up in the garbage.

Look, smell and taste

If yogurt, bread or jams have expired, rely on your senses and check carefully: "look, smell and taste", recommends the German Federation for Food Law and Food Science. If any changes in either color, consistency, smell or taste are detected, it is better to discard the food.

In cases of foods that spoil easily, such as hamburger meat, the best before date counts. Due to the danger of Salmonella or E. coli bacteria, the food must not be served after this date. Mold, too, must be viewed with caution: the metabolic toxins produced by the fungus are carcinogenic and may lead to liver damage. Moldy bread, vegetables or infected nuts must be discarded even if only parts are affected. The reason: toxins produced by the mold-causing fungus, such as aflatoxins, can spread unnoticed.

Consume quickly

Green areas on potatoes, which develop if exposed to light during storage, are also toxic. Difficulties evaluating freshness arise if spoilage cannot be tasted. Milk heated at ultra-high temperatures to produce long-life milk, for example, will not go sour if spoiled. As a rule, once a package is opened, its contents should be consumed quickly. Once opened, microorganisms, oxygen and moisture will enter and shorten shelf life. In closed packages, however, many foods are good for days, weeks and even months past the designated best before date. Juice, in an unopened glass bottle, for example, is good up to twelve months longer, up to 8 months longer in a carton and up to 3 months longer in a plastic bottle, states the Consumer Advice Center in Hamburg, Germany.

Millennia-old honey

Canned goods can last months to years past the date on the packaging. And some foods such as rice, pasta, salt and honey practically last forever if stored under dry, dark and cool conditions. For example, the honey found in the millennia-old graves of Egyptian pharaohs would theoretically be fit to eat today.

In order to support the fight against food waste, the German government wants to replace the best before date with the date of manufacture for those foods with long shelf lives. In addition, it supports research into intelligent packaging: freshness-indicators on the inside of the packaging lid will react with metabolic products such as sulfur dioxide or alcohol which are produced during food spoilage, and as result, the packaging lid will change color. Consumers then recognize immediately whether the food is still fresh. Perhaps they will be reassured and reach for it even if the product is already a few days old: a first step to counter the waste. ■

Consuming Versus Savoring

On the topic of food of the future, two opposing trends have recently become evident: while there is a strong desire for practical, readily available meals, we are simultaneously experiencing a rising awareness of health and sustainability.

Protein Source
A lab smoothie from soy and lentils – the food of the future?

Humans live in tight quarters, water is a luxury commodity, and instead of vegetables and meat, the only food available is "Soylent," an artificial laboratory food made from soy and lentils. The 1973 science fiction thriller "Soylent Green" is set in the New York of the year 2022 – depicting a world on the edge of an abyss.

While the near future of the US metropolis may not look quite as bleak, other parts of the world are already plagued with scarcities of both water and food which cause acute problems today. This is why researchers are actively searching for alternative sources of protein while developing industrial mass products as a response to the growing world population.

Powdered food from the laboratory

One of the artificial foods that have been on the market for approximately two years is actually marketed under the name "Soylent". According to the manufacturer, Rosa Labs in California, the brownish drink made from soy, lentils, fiber and trace elements satisfies the nutritional requirements of an entire day and is thus meant to replace natural food entirely. The joy of cooking, common meals and the experience of a natural variety of flavors seem to be falling by the wayside.

Products such as "Soylent" have their fingers firmly on the pulse of the time. According to a trend study by future-researchers at the AZTI-Technalia Institute in the Basque Country, food of the future must be readily available, practical and compact. The accelerated pace of life of city dwellers with their "here and now" mentality influences how and what we eat, the researchers explain. "Consumption with flexible time management" is their term for the increasing desire to satisfy needs immediately, everywhere and to the highest possible quality.

The food corporation Nestlé's® answer to this trend is "Boost". According to company information, Americans in particular like to reach for the low-calorie powder with supplemental protein, vitamins and minerals. Food services that allow intelligent purchases and consumption with the lowest possible time expenditure are also expected to do well according to the Basque researchers.

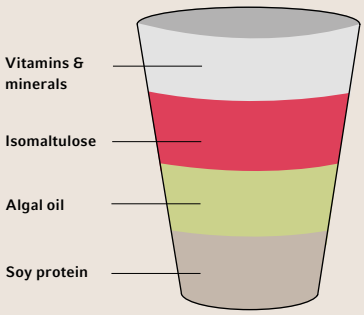
Healthy and sustainable

The growing consumption of snacks, power-bars and instant food, however, is countered by a second mega-trend: increasing health awareness and the desire for a sustainable life. According to a Nestlé study on the diet of the year 2030, humans will place increasing value on the gentle treatment of both the environment and our natural resources. Consumers will pay more attention to their own health and will want to know where their food is coming from. Fruit and vegetables will more often originate from local and organic sources, at higher prices than those seen today.

Quick and easy, but at the same time sustainable and healthy – this is the predicted food of the future. Time will tell whether these opposing demands will be able to coexist in real life. ■

i

SOYLENT:
What is in there?



The Lily of the Desert – the Myth Never Dies

For thousands of years, Aloe vera has been credited with healing powers. Viewed through a scientific lens, however, the plant can seldom do its legendary reputation justice.

Aloe vera is not only valued as a decorative, evergreen indoor plant, but it also enjoys the nickname "Empress of healing plants". The oldest historic texts testifying to the special powers of the plant, also known as the "lily of the desert" (see info box) were found on Sumerian clay tablets near the Iraqi city of Nippur and are more than 4,000 years old. Egyptian papyrus scrolls dating back to the 16th century BC, too, mention several medicinal recipes which are based on Aloe vera. Similar historic documents, which attest its healing and cosmetic properties, also exist in Roman, Arabic, Greek, Indian and Chinese sources.

Even Cleopatra, Alexander the Great and Christopher Columbus are said to have relied on the plant's special powers. The discoverer of America, who specifically carried potted Aloe vera plants on his ships, awarded them the title "doctor in a flower pot". Of the approximately 300 different species within this family of plants, Aloe barbadensis Miller is first and foremost credited with healing properties – hence the name "true Aloe" (Latin: Aloe vera).

Aloe products conquer the market

For the past few decades, the lily of the desert has experienced a virtual boom. The cosmetics and food industries, in particular, continue to bring ever more anti-aging products to the market. In gel form, Aloe is also used for a variety of skin conditions including sunburn, mosquito bites, eczema, wounds or burns. This is not solely due to the pleasant cooling effect of the gel, but also to the active ingredients acemannan and salicylic acid. The former is a long chain sugar molecule with immune defenses, while salicylic acid, a major ingredient in the drug Aspirin®, has analgesic properties.

Sparse scientific fact

Even though Aloe-based remedies have been used for a large number of skin problems, hardly any flawless scientific proof of their medical effectiveness exists to date. As such, only two randomized controlled studies are known which attest to the usefulness of an Aloe vera preparation in cases of psoriasis. Most other studies do not fulfill the stringent scientific standards applied to clinical studies, since, for example, they did not include a control group which received a placebo.

Capable of enhancing other substances

Professor Edzard Ernst is among those researchers who have intensively studied the different areas of application of Aloe vera for some time. The physician, origi-

Toothbrush
The juice of the leaves is applied internally and externally

nally from Germany, conducts research in the field of complementary medicine at the University of Exeter in England. Ernst confirms that Aloe vera is capable of enhancing the effect of cortisone-based preparations. "Certain blood pressure medications, too, are subject to increased effect, as well as heart medications, for example medication for arrhythmia and heart failure." That said, the physician adds a warning that Aloe vera juice may lead to diarrhea, kidney damage and salt deficiencies (loss of electrolytes). Topical use of the gel, on the other hand, has not been linked to any adverse effects. In 2009, an Iranian study conducted at the Mazandaran University of Medical Sciences in the city of Sari confirmed the long-held assumption that the lily of the desert may positively influence the healing process in cases of burn injuries.

The 30 patients on this study had suffered second degree burns on different areas of their hands or feet. In each patient, one burned skin area was treated with an Aloe vera preparation while another was treated with silver sulfadiazine. The result: the skin areas treated with Aloe healed significantly more quickly. Thus, the study provided proof of the antimicrobial, anti-inflammatory and cell-proliferative effects of the preparation.

No proof of a miracle remedy

In addition, convinced supporters credit Aloe vera all kinds of healing powers. In their opinion, the plant, as a natural medicine, helps with high cholesterol, diabetes, allergies, inflammation, joint and muscle pain, irritable bowel syndrome and ulcers. Some even insist that Aloe vera helps with multiple sclerosis, Alzheimer's dementia, AIDS and cancer. Caution is advised in the face of such claims, as conclusive scientific proof of the effectiveness of Aloe vera preparations in any of these diseases has so far been elusive.

A special vitamin cocktail?

Thanks to intense marketing efforts, which benefit from the old myth surrounding this plant, more and more customers also reach for food additives that contain Aloe ingredients. While it is true that the inside of the Aloe vera leaf contains vitamins, minerals, trace elements and essential amino acids as well as secondary plant substances which are valuable for the body, these nutrients are also available from other plant-based foods, and none of the substances is present in noticeably high concentrations. This is the reason that manufacturers refer to the serendipitous circumstance that the ingredients within the lily of the desert complement each other perfectly, thus creating a synergy which will achieve an optimal effect. This, however, cannot be scientifically verified; it is therefore best not to expect true miracles from the "Empress of healing plants". That being said, Aloe vera does not carry the title "doctor in a flower pot" entirely for nothing. ■

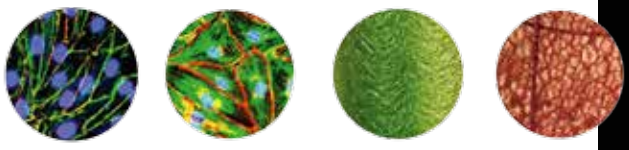
INFOBOX

CHOC-FULL LEAVES

Aloe vera is related to cacti and belongs to the plant genus of succulents. These are especially well adapted to barren climate and soil conditions. In order to survive extended periods of drought, they have the ability to store water. The lily of the desert uses its thick, spiky leaves for this purpose. If these 40 to 60 centimeter long moisture reserves are cut, a yellow bitter-tasting resin originating from within the outer layers will drip out. This resin has a strong laxative effect and mainly serves the plant as protection from animal predation. The inside of the leaf contains a clear, almost colorless viscous mass. In addition to 90 percent water, it also contains acidic heteropolysaccarides of mainly D-glucose and D-mannose. Additional components may include simple sugars such as glucose, mannose, galactose and xylose as well as water soluble vitamins, amino acids, amylase, alkaline phosphatase, lipase and salicylic acid.

Desert-Queen
Consists of 90 percent water

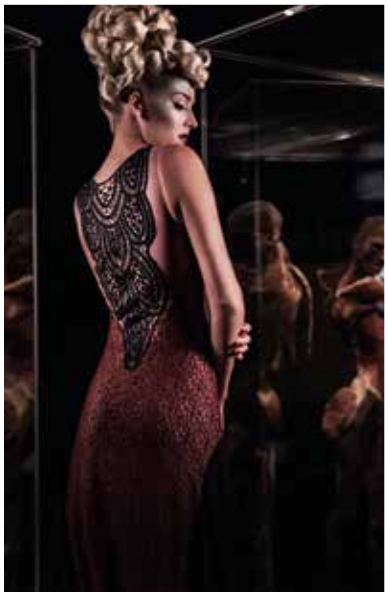
Lab Lifestyle



Science meets Fashion ▸

Fabrics reminiscent of neural networks. Dresses displaying complex scientific facts. The collective Descience takes science to the catwalk. Interdisciplinary teams of designers and scientists create fashion that finds its inspiration in, for example, molecular biology. The research focus of bioengineer Christopher Gibson, a rare genetic disease named "Cerebral Cavernous Malformation", provided the basic idea for the creation by designer Candice Wu, who was mainly inspired by textures and colors (see image). Wu's design is intended to stimulate public awareness for rare genetic diseases. In this way, research topics may be expressed in a unique fashion and simultaneously communicated to a broad audience. This concern is shared by Descience managing director and neuroscientist Yuly Fuentes-Medel. Her goal is to connect two worlds that have never before crossed paths and offer them a forum.

www.descience13.carbonmade.com



Creating awareness
Textures and colors, inspired by molecular biology

Make your own Jewelry!

Wear what others like to work with!
This is what you need:

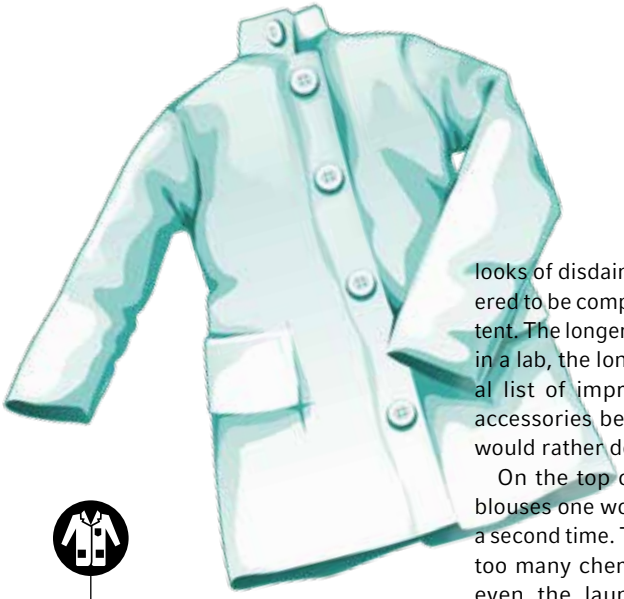
Tips:
6 x Eppendorf epT.I.P.S.®, Eppendorf Quality™, 0.5 – 10 mL
2 x Eppendorf epT.I.P.S., Eppendorf Quality, 20 – 300 µL
2 x Eppendorf epT.I.P.S., Eppendorf Quality, 2 – 200 µL
2 x Eppendorf epT.I.P.S., Eppendorf Quality, 50 – 1000 µL

Beads:
4 diced turn-up blocks
2 structured plastic beads
1 glitter bead
20 small sparkle beads

Others:
1 closure with eyelet and 2 squeeze beads
1 soft craft wire

Tool:
1 hand drill
1 jewelry tweezers

www.eppendorf.com/OTB/LabLifestyle



▲

Fashion in the Lab – the eternal Frontier?

Fashion magazines often cover topics like "The new business look" or "Casual Friday – what is allowed". This question does not often come up in the lab. My outfit on a Monday: a white lab coat. My outfit on a Casual Friday: a lab coat, grimy after a week of work.

Many Barbie accessories are banned from the lab in any case, "for safety reasons", such as handbags, ties or stiletto heels. Seriously, whoever shows up like that will most likely draw looks of disdain and be considered to be completely incompetent. The longer one has worked in a lab, the longer the personal list of impractical fashion accessories becomes that one would rather do without.

On the top of my list: (silk) blouses one would like to wear a second time. There simply are too many chemicals that defy even the laundry detergent from that long-running TV-show. And anyone who has ever worked with Trizol will know that open sandals are a sure-fire ticket to the ER.

No shorts under the coat

In university laboratories, people will hardly ever make the clothing underneath someone else's lab coat their business. Even an outfit like that of Bridget Jones is viewed with indifference by most as long as it is covered by the lab coat. But! There is one rule: no shorts under the lab coat unless you want to seem undressed. Large companies with a cafeteria, however, tend to foster a different attitude towards fashion. Who wants to be caught next to the socialites from Finance and Marketing wearing an inappropriate dress and immediately be labeled an annoying nerd? Our beloved lab coat has long been banned from the cafeteria, and rightly so. Genetically modified material does not belong in food. It also means that we will not be able to hide our style.

Well, does it exist, fashion in the laboratory? Thanks to the numerous regulations, it is met with more obstacles than it is in an office environment. But to quote Coco Chanel: "Fashion is not something that exists in dresses only. Fashion is in the sky, in the street, fashion has to do with ideas, the way we live, what is happening." So: there is fashion in the lab! After all, you may always choose your own personal style.

Janina Otto (26) is doing her PhD at the Institute of Anatomy and Cell Biology at the Philipps-University Marburg in Germany. Furthermore, since 2015, she has been participating in Science Slams to make research and science more transparent. Have a look on Facebook® *www.facebook.com/JaninaIOtto/* and also on YouTube®: *www.youtube.com/watch?v=mDNgf-GdqiBA*

At the Bench

www.eppendorf.com/pipetting

Natural Allure

Between the alpine foothills and the Jura Mountains, on the shores of Lake Geneva, lies the most international city in all of Switzerland. Geneva, with its fine boutiques, bistros and restaurants, is home to people from roughly 150 nations. Between July 2 and 5, 2017, the small metropolis with the international flair will host the annual meeting of the European Society of Human Reproduction and Embryology (ESHRE).

High quality of life
Lake Geneva, with its 140 meter high water fountain "Jet d'Eau", is the largest lake in Central Europe

Classic patrician houses
The Rhone flows from the Alps into Geneva's Old Town

A city that feels connected to the entire world is not in need of a Twin City. You will search in vain for any signs listing the otherwise common sister communities when entering Switzerland's second largest city. Geneva is open to the entire world. One could not ask for a better friend.

"Capital of Peace" is another name for the francophone city of 200,000 in Switzerland's southwest. Geneva is home to the offices of more than 200 international organizations, including the European office of the UNO, the Red Cross headquarters, the World Health Organization WHO as well as the United Nations High Commissioner for Refugees.

The streets, restaurants and cafes are meeting places for diplomats, scientists, bankers and visitors from the four corners of the earth. Geneva's share of foreigners is close to 50 percent. Perhaps a life of relaxed togetherness contributes to the laid back atmosphere. According to the American consulting firm Mercer, Geneva consistently ranks among the Top 10 of cities with the highest quality of life. Anyone who visits the city with its effervescent landmark, the 140 meter high water fountain "Jet d'Eau", in the summer will agree.

Participants of the ESHRE conference held in the Geneva Conference Center Palexpo, where Eppendorf is also represented (see info box on page 25), may want to consider arriving early to leave enough time to enjoy the colorful scenes in the winding cobblestone streets of the old town. A coffee at the Place du Bourg-de-Four in front of Saint Peter's Cathedral is an absolute must. Here, in the oldest ▶

square of the Geneva Old Town, you can rest and stay for a while, watching the passers-by swing their shopping bags filled with expensive luxury brands. If you are on the lookout for an exclusive souvenir yourself, take a short trip to the Rue du Rhône – one of the noblest shopping streets in all of Europe. The side streets and their small shops, boutiques and galleries invite you to go for a stroll.

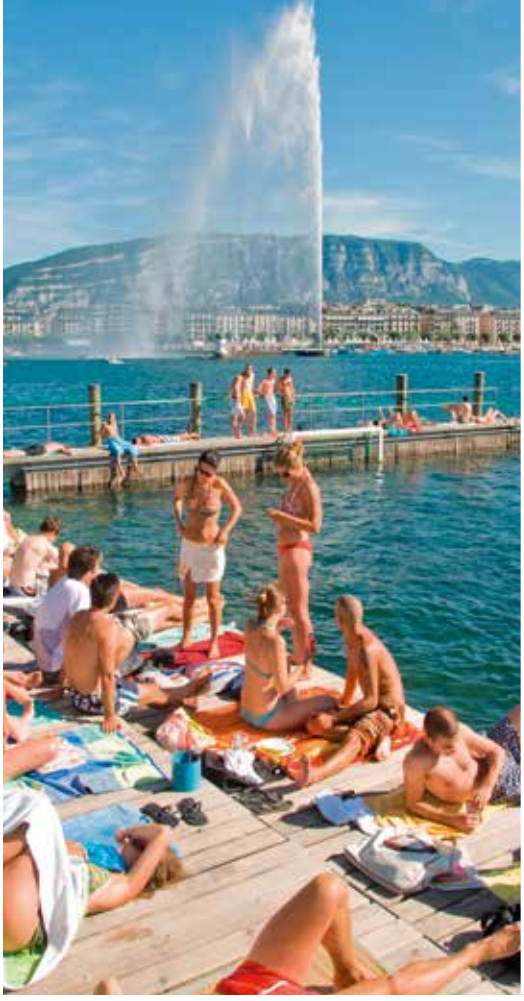
The town Carouge with its Saturday market on the Place du Marché is only a short streetcar ride from Geneva's city center. As early as the morning you may enjoy a glass of wine, along with the latest gossip: artists, antique dealers and the architecture with its Sardinian roots radiate a Mediterranean atmosphere. After all, Carouge once belonged to the kingdom of Sardinia-Piemont.

Are you looking to relax under ancient trees? On the old city wall, the four reformers Johannes Calvin, Théodore de Bèze, Guillaume Farel and John Knox keep vigil over the centrally located "Parc des Bastions". In the "Parc la Grange", 200 varieties of roses display their vibrant blossoms – surrounded by terraces, water basins, pergolas and stairs of natural stone.

The cultural heart beats in the "Quartier des Bains". Its Museum of Anthropology hosts approximately 80,000 artifacts. Numerous galleries and cultural establishments lend the former bath quarter the flair of "Little Soho" of Geneva.

Sophistication is at home on the right shore of Lake Geneva, with five-Star hotels and shimmering office towers standing side by side. The prices in the restaurants all around the prestigious marina give a hint as to why, according to a 2015 statistic by the economic magazine "The Economist", Geneva, along with Zurich, has been elected the most expensive city in the world.

For visitors leaving Geneva by plane, the city will not roll out the red but rather the black carpet. The Aéroport International de Genève is the first airport in the world that scans the shoes of the passengers using sensors embedded in the floor covering. This way, travelers will know in advance whether their shoes will trigger a metal detector alarm – allowing them to save time when passing through security. What a pleasant farewell service. ■



LET'S GO!

Day Trips and Leisure Activities in Geneva

1 **WATER TAXIS** and 130 year old ships from the "Belle Epoque", which also take their guests to neighboring France, cross Lake Geneva. If staying on shore, the largest lake of the Alpine Region can be explored on foot or from the comfort of a mini-train such as the "Trans-Eaux-Viviens".

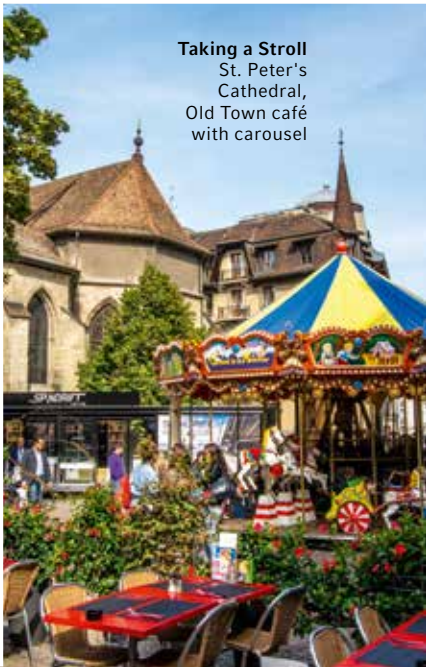
THE OLD TOWN with its 2000-year history towers over the southern shore of the lake. All paths to the center converge at the Place du Bourg-de-Four, which has been home to a market place since the 11th century. During the 16th century, Johannes Calvin preached in the Cathedral of Saint-Pierre.

3 Bathing while enjoying the breathtaking views of Lake Geneva – this is possible in the legendary **BAINS DES PÂQUIS.** Located just steps from the water fountain, it features a sauna, a hamam and a high-end snack bar.

4 **THE GENEVA WATCH TOUR** invites you to explore the history of Swiss watches, leading you past approximately a hundred boutiques and a dozen historical monuments. "All around the clock" is also the motto of the Patek Philippe Museum.

5 The specialties of the **CHOCOLATIER DU RHÔNE** in the Rue de la Confédération will weaken the determination of even the most persistent calorie-counters. The classic: dark chocolate ganache with the subtle flavors of exquisite teas.

Fun on the water
Relaxing at the Bains des Pâquis, cruising with the Swiss flag



Taking a Stroll
St. Peter's Cathedral, Old Town café with carousel

6

Leaving the city and delving into nature: the local mountain **MONT SALÈVE** is only a hop, skip and a jump from the city center. It offers lovely hiking trails with fantastic views of Mont Blanc.

7

The outside appearance of the **CAFÉ DU SOLEIL** in the Geneva neighborhood of Les Crêts may be unassuming; connoisseurs, however, praise the quaint little restaurant with the cozy courtyard for its exceptional cheese fondue.

ESHRE® 2017: EPPENDORF PRESENTS NEW MICROINJECTORS

At the annual meeting of the European Society of Human Reproduction and Embryology (ESHRE), held this year in Geneva from July 2–5th, Eppendorf will present its new manual microinjectors, optimized for the performance of manual microinjection and ICSI, to the scientific public. Design and construction of the CellTram® 4m Air and Oil placed special emphasis on optimal handling comfort and highest precision. Dr. Rudolf Walczak, Global Product Manager Cell and Liquid Handling, explains: "Both CellTram 4m models offer a number of improvements over our previous generation of microinjectors. The CellTram 4m Air is highly suited for the injection of cells, e.g. sperm, whereas the CellTram 4m Oil significantly facilitates working with involving oil-injectors. We are pleased to offer these new injectors to our customers." Eppendorf will present the new products at the ESHRE at the Geneva Exhibition and Congress Center Palexpo in Exhibition Hall 2.

8

Who are we and where do we come from? Answers abound in Meyrin in the Globe of Science and Innovation, which stands as a symbol of the earth, on the **CERN** research campus. The 27 meter high globe is home to the World of Science, particle physics and high technology. The exhibition features the "Universe of Particles".

9

The International Red Cross and Red Crescent Museum is located just across from the Palace of the League of Nations. The permanent exhibit "**THE HUMANITARIAN ADVENTURE**" provides an exciting overview of the challenges of humanitarian missions.

Expand and Deepen Your Knowledge

The new online platform "Eppendorf Handling Solutions" provides scientists and students with a comprehensive source of information, replete with expert knowledge on the daily challenges of laboratory life.

Eppendorf has created this online platform to share its extensive expertise in a contemporary format with its clients, providing them with the means to expand and deepen their knowledge of different subject areas in accordance with their specific needs and requirements. In the area "Cell Handling", clients will find information on the important challenges of cell identity, reproducibility and contamination. The latter, in particular, is a controversial topic in laboratories, as unidentified contamination can destroy cultures and render experimental data useless. For this reason, the platform includes a list of the most common types of contamination alongside their defining characteristics.

Videos are also available

The section "Did You Know" shines a light on the potential sources of mycoplasma and how contamination with these and other bacteria can be avoided. In addition, videos are available covering this and other topics. Users are invited to watch a short film on the movements of different bacteria in cell cultures and how they may be distinguished from harmless non-viable particles in the medium. Furthermore, Eppendorf cell handling experts provide professional training sessions on sterile technique and cultivation of eukaryotic cells. An overview of this and other training opportunities is available online under "Eppendorf Training Center" (see page on the right).

In the section "Liquid Handling", laboratory staff will find another broad selection of topics with scientifically interesting and helpful articles covering daily laboratory activities. Different contributions focus on helping them stay informed on the importance of exact pipette calibration, on how the quality of the pipette tip impacts experimental results and how automation can save valuable time, as well as on the most important aspects to consider when handling difficult liquids. Users will also benefit from practical tips on how to best pipet oily or foamy substances.

Interested researchers now have access to practical help in the form of PDF documents, webinars or videos, and Eppendorf clients are invited to test their newly acquired knowledge right away in the different games available on the online platform. For example, users can prove whether, as fast pipetters, they qualify for the title "Pipetting Ninja". Proficiency is rewarded in the form of a downloadable certificate. ■

https://handling-solutions.eppendorf.com/

Ongoing knowledge
Online test for pipetting: "Ninjas" can print out a certificate

Know-how for Daily Laboratory Routines

This year marks the 20th anniversary of the Eppendorf Training Center. Since its inception, we have continually expanded our training repertoire.

Exactly 20 years ago, Eppendorf created the Eppendorf Training Center. Since that time, experienced trainers have conveyed to users customized know-how geared towards their specific daily laboratory needs in face-to-face courses as well as through internet-based seminars (webinars). Thanks to these webinars, and the discussion periods which immediately follow them, Eppendorf customers worldwide have access to many topic areas around the laboratory, such as, for example, bioprocessing, automation and cell culture. Even more intensive practice-oriented training courses are offered in the three state-of-the-art training laboratories in Hamburg (Germany), Namur (Belgium) and Kuala Lumpur (Malaysia).

Broad course selection

All locations experience an especially strong demand for training in the area of Liquid Handling, offered by, for example, the course "Dispensing systems in the laboratory". Among other valuable information, it provides participants with tips for manual as well as electronic pipetting.

In addition to the correct use of pipettes and dispensers, course participants learn how to calibrate, clean and maintain the systems. Along the same lines, Eppendorf offers courses on the topic area of automation. The focus of this course is the time-saving pipetting station ep*Motion*® and how to program and operate it to perform standard laboratory applications.

Depending on the location, training courses in the topic areas of bioprocessing or PCR are also available. The training portfolio from Eppendorf has continually evolved over the past two decades; it was recently expanded to include a new training division in the field of Cell Handling." We enjoy a large cell culture laboratory with sterile workbenches. As instructors, this facility provides us with the ideal conditions under which to convey the fundamental basics of how cells are cultivated without introducing contaminations", explains Dr. Jessica Wagener, Application Specialist at Eppendorf Hamburg. Once again this year, Eppendorf offers international face-to-face training sessions in the area of micromanipulation, which will be held in cooperation with the European Molecular Biology Laboratory (EMBL) in Heidelberg, Germany.

Discussion and exchange of experiences

"It is important to us to address the individual questions of our participants, which is why we restrict group size. The contents reflect current laboratory demands and are designed in such a way that they may be transferred directly to daily laboratory routine", says Natascha Weiß, Application Specialist at Eppendorf.

Furthermore, seminars are designed to provide an opportunity for participants to engage in discussion, and the course schedule allocates time to allow for an intensive exchange of ideas and experience, thus providing the participants with additional input for their practical work. At the end of a course, participants will receive a corresponding certificate which certifies their qualifications. The Eppendorf schedule of training sessions is geared towards beginners learning the fundamental basics of a given application as well as towards advanced customers who wish to refresh or expand their knowledge. While the practical seminars are typically conducted at the Eppendorf training laboratories, certain training sessions may be held directly at the customer's site upon request. ■

ANNIVERSARY DISCOUNT

Book your training session until May 18, 2017 and secure your anniversary discount of 20 percent on the following cell culture training courses in Hamburg, Namur and Kuala Lumpur:

May 18–19, 2017: Cell Culture Basics, course language: German (Hamburg)

June 02, 2017: Cell Culture Compact, course language: German (Hamburg)

November 30–December 01, 2017: Cell Culture Basics, course language: German (Hamburg)

June 08–09, 2017: Cell Culture Basiscs, course language: French (Namur)

October 12–13, 2017: Cell Culture Basics, course language: French (Namur)

June 15–16, 2017: Cell Culture Basics course language: English (Namur)

October 19–20, 2017: Cell Culture Basics, course language: English (Namur)

July 25–27, 2017: Cell Culture, course language: English (Kuala Lumpur)

Visit *www.eppendorf.com/training* and mention **"Off the Bench"** in the comment field.

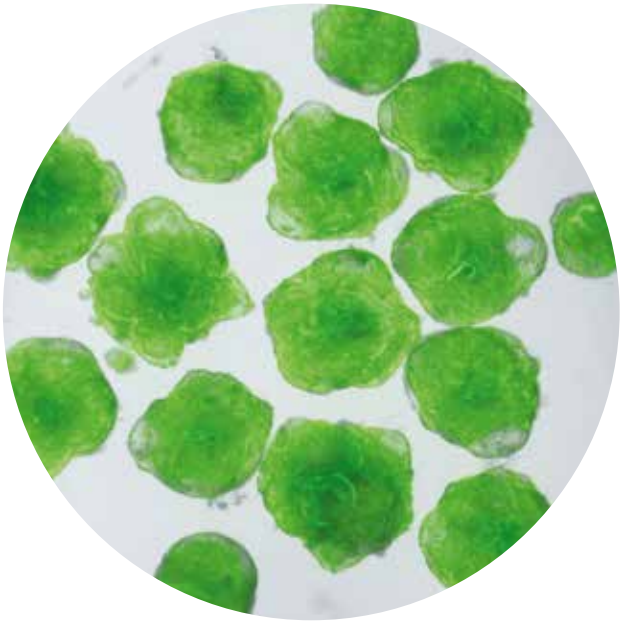
Technology for the Heart

Nothing less than the complete transformation of classic transplantation methodologies in cases of heart disease drives the scientists during the four-year term of the interdisciplinary research project "Tools and Technologies for Breakthrough in heart Therapies", in short, TECHNOBEAT.

Instruments and methods

The project, coordinated through the Hannover School of Medicine (MHH), is put into practice by eight interdisciplinary representatives from industry and research. With a budget of close to six million euros in grants, paid within the EU research framework program Horizon 2020, researchers, physicians and engineers are developing innovative instruments and methods in order to harness human stem cells for the production of micro heart tissue destined for regenerative medicine. "In the future, these small tissue composites may be cultivated outside the body in bioreactors and subsequently injected into patients in the form of a cellular implant in order to repair diseased heart tissue", says TECHNOBEAT project coordinator Robert Zweigerdt.

Eppendorf, as a leading manufacturer of bioprocess solutions, is one of the partners within this network. For the purpose of large-scale cultivation of stem cells, Eppendorf development engineers and product managers will develop novel impeller and vessel designs to optimize shear characteristics and to enable the integration of filter systems and holographic microscopy into the bioreactors.



Cystic cardiac speroids generated from human induced pluripotent stem cells.

▲

Eppendorf acquires Calibration Technology

The Eppendorf AG is expanding its international business ventures. In late 2016, the leading life science company with headquarters in Hamburg, Germany, acquired its long-standing partner, Calibration Technology Ltd (CTL) in Ireland. The company, founded in 2005 and based in the National Technology Park in Limerick, had at this time been an authorized Eppendorf Service Center for the calibration and repair of pipettes and dispensers for the past eight years. "We have had a very good partnership with Calibration Technology for many years now, and we are pleased that this acquisition will allow us to extend our service offering, especially for customers in regulated areas", comments Thomas Bachmann, President & Chief Executive Officer of Eppendorf AG.

Expanding the service

CTL, which is henceforth integrated in the Eppendorf Group as a wholly owned subsidiary, will continue to be led by company founder and Managing Director Brian Kelly. "We are delighted to be part of the Eppendorf group of companies and look forward to expanding our service range for existing and new customers. We plan on hiring a number of new Calibration Engineers over the coming years", explains Kelly. At this time, the firm employs 13 staff, including nine Calibration Engineers who primarily calibrate the pipettes on-site at the customer's premises. For this purpose, CTL uses state of the art calibration software linked to the Laboratory Information Management System to manage and process all aspects of the calibration process including the issue of calibration certificates.

▲

Eppendorf BioNews

Since 1993, BioNews has been a respected and popular source of information for researchers and scientific staff. It is published twice per year and features reports on new products and areas of application, tips and news as well as useful Application Notes written by the Eppendorf Application Specialists or guest authors.

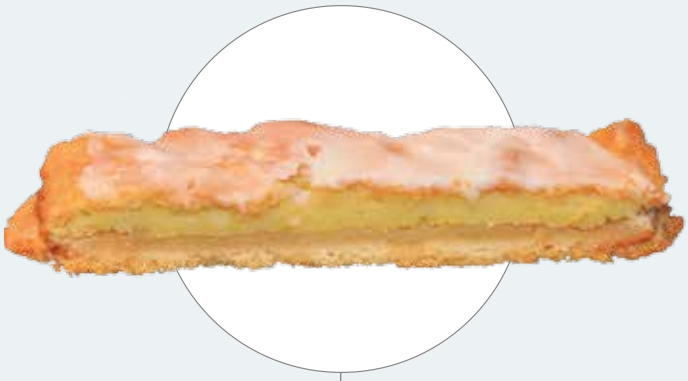
Scientific and always geared towards daily work in the laboratory, its clear layout and recurring columns provide a quick overview of novel products and relevant information for daily laboratory practice.

Project Leader Berrit Hoff: "The Application Notes in particular benefit from our international network of Product Specialists and Application Specialists who are always receptive to current trends during client visits, at training sessions, or when staffing the customer hotline and who contribute valuable content."

If you are interested in becoming a BioNews reader, ***www.eppendorf.com/bionews*** will get you started by ordering your free subscription, or simply peruse the online version at your leisure!

Easy Puff Pastry

Bring your own Recipe



INGREDIENTS

Crust:
1 cup flour
½ cup butter
2 Tablespoons water

Puff Pastry:
½ cup butter
1 cup water
1 teaspoon almond extract
1 cup flour
3 eggs

Icing:
1 cup confectioner's sugar (powdered sugar)
1 teaspoon almond extract
Milk to achieve desired consistency

Family tradition
Laboratory technician Tamela Steindorf, who works in an oil refinery in Kenai, Alaska, shares her favorite recipe with our readers in this issue of "Off The Bench". It came to her from her mother, who liked to serve the pastry at breakfast on special occasions. Tamela Steindorf and her sister are continuing in this family tradition. We hope you will enjoy baking, and – bon appetit!

1 Mix flour into butter and then add water. Divide into two parts. Spread each part onto ungreased cookie sheet in two 12" x 3" strips.

2 Bring water and butter to a rolling boil. Add the almond extract. Mix in flour quickly so that the mixture is smooth and doesn't separate. Remove from heat and add each egg separately, making sure that each one is well incorporated before adding the next. Spread evenly over crusts made in step one. Bake at 350° F. (175° C) for one hour. When cool, top with icing.

3 Combine powdered sugar and almond extract. Add milk to achieve desired consistency. Iced cooled pastry.

Tipp: If you really enjoy the flavor of almond, for a delicious variation, put a thin layer of marzipan paste (almond paste) between the bottom crust and the puff pastry layer.

What's your favorite recipe?
We want to hear from our readers! Send us your favorite recipe, along with a photograph.

magazine@eppendorf.com

Paper Writing Gone Hollywood

JEFFREY J. MCDONNELL

Science
AAAS

INFOBOX

This article is reproduced with the kind permission of the journal "Science", where this contribution was first published on January 6, 2017 in the section "Working Life".

So you want to be a writer?" one of my professors asked me when he learned I was interested in a career as an academic scientist – a pointed warning that a life of science is also a life of writing. But even knowing this in advance, I found that writing was a challenge as I made my way down the tenure track. I had trouble finding stories in my data sets. Even when I had a good tale, I struggled to tell it. I tried starting with the opening sentences and hoping I'd make it to the paper's end. But more often than not, I wrote my way down many blind alleys. My permanently unfinished papers outnumbered my published ones. Worst of all, I was not helping my PhD students and postdocs learn proper writing craft.

Outlining the overall story

My big break came shortly after getting tenure. In a passing conversation, a senior colleague mentioned that his process for writing research papers centered on structure. Rather than focus on words and sentences, the part of writing that so bogged me down, he highlighted the importance of outlining the overall story to be told. I had thought that the standard paper structure – introduction, methods, results, discussion, conclusions – was enough to keep me on track. But my colleague helped me realize that, even with those sections, there is still enough freedom to get stuck in writing cul-de-sacs.

I now see each of the standard paper sections as its own Russian nesting doll. Writing papers is easiest when you spend considerable thought and time stacking all these pieces first. I call it the top-down writing approach.

Each of my group's papers now starts with a storyboard session at a whiteboard. I pretend to be a big-time Hollywood producer and ask the PhD student or postdoc to play the role of would-be movie director pitching a new movie to me. Their pitch must answer three questions: What is the status quo? What is wrong with the status quo? How does this new paper go beyond the status quo? This approach helps frame the story and place key figures and technical findings in context. Balancing each of the status quo elements is a great way to set up the introduction – often the toughest section for early-career scientists to write – and to lead the reader to the research questions or hypotheses. Say too little about what we already know and one risks losing a large audience who may be unfamiliar with the topic. Too little about what's wrong with the current state of knowledge and the reader may wonder why we need yet another paper on that topic. Too little about how the work goes beyond what others have done and the novelty is unclear. The result is a roadmap of the novel elements in the work, which brings the discussion – the other tough section for the writing newcomer – into final focus.

This approach helps frame the story and place key figures

Once the pitch makes sense, we go back and forth stacking the Russian dolls on the whiteboard until the outline subheadings become paragraph topics, with every paragraph explicitly represented in the outline. Honing this outline prior to any writing allows us to determine whether the research story resonates from start to finish.

It's time well spent

We might spend days or weeks on the outline to get it right, but it's time well spent. The slavish adherence to nested headings shows at a glance whether the paper makes a clear and worthy contribution; whether the title, objectives, and results are properly aligned; what figures are truly essential to the storyline; and whether the message hums. Writing then becomes a much easier process of filling in the blanks. The paper is effectively finished before the sentence writing starts.

I haven't mastered the writing game, and I am still constantly learning. But the top-down approach has been a game changer in my group. Now, when a new grad student indicates an interest in an academic career, I ask, "So you want to be a Hollywood producer?" ■

Jeffrey J. McDonnell is a professor in the School of Environment and Sustainability at the University of Saskatchewan in Saskatoon, Canada, and Sixth Century Chair at the University of Aberdeen in the UK. *He thanks the faculty, students, and postdocs at the Global Institute for Water Security for feedback.*

From Big to Small
Before the magnificent mountain backdrop, the powerful wapiti bulls appear small and fragile. With this photograph, Robert Sommer secured first place in the category of adult photographers.

Fighting Wapitis

With his impressive photograph, Robert Sommer won the competition of "Photographer of the Year". The prize will be awarded by the Royal Society of Biology in cooperation with Eppendorf.

About Robert Sommer

I was born in 1984 in Röbel/Müritz in Mecklenburg-Western Pomerania. Growing up in the land of a thousand lakes, I have always enjoyed exploring nature and discovering new places. I fell in love with photography in 2009, taking pictures of anything and everything in sight.

For the past few years, however, I have been focusing exclusively on nature photography and I get outside as often as possible. With the broad spectrum that nature has to offer, from landscape photography to animal and plant photography, it is never boring.

My other passion, besides photography, is traveling, which is why the majority of my photographs originate from forays into foreign lands. That being said, I always appreciate my native landscape and I continue to explore the Mecklenburg Lake District or the nature reserves around the city of Hamburg, where I currently live and work.

About the Photograph

After arriving in Banff on the previous day and being able to take only a few pictures of Moraine Lake that afternoon, I made a plan that did not entirely meet with Lisa's approval. I wanted to greet the sunrise at a lake 90 km away. I spent all evening deliberating whether or not to go ahead – but since this was going to be our only opportunity, we were up by 4 am the next morning. The clear and starry skies proved to be deceptive: an hour and a half later, as we arrived at Moraine Lake, it was raining buckets. There seemed to be no end to the rain, and we decided to make our way back to the hotel.

Shortly before we arrived at the hotel, the sun came out, prompting us to stop briefly to enjoy the view of the Rocky Mountains. We had been hiking a short distance when Lisa suddenly spotted two Wapitis emerge from the forest. The two stags walked into the Bow River and started fighting! I could barely believe my eyes, two Wapiti stags engaged in combat in the middle of the river, with the Rocky Mountains behind them. I could not have dreamed of ever beholding such a spectacle.

When I did take the photograph, I was determined to capture the entire scene. The sparring stags alone would have been phenomenal, but the Rocky Mountains in the background made the scene absolutely unique.

I had witnessed and photographed beautiful occasions before, but this was by far the most stunning experience. We could hear the crashing sounds as the Wapitis' antlers collided. The spectacle lasted a mere five minutes, and the two stags disappeared from view as quickly as they had appeared. Both of us had a big smile on our face as we headed for breakfast. The rain at sunrise was long forgotten, and in fact, it had granted us this amazing experience. Sure, we would not have known what we had missed, but in the end, everything was just right.

ROYAL SOCIETY OF BIOLOGY YOUNG PHOTOGRAPHER COMPETITION

Since 2012, the Royal Society of Biology has held the International Photography Competition, and the competition "Photographer of the Year" has since been held annually with a different focal topic. Last year's topic was "from big to small", and for the first time microscopic shots have been admitted to the competition. Eppendorf has supported this competition as the only sponsor from the industry for many years. Two awardees are selected: photographers older than 18 years, like this year's senior winner, Robert Sommer from Germany, will compete in the adult category while younger talents, like Pradyuman Samant (see also pages 34 and 35), have the opportunity to compete for the title of Young Photographer of the Year.

Tiny Creatures, ready for their Close-up

Pradyuman Samant has been named Young Photographer of the Year by the London Royal Society of Biology. With his photo entry "The Beginning", the 16 year old from India convinced the expert jury and was awarded first prize in the category of under 18 year olds. The photograph, which shows a close up of tiny bush frog tadpoles inside their egg membranes, was, in the opinion of the members of the jury, the best among a total of 317 entries for this year's theme "Biology: from Big to Small". When asked about his award-winning photograph, taken in the region of Amboli in the West of India, the laureate says: "We have a huge planet with some tiny creatures we often ignore. Some people find it unpleasant to even look at them and some aren't even bothered. But no matter how big our world is, the beginning is always small. These bush frog tadpoles will be part of our big world someday, while others will be washed away in the rain."

eppendorf

Are You a True Master?

Cell culture work, which includes seeding, cultivation, and analysis, holds a special place in the daily laboratory routine. Whenever cells are affected, experimental conditions are as different as the cells themselves.

Become an expert in cell handling.
Join us at www.eppendorf.com/cellexperts

Eppendorf
Handling Solutions

www.eppendorf.com/cellexperts

AQ42813020/INT/33T/042017