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...since the very first issue of Lab Times saw the light of day. Can you believe it? In the inaugural edition’s editorial, we explained how we came up with the idea of creating this magazine: “In our numerous conversations with scientists, science officials or people from the bio-business community, the discussions ever more frequently went into the ‘European dimension’. Hence, it was easy to foresee that in the ensuing years, the life sciences in particular would have to fulfill an increasingly important European role, when plans for creating a ‘European Research Area’ and making the European Union into a ‘knowledge-driven economy’ were proclaimed. The life sciences in the old world would clearly have to become ‘more European’ in the near future.” Hence, the world’s first News Magazine for the European Life Sciences was born. Perhaps, in the hope of making a minor contribution to the ambitious plan of a grand European Research Area, in which research and science would be promoted and supported as much as other economic sectors across the whole of Europe.

Ten years later, however, we have to recognise (and accept) two rather dismal facts. First, with the recent Brexit and many other nations currently discussing leaving the European Union, we might be further away from a united Europe and, thus, also from a single European Research Area than ever before.

Many UK scientists fear the consequences the referendum might have on their research life and rightly so. Nobody knows exactly what will happen after the EU exit. This uncertain future will also keep foreign talent away and might even drive them to countries outside of Europe – the exact opposite of what the European Research Area is striving for. Will the UK and the EU get their act together and somehow reach an agreement? Or can we already kiss goodbye the idea of a “unified area open to the world, in which science works and what science needs.” Bureaucrats might be one handicap; in recent times, universities are increasingly run by bureaucrats that do not know how science works and what science needs." Bureaucrats might be one handicap; in recent times, universities are increasingly run by bureaucrats that do not know how science works and what science needs. Instead, they are now among the most conservative of intellectual time bombs that constantly shake up our society with new ideas. Instead, they are now among the most conservative of intellectual time bombs that constantly shake up our society with new ideas. Instead, they are now among the most conservative of intellectual time bombs that constantly shake up our society with new ideas. Instead, they are now among the most conservative of intellectual time bombs that constantly shake up our society with new ideas. Instead, they are now among the most conservative of intellectual time bombs that constantly shake up our society with new ideas. Instead, they are now among the most conservative of intellectual time bombs that constantly shake up our society with new ideas. Instead, they are now among the most conservative of intellectual time bombs that constantly shake up our society with new ideas. Instead, they are now among the most conservative of intellectual time bombs that constantly shake up our society with new ideas. Instead, they are now among the most conservative of intellectual time bombs that constantly shake up our society with new ideas. Instead, they are now among the most conservative of intellectual time bombs that constantly shake up our society with new ideas. Instead, they are now among the most conservative of intellectual time bombs that constantly shake up our society with new ideas. Instead, they are now among the most conservative of intellectual time bombs that constantly shake up our society with new ideas. Instead, they are now among the most conservative of intellectual time bombs that constantly shake up our society with new ideas. Instead, they are now among the most conservative of intellectual time bombs that constantly shake up our society with new ideas. Instead, they are now among the most conservative of intellectual time bombs that constantly shake up our society with new ideas. Instead, they are now among the most conservative of intellectual time bombs that constantly shake up our society with new ideas.

But not everything is bad. Throughout the last decade, also some good ideas to strengthen Europe as a research haven have been realised, like the European Research Council (ERC). After a few teeth-gritting troubles, the Council is now one of the cornerstones of European research funding and will continue to be so in the future. “I want to build on the work of organisations like the ERC, so that Europe remains an exciting destination for world-class research and becomes the home of open innovation, open science and open to the world,” Carlos Moedas, European Commissioner for Research, Innovation and Science recently stated in the annual ERC report.

For the last ten years, we did our best to bring European researchers closer together – through reading and interacting with us and the wider research community. At this point, we also want to encourage more of you, our readers, to tell us about your daily trials and tribulations, sorrows and successes, opinions and options.

To celebrate our anniversary, we, once again, broke the usual magazine mould and put together a special issue for you, with interviews, essays and a background story on European science in the news. In this issue, Eduardo Moreno, for instance, shares his thoughts on how science could, one day, make us immortal, one of our freelancers traces her career path from scientist to science writer, young investigators tells us about their experiences setting up a research group and senior scientists report on the various struggles with the current research system and what could be done to (borrowing a populist slogan) “make European science great again”.

We hope that when we celebrate our next anniversary, we can report a more positive trend, showing how things in Europe will have changed for the better. On this note, happy reading!
There’s no shortage of science in the news. But does the coverage reflect the true state of modern science? Jeremy Garwood reports. (p. 22)

The beginning of a successful career. Caroline Dean talks about her passion for plant biology and her strategy to keep more women in academia. (p. 36)

What happened to the 46 biotech companies that have been featured in Lab Times since April 2006? Did they reach for the stars – or did they crash and burn? (p. 40)

Dream or nightmare? CRISPR/Cas-powered gene drives hop across chromosomes and propagate themselves down through the generations. (p. 58)
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A Decade in Science and Lab Times

Celebrating our TEN-YEAR anniversary, we thought; why not look into the past and revive some memories from times gone by, including a few gems from the Lab Times archives.

2006

Research: In May, scientists involved with the Human Genome Project publish the sequence of Chromosome 1. This brings the ambitious international project, formally launched in 1990, to a successful end. “The completion of the project (...) is a monumental achievement that will benefit the research community for years to come and is a credit to all involved,” says Mark Walport, then director of the Wellcome Trust, in a press release. *Later this year, geneticists publish the genome sequence of the first tree, the black cottonwood poplar (Populus trichocarpa).*

Science Community: The bird flu virus, H5N1, keeps the world on tenterhooks. As the crisis is unfolding, scientists agree on sharing their samples and data, and creating a global consortium, the Global Initiative on Sharing Avian Influenza Data, which is still running today. *In one of the biggest research scandals of all time, Woo-Suk Hwang admits to having fabricated his human cloning data and is later charged with embezzlement and violating bioethics laws.*

Prizes: This year’s Nobel Prize in Physiology or Medicine goes to Andrew Fire and Craig Mello “for their discovery of RNA interference – gene silencing by double-stranded RNA”. The Nobel Prize in Chemistry goes to Roger Kornberg “for his studies of the molecular basis of eukaryotic transcription”.

Lab Times: In April, the very first issue of Lab Times sees the light of day. The inaugural edition features an article about the new hope for European basic science, the European Research Council, and an opinion piece by immunologist and spokesperson of the protest movement, Sauvons la Recherche, Alain Trautmann. In his article, Trautmann analyses the big divide between scientists’ and politicians’ mindset and notes that “our policy makers have a very naïve but deeply-rooted belief that public research efforts should produce results in a very short period of time, compatible with the horizon of the next election. Such a perspective is in deep contradiction with the needs of basic research”.

2007

Research: By virally inserting just four transcription factors, Japanese researcher Shinya Yamanaka and colleagues successfully reprogramme adult human fibroblasts to become induced pluripotent stem cells or iPSCs. This discovery would later win him a Nobel Prize. *Throughout the year, the genome sequencing race picks up speed. Everything that falls into geneticists’ hands is analysed: the rhesus monkey, grapevine, the ancient mastodon, even a four-year old Abyssinian cat named Cinnamon. The first “individual genome to be sequenced for less than $1 million” is that of James Watson, co-discoverer of DNA’s structure. Later that year, Watson would utter the infamous racist quote that cost him his reputation and post at the Cold Spring Harbor Laboratory.*

Science Community: A survey by the World Conservation Union paints a bleak picture for Europe’s flora and fauna. Not less than 250 mammals, among them the Iberian lynx and the European mink, are classed as “vulnerable”, or worse. *In July, Andrew Wakefield must answer for his research practices at a General Medical Council hearing. The scientist, who suggested a link between autism and the measles, mumps and rubella vaccine, is accused of working without proper ethical approval. Amongst other things, Wakefield must comment on the allegation that he “acted unethically and abused his position of trust as a medical practitioner by taking blood from children at a birthday party”.*

Prizes: The Nobel Prize in Physiology or Medicine goes to Mario Capecchi, Sir Martin Evans and Oliver Smithies “for their discoveries of principles for introducing specific gene modifications in mice by the use of embryonic stem cells”.

Lab Times: In issue 5-2007, we talked to Swiss-Austrian biochemist, Gottfried Schatz. Looking back on a long career, he has some interesting thoughts to share. “We older professors give most of our young colleagues the idea that teaching just takes time away from research and therefore endangers an academic career. When I was young and looked at a job offer, I always asked about the ‘teaching load’, but never about the ‘research load’. I am afraid that most young scientists behave that way. And you cannot really blame them, because tenure and international recognition come with success in research rather than success in teaching.”
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**2008**

**Research:** In January, scientists at the J. Craig Venter Institute in the US describe how they managed to create the world’s first synthetic bacterial genome. They did so by synthesising and assembling the 582,970 base pair genome of the bacterium, *Mycoplasma genitalium*. In 2010, the same team generated the first synthetic cell. *Across the pond, researchers at the University of Newcastle-upon-Tyne create embryos containing genetic material from multiple parents.* "I wouldn’t feel comfortable doing it [in patients] now for a number of reasons," lead scientist, Patrick Chinnery, told Nature News back then. In 2015, the UK allowed fertility clinics to offer the "three parent baby" technique. *In June, at a Spanish hospital, a certain Paolo Macchiarini performs the widely-acclaimed, first tissue-engineered, whole organ transplant, replacing the patient’s damaged trachea with a new one, generated from the patient’s own stem cells.* Just a few years later, the same Macchiarini would be accused of research misconduct and unethical practices.

**Science Community:** In January, the 1,000 Genomes Project is launched, aiming to sequence the entire genomes of 1,000 people to “create a highly detailed reference map of human genetic variation”. When the project was completed in 2015, the genomes of 2,504 individuals from 26 populations had been reconstructed. *Throughout Europe, hundreds of scientists receive the very first grants from the newly established European Research Council, ERC. With a budget of €7.5 billion, the ERC wants to “boost the careers of researchers” and thereby strengthen the European Research Area.*

**Prizes:** This year’s Nobel Prize in Chemistry goes to Osamu Shimomura, Martin Chalfie and Roger Tsien “for the discovery and development of the green fluorescent protein, GFP”. The Nobel Prize in Physiology or Medicine is shared between Harald zur Hausen “for his discovery of human papilloma viruses causing cervical cancer” and Françoise Barré-Sinoussi and Luc Montagnier “for their discovery of human immunodeficiency virus”.

**Lab Times:** In issue 2-2008, we spoke with Richard Smith, board member of PLoS and former editor of the *British Medical Journal*, about Open Access. “The forces that are driving Open Access are just too strong to resist. Eventually, I’m sure all scientific research will be open access in its fullest sense. Not only that you can have access to it for free but also that you can take the material and reproduce it; that you can work with it. Open access has to happen. The fundamental arguments about making publicly-funded scientific research available to everyone everywhere are now so strong that in the end they must prevail. Although, I’m not quite so sure about exactly how and in what time frame.”

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**2009**

**Research:** Another flu virus outbreak makes headline news throughout the year. This time it’s the swine flu (H1N1). In April, WHO’s director general, Margaret Chan, calls the outbreak a “public health emergency of international concern”. Research shows that the virus is particularly nasty, containing genetic pieces from four different influenza viruses (North American swine influenza viruses, North American avian influenza viruses, human influenza viruses and swine influenza viruses found in Asia and Europe). *At the European Molecular Biology Laboratory in Heidelberg, scientists make a big step forward to establish a model organism for systems biology. Peer Bork and colleagues catalogue all – the proteome, transcriptome and metabolome – of *Mycoplasma pneumoniae*, a respiratory pathogen and find that “a single protein has several different jobs in a cell”.

**Science Community:** Evidence is growing that a popular brain imaging method is to be taken with a pinch of salt. In “Voodoo correlations in social neuroscience”, later renamed “Puzzlingly high correlations in fMRI studies of emotion, personality, and social cognition”, PhD student, Ed Vul, finds that many brain imaging studies suffer from poor analyses, which distort scientific conclusions. Later that year, Craig Bennett et al would put a dead Atlantic Salmon into an fMRI scanner, adding more fuel to the flickering fMRI flame. *In July, EMBO announces its next director, taking office in January 2010. Developmental biologist, Maria Leptin, is only the fifth director in the organisation’s 52-year history and the first woman. “I am thrilled to continue the initiatives begun by previous directors that promote the molecular life sciences in Europe and worldwide,” she says upon her appointment.* *In September, José Manuel Barroso, acting President of the European Commission, thinks out loud about a European chief scientific adviser, “who has the power to deliver proactive, scientific advice throughout all stages of policy development and delivery”. Only three years later, in 2012, Anne Glover becomes Europe’s first (and, for now, last) chief scientist.

**Prizes:** This year’s Nobel Prize in Chemistry goes to Venkatraman Ravakrishnan, Thomas Steitz and Ada Yonath “for studies of the structure and function of the ribosome”. The Nobel Prize in Physiology or Medicine is shared between Elizabeth Blackburn, Carol Greider and Jack Szostak “for the discovery of how chromosomes are protected by telomeres and the enzyme telomerase”.

**Lab Times:** Celebrating Darwin year, in issue 1-2009, we talked to population geneticist and book author, Steve Jones, who told us that “in fact, molecular biology/genetics is really nothing more than what Darwin did, which is comparative anatomy. It just costs a lot more money; that’s the only difference.”
Polyomaviruses are prevalent in the human population

BKV is associated with different urinary tract diseases and is one of the major causes of kidney loss in transplant patients. An effective management of the infection requires an early detection and further determination of the viral load in urine and blood samples.

JCV is the causative agent of progressive multifocal leukoencephalopathy, a neurological disease, which occurs frequently in AIDS and other immunocompromised patients.

JCV and BKV infections are symptomless in healthy individuals.
**2010**

**Research:** Rummaging through marine sediment, Danish researchers find some strange bacteria. These prokaryotes possess “nanowires” to collaborate over long distances with electric currents. “Electrical communication between distant chemical and biological processes in nature adds a new dimension to our understanding of biogeochemistry and microbial ecology,” the scientists say. After ten years of hard work, the Census of Marine Life is finally released and reveals that there is much more swimming and floating in our oceans than we could have imagined. Participating researchers estimate there to be 50 million ocean species or even more. From just a tiny piece of finger bone, found in a cave in southern Siberia, scientists in Germany reconstruct the complete mitochondrial DNA sequence of an extinct hominin, the Denisovan. “In combination with the Neandertal genome sequence, the Denisovan genome suggests a complex picture of genetic interactions between our ancestors and different ancient hominin groups,” lead author, Svante Pääbo, says.

**Science Community:** In February, Europe has a new research commissioner. Máire Geoghegan-Quinn is thrown in at the deep end – she’s entrusted with designing the next Framework Programme of Research, FP8, or as it will eventually be called, Horizon 2020. During the summer, a number of stem cell researchers worldwide receive anonymous e-mails from a group called “Stem Cell Watch”, accussing them of scientific misconduct. The accusations seem made up of thin air and give the impression that this is nothing more than a smear campaign. At the end of the year, NASA scientists are ready to rewrite biology textbooks. In a Californian lake, they claim to have identified bacteria that use arsenic instead of phosphorus to make biomolecules. It doesn’t, however, take long before fellow scientists point out several issues with the Science paper, which put the final conclusion on shaky grounds. Despite heavy criticism and trouble replicating the finding (by other groups), the paper has neither been corrected nor retracted to this day.

**Prizes:** This year’s Nobel Prize in Physiology or Medicine goes to Robert Edwards “for the development of in vitro fertilisation”.

**Lab Times:** In issue 4-2010, Jennifer Rohn, cell biologist, book author and blogger, reveals scientists’ evil side: “When you write scientific papers, you have to thank everybody. Everybody is so polite. But, in reality, a lot of the time when you publish a paper, you are fighting against this sea of useless opponents. And I thought it would be a whimsical thing to point out some examples from the past when people – not very nice people – had muscled their way into my papers having done nothing, or otherwise having obstructed my life. This happens all the time, it’s just not pretty. It is a war out there with scientific publications. A war!”

**2011**

**Research:** 2011 was a “gutsy” year. In May, a group of scientists, spread all over Europe, describe enterotypes of the human gut microbiome. Independent of age, gender, nationality and diet, people can be divided into three groups, according to the predominant bacteria in their guts. “The three gut types can explain why the uptake of medicines and nutrients varies from person to person,” says Jeroen Raes from VIB and Vrije Universiteit Brussel, one of the lead researchers, in a press release. Around the same time, another gut bacterium, E. coli, strain O104:H4, wreaks havoc in Europe, especially in Germany. Just like 2009’s swine flu virus, this bacterium is a never-before-seen evil superbug, made up of several different pathogenic E. coli strains. Scientists reveal some of its unusual features: it not only produces extended-spectrum ß-lactamases, complicating its antiobiotic treatment, it also produces cytotoxic Shiga toxins. In the end, the pathogen will have killed 53 people and infected close to 4,000.

**Science Community:** In Denmark, a research scandal rocks the University of Copenhagen. Neuroscientist Milena Penkowa is accused of scientific misconduct and misspending grant money on a grand scale. The independent Danish Committee on Scientific Dishonesty investigates the case and later confirms the accusations. Six retractions and a court sentence for faking data (“nine month suspended sentence with a two years probation”) follow. In October, the two science advocacy groups, European Science Foundation (ESF) and the European Heads of Research Councils (EUROHORCs) join their forces and found ScienceEurope, a new European Science Foundation (ESF) and the European Heads of Research Councils (EUROHORCs) join their forces and found ScienceEurope, a new Brussels-based group, that wants to become “the single voice for science in Europe”. In an attempt to unite Europe’s research elite, the European Commission forks out some money: €1 billion over ten years for two Future and Emerging Technologies (FET) flagship projects. Six projects apply: Guardian Angel (nano-scale sensors and interfaces for detecting and responding to environmental dangers), Robot Companions (soft-bodied “perceptive” robots for the lonely), FuturICT (planetary-scale modelling of human activities and their impact on the environment), ITFoM (applying research data more efficiently in health care) and the later winners, the Human Brain Project and Graphene.

**Prizes:** The Nobel Prize in Physiology or Medicine goes to Bruce Beutler and Jules Hoffmann “for their discoveries concerning the activation of innate immunity” and to Ralph Steinman “for his discovery of the dendritic cell and its role in adaptive immunity”.

**Lab Times:** In issue 1-2011, Elena Cattaneo tells us that it’s not easy for a stem cell researcher in a Catholic country like Italy, “It took me a long time to realise that this discussion does not have to do with religion. It has been a challenging period of time, during which I learned what it means when somebody restricts my freedom to doubt, to inquire, to explore.”
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**Research:** A consortium of over 400 researchers release a new encyclopaedia, the Encyclopedia of DNA Elements (ENCODE). The participating scientists conclude that 80% of the genome has a biochemical function. This unexpectedly high number made some bioinformaticians turn into linguists. “Like many English language words, ‘functional’ is a very useful but context-dependent word”, project coordinator Ewan Birney would later write in his blog.  
In August, a team of scientists from the USA, Sweden and Austria would, almost unnoticed, publish a paper describing the workings of a bacterial immune system. “Our study (...) highlights the potential to exploit the system for RNA-programmable genome editing”, is the paper’s last sentence. It takes about a year, before scientists and media realise the true revolutionary potential of the CRISPR/Cas system for molecular biology.

**Science Community:** Discussions about the risks of mutant flu research flare up in the beginning of the year. Will the benefit of better understanding a potentially deadly pathogen, outweigh the risks of accidental or intentional release of the virus? To give the public, government officials and scientists time to find answers to these pressing biosecurity questions, flu researchers agree on a voluntary pause of research for, initially, 60 days. After a one-year moratorium, work on mutant influenza restarts in early 2013. In 2012, the open science movement takes a big step forward. First, mathematician Timothy Gowers publicly pledges to neither publish, nor referee or do editorial work for publishing giant, Elsevier. (To-date, 16,000 scientists signed Gowers’ petition.) Then, two new publications that want to do things differently and improve scientists’ publishing experience, are launched: eLife, funded by the Howard Hughes Medical Institute (US), the Wellcome Trust (UK) and the Max Planck Society (GER), and PeerJ. The latter offers a one-off lifetime membership fee (currently $399) for unlimited open access publications and submissions.

**Prizes:** This year’s Nobel Prize in Chemistry goes to Robert Lefkowitz and Brian Koblika “for studies of G-protein-coupled receptors”. The Prize in Physiology or Medicine is shared between Sir John Gurdon and Shinya Yamanaka “for the discovery that mature cells can be reprogrammed to become pluripotent”.

**Lab Times:** In issue 1-2012, we talked to newly-minted Balzan Prize laureate and theoretical biologist, Russell Lande, who told us that too much knowledge can be a hindrance. “I never had a formal course in genetics nor a formal course in statistics. But I became well known for my contributions to statistical genetics. If you are too highly trained, you’re stuck in traditional ways of thinking and it’s difficult to break out.”
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**Lab Times**

**Review**

**2014**

**Research:** With the help of supercomputers with a terabyte of memory, an international team of scientists sifted through the genomes of all modern birds (Neovaves). What some called the “most comprehensive genome study of any major branch of the tree of life”, revealed that bird diversity exploded some 60 million years ago, just at the time when the dinosaurs had exited the world stage. “We’ve figured out that protein-coding genes tell the wrong story for inferring the species tree. You need non-coding sequences, including the intergenic regions,” co-author Erich Jarvis says. *Meanwhile, in California, scientists create the first “semi-synthetic organism with an expanded genetic alphabet”. The engineered E. coli bacterium faithfully replicates a plasmid with an unnatural base pair called d5SSCS–dNaM.* *Other researchers employ the power of mind to control gene expression. Using an EEG headset, the brain activity of human volunteers fires up an electrical field generator, which in turn powers an LED, implanted under the skin of a mouse. The emitted light then causes optogenetically engineered cells to produce a reporter protein. “Being able to control gene expression via the power of thought is a dream that we’ve been chasing for over a decade,” lead author Martin Fussenegger says.*

**Science Community:** A sensational announcement astonishes stem cell researchers right at the beginning of the year. Japanese scientists claim that all it needs to generate pluripotent stem cells is some external stress, such as physical squeezing or exposure to low pH. This sounded too good to be true and it didn’t take long before the initial amazement turned into doubt about the two papers’ validity. Ultimately, the STAP cell saga ended in two retractions, a co-author’s suicide and the lead author’s resignation from her post. *After a public vote to impose immigration quotas, Switzerland is excluded from applying to EU grants. Later that year, the ban is loosened somewhat and Swiss scientists can again apply for grants from the Horizon2020 programme.*

**Prizes:** This year’s Nobel Prize in Chemistry goes to Eric Betzig, Stefan Hell and William Moerner “for the development of super-resolved fluorescence microscopy”. The Nobel Prize in Physiology or Medicine is shared between John O’Keefe, May-Britt Moser and Edvard Moser “for their discoveries of cells that constitute a positioning system in the brain”.

**Lab Times:** In issue 1-2014, Pascale Cossart, pioneer in infectious disease research, talks about being a woman in science. “What is hard is not what people generally think is hard. I did not find it hard to combine life as a scientist and as a mother. What I found hard is the kind of internal guilt. When I was working in the lab and thought of my children at home I felt guilty for not being at home. When I was on vacation with my children I felt somehow guilty because I was not in my lab taking care of my group.”

**2015**

**Research:** Iceland paints the “genomic portrait of its nation” - with the brain and computer power of deCODE genetics. Based on whole-genome sequence data from over 100,000 people, the scientists identify, for instance, several thousand human knock-outs. “It also shows how a small population such as ours, with the generous participation of the majority of its citizens, can advance science and medicine worldwide,” Kari Stefansson, deCODE’s founder and CEO, comments. *Just when you thought there’s nothing new to discover, UK researchers find two extra neurons in the exceptionally well-studied C. elegans worm. These two “mystery cells of the male”, or MCMs, have an important function – they “allow males to remember previous sexual encounters and prioritise sex [over eating] in future situations”.*

**Science Community:** As a world first, Chinese scientists report using the CRISPR/Cas technique to genetically modify human embryos – to explore a possible cure for ß-thalassaemia. The scientific community is split: some demand an immediate stop of human embryo research: others say it will produce valuable knowledge and should proceed. *In the UK, a research team at the Francis Crick Institute applies for a licence to edit genes in human embryos to gain “fundamental insights into early human development”. After months-long waiting, accompanied by massive media reports, the license is granted on February 1st, 2016. *Willful modification, duplication or mislabelling of images in order to make them look cleaner or more convincing", bring about plant scientist Olivier Voinnet’s downfall. The scientific misconduct will, eventually, result in 22 corrections, seven retractions and a funding ban for three years.* *In November, the European Commission announces its new science advice mechanism – a panel of seven researchers from all corners of science. Amongst them: CERN’s former head, Rolf-Dieter Heuer, and Janusz Bujnicki, a bioinformatician from the International Institute of Molecular and Cell Biology in Warsaw. Currently, the panel is pondering its advice on cybersecurity and “real-world CO2 emission testing for light duty vehicles”.*

**Prizes:** This year’s Nobel Prize in Chemistry goes to Tomas Lindahl, Paul Modrich and Aziz Sancar “for mechanistic studies of DNA repair”. The Nobel Prize in Physiology or Medicine is shared between William Campbell and Satoshi Ōmura “for their discoveries concerning a novel therapy against roundworm parasites” and Youyou Tu “for her discoveries concerning a novel therapy against Malaria”.

**Lab Times:** In issue 3-2015, we spoke with Peter Tindemans, Secretary-General of Euroscience, a grassroots association of researchers in Europe about the best way to spend EU funding: “Research infrastructures are an evident case where you could do many good things at the European level, because the practice in Europe has been that it all depends on individual countries, who act with a very complex but, in effect, non-existing model and who then have to try to find agreement.”
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Science and immortality

A Scientific Afterlife?

Could we imagine a mixture of scientific methods, which would permit human consciousness to exist after the death of the body? Scientist and writer Eduardo Moreno Lampaya explores this idea.

Death makes no discriminations. We are all fated to die but we have a strong survival instinct. To cope with this, many persons around the world find relief believing in life after death. Interestingly, among my generation, more people appear to have faith in afterlife than in God: a survey of the 1970 British Cohort group – 9,000 people currently in their forties – found that more than 50 per cent believed in an afterlife, while only 30 per cent believed in God. If reality will be decided by a democratic vote, we will have afterlife. An afterlife without God.

Just a tradition

Is the majority right? Somehow surprisingly, most modern scientists do not seem to agree. An informal poll I made, asking scientists via Twitter if they believe in life after death, showed that more than 80 per cent do not believe there is an afterlife. “There is no proof for it, it is just a tradition” is a common answer to explain why many scientists think there is nothing beyond biological death. This is somewhat discouraging because it means there is little comfort in science, once medical technology fails to save the life of your loved ones.

As I am typing these letters, my grandmother, Carmen Lelita Latorre, 93 years old, is sedated, in a hospital bed, with pulmonary infection. Doctors have given up on treatment. Earlier this year, Marcos Vidal, a friend and researcher at the Beatson Institute for Cancer in Scotland, died in his early forties, leaving his wife Julia and two kids. As a consequence of those sad events, just as an injured animal licking his wounds, I found myself thinking and researching about how science could resuscitate loved ones.

No escaping?

First, I learned it is possible to separate human tradition from the possibility of an afterlife, because not all traditional cultures have faith in eternal life. For example, the Hadza hunter gatherers of Tanzania have no specific belief in the hereafter and the decease of an individual is simply the end of human existence. One could, therefore, consider the Hadza as a traditional society that believes in the everlasting cessation of a person’s consciousness after death. Time is limited and there is no escape. But we could at least try to upset Death’s plans!

Interfering with death

Very much like naughty kids harassing a dominant adult, scientists could try to interfere with death. One of the most exciting tasks of a scientist is to formulate a hypothesis. Could we therefore hypothesize a combination of plausible, even if not yet available, methods, through which science might achieve endurance of human consciousness after the death of the body?

There are several problems to ponder. For instance, most scientists believe that consciousness requires a functioning brain. Because brain function ceases upon death, consciousness should disappear at that time. Endpoint. But what if consciousness could be transferred from the brain to another support system just at the time of death, or shortly before?

It has been recently argued that we may be able to upload our consciousness to computers (Artif Intell, 171 (18): 1161–73). If this speculation were to come true, uploading your soul to a computer before death might be the scientific equivalent of an afterlife. But we are far from realizing this goal. The Human Brain Project will probably show that knowing the position and connections of all human neurons is not sufficient to understand the mind; just like knowing the position and connections of all neurons in a simpler animal, like the worm C. elegans (Dev Biol, 56, 110-56), was not sufficient to fully understand the worm’s behaviour.

Digital immortality

One could be optimistic and argue that, in the future, further understanding of the functional relations, neuronal types and plasticity will eventually allow us to understand the human psyche. This, together with the development of computation that resembles biological brains, may at some point allow digital immortality. After biological death, people will be able to spend the rest of their life in virtual worlds by uploading their minds to computers, transcending the need for a biological body.

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is, however, unlikely that this could be directly applied in the already deceased.

Another possibility could be the achievement of biological immortality. Stimulation of telomerase (Cell, 43(2 Pt 1):405-13) and rejuvenated cells, enabling selection of the best cells within tissues (Cell, 160(3):461-76) or protecting against cancer (Cell, 135(4):609-22), could gradually increase life expectancy. And then, at some point, we may be able to increase it every year more than the year just gone, which has been termed “longevity escape velocity”.

From that moment, there will be a great divide. The first immortal person may only be a few years younger than the first 150-year-old person. Although not everyone may agree, a colleague at a recent meeting said she wanted to believe that that generation will be called “The Lucky Ones”. Forever young? But what if your loved ones already died? Is there hope for them? Let’s imagine we could travel in time.

Travelling to the future should be easy. According to Einstein’s theory of relativity, an elementary form to travel to the Earth’s future could be accomplished by cruising in space near the speed of light and then coming back to Earth (The Future of Space-time, 2002). A further improvement of future travelling could be achieved by bending space-time using parallel cosmic strings. But, just like swimming against a current is more demanding, travelling to the past (against the arrow of time) is not so simple and many physicists believe that it is unlikely. One theoretical possibility for backward time travel is, however, going through a wormhole connecting distant regions of the Universe (Phys Rev D, 47 (2): 554–65). Theoretically, it may not be impossible, after all. Remarkable. So, let me now speculate about an audacious scenario, in the distant future, in which humans had achieved the three goals mentioned above.

Our descendants had subsequently become downloadable, eternal and able to travel in time. Then the rescue could start. People from the future could travel back in time to see their loved ones, download their minds before their death. And send them to the future. Once back in the future, they could upload their minds into avatars and resuscitate their long lost heroes, relatives and friends. Beautiful.

Just like Heaven... or Hell

But would people want to go and trawl the past for ancestors? For the resuscitated, it would be like going to Heaven. Only those who had nobody going back to resuscitate them, would die the usual way. It could be said that Hell was having nobody in the Future that loved you enough to come back for you. Ruthless.

But, then again, maybe not everybody wants to enjoy an afterlife. Would that result in overpopulation, resource distribution tensions, social inequalities? Would living forever, after resurrection, become a boring schedule of habits, stuck with one personality, one view of the world? Or would we be enjoying an exciting afterlife of permanent novelty? What would you choose if the choice existed?

Eduardo Moreno Lampaya
UK vote to leave the European Union

Common Market Grief

Brexit came unexpectedly for many British researchers. In this essay, neuroscientist Vincent O’Connor vents his disappointment and looks into the future.

On the 24th June at about 4.45am it was official, the UK had voted to leave the European Union. I had already gone to bed after the traditionally early electoral announcement from Sunderland confirmed this region had an 80% in favour of Leave. This was an area of the North East England, from where the Jarrov workers had marched to highlight the plight of the unemployed during the Great Depression in the 1930s. If a region with such a rich history in the fight for social and economic equality, in which there was traditionally little immigrant influx, had voted to leave, the cause was lost. I had hoped that despite clear imperfections in the EU, its encouragement of rights that spoke to the highest denominator would be recognised by the more marginalised communities across the UK and help win the day. When I awoke, my worst fears had been realised and the majority (insert slight, sizeable or significant, depending on your sensitivity) had rejected my strongly held view that we should remain. More profoundly, my bias was indeed quite at odds with large pockets of the country, who had by some margin taken the Brexit view.

Bursting the bubble

I suspect I was not alone in lashing out with my perceived view of the stupidity of these people. However, percolation of reality set against the truly great English/British spirit of free speech tempered my outrage. Gosh, I was angry but reflection led me to a deeper self-loathing and disappointment in self.

My initial conclusion was, this was based on embarrassment of not having done what much of the World and Europe, Russia withstanding, suggested was the "Right Thing". I was recognising that a lifetime in pursuit of the University life has placed me in a bubble and out of touch with large pockets of other people’s reality. I want to stress that this view is not based on the lazy slur that others often hold, suggesting Universities are ivory towers. Simply, my point is that the energy, focus and high end intellectual aspect that drives academic achievement leaves one largely untouched by any palpable disaffection that has motored the Brexit vote. In academia, we are surrounded by a highly converged view of the clear benefit that the EU positively makes to the state of our nation. This had clearly not prepared the collective us for such a crushing disappointment as evidenced by the nationwide re-assurances hastily put out by Universities as the sun rose on our brave new dawn.

No attention to University Life

I have always had an innate unease with the human brain makes its best decisions on a balance of judicious emotion and cold-hearted logic. In contrast, the Brexit decision seemed to be an opportunity to allow our Great Nation to articulate itself through some simple and rather base binary choices. This is a personal view but when confronted with a pencil and a ballot paper, whose marking can briefly wipe away a lifetime of disappointment, the result is unlikely to be considered.

I am a jobbing educator and aspiring scientist and the debate surrounding the impact of Brexit on this, my sector, would not even have been on the radar of the malcontents on the Hartlepool omnibus. In the Universities and Research environs the view was fairly unanimous: we would be lunatic to leave. This was the shielded view, unless you spoke to the colleagues in your Institution, who worked outside the academic ranks. To the credit of my own and most other institutions, the bare facts that the sector would be traumatised and uncertain by a Brexit vote was not fan-fared and people were largely allowed to draw their own conclusions.

My personal regret was that I was not more vocal in pointing out the difficulties that a Brexit vote would generate. It was clear that our academic communities and thus the institutions and infrastructures housing them did not feel the need to take up the Brexiteers offer to “Take Back Control”. We were empowered by membership of the European Union. The freedom of movement had allowed excellent colleagues to pitch up, be employed and enhance many if not all UK universities. We had enjoyed the dedication, aspiration and exoticism of EU undergraduates, who had chosen to take advantage of our excellent education culture and spend their money while doing so. And finally, with a suitable dose of British self-denouncement, the UK is good at research and science. This left us well-placed to be net winners in the competitive funding that EU structures provided. Thus, over and above any liberal minded world view, our membership came with a huge plus on the balance sheet.

A National Treasure on the line

Our science base, which I recognise as hugely undervalued in the national consciousness, is critical to our contribution on the world stage. However, this important point was likely not on any of the horizons that set the agendas for Brexit until after it was clear that we had voted to leave. The country has let down and made life more difficult for its Universities. However, “to be fair” why should those that voted for this, worry about this if they carry such levels of disaffection? What they should be clear about is that with great power comes huge responsibility. Thus, the Society, which despite its convenient mistrust of expertise, Vincent O’Connor is profess- sor of Neurochemistry at the University of Southampton, UK. He studies the molecular mechanisms of synaptic function and dysfunction.
will have to decide how important Universities and Research are. This means making good the shortfalls that a Brexit will cause or see the retraction of a National Treasure and diminution of a huge creative force that has delivered across millennia from Newton to Berners-Lee.

At the beginning of the debate, I had been pricked by Fintan O’Toole’s *Observer* article, which recognised deficiencies within the EU but defined a structured logic and emotional view about its force for good. The piece was illustrated by light map of a peace time continent. And how related we look when reduced to the light that emits from major European urbanisations. He stressed that the EU’s collectivism trolled a period of sustained peace on a continent that had endured two major wars and its associated human devastation. It seems strange that the EU’s contribution in challenging such re-occurrences failed to resonate sufficiently with those who thought they would Take Back Control.

On the contrary and based on some personal observations, depicting the political union as a harbinger of underhand fascism was a tacit explicit in the language of the leaders of the Brexit campaign. This was shameful but, based on my own experience, is a view that has been re-articulated by some people in the afterglow of the Brexit victory. Yes, some think by marking their ballot sheet, they participated in and have now won some kind of trans-European quasi military victory. I suggest (and secretly know) that we would be better placed to execute important trans-European victory by contributing economically, culturally, socially and politically from within Castle Brussels. Indeed, the kind of victories that our forefathers ensured would be more likely and less bloody with the immense contribution that the UK can make in smoke-filled rooms.

Of course it’s personal

The issue that clearly won the day was that we have too many immigrants and much of what resonates as disaffections follows from this. This hurts. My maternal grandparents and my father came as immigrants from the Irish Republic; they aspired and worked hard and in my grandfather’s case even joined a wartime British army. Their influx was met with boarding house signs of No dogs, No blacks, No Irish. By the time, I came along, this anti-immigrant view, particularly towards the white Irish, had subsided. Their Catholic Church going, sing-song socialising and fish on Friday eating had been assimilated and were now fully tolerated by UK society.

I, like many of the offspring of the Irish Diaspora into the UK, had climbed to various levels of differing greasy poles and played out all the elements of the re-occurring and universal immigrant story. It would be difficult for one with that backstory not to resent a decision obliquely driven by immigration. The global movements of people might be more challenging but the exemplar of the Irish driven by intelligence, aspiration and hard bloody work, will surely be repeated across future ages. It is clear that the UK’s experience in such matters would have been an important moderator in the developing debate and challenges facing Europe. Now, we will be shouting the advice from outside the tent and probably won’t be heard or trusted.

This disappointment is compounded by re-stating that the freedom of movement established within the EU has facilitated an important personal development. I was an unpublished post-graduate when I finished my PhD. With just interest, aspiration and a good UK education, I was looking to advance my scientific training. I was lucky that a German Professor (HB) saw something in my raw skill set. He invited me to work with his colleagues in Frankfurt am Main. I was free to travel with my young family and generously supported by the Max Planck Society, Royal Society and Alexander von Humboldt Foundation. This was eventually supplemented by funds from the German Research Fund (DFG). This was blind to my nationality, providing a raw UK scientist with the single most important experience in determining him becoming a fully fledged independent scientist. This training has advantaged (and some might say hindered) the UK University sector for the last 15 years. I was welcomed, encouraged and cajoled in Germany by an international cast of colleagues often with huge grace and kindness. This consequence of the EU culture has an additional inward benefit as several young and well-trained European scientists will have arrived, enjoyed and added great value to the UK research base. On the 24th June, upon arriving at work, there was a large group of forlorn-looking colleagues gathered around the kettle! This included UK nationals and young scientists from several EU countries. They were anxious for their futures. Reassuringly, they had been very British about it and gathered to drink tea at a time of crisis.

My own view is that freedom of movement is as important as goods in cutting-edge research. Thus, keeping the status quo post-Brexit is non-negotiable, if our research base is to be taken seriously on the world stage. However, perception is also 9/10 of the law and the disaffection that fuelled Brexit has caused great damage to the international view of UK Universities and research.

We must be proactive

These are personal hurts, which clearly cut to more private sensibilities. One thing that is clear, however, is that the re-configured administration will have to execute a Brexit. A defining feature of the British Psychology is the acceptance that the referee’s or umpire’s decision is final.

As I emerged from the grief-like state, I have tried to rationalise ways of ensuring as many tangibles as possible to mitigate the frustrations that will follow Brexit. On a personal level, my Christmas cards to all those dear European friends will become a little bit bigger. This will act as a metaphor for keeping us in Europe’s mind’s eye. We should retain and extend our European reach by using European colleagues as PhD referees and grant review specialists. Further, we should allow the research funding streams to facilitate paid contribution of overseas colleagues when they add value to a research grant and actively seek cross border collaboration. This would ensure that Europe and the UK research excellence can continue to act synergistically.

An important part of this will be home-grown funding schemes that promote human training mobility. Twenty-five years ago, both the Royal Society and Wellcome Trust had pioneered very well-used schemes that allowed young UK scientists to enjoy such interactions with Europe and beyond.

Whether we flourish or flounder relative to where we would have been, had we chosen to remain, will play out over years. Look how little we know about what will happen next. But while we are guessing, the defining perception that the vote was our statement that we are better off alone must be crushed. If we succeed as individuals, universities or as a nation, it will be through interconnectivity and collaboration. My plan is to act as far as an individual can, to honour the goal of outward looking collaboration and interaction. This usually makes for a far more interesting life and is an excellent way to honour the memory of my Grandfather as well as express gratitude to the German professor who gave me a chance.

VINCENT O’CONNOR
End of Story!

Once upon a time, scientists needed a well-woven story if they wanted to publish in high-ranking journals. Could there be a happy ending to this tragic tale? Lawrence Rajendran tells us why we should start to cherish single observations again.

Academic publishing

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ience works best when everyone has free access to data, publications and deliberations arising from scientific studies. Advances in information technology have made the implementation of the Open Science principles possible but their adoption has lagged, due to structural and social limitations in the scientific enterprise. One notable limitation is the current science publishing system, which arose at a time when ‘closed science’ policies of private data, confidentiality and restricted access were the norm. Today, billion-dollar publishing companies actively perpetuate these ‘closed science’ policies, which is a central part of their business models. Current publishers also impede Open Science through their ever-increasing demand for long, sexy stories, which incentivise some through their ever-increasing demand for rent. Publishers also impede Open Science through their ever-increasing demand for long, sexy stories, which incentivise some of the biggest problems in science today.

Told for entertainment

Stories have been at the heart of fictional and biographical literature. However, stories have also crept into science more often than we would have liked. “Story”, as defined by the Oxford English Dictionary, is “an account of imaginary or real people and events told for entertainment”, which is in stark contrast to the “fact” or “data”, which should lie at the heart of scientific narratives. A cursory look at some of the “advice” given by journal editors to scientists aiming to publish in high-ranking journals, suggests a disturbing coincidence of the terms “story” and “success”. My contention is that this is a problem — you can argue whether this is the core causal cog in the wheel of the current, perpetuated problems of scientific irreproducibility and infidelity of data or is a necessary evil, but it is in the inner zone of the core problem area and associated with frustrations related to science publishing.

How many stories are we told, in the name of science? Take the acid-induced stem cell differentiation — this didn’t last long enough to survive its own acid test. Or the famous example of the gay conversion study. There are not only these “stories” but numerous others where, we, the scientists, have cured multiple cancers, Alzheimer’s and other diseases in impressive numbers. Sadly, some remain what they are, fictional numbers without any solid, reproducible scientific data to back them. These studies are no different than the claims of a religious leader to have cured diseases by prayer alone.

Sharp edges removed

What contributes to this irreproducibility problem? I think only a small percent is due to scientific misconduct and fraudulence. However, the desire to tell a smooth, round-edged story is not only inherent to wanting to earn credibility in the scientific community but also highly demanded by the current publishing ecosystem that we created and live in. Unless you tell a story that answers all the scepticism/concerns of the reviewers and remove all the unfitting, edgy pieces, presenting a coherent, pruned and linear main plot full of good news and positive data, you can’t publish high these days. This desire to tell a full story as well as the demands and attempts to perpetuate this, contribute to mainly two things: unfitting, negative or non-story worthy observations are not published and only data that fit the narrative or non-robust pieces of data to convince the reviewers and quality controllers are presented.

While story-telling for entertainment purposes can include all the elements of fiction and figments of imagination (and story-tellers have the rightful and enviable license to do so), science shouldn’t rely on the ability to weave or tell stories. Narration only plays a minor part in science. So why are we forced to narrate a coherent story already when we submit papers? While I am not entirely against story-telling (I am sucker for Game of Thrones, Alan Ball’s screenplays and many other fictional works), my concern is this need to tell stories from the beginning and that these stories have to be coherent, cogent and well-rounded.

The narrative of the future

We can do better than this. We can do something different. Instead of demanding a long, winding story from a simple observation, where it often starts, we can now enable researchers to create a narrative online, with observations as some sort of nodes that constitute a network. Starting from single observations, scientists can publish these, one after the other in a linked manner, each one of them peer-reviewed, independent of the story-line, to eventually become the narrative in the future. We live in a digital world that makes it possible. From that idea, ScienceMatters was born. Not so much as an enterprise against story-telling in science but to enable scientific narration in its entirety. With ScienceMatters, there is now a space, dedicated to publishing single, well-validated observations. The platform eliminates the need to spin big stories from simple observations as there is no pressure to create stories, no reason to delay publication, no reason to omit ‘inconvenient truths’, thus providing
a free path to publishing orphan and negative observations and direct experimental reproductions.

John Yorke in his book “Into the Woods, A Five Act Journey into Story” suggests that stories are built from acts, acts are built from scenes and scenes are built from even smaller units called beats. My suggestion is that akin to story-telling, the scientific narrative can and should arise from smaller bits of observations, the core units of science. We need to bring back the emphasis on observations and honest communication of scientific data. Robert Hooke, who is considered a founding father for cell biology, said in 1665: “The truth is, the Science of Nature has been already too long made only a work of the Brain and the Fancy: It is now high time that it should return to the plainness and soundness of Observations on material and obvious things.”

An Internet of Science

With ScienceMatters, we hope to do exactly this – each and every scientist is welcome to publish their observations and by linking all these observations, we hope to create an Internet of Science. Some researchers have the capacity and resources to see and build a narrative from key observations and there are numerous publishing outlets for them. For those, however, who have made ground-breaking or interesting observations but cannot always follow up these observations; for those PhD, Master’s and Bachelor students, who, through their scholarly scientific theses, have made incremental yet important contributions to science; for clinicians, who need a place to talk about their peculiar cases and clinical trial outcomes; and for rural researchers, who don’t have available exorbitant funds to turn their powerful observations into stories; for all those researchers, who do not have the expertise to perform all the experiments that the reviewers demand; for those, who made observations outside their field of expertise but think that this could be a missing piece of someone else’s scientific puzzle; for those, who try to reproduce key scientific results to start their PhD and postdoc projects; for our industrial partners, who want to see key targets/drugs getting validated or invalidated through reproducibility programmes, there is now a new destination: ScienceMatters.

In short, we are here for scientists and in the long run for science. Because science and science alone matters.

LAWRENCE RAJENDRAN

BEST OF PAUL THE POSTDOC

LAB DRESS CODE: ALWAYS CHOOSE THE APPROPRIATE LAB WEAR FOR THE TASK TO BE PERFORMED

NORTHERN BLOTTING  SOUTHERN BLOTTING  WESTERN BLOTTING  BLOT ANALYSIS

HEY, WATCH OUT! WHOEVER YOU ARE I HAVE A PIPETTE AND A TUBE AND I’M NOT AFRAID TO USE THEM!

LORD OF THE PETRI DISHES

AT LAMINAR FLOW VALLEY, PAUL, ARMED WITH “LOLITA” HIS INCANDESCENT INOCULATION LOOP AND A BOTTLE OF ANTIBIOTICS, FACES THE RESIDENT EVIL THE CONTAMINATING BUG THAT HAS BEEN TRYING TO OCCUPY HIS PLATES...
More Science, Less PR!

Science in the news

What is really of interest in current research? Who can decide? On the one hand, it is impossible to read all the research literature to make a truly objective judgment. On the other, there is the incessant buzz of the ‘science image machine’, churning out its press release hype. Jeremy Garwood reports on how news about science is looking increasingly like a prolonged public relations exercise.

For its anniversary issue, Lab Times asked me to give an overview of the scientific highlights during the last ten years. My first reaction was that this is not such an obvious thing to do. I have been writing regularly for Lab Times since 2007 but looking back through the magazine and online contents did not immediately reveal the best or most important research. How do we define what is a highlight or the best or even ‘good’ research? For a start, Lab Times cannot pretend to fully cover all areas of life science and biomedicine. I decided to look at what other journals had to say. What had they identified as the best and most important science during this period? Soon it became apparent that there is a fundamental problem. A research scientist will not look at the science in the news in the same way as a science reporter or a journalist. A science administrator may make funding decisions based on a different reading than a politician. And the general public may form confused and contradictory opinions for lack of clarity and understanding.

Too much to digest

Given the ever-expanding research literature, scientists face a constant challenge to find and assess ‘good’ research. The numbers of research papers published each year is huge. A recent study of growth in modern science found an annual growth rate of eight to nine percent between 1980 and 2012. During this period, there were 15,435,641 publications in the natural sciences and 12,796,558 publications in the medical and health sciences (J Assoc Inf Sci Technol, 66:2215).

Just for the year 2012, it counted 1,859,648 publications. That’s an awful lot to read! Faced with the usual time pressures, most scientists focus on their specialised domains. This is probably what they know best and they should be able to judge what seems to be ‘good’ in the relevant research literature – what looks like a big advance, a proof, or a clear demonstration that a radical new model works. But how well can they judge research literature from other areas?

Often, we have to read general science news to get an idea of what is happening beyond our specific expertise. Yet only a small proportion of all the research literature will be mentioned in the popular press (newspapers, magazines, radio, TV and their online variants). How much of this science news corresponds to what researchers themselves would consider to be ‘good’ research? Furthermore, who decides what will appear as news or be declared as an important scientific finding or discovery?

The best of… Science news

At the end of each year, there is a profusion of lists informing us of the ‘best’ books, films, music, etc., for the previous year. Science is no exception and there are several lists of the best science as carefully judged by the relevant arbitrary criteria. One of them comes from the prestigious Science magazine. Its “Top 10 science achievements of 2014” were presented by Meghna Sachdev, the magazine’s ‘social media strategist’, who explained how each year since 1996, Science’s editors have chosen a singular scientific achievement as “Breakthrough of the Year” (sciemag.org, 18/12/14). Their winner for 2014 was “the Rosetta mission lands on a comet” because, she said, it “captured the world’s attention and reminded us of the immense scope of human scientific accomplishment”. Despite this grandiose claim, Science had another “Breakthrough of the Year” to present. This was the “People’s Choice”. During the previous 20 years, Meghna explained, only the editors had chosen the breakthrough. Now, for the first time, they had decided to let the general public vote for their top science of the year.

An online voting system allowed the Science-reading public to choose their favourite research from 19 pre-selected options. Science received a total of 35,676 votes over two rounds. In the first round, the list was reduced to five. In the second round, these five were ranked. The first “Breakthrough of the Year People’s Choice” – with 34% of the popular vote – was for “giving life a bigger genetic alphabet”. We are told that it wasn’t an easy win since the expanded genetic alphabet “squeaked” into first place with just 198 votes more than its closest competitor – “the discovery that young blood can be used to fight aging” (32%). The Science editors’ favourite breakthrough – “probe lands on comet” – was only the People’s third choice with 17% of the vote.

Should anyone be interested in the scientific details behind the hype, it took some hunting to find the original research papers. Instead, these evaluations were made on the basis of Science News stories that had been written by news reporters and staff writers. The People’s Choice for “Breakthrough of the Year” – the “genetic alphabet” – appeared in May 2014 titled...
“Designer Microbes Expand Life’s Genetic Alphabet”. It reported on research, in which modified DNA bases were incorporated into bacterial DNA. “For now, the artificial bases – call them X and Y – don’t code for anything, unlike natural DNA base pairs” but this was no reason not to speculate wildly about what might happen, if they did code for something and what this might mean for synthetic biology, making it the top science “Breakthrough” for 2014, as voted for by some 4,000 online clicks.

Research with a high media profile

Meanwhile, the news article “Young Blood Renews Old Mice” (Science, 4/05/14) was the basis for the second-placed “People’s Choice”. In it, staff writer Jocelyn Kaiser admitted that “hope and hype are high in the anti-aging research arena, and other researchers caution that the work is preliminary”. Yet these reservations did not prevent it being accorded a lot of publicity as a Science “Breakthrough of the Year”.

The staff at Science also look to the future. “In addition to looking back on achievements of the previous year, the Breakthrough staff also hazards a few informed guesses about developments likely to make news in months to come.” In effect, they make predictions about how the research they have written up as “Breakthrough” news stories during the past year will continue to develop over the coming year. This, of course, provides an excuse for yet another review article, “Scorecard for 2014” (Science, 19/12/14), in which they can compare their ‘informed guesses’ to what happened during the year. Note that their interest is in scientific developments likely to “make news” in the coming months rather than in the science itself. That is, they are directly choosing scientific research on the basis of its ‘media profile’, rather than its scientific content. Perhaps this might explain some of the appeal that space exploration holds for these editors – while it takes so long to plan, build, launch and analyse space missions, there are numerous opportunities to report it all, over and over again.

For those seeking a different approach, however, to what is currently of interest in science, we now have the carefully calibrated lists from Altmetrics. These alternative measures of the popularity of scientific research were announced in 2011’s Altmetrics Manifesto. It said it would explore new ways of assessing the impact of research, notably through internet activity. In 2013, the Declaration on Research Assessment (SF DORA) pointed to the development of Altmetrics’ Article-level metrics as a possible counter to the disastrous effects that the Journal Impact Factor has had on science (see LT 05-2013, p.18-23).

By the end of 2013, Altmetric.com had presented its first Top 100, listing the research papers with the most online attention. The list in itself provided some surprising revelations about what appears to interest people, who talk about scientific research. In 2014, Lab Times asked Martin Fenner, responsible for the Article-level metrics project at PLoS, about the difficulties of developing Altmetrics. He said its real value was as a “discovery tool” (LT 04-2014, p.10-15). Unfortunately, Altmetric’s Top 100 has revealed a strikingly different idea of how scientific research publications have “caught the attention of the public and
mainstream media”; often they seem to be less receptive to the actual research than to the news story that has been written about the research (see textbox on this page).

PR and the loss of scientific content

Since the 1990s, the number of people working in traditional journalism has been in decline. During the same period, there has been an increase in public relations (PR) jobs. In the US, journalism jobs fell from 52,560 in 2004 to 42,280 in 2014, while PR jobs rose from 166,210 in 2004 to 208,030 in 2014 (The Washington Post, 23/4/15). Both journalism and PR share certain characteristics, especially at the level of writing news stories. While journalists are meant to provide an objective account of events that is independent of bias, public relations is, however, concerned with managing the spread of carefully selected information between an organisation and the public. PR often uses topics of public interest or news items to promote the exposure of its clients. But unlike the paid exposure of advertising or marketing, PR seeks to create media coverage for free. It wants its promotions to be incorporated into news articles. This is a deliberate tactic, since PR is considered to be more effective, if it is disguised as objective and impartial journalism (Wikipedia).

Traditionally, science has relied on communicating to the public through educators and popular writers, but this situation has been changing. The basis of science communication has also been affected by public relations. In 2014, a special issue of the Journal of Science Communication asked just how far public communication from research institutes had been moving away from science communication towards public relations (JCOM, 13:03). The editor noted that there is “growing competition among publicly funded scientific institutes and universities to attract staff, students, funding and research partners. As a result, there has been increased emphasis on science communication activities in research institutes over the past decade. But are institutes communicating science sim-

### Altmetric’s Top 100 reveals the Attraction of Science?

Since 2013, Altmetric has published a yearly summary of the Top 100 research papers based on online “attention” criteria (www.altmetric.com). Commenting on the first Top 100, David Colquhoun said that it showed “Why you should ignore Altmetrics and other bibliometric nightmares” (www.dcscience.net, 16/01/14). “The superficiality of Altmetrics is demonstrated beautifully by the list of the 100 papers with the highest Altmetric scores in 2013. For a start, 58 of the 100 were behind paywalls, and so unlikely to have been read except (perhaps) by academics. The second most popular paper (with the enormous Altmetric score of 2,230) was published in the New England Journal of Medicine. The title was ‘Primary Prevention of Cardiovascular Disease with a Mediterranean Diet’. It was promoted (inaccurately) by the journal with the following tweet: ‘our new post focuses on trial that shows the Mediterranean diet results in less cardiovascular events than low-fat diet’. Many of the 2,092 tweets related to this article simply gave the title but inevitably the theme appealed to diet faddists, with plenty of tweets like the following: ‘huge study in NEJM. Mediterranean diet is shown to ward off heart risks’ (Tim Piser @pisertm) or ‘get your nuts and virgin olive oil here. Primary prevention of cardiovascular disease with a Mediterranean diet – NEJM’ (Tracy Lawrence @ DrTracyLawrence).” David Colquhoun concludes that most interpretations of the paper promoted by these tweets were “desperately inaccurate”.

The Top 100 for 2014 produced even more surprising results. “What Does It All Mean?” asked David Crotty at the Scholarly Kitchen blog (scholarlykitchen.sspnet.org/2014/12/17). The article with the most online attention in 2014 was “Experimental evidence of massive-scale emotional contagion through social networks” (PNAS, 111(24):8788). This had an “Altmetric Badge Score” of 5,044. The article describes a “hugely controversial study” that Facebook performed to see if they could emotionally manipulate users. It is perhaps not so surprising that it attracted online social media sharing with 3,801 tweets, and posts on Facebook (345), Google+ (115), and blogs (130). It also featured in 301 news stories. The second highest ranking article of the year (score 4,623) was “Variation in Melanism and Female Preference in Proximate but Ecologically Distinct Environments” (Ethology, 120:1090). This was an “unremarkable” paper on melanism that only attracted attention because the authors and editors forgot to delete a note to themselves from the final manuscript (“should we cite the crappy Gabor paper here?”). An article in Nature – “Unusual reference attracts notoriety” – had further boosted the statistics.

Number 5 on the Top 100 list was the paper – “Dogs are sensitive to small variations of the Earth’s magnetic field” (Front Zool, 10:80). This had an Altmetric Badge Score of 2,956, appearing in 54 news stories, 33 blog posts, 2,668 tweets, 6 peer reviews, 605 Facebook posts, 119 Google+ posts, 14 Reddit posts and 2 videos. As with most of this online chatter, there is little evidence that anyone has actually read the research paper. However, this study was also the subject of a Lab Times “Research letter from...” entitled “Magnetic Excretions” (LT 2-2014 p.16). Here, a closer analysis of the article (rather than the university press release or news stories) revealed that the key result – i.e. that defecating dogs align along the North-South axis – had been obtained by subtracting the majority of the shitting dog alignments (88%) that were perpendicular to the North-South axis!

Meanwhile, at number 6 in the Top 100 was the most popular of several “clever joke and semi-joke articles”. The title says it all: “The survival time of chocolates on hospital wards: covert observational study” (BMJ, 347:j7198).

Overall, David Crotty insists that Altmetric’s Top 100 list is “fascinating” for what it tells us about communication between scientists, the attention paid to science by the general public and also for what it tells us about Altmetrics themselves. It does not, however, paint a very reassuring picture of the state of modern science.

-JG-
ply for the sake of improving the institute’s image?"

Michel Claessens, currently head of communication at ITER, the International Thermonuclear Experimental Reactor, said the priority for most research institutions is to target their stakeholders, including decision-makers, politicians and the scientific community. With over 20 years experience of communication and PR at publicly-funded research organisations in France and the EC, he says his target was not to communicate with the general public. The science research institutions see the public (and young people in particular) as being too far away from their “short-term objectives and long-term challenges”. Contacts with the popular media are essentially a means to reach (and hopefully influence) stakeholders and opinion leaders.

German professors of communication, Frank Marcinkowski and Matthias Kohring, agree with this analysis but find that the changing rationale of science communication represents a challenge to scientific autonomy. “Public communication of science now primarily serves the purpose of enabling academic institutions to promote themselves in a competition that has been forced upon them by the political domain. What academics working under these conditions say about themselves and their work (and what they do not) will depend crucially on the strategic communication goals and concepts of the organisations to which they belong. We surmise that the inherent logic of this form of science communication represents a potential threat to the autonomy of scientific research.”

How it works
PR is usually aimed at making an institution look good and helping it achieve its strategic goals, such as elevated prestige among its peers or increased research funding. Charlotte Autzen, communication adviser at the University of Copenhagen, says the most commonly used tool is the press release. This is essentially a short news article written in a journalistic style that explains a newly published scientific result in a common and not too specialised language. As science communication, it puts the results into context and shows the reader the relevance and perspectives of the new findings. And as PR, it increases the likelihood that the media will actually report on the research, which will increase visibility while attracting public interest to both the research and the institute that hosts it. This has become the “ultimate goal” of research institutes.

A press release issued by a University press office is likely to draw attention to the University name and to present the University in a positive light. Reasons why universities might want to enhance their reputations include improved student recruitment, helping staff to “feel positive” about their workplace, and ensuring that funding panels “recognise” that they have a strong research presence.

It is not entirely coincidental that the changing working conditions of journalists have created a demand for press releases. The general trend has been to employ fewer journalists but to get them to produce more news stories. Due to lack of time, they cannot investigate or verify their facts and sources as much as they used to. Instead, they will often accept the PR materi-
Research Letter from:… Someone who actually reads the research article

Feeding the PR Machine

Research Letters from…’ is a regular satirical science column in Lab Times that I began in 2008. Some 60 have appeared so far. Each ‘Research Letter’ takes an imaginative look at recently-published scientific reports from European researchers. Originally, I was thinking of writing something like a humorous summary of a laboratory journal club, where someone in the lab dissects a research paper, looking at the experimental evidence, how it was obtained and whether it was good enough to support the conclusions.

I soon came to realise that there was a big gap between the original research papers and how this research was being presented in press releases and news articles. When ‘Research Letters from…’ started, the hardest part was finding articles to analyse. Faced with thousands of newly-published articles each month, I had no idea how to choose ones that would make ‘good stories’. Fortunately, the editors of Lab Times were happy to send me suggestions. After a while, I noticed that all of these suggested articles had press releases written by the universities/research institutions, in which the researchers were employed. Often, it was these press releases that had drawn our attention to the research articles and the ‘stories’ that they were telling. Indeed, many of the research articles had already appeared in science news reports.

Naturally, I read and analysed the source material, i.e. the published peer-reviewed research articles. But it soon became clear that most science news is closely based on the press releases, not upon the actual research papers. This poses several problems because these press releases are not written by the scientists who performed the research but by public relations staff employed by the researchers’ host institution. In these press releases, there is often a big difference between what the researchers actually did and the significant claims that are subsequently made. Incomplete or preliminary research results are frequently overstated. Speculative discussion about the possible significance of the result is transformed into a near certainty. Meanwhile, the critical reasoning that defines scientific research is considered too difficult to explain, or too hard to adapt for a general audience, or unhelpful for the purposes of a press release.

The more publicity, the better

Despite this, some researchers appear to be happy to help the PR machine, spending more time publishing press releases than research results. A good example of this is Wieger Wamelink, from Wageningen University, who has generated lots of media interest in his quest to grow plants on Mars. I wrote about his research in a ‘Research Letter from the Netherlands’ (LT online editorial, 3/12/14).

His research paper – ‘Can Plants Grow on Mars and the Moon? A Growth Experiment on Mars and Moon Soil Simulants’ – was published in August 2014 (PLoS ONE, 9(8): e103138) but his press releases about this research began before he had even started the first experiment. This dates back to March 2013, that’s to say, a whole 17 months before the research paper was published. Even better, Wamelink announces the day on which he started the experiment: ‘The future will begin on 2 April’ (2013) when the first trial crops “will be planted in greenhouses”. He then grew his plants for several months, analysed results and wrote the manuscript. Coinciding with the manuscript’s submission for publication, another press article appeared (Amsterdam Herald, 14/01/14). This enthusiastically asserted that Wamelink’s “discovery is the latest evidence that life could be revived on the Red Planet.” The manuscript itself had a lengthy review process but this did not prevent yet another press release being issued in April 2014 (“Vegetables on Mars within ten years?”). With the article’s publication in August, scientists could finally read Wamelink’s experimental details and check his data. Obviously, this was the opportunity for yet more publicity. Inside Science reported that “Astronauts May Grow Better Salads On Mars Than On The Moon” (11/09/14).

Compromising data in the press release

Bizarrely, there are times when press releases contain research details that do not appear in the formal research paper. Indeed, some of these additional details actually contradict and compromise the research reports.

For example, I wrote a ‘Research Letter from Switzerland’ about the University of Zürich’s evolutionary biologist Erik Postma (LT online editorial, 11/06/14). In his scientific article, he claimed to have found an evolutionary relationship between the facial attractiveness of professional cyclists and their performance in the 2012 Tour de France cycle race (Biol Lett, 10: 20130966).

Postma conducted an online survey, in which 816 volunteers from around the world were asked to rate the selected photographs of the cyclists for ‘attractiveness’, ‘likeability’ and ‘masculinity’. This survey provided the article’s key experimental data. Unfortunately, readers could not examine the survey since it has been removed from the website and Postma’s paper does not provide the names of the cyclists nor the photos used to rate their attractiveness. Scientists could only rely on Postma’s assurances that he had carefully analysed the performance data of each cyclist and checked his data. In his scientific article, he claimed to have found an evolutionary relationship between the facial attractiveness of professional cyclists and their performance in the 2012 Tour de France cycle race (Biol Lett, 10: 20130966).

Hence, journalists, but not researchers, were provided with several reasons to doubt Postma’s confident claim to have demonstrated evolutionary mechanisms in professional cyclists.
rials and adapt it to their requirements. For science stories, press releases can be readily obtained from reputable sources – universities, scientific institutions and public research agencies. They are free of charge and they can be easily copied.

**Online press release distribution**

Scientific press releases are also made freely available at online sites like EurekAlert! and ScienceDaily. EurekAlert! is an online global news service operated by AAAS, the publishers of Science magazine. Founded in 1996, it provides a central place through which universities, medical centers, journals, government agencies, corporations and other organisations engaged in research can bring their news to the media (www.eurekalert.org). "Public Information Officers from hundreds of organisations worldwide use EurekAlert! to distribute science, health and technology news, experts and other resources to reporters."

Autzen says the platform is a well-established international science news source for journalists with more than 10,000 registered reporters. In 2013, EurekAlert! published more than 20,000 press releases provided by 8,655 registered Public Information Officers at 1,829 contributing institutions. The ‘most productive’ universities post nearly one press release a day.

A year earlier, in 1995, ScienceDaily was launched by US science writer/editor Dan Hogan. It claims to be one of the internet’s most popular science news sites (www.sciencedaily.com). Most of the articles it publishes are selected from press releases submitted by universities and other research institutions but “some” articles are written by ScienceDaily staff. The website is updated once daily from the main office in Rockville, Maryland, and is “hosted on servers provided by Amazon.com”. ScienceDaily boasts that no other website “offers readers the depth and breadth of breaking news about the latest scientific discoveries in such a user-friendly format”. It says it has a total of more than six million monthly visitors with nearly 20 million page views a month. It does not charge for posting press releases from universities and other academic or non-profit organisations but says it “cannot guarantee posting of all the releases we receive, since we try to select those which we think would be of most interest to our readers”.

**Neither science nor journalism**

There are concerns that websites like ScienceDaily and EurekAlert! represent PR material masquerading as journalism. Readers may not be aware that they consist of carefully packaged PR stories rather than impartial research reports (discussed in the textbook “Research Letter from...”).

Furthermore, Emma Weitkamp at the University of the West of England says her science communication research has shown that the growth of the science PR machine affects the way that scientists interact with the media. She points to the rise of conference-related PR, noting that many of these press releases are produced for studies which have not yet been through peer review. “This move to communicate before publication is a trend that has developed in the past few years” (http://eprints.uwe.ac.uk/24758). Weitkamp also notes that scientific journals themselves now issue press releases. She says this is not necessarily because they are trying to sell more copies because they are seeking to enhance their own reputations with the research community and the wider educated public. And this may affect what they choose to publish or how they report it. Journals like Science and Nature have been accused of hurrying to publish some research for its big news potential rather than waiting for scientific doubts to be addressed.

A striking example of this was the STAP scandal in 2014. Nature had published two sensational articles from the RIKEN Center for Developmental Biology in Japan. These claimed to have transformed blood cells into stem cells by simply bathing them in a mildly acidic solution (called STAP, for stimulus-triggered acquisition of pluripotency). This appeared to be a very major scientific discovery and generated lots of publicity for Nature. Unfortunately, other scientists couldn’t repeat the work and spotted image manipulations in the papers. In February 2014, RIKEN launched an internal investigation that found the 30-year-old lead author, Haruko Obokata, guilty of scientific misconduct. In June 2014, Science magazine reported that earlier versions of the STAP work had been rejected for publication by Science and Cell, and that Nature had initially refused the manuscript. It was Nature, however, that had finally decided to publish the STAP research, clearly attracted by its huge news value (Science magazine was happy to provide further details of its rivals poor judgement in September - “EXCLUSIVE: Nature reviewers not persuaded by initial STAP stem cell papers”).

**Hype over substance**

The STAP scandal seemed to epitomise the problem that “journals today value hype over substantive science” (aeon.co, 23/12/14). In July 2014, Nature retracted both papers but the scandal had a further tragic note. In August 2014, Yoshiki Sasai, Obokata’s lab director, committed suicide. Although he had been cleared of fraud, he had lacked sufficient oversight of the project. In a suicide note to his family, he wrote that he was “worn out by the unjust bashing in the mass media”.

The site, Retraction Watch, has described the rising pressures on scientific journals to retract published articles known to be seriously flawed. Unfortunately, journals that want to promote their reputations with big stories are not so quick to retract the articles when they are found to be wrong. Mistakes do not improve reputations and the problem can get out of hand.

In just the first half of 2016, Nature has retracted seven more papers.

Meanwhile, universities and research institutions clearly think that their public relations efforts are worth paying for – they employ increasing numbers of staff to write and manage their PR, and generate their promotional press releases. The science public relations industry has grown a lot in the past 30 years. In the competition for reduced public funds they want to assert their reputation for doing lots of ‘good’ research, to promote their ‘brand’. When asked to justify themselves, they can simply point at the news articles based on their own PR as proof. Unfortunately, saying that their research is ‘good’ is not necessarily the same thing as doing ‘good’ research.

Jeremy Garwood
Career strategies for young European scientists

From Lab Rat to Science Writer

Often we are asked, how do I become a science writer – what abilities do I need, should I study journalism, is the career detour really worth it? One of our freelance writers, Alex Reis, tells her story.

As a child, I remember trying to dissect every kind of slimy creature I could find in the garden. Or “re-building” the skeleton of the chicken my mum had bought for dinner. I was naturally curious about science and wanted to learn everything I could about the natural world.

When I grew up, I embarked on the traditional academic route: degree/Master’s/PhD, and eventually landed a postdoc position. During this period, even though becoming a science writer was never (consciously) on the agenda, I discovered a love for writing I never knew I had. I guess I should blame my PhD supervisor, who taught me to never be happy with anything else other than the perfect word for every occasion.

Putting ideas to paper

I really enjoyed my time in the lab but, after a few years, my partner and I decided to move away and start a family. I took some time off while our children were young babies but as they grew up, I found myself with some free time on my hands. I remembered my love of writing and I started putting some of my ideas to paper, mostly for free and in obscure science blogs.

Every time I read those first few articles now, I cringe. Surprise, surprise. It wasn’t quite as easy as I first believed it would be. It turns out that writing a PhD thesis or a scientific paper is totally different from writing for a general audience. I never thought I needed formal qualifications in journalism but I realised that, if I wanted to succeed, I had to learn quickly. I did what I’d always been good at: I read books. Lots of books. And I wrote. A lot.

More luck than good management, I ended up with a few assignments in a small online newspaper. This was perfect to get those elusive first clips and I also got some help from a supportive editor. At this stage, I started calling myself a freelance science writer and used these initial clips to get better ones. Ones that I was proud to put on my CV. With varying degrees of success, I contacted many news outlets with my ideas. One of them was Lab Times, for whom I still write today on a regular basis and hope to continue to do so in the future.

My background in science actually turned out to be extremely useful. It’s not so much what I know about a particular subject, but more the fact I know how research works and I can read a manuscript with a critical eye. For every paper that goes through my hands, I can decipher what I understand and what I don’t and, more importantly, what questions to ask.

A steep learning curve

In those early days, I’ve made more than my fair share of mistakes. Some were worse than others but thankfully nothing too serious to kill my aspirations of becoming a science writer. Besides, within a few weeks, I was so addicted to scrutinising the latest papers and press releases looking for that hidden gem, that I couldn’t stop. All of sudden, writing about a wide range of subjects was a lot more fascinating than the narrow approach offered by academia. After all, there’s an endless source of material jumping out of every lab around the world on a daily basis. You just have to take your pick.

First, however, I needed to master one last technique to become a fully fledged science writer: the pitch. It turns out editors don’t just hand out assignments because you ask them nicely. You actually need to write a “miniature article” to describe your ideas. It’s important to understand each publication: its audience, its style, its scientific detail, to name just a few. It’s a vital part of my job to know these differences.

For me, undoubtedly, the hardest thing to learn was how to deal with an editor heavily editing my work or rejecting one of my pitches. Some editors will tear apart your work and the sooner you accept this, the sooner you become a successful writer. Instead, I forced myself to turn criticism to my advantage and use it to write better pitches and better articles. After all, hearing a no is not exactly the end of the world (even though it may seem so on the day it happens), it’s run-of-the-mill stuff for every freelance writer.

The dirty business of networking

I’m naturally quite shy and the idea of hiding in my office all day sounded like heaven. However, as every writer and reporter knows, articles are only as good as their sources. As a result, networking and contacting strangers to ask questions about their work soon became an unavoidable part of my day.
To my surprise, this has become the best part of being a science writer. I get to approach the best scientists in the world and question them about their latest discoveries. I find that if I show a genuine interest in what they’re doing, they will invariably take some time out of their often busy agenda to talk to me. If I ask the questions that I want to know the answer to, the article will almost write itself and it’s much easier to create a story around their results.

Of course, this needs to be done in a respectful manner towards scientists and their work. The attention to detail, being scientifically accurate in the article, all these go a long way to be recognised as a trustworthy science writer and someone with whom scientists will discuss their work.

Overall, I can genuinely say that meeting researchers across the world (even if it is just over the phone) has been as rewarding – if not more – than the actual writing. I hope this reflects in my work as I believe that, even for science, good writing should include the people behind the discoveries. It cannot be just about dry results but it also needs to focus on the researchers themselves, to captivate and excite the readers. Nowhere is this more accurate than in Lab Times, where there’s always space for that personal touch!

Why I love being a science writer

At the end of the day, it’s not easy but I love being a science writer. I get a chance to write short articles. And feature articles. And interviews. And blog posts. And I fall in love with every single article that I write and I always learn something new. From biology and medicine, to chemistry and technology, no two articles are the same. In addition – the icing on the cake – working from home gives me flexibility to be there for my children. I can easily plan my day around their activities, and work evenings and weekends if necessary.

There was never a grandiose plan for my science writing career. Yes, I decided to start writing full-time a few years ago but after that stuff just happened. I suppose I would describe my career as a series of lucky events, which allowed me to pursue interesting opportunities as they popped up. Even now, I really don’t feel I need a long-term strategy. My only plan is to keep doing the things I love and keep learning about science.

Not for everyone

Moving without a plan may seem like crossing the wire without a safety net, but I think this flexibility is essential for freelancers like me. In a constantly changing world, with new technologies popping up on an almost daily basis, it’s vital to be prepared to go in a new direction in the blink of an eye. For those searching for a steady and predictable job, my advice is to keep looking. Freelance writing isn’t it!

As a curious person, I’m always eager to try new projects. In addition to traditional print, the Internet opens up a myriad of new opportunities: podcasts, vlogs, social media and the list goes on. As my children grow up and start showing their inquisitive minds, I would love to explore the idea of writing something dedicated to the younger generation. But I suppose, for the time being, this is just a pipe dream.

Most of my friends don’t really understand what I do but I feel very lucky. I make a living of being curious. I make a living of asking the great minds of this world about their research. And then I get to write about it.

Alex Reis
What made three international researchers establish their own groups in Poland? What are the issues they struggle with most? And what made three Polish researchers return to their home country? Here are six first-hand reports from Southern Poland.

Krakow is the second largest city in Poland and has traditionally been the centre of Polish academic and cultural life, since its foundation in the 10th century. The former capital of Poland hosts more than ten million tourists per year from all over the world, and provides an extremely vibrant and international atmosphere. Besides its long-standing cultural and historical heritage, Krakow has established itself as the central economic hub in southern Poland, attracting a large number of talented young people and a plethora of multinational companies, especially in the high-tech, communications and biotechnology sectors.

The Jagiellonian University, established in 1364, represents the oldest and the most prestigious university in Poland. As Krakow also harbours additional centres of higher education, the city offers a large variety of academic training possibilities for the 200,000 students in town. The large number of students and tourists also make Krakow a young, outgoing and lively city, offering many kinds of sports activities, cultural events, local and international cuisine, and a vivacious nightlife.

The recently founded and established Malopolska Centre of Biotechnology (MCB) is one of the flagship projects of the Jagiellonian University. The centre was founded to establish a research-focused life science institute of excellence under the protectorate of the larger University body. The MCB has been in full operation since last year and already provides state-of-the-art instrumentation, high-class postgraduate education programmes – an excellent international environment for top class scientists and the opportunity for direct co-operation with industrial business partners.

Recently, three of us (Sebastian Glatt, Jonathan Heddle and Kenji Yamada) started their independent research groups, representing the first three international group leaders on the campus. We are leaders in our respective research fields and bring long-standing experiences from our previous positions in world class institutes (including the European Molecular Biology Laboratories, EMBL, or Japanese institutes like RIKEN or Kyoto University).

The presence of our groups allows the best students from abroad or the neighbouring faculties to gain international experience and prepare them for the competitive academic job market. Our research teams consist of young scientists from all over the world and our working language is English; we truly enjoy our team spirit and share a passion for scientific breakthroughs and challenges.

These recent developments have been further supported by the return of several well-trained postdocs of Polish origin, who, realising the changes and new job opportunities in Poland, now pursue their scientific careers with us at the MCB. Obviously, we hope that increasing numbers of excellent people with international experience decide to join our teams and take part in our journey to the top. We currently stand only at the beginning but we are all very excited to see what we will be able to create in the coming years, here in Krakow, at the Jagiellonian University and especially at the MCB.

Below, you will find answers to some of the most burning questions related to the current situation of scientists and academic career possibilities in Poland. We try to provide insights from the group leader and postdoc perspectives into the current funding opportunities, general living conditions, internationality, applied science and technology and tenure options in Krakow and more generally in Poland.

“Let's not Waste this Chance!”

Young investigators I: Krakow, Poland
Sebastian Glatt (Austria)

**Why did you move to Poland?**

As Poland offers a combination of excellent, trained students, various funding opportunities and a great quality of life, it was an easy decision to accept the offer from the Max Planck Society and the Jagiellonian University to establish my first independent laboratory at the MCB in Krakow. The newly-founded institute also offers all necessary equipment and research infrastructure (e.g., Solaris synchrotron) to conduct structural biology at the highest possible level. All in all, I am very happy with my decision of moving to Poland and I invite everybody to visit and experience the amazing transformation that this country has gone through during the last decades.

**What is your current research focus?**

My group is interested in the detailed structural and functional characterisation of tRNA modification enzymes and other macromolecular complexes involved in the control of protein synthesis using x-ray crystallography, electron microscopy and cell biology. We aim to obtain snapshots of the involved proteins and try to deduce their biochemical activities from the observed structures. Subsequently, the team employs different in vitro and in vivo approaches, to validate and challenge the structure-guided working hypotheses. It has to be highlighted that these cellular mechanisms are not only highly conserved, vaguely characterised and extremely complex but are also of high clinical relevance and importance. Alterations of these modifications cascades lead to intellectual disabilities and the onset of various neurodegenerative diseases and cancer types.

**How do you get money for your research ideas in Poland?**

To create experience and sustainable growth in the high tech, R&D and biotechnology sectors is currently one of the highest priorities for Polish authorities. This dedicated strategy is supported by the presence of several funding organisations (e.g., NCN, FNP, NCBR), which are specialised in different areas. Poland offers a whole variety of grant and fellowship schemes for every level of a scientific career – everything from small exchange fellowships for undergraduate students to large project-based grants for interdisciplinary and international research consortia. Particularly at the early stage of scientific independency, Poland offers unique opportunities to establish your first research group and expand the team with the support of third party money. The number of successful Polish applications to prestigious European funding programmes, like ERC grants, is still relatively low, but I am sure that the increasing number of experienced international scientists moving to Poland will help to increase these success rates.
Jonathan Heddle (UK)

Why did you move to Poland?
After many years away from Europe, I decided to return last year and when choosing which country to return to, Poland was clearly outstanding: it was one of the few which seemed to have survived recent economic hardships with a healthy economy and was making a clear commitment to developing its research science base. My institute, the MCB, is new and well-equipped and part of a new campus built to a very high standard. In the end, the decision to come to Poland was really very easy.

What is your current research focus?
I am interested in biological nanomachines, both natural (enzymes) and artificial. Understanding these machines and building them de novo could give us tremendous capabilities in a wide range of fields, not least the development of new medical treatments. The natural nanomachine I am most interested in right now is DNA gyrase (using a technique called DNA origami) and with protein, using known protein structures as a start point. We are currently building novel assemblies using both materials and we hope to be able to employ them as smart, drug delivery vehicles. In the future, we expect that these structures will be combined into ever-more complex and programmable nano-devices.

Kenji Yamada (Japan)

Why did you move to Poland?
I initially applied with my research proposal for another group leader position at MCB. After this selection process, MCB created more international group leader positions and offered me the chance to come here to continue my work. I did not hesitate and quickly responded to come, which now allows me to expand my research network in Europe and I am very much enjoying my new scientific environment here in Krakow.

What is your current research focus?
Our research is concerned with how plant organelles work to establish plant defence systems. We are using Arabidopsis thaliana as a model plant. We found that it produces rod-shaped organelles from the endoplasmic reticulum (ER), which we named "ER bodies". ER bodies accumulate in the epidermis of seedlings and roots, and store an enzyme, β-glucosidase. For a long time, the function of ER bodies was obscure. Recently, we found that mutant seedlings deficient in ER body formation are susceptible to damage by pests. It seems that β-glucosidase in ER bodies produces repellent molecules to prevent damage from pests. We are excited about these results and are trying to understand the cellular and molecular mechanisms for ER body-based defence systems against pests in more detail.

How do you keep in touch with international networks and collaboration partners?
I came from Japan this February. When I was in Japan, I already had collaborators in Poland and Germany. This was one of the reasons, why I decided to move when I luckily got the chance to work here. There are many top class researchers, who I would like to visit in Europe but it was too far to visit them frequently from Japan. Now, I am very close to them and I feel I will have a greater opportunity to visit them. This will be good for my career; allowing me to establish international networks connecting Europe and Japan. I am also surprised that there are many grants for international collaborations in Europe: in Japan, there are not so many, despite the fact that the Japanese government is focussing on internationalisation. Here, I found that funding bodies very much encourage international collaborations, which, through connecting prominent researchers in each country, strongly supports the maintenance of high level of research in Europe.
Why it is imperative for business and academia to go hand-in-hand?

Curiosity has always been a foundation of progress, which, through applied sciences, can improve the day-to-day lives of the masses. In order to accelerate application of scientific discoveries and innovations in everyday life, a close collaboration of science and industry needs to be maintained. Despite strong Polish economic growth in the past decade, bioscience is far from being a leading part of industry. During my PhD in Heidelberg, I had the opportunity to learn how research and business can function together. Placement of academic units, medical institutes and private companies in one area improves knowledge transfer. Sharing the infrastructure of a single Campus and participating in interdisciplinary conferences allows not only for a vivid exchange of ideas but can also lead to development of patent applications and innovative medical therapies. In my opinion, this is one of the areas, which require most improvement in the Polish life science clusters.

How do you see the future of life sciences in Poland?

Poland is well known for its well-educated students, especially in life science. The problem I saw a few years ago was that there were not so many opportunities for the graduates to keep them in Poland. The same happened to me and many of my colleagues. The chance to pursue your scientific career abroad, together with (not to hide it) much higher salaries, was very tempting. Many European and American scientific institutes were just waiting for us, there was no limit. After spending almost six years in Germany, I was afraid to come back but, to my surprise, things have really changed and are still in the process of changing: there are new research institutes, more funding, professional equipment and attractive grants for young scientists. Slowly, I see some of my friends actually coming back to Poland, not only because of family or language reasons but because of the scientific opportunities! Let’s not waste this chance, Poland! Being hired now in a newly-opened research institute in Krakow I’m happy to contribute my knowledge, experience and motivation to the development of the life sciences in Poland.

Teaching, research or both?

Before I came back to Poland, I never had any thoughts about Polish academic career paths and teaching systems at the Universities. When I started my postdoctoral fellowship, I quickly realised that a postdoc position simply does not exist in the Polish system. There are plenty of staff positions ranging from assistant in research and adjunct to full professor, and all of them are overloaded with teaching duties. Thus, my new position was simply different. How could one have no teaching activities at all? Usually the research conducted by scientists in Polish Academia is strongly compromised by teaching duties. Since lectures and classes in some cases could take even up to half of the working time, the progress in the laboratory is simply slower than it could be. Personally, I think that this system should be changed into a more flexible one, where a scientist may choose from either a teaching or a research path. With the implementation of research grants and the increase in the number of research-only positions, this change is slowly happening. Nevertheless, some mechanisms that would allow individuals to opt out from teaching in favour of research (or vice versa) should be introduced.
Bringing Expertise Back Home

Excessive mobility is not always required for a successful scientific career. *Lab Times* talked with Ondřej Štěpánek, who has spent most of his life and career in Prague but recently returned from a four-year stint as a postdoc in Basle to become a group leader at a state-of-the-art institute in his home town.

“As a small new group, we have three grants. So my funding is secure,” said Štěpánek. In 2015, the T cell expert received an EMBO Installation Grant to relocate from the University Hospital Basle, Switzerland, to the Institute of Molecular Genetics of the Czech Academy of Sciences (IMG) in Prague.

He will receive €50,000 annually in the next three to five years and will participate in the EMBO Young Investigators network. “This grant is very flexible and I have a high degree of freedom in how to spend the research money. I can easily find collaborators through the Young Investigators network,” the scientist explained. Moreover, from 2016 to 2018, the Czech Science Agency will support his research activities with an additional €100,000 annually. The most generous grant of over €570,000 over five years has been awarded to him recently by the Swiss National Science Foundation (SNSF) for the project “T cell calculus: how T cells measure and interpret antigenic signals in health and disease”. The scientist is benefiting from the SNSF’s PROMYS initiative, short for Promotion of Young Scientists in Eastern Europe. Štěpánek’s mentors for this project are his former boss Ed Palmer and Daniel Pinschewer from the University of Basle.

**Group leader in a familiar environment**

To re-integrate in Prague has hardly been a problem for the researcher, who admitted that he “hates moving”. His parents, who live in Prague, are also scientists, although in a different field. “They influenced me a lot and are a big inspiration,” he said. Štěpánek grew up and studied in Prague. He also did his PhD and a short postdoc in Tomáš Brdička’s and Václav Hořejší’s groups at the IMG, where he is now head of the Laboratory of Adaptive Immunity.

“We moved house three days ago and still have to unpack some things. My group at the IMG started up in January, this year. Organising the transfer of the mice took some time as all the mice had to be re-derived through embryo transfer and, for the first time, I had to organise the paperwork on my own. At first, there was not enough space for all the mice in the quarantine facility in Prague. Additionally, I had to deal with pending mouse health reports and with EU import regulations. I travelled between the two cities throughout the last six months. During this time, a postdoc has been working 50 per cent for me in another lab at the institute. From next week, my lab will be fully equipped,” the researcher said. His group is sharing a large lab and an office with the research group of Vladimír Varga, who studies the molecular mechanisms of cell motility.

During his doctoral and postdoctoral years in Prague, the immunologist studied the regulation of T cell receptor signalling, the role of kinases in the initiation of B cell antigen receptor signalling, and the signalling downstream of MHC class II in antigen-presenting cells. In Ed Palmer’s group, Štěpánek analysed how high-affinity, self-reactive developing T cells are eliminated in the thymus. If this process is faulty, autoimmune diseases can result. Using a transgenic mouse model, the scientists found that the kinase Lck, coupled to CD4 and CD8 co-receptor molecules, plays a crucial role both in measuring the duration of T cell receptor-antigen interactions and in initiating negative selection (*Cell*, 159(2): 333–45).

**Low salaries but good beer**

“I really enjoyed the years in Basle. In Ed Palmer’s lab I had a high degree of independence and developed some skills in project management, which I can now apply in my own lab,” Štěpánek said. “Basle is a very active life science hub with a long tradition, it is more international than Prague and basic research groups are getting more financial support from the pharmaceutical industry,” the immunologist observed. “The salaries in Basle are much higher than in Prague. This makes it easier for me to pay my group members with the available funding. On the other hand, it is difficult to attract international researchers. This is one of the reasons why I hired staff from the Czech Republic and Slovakia,” added the group leader. “In the end, you can buy more with a Swiss than a Czech salary, unless of course, you spend it on beer which is better in Prague,” he joked. The average annual postdoc salary at the IMG is approximately €20,000 and over €83,000 in Switzerland. “We have seminars in English, but the language barrier can be a problem for international scientists if they have to organise things outside the institute. However, English is now spoken more frequently around town than before I left,” the scientist noted.

The IMG provided a lot of administrative support with grant applications, orders and purchases, noted Štěpánek. The institute also organises an annual PhD candidate selection process, which makes it much easier to find good candidates. The students...
can apply online. “There are more interested students than immunology labs, so I even had to choose between the applicants.”

The institute, where his new group is located, was founded in the 1960s. Since 2007, the IMG’s home has been a modern building in Prague-Krč with 4,500 square metres of lab space. It houses 28 research groups, one research service group and also a kindergarden for children aged 2 to 7 years. “For our son, we found a kindergarden close to our home, which is currently more practical for us,” said Štěpánek.

An evolving attraction

Štěpánek became interested in immunology during his PhD. “When I was looking for a post as a doctoral student, the project in Tomáš Brdička’s lab appeared very promising,” he said. “I came to like the field and so I stayed with it. In immunology, even basic research can be clinically relevant, which is very rewarding for the researchers. Moreover, the techniques are well developed and can straightforwardly be used to solve scientific questions. For example, we are working with blood cells, which are easy to isolate and to transplant from one mouse to another.” As a student, he had been undecided, which career to choose, so he studied both Biology and International Economic Relations. “However, after a while, I realised that I preferred biology, especially molecular and cell biology. The quantitative approach of economics, particularly the acquired knowledge in mathematics and statistics even proved useful in biology,” he added. “During my career I also learnt that presenting ideas clearly in publications and seminars is as important as generating the data by experimental research.”

As a mature scientist, his plans are well defined, although he still is surprised at how slowly science progresses and how big a role luck plays in science. “I am looking forward to doing good science here, and to strengthening molecular and cellular immunology,” he said. Štěpánek is now focusing on establishing the group and on increasing his reputation in the field. What will happen in the next 30 or more years of his active career, the future will show. “I am a bit afraid of the moment when I stop working at the bench. I don’t know whether, after ten years as principal investigator and supervisor of my group’s research activities, I will still be effective in managing the people,” the immunologist wondered.

He is in the privileged position that, presupposing positive evaluations, his fixed-term contracts can be extended indefinitely. “Currently, I am leading an IMG fellow group. After three years, I can become head of a junior group and then of a senior group.” In September this year, his group will comprise two postdocs, three PhD students, a lab manager and maybe one undergraduate student. “This is the ideal size at the moment,” he observed.

A Prague community

Štěpánek also has some ideas on how to improve his current research environment. “In Prague, we have good immunologists, but there could be more exchange and collaboration between the scientists. In the future, it would be nice to have a Prague Immunology Network similar to the University of Basle Immunological Community, UBiCo, which organises seminars and retreats. Maybe I can initiate this in a year or two,” he said. “More open positions and especially more tenure track positions would be a boon to junior researchers who want to become independent,” he added. “And of course, more institutional funding would be desirable. This would give researchers more security and more freedom in developing the direction of their work,” the scientist noted. “When you apply for a grant, you have to specify what you intend to do. Each change, occurring as the research progresses, must be justified. This can create problems,” Štěpánek observed. “When you start from scratch as a new lab head, it can also be difficult precisely to calculate the costs for services and material. Having applied for a grant you might have to change these figures, retrospectively. With more flexible institutional funding, which can be allocated in different ways, this might be easier.”

On the institute’s website, the IMG’s director, Václav Hořejší, also acknowledges the severe under-financing of the Czech Science Foundation and the stagnation of funding for Czech science, in general. IMG’s budget is, however, increasing.

Understanding the first steps

On the scientific side, there is certainly no lack of ideas. Štěpánek and his team are interested in how T cells recognise the structural features of the antigen and how the antigen triggers the signalling inside the cells. “The first steps of this process are still not well understood, although much work has already been done on this topic,” he explained. The immunologist also wants to analyse how this signalling influences T cell fate choices at different stages of the T cell life cycle and in infection. Bettina Dupont
Women in science

“Just Jump and Then Think”

Caroline Dean made her way, both as a plant researcher and a woman in science. Alexandra Taylor spoke with her about the neglect of plant science in biology, the importance of role models and meeting Jacques Cousteau.

As a pioneer in an underrepresented field, Caroline Dean says she was flabbergasted to learn that she would be made a Dame Commander of the Order of the British Empire. Dean feels that plant science is often overlooked by institutions and funding agencies, and was very pleased to hear that, through her, the field would be celebrated. “It’s just for recognition of so many people’s efforts in my lab for such a long time and plant science doesn’t get terribly many awards like this, so I think it’s great that it was recognised,” she says.

Dean has been singled out both for her contributions to plant biology and her work promoting women in science. She was educated in a time when many women in research were forced to decide between having a family and running a lab, a choice that Dean was able to avoid. “I’ve had a family as I’ve gone along and had a thoroughly good time,” says Dean. “I think science is a great career and I think it’s good to encourage more women to aim for senior positions earlier on.”

Today, Dean is one of the world’s leading plant biologists but she almost ended up in a different field entirely. She was inspired to study marine biology as a teenager and once dragged her boyfriend to the South of France to try and track down her hero, Jacques Cousteau (the expedition was unsuccessful). In college, she realised that she loved biochemistry and transferred to the University of York to study it.

Unimportant plants?

An undergraduate project on isolating chloroplasts for electron transport analysis got her hooked on plant biology. Dean says that plants are fascinating systems for studying genetics, epigenetics, evolution, molecular biology and environmental science. “There have been so many things discovered in plant biology” – chromosomes, transposable elements and small RNAs, to name a few – “but people sort of forget that over the years. Somehow, in biology, if it’s not in humans, it’s not important.”

Dean had found a field she was passionate about but she was aware that very few women stayed in science over the long term because of the difficulty of juggling research and family life. “There weren’t very many role models at that point, in terms of senior women who had had families and carried on in science, so I just thought that wasn’t an option,” says Dean. As a result, she made the conscious decision not to stay in academia. She wrote to the scientist John Bedbrook, who had taken plant biology by storm by being the first person to clone plant genes. Bedbrook ran a genetic engineering company, Advanced Genetic Sciences, in Oakland, California. Dean went there to study how to express foreign proteins in transgenic plants. “I became a much more serious scientist at that juncture,” she recalls.

American tulips

One day during her postdoc, Dean went to a nursery to buy some tulip bulbs. She had always loved tulips in springtime. The man who sold her the bulbs told her to put them in the fridge for six weeks. Dean was amazed: in the UK, tulip bulbs went straight into the ground. But this was not the case in sunny California, which is temperate most of the year. Dean had never considered that the tulips might need the cold to bloom. “I decided when I came back to the UK, when I started my own lab, that’s what I would study: the process of why plants need cold in order to flower.” This process, known as vernalisation, is important for crops: the differences between winter-sown and spring-sown varieties of cereals, wheat and rape are largely dependent on whether those varieties need vernalisation.

When Dean returned to the UK in 1988, she established her own lab at the John Innes Centre and began to unpack some of the relevant questions. Why do some varieties of plants need winter? How does the plant know that it has had weeks and months of cold? How have different plants adapted to different climates?

The Arabidopsis wave had hit while Dean was in California. Today, Arabidopsis is the model organism most widely used to study plant biology; Dean calls it “the Drosophila of the plant system.” The plant grows from the Arctic Circle to the equator and has a very small genome. Dean used molecular biology to unravel complex genetic problems using Arabidopsis as a model. For instance, Dean’s group stumbled upon a chromatin mechanism that helped plants remember that they had been exposed to cold: a cellular memory system, triggered by non-coding RNAs.

Chromatin mechanisms are the same for every organism that has chromatin. The cellular memory system that Dean’s group found is highly conserved throughout plants and mammals. This
means that what the researchers discovered in plants is equally relevant to human cellular memory systems as it is to other plants. When these cellular memory systems go awry in mammals, genes that should be silenced can get switched on, leading to problems, such as cancer. “So we find ourselves in a very, very exciting area,” says Dean. “By studying plants, we’re discovering new cellular mechanisms that people really want to understand in human systems.”

In her current work, Dean is trying to understand how plants sense and register weeks and months of cold exposure. Having worked out the cellular memory system, they now want to understand the molecular thermosensors that monitor temperature over long timescales in noisy environments. Temperatures go up and down every day, and plants must somehow translate that to mean “winter”.

Dean’s contributions to biology have not been limited to her research. She tries to encourage many of the women in her lab to stay in science. “There were so few role models around when I was a graduate student,” says Dean. “I think having role models around is really important. In that way I’ve helped, hopefully, by showing that you can have a reasonably balanced family life and have a big lab, and keep pushing hard in particular research areas.”

**Doubts allayed**

Stefanie Rosa is a Humboldt Fellow working in plant biology at the University of Potsdam. She is a former postdoc of Dean’s, who first collaborated with her when she was a graduate student at the John Innes Centre, Norwich. After Rosa left Norwich to join a new lab, Dean called her to come back and continue her research. “I think she kept me in science,” says Rosa. “For me, it was a great thing because I had someone who was believing in me and wanting to work with me, in a moment when I was really doubting my ability to stay in academia. Having someone with such a reputation and such a career believing in you really makes you also believe in yourself.”

Rosa describes the atmosphere in Dean’s lab as demanding but motivating. “People are really driven and I think, in part, it’s because of her endless optimism,” she says. “She believes so much in the people who are working with her. Often in science, things go wrong and it’s important to have someone that gives you the energy and motivation to keep going.” Rosa notes that Dean is extremely focussed and goes deep into the details in her research.

Although the numbers of women holding senior positions in science have certainly improved since the early 1980s, there is still work to be done. Dean believes that often what holds women back is their own self-belief, rather than institutionalised bias. “I don’t feel I’ve ever been held back by the system or a ceiling or anything,” she says. “I think it all comes down to the individual. What holds people back is just that they need to set long-term goals and go for big things and be very ambitious, and it will happen. I think a lot of women tend to hesitate.” Referring to the 2013 best-selling author of Lean In, she says, “I go with the Sheryl Sandberg mode of just jump and then think, and things will work out.”

“She is an incredibly strong woman,” says Rosa, “But she often says that, for her, it was also a progression and that we should force ourselves to get out from our comfort zone in order to grow.” Working with Dean made Rosa understand that it was normal to feel self-doubt but that she had to push on in spite of it. Even if something made her nervous or stressed – for example, giving a talk at an important conference – she learned that to succeed she would have to do it anyways, and do it over and over until she felt comfortable.

Dean is helping to foster the next generation of scientists as well. As the governor of a local all-girl’s school, she tries to encourage those students who are strong in science, not only to consider careers in medicine or dentistry – the more typical tracks – but also research.

**You will get there!**

Although Dean’s approach has been very successful, she stresses that there is no one way to combine science and family. “If you really want to do it, there are lots of ways of making it happen,” she says. “You just have to have the mindset to say, I will figure out a way to do it, and, depending on the circumstances, you will get there. But for different people, it’s a slightly different formula.”

Rosa says she was proud to hear that Dean had been made a Dame. The recognition will be positive for the field and Dean, she says, is highly deserving. “She’s the one that really believes in you that really pushes you and she will be really proud of you, if you do well,” says Rosa. “I think women tend to more easily doubt themselves, so having someone like Caroline will inspire more women to follow their passion and continue in science.”

- **Alexandra Taylor**

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We asked two scientists about their opinion on science’s most pressing issues. Here are their answers.

“Very Few Minds are Truly Free”

Petra Schwille asks a very short question in her research: what is life? To find the answer, she created not only new techniques to observe living matter, such as fluorescence correlation spectroscopy, but also a career that redefines how girls and boys should walk the science path. After getting her PhD in Braunschweig, Germany, and doing a couple of postdocs in Göttingen and Cornell, she set up her group of experimental biophysics in Göttingen and soon after became a full professor at the Dresden University of Technology. Since 2011, she’s been director of the Max Planck Institute of Biochemistry, Martinsried, Germany, and has led, for example, the discussion on reaching a balance between family, science, gender equality, and the scientific publishing system.

The Peer Review System

“Since my first paper submission in 1996, the review process has changed quite a bit, and it will likely continue to change in the future. I don’t think that dramatic measures should be taken; it will probably develop rather smoothly into more appropriate and timely procedures anyway. Web-based submission and publication will continue simplifying and speeding up every single step but one: the actual assessment by the reviewer. For this, I don’t think that specific training is required; a PI should know perfectly well how to evaluate a scientific story. The problem that reviewers are sometimes (especially so-called “high impact journals”) overly critical or, to the contrary, too sloppy, will likely persist. Likewise, the conception that some journals are considered more attractive than others will be in the leading positions in science and probably continue to change in the future. I changed quite a bit, and it will likely remain in effect in its largest part even today!). We should probably give people more time to adapt, not only their rational thinking but also their lifestyles and traditions. Ideally, the brightest minds should act cooperatively, they may be able to delay this process for a couple more decades. The more reasonable deals they offer to remain affordable – also for universities with limited budgets, the better their perspectives of staying relevant.”

Open Access

“I am pretty certain that research communication will soon be mainly through other channels than the known publishers, digital or not. This may be a sad development for these organs that have been so vital over the last century and, if they act cooperatively, they may be able to adapt this process for a couple more decades. The more reasonable deals they offer to remain affordable – also for universities with limited budgets, the better their perspectives of staying relevant.”

Gender Equality

“It will take longer than ten or twenty years to reverse the “culture” of discrimination against women that have been existing for millennia around the world (and remains in effect in its largest part even today!). We should probably give people more time to adapt, not only their rational thinking but also their lifestyles and traditions. Ideally, the brightest minds should be in the leading positions in science and not the loudest voices or strongest elbows. But very few minds are, or want to be, truly free. This is the greatest obstacle for equality. In general, we should educate young people, in particular women, even better than today in this very special skill of having a free and independent mind. And why not be a bit more patient: we have already come very far – if I only compare the situation as it is now with how it was for me as a student. We can be proud of this development, and stay optimistic and self-confident. That’s the best armour for the future.”

Lab Times: Can you imagine your career, if you would have been a male instead? Would you have made different decisions? “I can’t imagine having had different decisions regarding my research or my career. My career was anyways all but female-specific. The differences in my private life would certainly be much greater.”

Research Communication

“I have to admit that I consider the priority of discovery question less important for science. It’s very often not the first person to discover or conceive something who also gets the most credit for it. Equally, or even more important, is the right timing (others have to appreciate what you are doing) and what you make of your discovery. Doing things technically better or more thorough than others (who may have had the original idea) has made many careers.”

Evaluating Young Scientists

“The impact factor race is certainly detrimental, and everybody knows that. But the only good alternative is taking more time to look at the people and their work. Thus, one of the most important traits in young scientists to become successful is the ability to communicate well, being able to attract the attention of others long enough to make their important point. Not surprisingly, whether a story can get into a high impact journal or not also depends very often just on the way it is told. Therefore, I don’t think that the current system induces too much of a bias against other possible ways of evaluation.”
“Peer Review Should be Paid”

Tony Hyman is a perfect example of a 21st century scientist. In the pursuit of knowledge, he’s travelled the world, getting a PhD in Cambridge, UK, doing a postdoc in San Francisco, USA, and then establishing a group at EMBL, Heidelberg, Germany. His curiosity has taken him from studying microtubules and cell division to the basic physicochemical principles of liquid-liquid phase separation inside the cell. After becoming a founding director of the Max Planck Institute of Cell Biology and Genetics in Dresden, Germany, in 1999, his idea of how we can do better science have gained widespread attention in both the scientific community and social media.

The Peer Review System

“I think that getting rid of peer review would have been a huge mistake. The public look to peer review as a stamp of quality. If we were to remove it, then there would be no way to distinguish facts established by the scientific method from beliefs. We have seen what has happened to politics with the decline of newspapers and the rise of Facebook and other internet media that are not fact-checked. That is not to say that it could not be improved – it can be.

“It should become a more established part of a scientist’s life, such that it is paid and acknowledged. For instance, eLife is a good example of a journal, in which the reviewing editors are a key part of the journal. Just as hiring women requires efforts to work against unconscious bias, so does the publication system. But as in a marriage – it’s much better to work things out than to divorce.”

Open Access

“I think that open access is crucial. You only have to see members of the public trying to get at the facts when the publications are closed off from the world, to see how wrong it is. The research is funded by the public and should be available to the public.”

Gender Equality

“I think one needs to start [improving gender equality] at the postdoctoral level. This is where a lot of the loss happens. Too many women start to doubt their ability to have a science career at this stage. Men do, too, but there is less cultural support for them to pick alternative careers. The key will be careful mentoring at this stage, as well as providing funds to support female scientists while they have children.

“Recently, I was wondering, why not have 50% of the jobs for women and 50% for men. A job would either be advertised for a man or a woman. This would take care of the problem and allow men and women, for instance, to have different speeds through the career path. This would mean that it would not matter if having children slowed down the rate of publication for a while. After a decade, the issue of gender balance would be solved.”

Research Communication

“There is a problem in science. On the one hand, information should be out there as soon as possible, so that others can use it. On the other hand, scientists need to establish priority for the discovery, in order to ensure future funding, students, etc. On the other hand, peer review is an essential part of our process. By disclosing the work in a pre-print format, we have the chance to disclose work before peer review, so that others can take advantage of it.”

Evaluating Young Scientists

“Young scientists must be selected on two criteria. First, is their demonstrated ability to make discoveries based on their previous publications. Second, is their ability to propose innovative new directions. The EMBL/ERC system provides a novel way to assess and fund young scientists, because it separates funding of junior from senior scientists and allows starting scientists to compete with each other rather than with more senior scientists. It also allows funding criteria to be somewhat different for the different seniorities, so that, for instance, young scientists can be judged purely on innovation and not preliminary data.”

Interviews: Alejandrovldo
Ten years later: what happened with all these European start-ups?

Still Alive! (Mostly)

Since the foundation of Lab Times in April 2006, 46 biotech companies have been featured in our magazine. Were they successful? Did they reach for the stars – or did they crash and burn? Lab Times investigated all over Europe – from Spain to Lithuania and from the United Kingdom to Israel – and found some high flying success stories, a lot of prudent company leaders and a few mysterious disappearances.

Sometimes things turn out differently than expected. Take the young Israelis Dan Frumkin and Adam Wasserstrom. Lab Times reported on the two scientists in issue 5/2009 (page 55). In their still noteworthy paper, published online in Forensic Science International: Genetics, Frumkin and Wasserstrom describe how DNA evidence can be faked in an alarmingly simple way (FSI: Genetics 4 (2): 95-103).

“You can just engineer a crime scene,” Frumkin told the New York Times at that time. Every skilled (and malicious) molecular biologist with access to a genetic database, or a single person’s specific DNA profile, would be able to construct faked samples to match that profile, without obtaining any tissue from the person. “This artificial DNA can then be applied to surfaces of objects or incorporated into genuine human tissues and planted in crime scenes”, the authors further outlined in their FSI: Genetics paper.

But criminals should not celebrate yet. It’s not so easy to shake the credibility of this (at least for villains) unpleasant evidence, invented by British geneticist Alec Jeffreys in 1984. In order to put the axe in the helve, Frumkin and Wasserstrom promptly developed an authentication assay, “which distinguishes between natural and artificial DNA based on varying methylation analysis of a set of genomic loci”. While in natural DNA some of these loci are methylated, artificial DNA is completely unmethylated.

Great! Mission accomplished, DNA evidence successfully rescued.

Israel: Nucleix’s risky 2009 forensics business…

What could be more useful than putting this technical knowledge to work by establishing a commercial enterprise? The Israelis asserted that the mentioned assay was successfully tested, “on natural and artificial samples of blood, saliva, and touched surfaces”. So, in 2008, biochemist Frumkin and Wasserstrom, a bioinformatics specialist, founded their Tel Aviv-based biotech company, Nucleix, specialising in forensic DNA analysis. They put, as reported in Lab Times 5/2009, all their eggs into one basket, because they had, “no additional product to offer their customers, nor any distributor in Europe and the USA, so far”.

Well, biotech is a risky business. In Israel possibly even more than anywhere else. Since then, a lot has changed at Nucleix. Years ago, the company radically changed its focus to cancer detection in body fluids such as urine and plasma.

Lab Times recently spoke with Arnon Horev, who manages sales & marketing at Nucleix. In his opinion, cancer detection provides, “a much larger commercial opportunity than the previous focus of forensic applications”. So, Frumkin and Wasserstrom, who still are with Nucleix, are betting on epigenetics now.

…changed into (hopefully) more lucrative epigenetics

Currently, Nucleix is developing a test for the early detection of bladder cancer. To date, the company has raised about €12 million venture capital for it, working with a “significantly grown team”, according to Horev.

To distinguish an early stage cancerous cell from a healthy one, the Israelis use a combination of fifteen epigenetic indicators, i.e. subtle changes in methylation patterns, as they announced on the Nucleix website. And because bladder cells’ epigenetics may be tested easily in a urine sample, their new and “inexpensive” method might be superior to common invasive procedures.

The preliminary results of the non-invasive cancer screening are “promising”, Nucleix affirmed in a recent press release. In fact, they yielded “strong clinical results”, Horev maintains. They hope to launch their novel detection assay onto the EU market in late summer this year, Horev also told Lab Times.

This endeavour is challenging enough. There are quite a few (and better known) companies that also use epigenetic testing for cancer detection, such as Epigenomics (Berlin, Germany), MdxHealth (Irvine, California), and Ferrer (Barcelona, Spain).

But Horev is confident in his company. He also believes that the climate in Israel has been very good and has improved significantly since 2009, and that the general atmosphere of biomedical investments in Israel has developed with larger investments and more involvement from multinational organisations.
Proximagen from London (featured in Lab Times 2/2006) as well as Lithuania’s Fermentas (LT 3/2008) were bought up just a few years later by competitors. To avoid confusion: Takeovers are a sign of success!

UK: Proximagen’s CNS pipeline...

Let’s move 4,700 kilometres northwest, to the United Kingdom. You remember Proximagen? In 2006, Lab Times featured this promising band of British neurodegenerative researchers, founded in 2003, that had at that time grown into a company with 25 employees (issue 2/2006, page 40: “Keeping Memories Alive”). The mastermind behind the London-based King’s College start-up was Peter Jenner, a leading Parkinson’s disease scientist with decade-long expertise in neurodegenerative research. Together with his companions, Kenneth Mulvany and Bruce Campbell, both experienced in applied biotech as well as in financing issues, Jenner was keen to launch the first efficient drug against maladies such as Parkinson’s and Alzheimer’s disease.

To fulfil this goal, the brain disease specialist completed a successful IPO in March 2005, acquired two early-stage CNS programmes from GlaxoSmithKline, and built a handsome pipeline of drug candidates with significant potential. They raised €70 million in a huge fundraising in 2008 and bought out Cambridge Biotechnology, together with a Phase II treatment for chronic pain, from Sweden’s Biovitrum one year later.

Proximagen’s breathtaking pace climaxed on 13th June 2012, when Chief Executive Mulvany announced that the US drugmaker Upsher-Smith Laboratories was to buy his company and its four experimental CNS drugs for €500 million. Proximagen’s promising obesity drug as well as a medicine for rheumatoid arthritis also were included in the takeover package.

...sold to US drugmaker Upsher-Smith

Wow, what a deal! Proximagen’s lucky shareholders have presumably multiplied their invested capital.

But it was not the end of the company, not at all. Admittedly, the British lost their independence after the acquisition, but have acted since then as the core drug discovery subsidiary of Upsher-Smith, located in Cambridge, UK, and still strike major deals. The last big one was with Roche, Switzerland, on the further development of an oral small molecule drug, that might be effective in the treatment of inflammatory disease. Roche purchased a worldwide exclusive license to develop and commercialise the compound, that is currently in Phase II clinical development. If everything goes well, Proximagen/Upsher-Smith will receive upfront and milestone payments worth dozens of millions, along with royalties on net sales if a future drug containing the molecule receives marketing approval.

If so, it would certainly delight Peter Jenner most of all, who is still investigating the cause, treatment and cure of Parkinson’s disease as an Emeritus Professor at King’s College London.

Another company that was acquired soon after being featured in Lab Times is Fermentas. In issue 3/2008, we portrayed the “Baltic Boom” around this Lithuanian supplier of molecular biology reagents in an extensive four-page story, meeting up with the brand new Fermentas CEO, Algimantas Markauskas. We described how a formerly Soviet academic institute adapted to capitalism and became the world’s second biggest provider of restriction enzymes.

When, in the 1970s, three Western scientists, Werner Arber, Hamilton Smith and Dan Nathans, paved the way to the modern life sciences by establishing restriction enzymes as the work horses of molecular biology, the Soviet Union and its satellite states were left out. There were no Soviet producers of the desired reagents, and buying them from western countries was too expensive for the economically weak federation. So, born out of necessity, Soviet scientists had to create their molecular scissors themselves.

Lithuania’s biotech gem goes to Thermo Fisher

This was the birth of Fermentas, established in 1975 not in the Russian centres of science, but in the Lithuanian capital, Vilnius, under the name of the Institute of Applied Enzymology (IAE). Some thirty years later, Fermentas employed 500 people, yielded full-year revenues of about €50 million and even grew into a serious competitor of market leader New England Biolabs.

In May 2010, however, the Lithuanian company vanished from the scene, being acquired by Thermo Fisher Scientific for €235 million in cash. In retrospect, this measure was not so unexpected, in the light of Markauskas’ statements in Lab Times two years ago...
earlier. We asked him in 2008 whether he was thinking about going public or about merging with a competitor. His answer was, “I don’t want to disclose any plans for the future – but we are open to any business decision that will be necessary in future. We are not restricted to
something.”

For those who were able to read between the lines, Fermentas’ imminent company sale was evident.

Thermo had also acquired another well-established enzyme producer, the Finnish company Finnzymes, shortly before, to complete its molecular biology product range. Both, Fermentas as well as Finnzymes, disappeared from the list of biotech companies. And Algimantas Markauskas? He is still with Thermo Fisher, as a General Director for the Baltic states in Vilnius.

UK: Isogenica’s most exciting period

We return to Cambridge, UK. Isogenica, another British biotech start-up, was the fourth company to be portrayed in Lab Times (“A Walk in the Park”; issue 4/2006, page 40). Our Lab Times reporter then visited a small team of nine mostly academ-ic scientists, at Babraham Research Campus, located in the beautiful little Cambridgeshire village of Babraham in the midst of the lovely English countryside. An, “inspiring working environment”, as we described it in 2006.

Lined up six years before the Lab Times feature as a spin-off from Active Biotech (Lund), Isogenica has Swedish roots. In the beginning, they counted on their CIS-display core technology, an in vitro display method that allows the rapid generation of peptide libraries, to create therapeutic peptides against serious diseases. Those molecules allegedly have, “not only high levels of affinity and specificity but also proteolytic resistance and cell penetrating capabilities”, according to Isogenica’s founder Kevin Fitzgerald.

“Currently between two CEOs”

When moving from Babraham a few kilometres southwards to Chesterford Research Park, the British had doubled their staff to 18 people by 2011 and also discarded former key personnel, such as initial CEO Fitzgerald and (former) business developer, Bill Eldridge. Command switched to Kevin Matthews for the next few years, until the late summer of 2014, after Matthews’ decision to join a polymer technology company. Then things became bumpy: They appointed their long time Chief Scientist, Chris Ullman, as CEO with effect from September 29th, but replaced him with an outsider, Carolyn Rand, just two months later. Rand, however, a financially experienced executive of solid reputation, took the helm for just another 22 months to raise money, boost efficiency and restructure the company. She left in June 2016 after, “doing an outstanding job at Isogenica”, according to the company’s shareholders.

Now, Isogenica’s 26 employees are without CEO leadership once again. “We are currently between CEOs”, comments Marketing Executive, Ambili Nair. Until a new chief executive is found, the former Ablynx scientist Guy Hermans will play the leading role in Chesterford Research Park. Hermans is Belgian by birth and has, “over a decade of experience” in antibody fragment disc-
covery, as well as in antibody discovery technology development.

According to Nair, Isogenica has meanwhile grown into a, “primarily antibody drug discovery company whereas in 2006, we were solely a peptide drug discovery company”. Moving into the antibody drug discovery arena is what Nair calls one of the most important decisions that the company has made since 2006. With regard to the big picture, she thinks that the general climate for biotechnical enterprise has improved in the United Kingdom since 2006. Nair brings into consideration, however, the fact that the impact of the country’s withdrawal from the EU (“Brexit”) is yet to be seen.

Brexit has indeed created serious problems for the UK biotechnology industry which, after all, is still the strongest and most advanced in Europe.

Concerns about Brexit

Steven Bates, CEO of the UK Bioindustry Association (BIA), told FierceBiotech that the vote, “wasn’t the outcome the BIA wanted.” Bates added that he wasn’t afraid of a mass exodus to the USA or onto the Nasdaq in the wake of the vote, “UK biotech has sought finance from around the globe for many years and will continue to do this.” According to the latest BIA press release (of June 2016), British biotech companies recorded in 2015 the highest level of venture finance in recent years and, “continue to build on the success of previous years”. Quantified in concrete figures, they raised venture funding of £489 million in 2015, “accounting for over a third of the European total.”

Moreover, British biotech companies have 585 pipeline projects in development, which, according to the BIA, far outstrips other European countries, and run the highest number of Phase III projects in Europe. No wonder that BIA executive Bates stated that, “the UK biotech sector is in great shape.”

But for how long will UK biotech keep its pole position after leaving the EU? In a recent comment for FierceBiotech, healthcare journalist, Ben Adams, points out that, “many questions are left unanswered – and the only thing anyone is certain of is uncertainty. But business, especially one built on long timelines and with a typically precarious funding situation such as the biotech industry, does not like uncertainty.”

Adams continued that, “the big issue for biotech is how its backers now and in the future will deal with the increased risk prompted by a looming Brexit and months of uncertainty. (...) Whether Brexit will be a good thing in the long term for British biotech or not remains an open question.”

Proximagen mustn’t worry about the upcoming difficulties because they committed themselves to a US parent company years ago. Brexit won’t touch them. Isogenica, however, is in a more tricky situation. They should act with prudence in the turbulent years ahead.

The 30th anniversary cake

Let’s move on to Scandinavia. Agrisera, the Swedish antibody producer portrayed in Lab Times 1/2008 (page 41), is a nice example of relaxed continuity in the life science business. The company has carried on along the path that its founder, Greger Nor-
dlund, laid down more than three decades ago in the Swedish, “middle of nowhere” – the sleepy hollow of Vännäs, 28 kilometres northwest of university city Umeå. While this lonesome location with 4,100 residents has little to offer beyond a reunited hardcore punk band (Refused) and a former “Best Swedish Female Artist of the Year” (Lisa Miskovsky), Agrisera provides a vast number of polyclonals as well as monoclonals, produced mainly in rabbits and chickens. And because celebrating birthdays alone in Swedish seclusion is pretty boring, the company’s staff provided a number of celebratory cakes, went to Umeå University several times in spring 2014 and celebrated their 30 years in business together with local and guest scientists of Umeå’s biological and medical departments.

A few weeks ago, the small Swedish company had been listed as one of the “fastest growing companies” in a research antibody market report. It was placed between large companies on the world antibody market such as EMD Millipore and Thermo Fisher. That’s a pleasant success for Nordlund, who is now approaching retirement age (he is 67).

Despite their remote Vännäs headquarters, Nordlund has increased Agrisera’s staff since 2008 and expanded worldwide operations to countries like Brazil, Egypt, Nigeria, Serbia, Singapore and The Netherlands. The most important decision of the last ten years was, according to Agrisera’s product manager, Joanna Porankiewicz-Asplund, to focus on the niche market of plant and algal antibodies, and to establish a large secondary antibody collection. In addition, the Swedes redesigned their online webshop and increased their sales fourfold.

Paralysing European bureaucracy

Asked whether the climate for biotechnical enterprise has improved or deteriorated in Sweden since their Lab Times feature, Porankiewicz-Asplund cannot pinpoint any substantial change. The most pressing issue remains Europe’s exuberant bureaucracy, she adds. Business has an urgent need for more efficient rules and regulations, according to Porankiewicz-Asplund. Who knows whether they will listen to her message in Brussels!

Complicated bureaucracy is obviously a burning issue for the European biotechnology sector (the other, probably more urgent subject, is financing). More than half of all company leaders with whom we have spoken in recent months complained about tenacious administrative structures and outdated regulations that slow down biotechnological progress.

Given the fact that at least half of all (!) medicines now originate from biotech laboratories, there’s need for action for the EU to make it easier for companies to get their often novel business models up and running without unnecessary restrictions. The biotechnology industry has grown to become a major player within just a few decades. According to recent Ernst & Young figures, healthcare biotech comprises, “more than 1,700 companies and a market worth more than €17 billion in Europe alone”.

In their review, Ernst & Young furthermore emphasise the high stability of the European biotech industry, at least, “with respect to the number of biotech companies over the past decade”. Europe is, next to the USA, one of two key regions for the global biotech industry. However, in comparison to the US, the Old World’s biotech scenery, “is dominated by small to mid-sized private players, constituting nearly 90% of the biotech industry”.

Tools for research and bioprocessing in Spain

Let’s take a look at one typical small player. In issue 1/2007 (page 46), Lab Times visited Biomedal, who do business in the ‘biotechnological desert’ of southern Spain. In Seville, the cultural and financial centre of Andalusia, endless clusters of tourists stroll through the streets. But biotechnology? Here? Your
Lab Times reporter actually found it, between the Guadalquivir river and the Monasterio de la Cartuja, where Avenida Américo Vespucio is meeting Calle Gregor J. Mendel.

Nine years later, Ángel Cebolla is still Biomedal’s Director General. But apart from that, Cebolla proudly tells us, a lot has changed at Biomedal, after an average yearly growth of more than 20 percent in the last four years.

Since its foundation in 2000, Biomedal has developed and commercialised products and services for life science research and diagnostics. According to Cebolla, the company has continuously grown over the past 15 years, reaching sales of €2.2 million in 2015 (“ten times higher than those in 2006”, Cebolla points out). In addition to “regular” sources of income, Biomedal is currently benefiting a few public research grants that have brought a further €0.3 million into the coffers.

Biomedal’s comfortable situation is the opposite of Spain’s desolate economic state, which has still not recovered from the 2009 worldwide financial crisis. Youth unemployment has increased by an incredible 50 percent, and many well-educated academics are seeking their fortune in other European countries such as Germany and the UK. The Sevillian company, however, has realised an average yearly growth of over 20 percent in the last four years, according to Cebolla. Thanks to this encouraging trend, Biomedal has doubled its workforce from 15 people in 2006 to 30 employees.

Only a small proportion of Biomedal’s workforce produces research tools and provides R&D services. The bigger part of revenues (about 80 percent), however, comes from their diagnostics division. At present, their main product is the “Glutentox” test kit that detects gluten cross-contamination from wheat, barley, and rye in food and on surfaces. To avoid gluten-related disorders such as celiac disease, wheat allergy and others, Biomedal assays can be used in industrial food production as well as at home to track possible gluten contamination. Cebolla points out that Biomedal’s analytical tools for gluten detection are, “the only clinically tested gluten detection method on the market”. Recently, they have developed new methods for the detection of gluten peptides in human samples, stools and urine – crucial for celiac disease clinical management when managing a gluten-free diet.

In fact, the future looks bright at Biomedal.

The Spanish biotech challenge

Let’s stay in Spain, where more than 700 companies are focussed primarily or exclusively on biotechnology. In contrast to Europe’s leading biotech regions – the UK and Germany – food companies carrying out biotechnology activities are disproportionately well represented in Spain, while human health applications follow behind by some distance. Yes, the rest of Europe is a dwarf compared to the USA when it comes to agricultural biotechnology. The EU is absent from the list of world’s top 10 countries planting GM crops, due to a broad rejection by the population as well as political sluggishness. Only Spain makes an exception and is notably cultivating GM crops in Europe. That’s probably one of the reasons that, despite the lingering recession, the Spanish biotech sector continues to grow in size, according to figures provided by the Spanish Bioindustry Association (ASEBIO).

However, healthcare biotechnology exists in Spain, of course. Take Pharmamar from Madrid.

Pharmamar: searching for marine antitumor drugs

Founded in 1986, Pharmamar has become one of the country’s biotech heavyweights. The company is searching for molecules with therapeutic activity in the oceans, calling themselves, “a world leader in the discovery of antitumor drugs of marine origin”. With trabectedin (trade name: Yondelis), Pharmamar scientists developed the first cancer drug that “comes from the sea” (and the first antitumour agent produced by a Spanish company). Trabectedin is approved in Europe for the treatment of advanced soft tissue sarcoma as well as for ovarian cancer, and is undergoing clinical trials for the treatment of breast, prostate, and other sarcomas. Originally, the substance was found 1969 in the sea squirt Ecteinascidia turbinata (produced there by a microbial symbiont), while it is now manufactured for medical use by a semisynthetic process developed by Pharmamar.

When the biopharmaceutical company was featured in Lab Times 4/2007 (page 50, “20,000 Leagues under the Sea”), Yondelis had just got European-wide approval. Nine years ago, Pharmamar was already one of the main biotechnological companies in Spain, with a total of 262 staff. By the end of 2015 and still dedicated to the research and development of cancer drugs of marine origin, the metropolitan had tripled this number to more than 700.

Pharmamar’s core business still focusses on Yondelis, Luis Mora, the Managing Director of the company’s oncology business unit told us. They have advanced their global expansion in recent years, opening affiliates in Germany, Italy, France and the UK. Apart from Yondelis, they have three additional compounds in clinical testing, all of marine origin: First the anticancer agent Plitidepsin, originally obtained from the ascidian Aplidium albicans; second Lurbinectedin, a second-generation analogue of trabectedin; and third PM184, a drug candidate found in the sponge Lithoplocamia lithistoides. Lurbinectedin targets microtubule formation and thus blocks cancer growth by inhibiting cell division of tumor cells. It is currently being investigated in Phase I and II trials.

Italian dynamics next to Ancona

A small band of Italian scientists is also working close to the sea, but has no ambitions to do with anticancer drugs. Daniela Bian-
chi and Caterina Trozzi established their molecular business services, Bioaesis, in 2004 in Jesi, a small city in the hinterland of the Marche region in Northeast Italy, and were portrayed by Lab Times in issue 6/2009. Our readers learned that they,

“offer genetic profiling services, such as DNA analysis for the detection and quantification of genetically modified organisms, and also develop molecular systems for the diagnosis of many bacterial and viral pathogens, as well as reagents for molecular analyses.”

Lab Times recently contacted the CEO, Caterina Trozzi, again to interview her about the last six years with Bioaesis. She told us that the company’s health analytical services have had a significant increase compared to their food and feed analytical services, while the number of staff has remained almost unchanged (at about seven people). Their newly launched Genokit assay set includes one that evaluates the genetic predisposition of an individual to a specific sport (useful for sports clubs when deciding whether to engage a potential new athlete), and another test that analyses the genetic polymorphisms associated with high blood pressure, blood triglycerides and cholesterol levels, which are considered risk factors for cardiovascular diseases.

Trozzi has worked for about 20 years in molecular biology, partly at the Merck Research Centre, based in Pomezia, Rome, and owns a patent for the quantification of GMO in food. In 2012, Bioaesis moved to new headquarters, also in Jesi. Proudly, Trozzi told Lab Times that the new premises with 500 square meters lab space, which are, “one of the few, if not the only, laboratory in the Marche region of this size”, are owned now by Bioaesis.

Regarding the general situation in Italy, Trozzi thinks that the economy has worsened over the past 10 years and that biotech companies have been affected by the crisis. In order for a good recovery in Italian as well as in European biotechnology to take place, “it would be necessary that community funds are better allocated for the biotech sector to allow companies to continue to invest in new technologies and encourage the recruitment of new staff.”

France: growth despite money pinch

When visiting the border river at Illkirch, near Strasbourg, the picture changes. Géraldine Guérin-Peyrou, who is marketing manager at Polyplus-transfection, a French supplier of transfection reagents, is looking back at constantly increasing sales in the past 10 years. So in her mind, “the climate for biotechnical enterprise has improved”. Guérin-Peyrou adds that, “we sell worldwide, and the number of markets that we can reach has also increased, hence we are quite confident for the biotechnology world”.

That’s great news from the Alsatian company that was visited by a Lab Times reporter in the spring of 2007 (issue 2/2007, page 42). At the Parc d’Innovation d’Illkirch, located in the Rhine valley, the then five-year-old spinoff of the University of Strasbourg had rented a few lab rooms to develop and commercialise their gene delivery reagents, led by two smart women, Joelle Bloch and Anne-Lise Monjanel.

Bloch and Monjanel had founded Polyplus-transfection in 2001 together with master mind Jean-Paul Behr, a prominent expert in drug delivery and Research Director at the National Centre for Scientific Research (CNRS). Behr had done pioneering work, which led to nucleic acid carriers that were marketed by companies like Promega, Roche and Invitrogen, and decided to try his luck with his own company, dedicated to the delivery of biomolecules.

15 years later, the leadership has changed. Bloch and Monjanel left the company years ago, replaced by Mark Bloomfield, who joined Polyplus-transfection in February 2010 as CEO after more than 20 years in leading business management positions with global companies such as Hewlett-Packard, Thermo Electron (now Thermo Fisher Scientific) and Applied Biosystems. Some other first-hour key personnel are still on board, however, such as Patrick Erbacher (now CSO) and Pascale Belguise (now Business Development Manager).

Their core business is the same as in 2007, while Polyplus-transfection employs more staff today – about 30 people.
worldwide, compared with 22 when Lab Times visited Illkirch. But what can be said about their transfection products? Do they work?

You can bet they work, considering that, as early as 2008, one of their customers entered a Phase II clinical trial using their GMP grade reagent. Furthermore, Polyplus-transfection launched advanced bioproduction reagents in 2012 and 2014. According to Guérin-Peyroux, the “PEIpro” and “FectoPRO” transfection kits, “achieve superior and reproducible protein yields at increased productivity when using transient transfection and gene expression”.

With regard to the perspective for France’s biotechnology sector as a whole, Guérin-Peyroux’s remarks that, “it is time for the government to invest more in the biotech segment, and to propose long-term investment to allow start-ups to become real SME companies”. We shall see whether Emmanuel Macron, the French Minister of Economy, Industry and Digital Affairs and a former investment banker, has heard the message.

Is Germany missing the biotech boat?

Whether the French government will take action is up for debate. The German government, however, definitely heard the call for better biotech financing. Since the late 1990s, the most populated and economically powerful country in the EU has pulled the national biotech industry forward. Germany’s biotech engagement was started by Research Minister, Jürgen Rüttgers, who in 1996 initiated the legendary BioRegio competition to push-start the previously non-existent sector. All his successors did the same, more or less supporting private and academic efforts to found biotech start-ups and thus transfer scientific knowledge into industrial applications.

Within a few years, Germany had the biggest number of companies by far. However, their economic impact is still negligible. The old problem is that German start-ups very often remain small for many years and employ just a handful of people. Admittedly, there are a few exceptions, such as big players, Qiagen, Morphosys, Miltenyi Biotech and Evotec, but the vast majority of the remainder has little impact on the overall economy (and little political influence, too).

No wonder that Ernst & Young’s biotech experts stated in 2014 that the German biotech sector, “is in a state of perpetual stagnation”. And in 2016, they complained that Germany’s biotech companies missed the reviving stock market boom in Europe because of their lack of IPO readiness. In addition, Ernst & Young noted that, “real incentives for entrepreneurial activity, such as tax incentives, still are taboo in Germany”, while the government continues to implement “anti entrepreneurial” instruments such as public funding.

Self-made entrepreneurs in Martinsried

Intana Bioscience has made it without much funding but with a lot of entrepreneurial commitment. There was a kind of “garage atmosphere” when your Lab Times reporter visited this young company in Martinsried, near Munich (issue 3/2011, page 44, “Spotting the Invisible”; see picture above). Two stranded biologists, Stefan Hannus and Frank Becker, had used the unique opportunity to establish a new company after the collapse of their former employer, GPC Biotech, in 2007.

Intana’s key competence is a sophisticated kind of coupled molecule analysis, Fluorescence Cross-Correlation Spectroscopy (FCCS), that has been developed by German biophysicist and cell researcher, Petra Schwille (see also interview on page 38 of this issue!). While Schwille has been awarded the €2.5 million Gottfried Wilhelm Leibniz Research Prize for her FCCS achievements, Hannus and Becker employ FCCS as a service provider for the pharmaceutical industry. Have they succeeded since then?

According to Hannus, they have. Intana is still offering customised assay development, screening and target/hit validation, and also employs the same number of people as in 2011 (around ten). The company was among the five finalists of the 2011 German Industry Innovation Prize due to the great value of the FCCS method of stratifying and rationalising drug discovery. A while ago, Hannus and Becker performed a management buy-out and thus became the company’s owners.

Does young entrepreneur, Hannus, have any suggestions for the German government, or even the European Commission, concerning the biotech start-up scene? Of course he has. Hannus told Lab Times that there are multiple useful funding opportunities when it comes to a university spin-off. It is completely different, however, for company spin-offs, he says, and raises the rhetorical question, “Is this fair?” Hannus estimates that a rule change in this case would result in dozens of newly founded companies.

Ibidi’s huge steps forward since 2006

Ibidi is also located in the greater Munich area, and, just like Intana Bioscience, they have founded their company from scratch. Ibidi was the third start-up to be portrayed in Lab Times (issue 3/2006, page 44), and has taken huge steps forward since then. The company’s foundation in 2001 was the result of a crazy gag (to participate in a business plan competition) associated with an ultimately unsuccessful idea (to build a novel apparatus to separate DNA fragments more accurately than existing systems). But the three young founders never gave up, established a private limited company (“GmbH”), moved to the University’s basement into, “three forsaken rooms that had to be cleared out and painted” – and started to work on microscopy and microfluidics there.

“Our goal is to enable all imaginable analyses on a small microscopy support, so that you can do all kinds of cultivation and manipulation with living cells in a very small volume of water”, co-founder Valentin Kahl told the Lab Times reporter in 2006. In other words, Ibidi intended to become a provider for functional cell-based assay technologies. They reached that goal and soon came up with their trademarked “Lab-on-a-Slide”. At that time, Ibidi’s office comprised of 11 people, second hand furniture and a strong business connection with Japan.

Ten years later, Ibidi is still operating in the microfluidic/cell analysis area, providing cell-based assays, cell biochips and the relevant instruments to cell researchers. But they have grown much bigger now. The “µ-Slides” and “µ-Dishes” from Bavaria are sold and sent around the globe, and the Germans’ staff has increased from 11 to 60. Since 2006, they have grown under their own steam, supported solely by public funding from the Bavarian and German state as well as from the EU. According to Ibidi’s CEO, Roman Zantl, the company has been profitable in the last eight years and recently has also successfully completed the step across the pond, entering the important US market with its own subsidiary.

In the end, Zantl still points out that research funding should be further strengthened, especially for technology-based start-ups. Certainly, his colleagues from other European countries agree.
The mystery of the vanished companies

Of course, some biotech players have vanished from the scene in the recent ten years. As mentioned above, UK-based Proximagen was snapped up by a US pharmaceutical group in 2012. The Fermentas/Thermo Fisher deal is another example of a successful company that became part of a bigger competitor.

However, there are also some mysterious cases. Biotech companies that suddenly, oops!, had a dead website and no longer answered email requests. Take SXT (Sistemi per Telemedicina) from Lecco, Italy, as an example. In Lab Times 6/2008 (page 50), we featured this band of five young scientists who built a pocket device to monitor the health of elderly and sick people. Are they still doing business on the south-eastern shores of Lake Como?

The latest news on their website is from 2012, and not a single email sent by Lab Times provoked a response.

A similar case is the disappearance of Artbiochem from Archena, Spain. They were born as the first spin-off of the University of Murcia in 2002, dedicated to the production of enzymes and other biomolecules from artichokes (*Cynara cardunculus*), and featured in Lab Times 5/2008 (page 46). Some years later, they were gone. Our local Lab Times reporter phoned the town hall of Marchena (the city where Artbiochem was located) for information. The only details gleaned were that Artbiochem disappeared with the stoppage of public funding due to the financial crisis.

Other companies that disappeared without trace are Aequotech from Ferrara, Italy (*Lab Times* 3/2009), and Innovative Health Diagnostics (IHD) from Strasbourg, France (*Lab Times* 5/2009).

Biotica from Cambridge, UK, at least published a few press releases when their company died in the spring of 2013, announcing that, “the company hit cashflow problems resulting from a licensing dispute with a drug development partner”. A few weeks later, they told the public that, “Biotica, established in 1996, specialised in the discovery of novel polyketide therapeutics to create new medicines (...) entered administration after exhausting funding options and (...) completed the sales of (their) assets.”

In other words, they were liquidated.

**Sloning: gone but not forgotten**

There’s a more appropriate way to terminate a company’s existence: to integrate their technological know-how into another, bigger company (just as Proximagen and Fermentas did). 18 months after the German Sloning Biotechnology was featured in Lab Times 1/2009 (page 40, “Test-Tube Evolution”), they were acquired by their Munich neighbour, Morphosys.

Sloning was a manufacturer of genetically diverse protein libraries comprising defined mixtures of amino acids at pre-determined positions. No wonder antibody producer Morphosys was keen on this technology that “opened the way to a new and flexible approach to generating optimised proteins, such as antibodies”. With the takeover, Sloning’s technology became an important part of Morphosys’ Ylantia antibody technology platform that was introduced onto the market in 2011, just one year after the acquisition of Sloning by Morphosys.

But what about Sloning’s staff? Did they survive the takeover turmoil?

Heinz Schwer, who founded Sloning, recently told Lab Times that, “most of the Sloning people who joined Morphosys back in 2010 still work for Morphosys today. Naturally, there has been some fluctuation, but in the absolutely normal ballpark. Colleagues basically work in the same fields that they already used to work at Sloning. That means mainly in R&D or in General and Administration”. Schwer himself is now the CEO of Lanthio Pharma, a Dutch subsidiary of Morphosys that develops therapeutic peptide drugs enhanced for stability and selectivity.

Schwer, who worked at an oil distillery in his hometown of Ingolstadt as a refinery technician before he decided to study organic chemistry and became a biotech entrepreneur, calls for more courage and entrepreneurship. “That should be encouraged early in childhood”, he proposes.

He is surely right. But is entrepreneurial courage something that can be learned at school?

Winfried Koeppelle

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He is surely right. But is entrepreneurial courage something that can be learned at school?

Winfried Koeppelle

Biotica from Cambridge, UK, at least published a few press releases when their company died in the spring of 2013, announcing that, “the company hit cashflow problems resulting from a licensing dispute with a drug development partner”. A few weeks later, they told the public that, “Biotica, established in 1996, specialised in the discovery of novel polyketide therapeutics to create new medicines (...) entered administration after exhausting funding options and (...) completed the sales of (their) assets.”

In other words, they were liquidated.

**Sloning: gone but not forgotten**

There’s a more appropriate way to terminate a company’s existence: to integrate their technological know-how into another, bigger company (just as Proximagen and Fermentas did). 18 months after the German Sloning Biotechnology was featured in Lab Times 1/2009 (page 40, “Test-Tube Evolution”), they were acquired by their Munich neighbour, Morphosys.

Sloning was a manufacturer of genetically diverse protein libraries comprising defined mixtures of amino acids at pre-determined positions. No wonder antibody producer Morphosys was keen on this technology that “opened the way to a new and flexible approach to generating optimised proteins, such as antibodies”. With the takeover, Sloning’s technology became an important part of Morphosys’ Ylantia antibody technology platform that was introduced onto the market in 2011, just one year after the acquisition of Sloning by Morphosys.

But what about Sloning’s staff? Did they survive the takeover turmoil?

Heinz Schwer, who founded Sloning, recently told Lab Times that, “most of the Sloning people who joined Morphosys back in 2010 still work for Morphosys today. Naturally, there has been some fluctuation, but in the absolutely normal ballpark. Colleagues basically work in the same fields that they already used to work at Sloning. That means mainly in R&D or in General and Administration”. Schwer himself is now the CEO of Lanthio Pharma, a Dutch subsidiary of Morphosys that develops therapeutic peptide drugs enhanced for stability and selectivity.

Schwer, who worked at an oil distillery in his hometown of Ingolstadt as a refinery technician before he decided to study organic chemistry and became a biotech entrepreneur, calls for more courage and entrepreneurship. “That should be encouraged early in childhood”, he proposes.

He is surely right. But is entrepreneurial courage something that can be learned at school?

Winfried Koeppelle
Open Science Hardware

GOSH, that's Handy!

Global Open Science Hardware extends the philosophy of open source coding to making real objects. It is rapidly gaining importance as hardware manufacturing becomes more digital and DIY, with advances, such as 3D printing and modular electronic controllers. This brings exciting new opportunities for collaboration, both between academics and with interested citizen scientists.

A few weeks ago, a group of international pioneers compiled a manifesto for the Open Science Hardware movement at the Gathering for Open Science Hardware (GOSH) meeting in Geneva, Switzerland (http://openhardware.science/gosh-manifesto). This movement aims to reduce barriers between the various creators and users of scientific tools. The values condensed in the manifesto align well with the wider Open Science movement; they have served the pioneers well while disrupting the “business as usual” community. The truth is, not every development needs exclusive legal protection, either in hardware or software. Sharing can create large and active user communities that add value to the product or publication. What’s more, user-based development can be more suitable, more adaptable and much cheaper.

Consider the story of Arduino, an open source prototyping platform, whose adaptability has captured the imagination of millions over the last years. Technology magazines are full of news about the component that allows users to easily automate and control almost any hardware.

Academic motivation

While the component has found its way into household appliances, toys and workshops, there has also been an academic motivation for the development of Arduino: Tom Igoe, one of the co-founders and a professor in New York, got involved because it was the tool he needs for teaching interactive systems and arts, “I’m not interested in whether students learn to be good programmers, or good electrical engineers. I just want them to have a platform, with which they can build tools they need. I think there is an attitude in many fields that you should just accept what experts give you. That seems backward to me. Expertise should be used in service to one’s larger community.”

Originating from a laboratory in that spirit is the Open Quartz Crystal Microbalance (http://openqcm.com), a sensitive microbalance applied in chemistry, biology and material science when small weight matters. An openQCM team member Marco Mauro, details his experience, “When we tried the approach of open source hardware as a private company, by launching one of the first scientific analytical instruments in the world completely open, we would never have imagined this level of positive reinforcement. The community of users has helped us a lot optimising the device and inspired our next products.”

Electronics and cockroaches

On the other side of the world, a US company from Ann Arbor, Michigan, with operations in Chile, called Backyard Brains, has made teaching neurophysiology cheap and appealing through demonstration sets combining electronics and cockroaches. They initially chose open hardware because they wanted to put their first dollar to work instead of serving legal fees. To date, they have spread thousands of educational tools around the globe from cyborg insects to microscopes, while maintaining a lean operation. That said, what must be the coolest open source microscope, so far, has been designed by Richard Bowman. It’s so exciting that it deserves its own Lab Times article (www.labtimes.org/labtimes/trick/tricks/2016_02.lasso).

Various open source hardware items: 3D printed models, microscopes, the open parametric gel box and an electrochemical device.
These tools are appropriate for both professional and citizen scientists. Targeting the latter is the Civic Laboratory for Environmental Action Research (CLEAR), a feminist Open Science Hardware lab in Canada. They create do-it-yourself monitoring devices, or trawls, that target marine plastics, so people most affected by pollution can investigate their environments. The director Max Liboiron is also an advocate for a thorough community engineering approach, “We recently tested our open science hardware trawls against the expensive industry standard, so we can be sure that our DIY versions capture data comparable to other research tools, and it got a lot of media attention.”

Hundreds of available tools

Joshua Pearce, author of the book Open-Source Lab (www.appropedia.org/Open-source_Lab) has been using open hardware in his lab for several years already. For us, he summarises, “Now that most labs have access to digital fabrication equipment such as 3D printers, it just makes sense for scientific equipment to be open hardware. It provides access to high-end scientific tools at low costs, while enabling reproducibility of experiments by replication of equipment itself. At the same time, the more stringent sharing of source code for the hardware makes customisation of tools easy. Hundreds of tools are already available on the web and more are added or derived from them every day.” Still, much needs to be done to make open sharing of science hardware designs the status quo. Currently, scientists often publish results without providing information about the hardware used to obtain them, particularly if it’s home-made. To change this, a lot of infrastructure has recently been created that addresses some of the open hardware-specific challenges.

Two new journals are being created, to provide a platform for academic exchange and to enable further recognition of involved scientists: HardwareX and the Journal of Open Hardware (launching later this year beside the existing Journal of Open Research Software, but submissions are already welcome).

Business models based on open source hardware are tested by an increasing number of start-ups and studied by academics. Licences specific to open hardware are created by the likes of CERN OHL, TAPR, and Solderpad. And the open source documentation software DocuBricks (http://docubricks.com) is developed by community members, which makes creating good instructions easier for hardware makers.

This addresses an important concern of the community about quality management and the interpretation of the open source hardware definition (www.oshwa.org/definition). Many currently released instructions are step-by-step guides that enable users to recreate hardware. But to be called open, they also need to contain modifiable design files with information that gives power to the community to creatively modify. It is worth writing a documentation that communicates the design rationale and allows for modularity. Only when other makers can improve and adapt the design, can we unleash the true power of open sourcing.

Get involved

If you want to benefit from more hands-on teaching, improved impact opportunities, better reproducibility and new pathways for collaboration at lowered cost, there are many ways to get involved: (1) Talk about it! (2) Start creating hardware. (3) Remember that documenting and sharing is worthwhile for you and essential for the community. (4) Get your hardware designs published!

As early free software pioneer Dennis Allison said, “Let us stand on each other’s shoulders, not each other’s toes.”

Tobias Wenzel & Robin Lamboll
(University of Cambridge)
Product survey: Western Blotting Transfer Systems

Changing of the Guard

Protein transfer in Western blotting is still performed in many labs in the traditional way with tank or semi-dry blotters. But alternative Western blotting systems based on capillary electrophoresis or microfluidic chips are gradually gaining ground.

There is hardly another life science technique that has changed so little over time than Western blotting. Established independently in the late seventies by Neil Burnette, George Stark (both from the US west coast, hence the wordplay) and Harry Towbin from Switzerland in slightly different implementations, the classical Western Blot is still one of the most employed life science methods – regardless of its many shortcomings and pitfalls.

Simple but effective

One reason for the prolonged success story is the simple setting of a Western. In its most basic form, introduced by George Stark’s group, the protein transfer from the electrophoresis gel to the blot membrane even runs without a power supply by simply utilising the capillary forces of a stack of filter papers: just place the membrane onto the gel, add a few filter papers soaked in transfer buffer, put a weight on top of the stack and give the proteins enough time to migrate out of the gel onto the surface of the membrane – very old-school but still in use. And not the worst way to accomplish a perfect blot that represents the complete spectrum of separated proteins, including very low as well as very high molecular weight proteins.

Capillary Westerns may be performed with simple standard equipment available in every ordinary lab, such as plastic trays, plexiglass plates and some kind of weight. Commercial capillary blotters, which are still offered by specialised companies, usually apply a bracket (pushed down with screws) that depresses the cover plate placed on top of the blotting staple. This assures a tight contact between blotting paper, membrane and gel and prevents the formation of air bubbles, which may interfere with protein transfer. But even this improved set-up cannot zero out the major drawback of capillary Western blotting: the protein transfer is awfully slow. It usually takes several hours or overnight to complete and requires a lot of time and patience – which most researchers don’t have.

Hence, Harry Towbin came up with the idea to install the blot sandwich made of gel, nitrocellulose membrane and filter papers in a gel destainer, filled with either diluted acetic acid for blotting of urea gels or the classical Towbin buffer (25 mM Tris, 192 mM glycine, 20% methanol) for blotting of SDS-PAGE gels. He connected the anode and cathode of the destainer to the respective pins of a power supply, and adjusted voltage and current to levels that enabled fast electrophoretic migration of the proteins without too much heat production.

Towbin’s so-called tank or wet blot technique hasn’t changed much over the years. Granted, tank blots are no longer performed in destainers. Current manufacturers of blotting equipment offer stylish blot apparatuses in different sizes, usually provided with closely-spaced wire electrodes, to provide strong electrical fields. Researchers have also developed new blotting buffer systems, such as CAPS buffers, however; Towbin’s original recipe is still widely used in many labs as a standard buffer.

Speeding up protein transfer

Tank blotting is faster than capillary blotting but it still takes about one to three hours until the protein transfer is finished. Transfer speed may be enhanced with semi-dry blotting systems, equipped with inert graphite or carbon plate electrodes on the bottom and the top of the blot apparatus. The semi-dry blot sandwich consists of a pre-wetted extra thick filter paper, membrane, gel and a second pre-wetted filter paper – all exactly cut to the size of the electrodes. After closing the lid, the sandwich is tightly squeezed between the two electrodes, allowing maximum current to flow through the gel, leading to a strong electrical field that cuts down transfer time to about 30 minutes to one hour.

Reducing the amount of buffer even further gave rise to dry blotters with extremely short transfer times of only a few minutes. Dry blotters utilise gel matrices functioning as ion reservoirs, instead of wetted filter papers as well as copper electrodes in place of inert graphite anodes and cathodes. This modified design has two advantages: in contrast to graphite electrodes (which electrolyse water), copper electrodes do not generate oxygen bubbles that may disturb protein transfer; the minimised distance between the copper electrodes allows high field strength, enabling very fast transfer.

Smart researchers combine dry blotting with the fast Bis-Tris gel electrophoresis system, to execute the first two steps of the Western blotting process in less than 45 minutes. According to a recent paper by Jillian Silva and Martin McMahon from the University of California, that’s the “fastest Western in town” – the fastest classic Western to be precise (J Vis Exp, 84 e51149). But besides the fact that 45 minutes, plus the additional time needed for protein detection and washing steps, is not really “fast”,
traditional Western blotting has some more severe drawbacks: it is still very labour-intensive and requires a lot of manual work, it swallows up tons of proteins per assay and last but not least, it is only poorly suitable for multiplexing, i.e. multi-protein analysis.

Hence, researchers have developed several non-traditional Western blotting concepts, mostly based on capillary electrophoresis (CE) or capillary gel electrophoresis (CGE) techniques and microfluidic systems. Capillary electrophoresis was already introduced back in the early nineteen eighties but has been applied in Western blotting devices only recently. There are basically two major approaches of capillary Western blots. One is based on a technique developed by Robert Kennedy’s group at the University of Michigan, the other has been put forward by Roger O’Neill and his co-workers from the US company Cell Biosciences, now ProteinSimple.

Kennedy came up with the idea to separate the protein mixture in a gel-filled capillary, surrounded at the end by a sheet capillary, which has direct contact to a blotting membrane. The blot membrane is moved along the x-axis by a translational stage, to capture proteins exiting the capillary on the membrane. Detection of the deposited proteins is done similarly to a classic Western with an immunoblot. The complete process takes about one hour.

**Western without blotting**

O’Neill’s group went one step further by skipping the blotting step altogether. Similar to the approach of the Kennedy group, proteins are separated in the first step by capillary electrophoresis. However, O’Neill and his co-workers utilised a capillary filled with a sieving media (capillary gel electrophoresis) and immobilised the separated proteins onto the inner surface of the capillary with a special capture chemistry. Primary and secondary antibodies are then flushed through the capillary to detect target proteins inside the capillary, eliminating the blotting step of traditional Westerns. ProteinSimple’s so-called “simple Western” system runs automatically and requires only small volumes (40 nL) of sample material.

Microfluidic Western blotting approaches try to integrate the western workflow in microfluidic chips, containing a set of micro-channels usually fabricated from glass, silicon or polymers, such as Polydimethylsiloxan (PDMS). A very interesting microfluidic device suitable for multiplexed Western blotting has been published by the Kennedy group in the June edition of *Analytical Chemistry* (Shi Jin et al., 88, 6703-10). The blot device is basically a miniaturisation of Kennedy’s CE-blotting system described above. Instead in a capillary, however, Shin et al. separated the proteins in the tiny channel of a glass chip filled with a sieving media. Similarly to the CE-Western, the microfluidic chip is dragged along a PVDF blotting membrane to deposit the proteins flowing out of the channel’s exit onto the surface of the membrane. The trick to obtain multiplexed Western blots is pretty simple: the same protein sample is repeatedly injected into the chip, leading to multiple protein tracks on the membrane that can be probed with different antibodies. According to the authors, as little as 400 ng of total protein, injected into nine fractions, were sufficient to detect eleven different proteins.

**Single cell Western**

Another notable microchip-based, western blot device has been put forward by Amy Herr’s group at the University of California, Berkeley. The group developed a single cell Western blot assay that enables parallel analysis of thousands of individual mammalian cells (*Nature Methods*, 2014, 11, 749-55).

The basic idea of Herr’s single cell Western blot is pretty straightforward. Single cells are captured in the tiny microwells of a 30 µm thick, photoactivatable polyacrylamide gel (PACT-gel), coated onto a silicon wafer (with dimensions of a microscope slide). After a washing step, the individual cells in the microwells are lysed within a few seconds by simply pouring a lysis buffer onto the chip.

An electrical field is applied to the chip that drives the proteins of the lysed cells into the PACT-gel layer, where they are separated according to their size. After 45 seconds a UV light is switched on that triggers the crosslinking (blotting) of proteins to the gel. Lysis, electrophoresis and “blotting” took a mere 75 seconds: Herr’s single cell western transfer technique is not only super clever, it is undisputably the fastest in town.

But there’s a fly in the ointment. The in-gel immunoprobing of single cell Westerns via primary and secondary fluorescent labelled antibodies as well as the necessary washing steps still take 1.45 hours – but this problem will no doubt be fixed by further generations of researchers enhancing Western Blotting.

Harald Zähringer
## Western Blotting Transfer Systems

<table>
<thead>
<tr>
<th>Company/Distributor</th>
<th>Name of Product</th>
<th>Transfer Technology</th>
<th>Capacity</th>
<th>Format</th>
<th>Transfer Time</th>
<th>Miscellaneous, Specialties, Generally</th>
<th>Price (EUR)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bio-Budget</strong></td>
<td>Semi-Dry Electroblot 10 x 10</td>
<td>Semi-dry blotting</td>
<td>11 x 11 cm</td>
<td>10 min up to 2 hours</td>
<td>High quality plate electrodes for homogeneous transfer</td>
<td>795.–</td>
<td></td>
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<td><strong>Technologies</strong></td>
<td>Semi-Dry Electroblot 20 x 20</td>
<td>Semi-dry blotting</td>
<td>21 x 21 cm</td>
<td>10 min up to 2 hours</td>
<td>High quality plate electrodes for homogeneous transfer</td>
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<td><strong>Biozym Scientific</strong></td>
<td>Tank Blotter</td>
<td>Tank blotting</td>
<td>1-4 gels</td>
<td>9 x 9 cm</td>
<td>10 min up to 2 hours</td>
<td>High quality plate electrodes for homogeneous transfer</td>
<td>1,050.–</td>
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<td><strong>Hessisch Oldendorf, Germany</strong></td>
<td>Tank Blotter</td>
<td>Tank blotting</td>
<td>2 gels</td>
<td>18 x 20 cm</td>
<td>20 min to several hours</td>
<td>High quality plate electrodes for homogeneous transfer</td>
<td>1,375.–</td>
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<tr>
<td><strong>Bio-Rad Laboratories</strong></td>
<td>Trans-Blot Turbo Transfer System</td>
<td>Rapid blotting system</td>
<td>2 independent cassettes to transfer 4 x mini gels (10 x 7.5 cm) or 2 x midi gels (15 x 9.4 cm)</td>
<td>3-30 min</td>
<td>Rapid, high through-put transfers</td>
<td>1,990.–</td>
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<td><strong>Muenchen, Germany</strong></td>
<td>Mini-Trans Blot Cell</td>
<td>Tank transfer system</td>
<td>10 x 7.5 cm</td>
<td>1 hour to overnight</td>
<td>Use with pre-cast or hand-cast gels</td>
<td>1,071.– (stand-alone apparatus)</td>
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<tr>
<td><strong><a href="http://www.bio-rad.com">www.bio-rad.com</a></strong></td>
<td>Criterion Blotter</td>
<td>Tank transfer system</td>
<td>10 x 7.5 cm</td>
<td>30 min to 1 h</td>
<td>Use with pre-cast or hand-cast gels</td>
<td>1,115.– (incl. tank &amp; plate electrodes)</td>
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<tr>
<td><strong>Trans-Blot SD</strong></td>
<td>Semi-dry transfer system</td>
<td>4 x mini gels (10 x 7.5 cm)</td>
<td>Maximum gel size of 24 x 16 cm</td>
<td>15-60 min</td>
<td>Fast and efficient blotting without buffer tank or gel</td>
<td>1,354.– (Trans-Blot SD only)</td>
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<tr>
<td><strong>Trans-Blot Cell</strong></td>
<td>Tank transfer system</td>
<td>Up to 12 mini gels or 6 midi gels at the same time</td>
<td>Fast and efficient blotting without buffer tank or gel</td>
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<td>2,349.– (with PowerPac HC)</td>
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<td><strong>Trans-Blot Plus Cell</strong></td>
<td>Tank transfer system</td>
<td>Up to 27 mini gels/12 midi gels at the same time</td>
<td>Fast and efficient blotting without buffer tank or gel</td>
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<td>Please enquire</td>
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<td><strong>Biometra</strong></td>
<td>Fastblot B33/B34</td>
<td>Semi-dry blotting</td>
<td>16 x 20 cm</td>
<td>Cooling option (Fastblot B33)</td>
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<td><strong>Goettingen, Germany</strong></td>
<td>Fastblot B43/B44</td>
<td>Semi-dry blotting</td>
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<td>Cooling option (Fastblot B43)</td>
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<td>595.–</td>
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<td><strong><a href="http://www.biometra.com">www.biometra.com</a></strong></td>
<td>Tankblot Eco-Mini</td>
<td>Tank blotting</td>
<td>4 gels</td>
<td>Maximum gel size of 9.2 cm x 9.5 cm</td>
<td>4 separate blotting cassettes for single gels</td>
<td>873.– (system)</td>
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<tr>
<td><strong>Contact:</strong></td>
<td>Tankblot Eco-Maxi</td>
<td>Tank blotting</td>
<td>2 gels</td>
<td>Maximum gel size of 9.2 cm x 9.5 cm</td>
<td>Buffer tank with integrated cooling base</td>
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<td><strong><a href="http://www.biometra.com">www.biometra.com</a></strong></td>
<td>Dot Blot 96</td>
<td>Vacuum blotting</td>
<td>96-well format</td>
<td>Innovative sealing system</td>
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<td>1,990.–</td>
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<td><strong>Biostep</strong></td>
<td>Gelco Electroblotting Systems</td>
<td>Wet blotting system</td>
<td>Mini: Up to 5 blots 10 x 10 cm</td>
<td>Cost-effective, safe and easy-to-use system</td>
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<td>From 526.–</td>
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<td><strong>Burkhardtsdorf, Germany</strong></td>
<td>Gelco Semi Dry Systems</td>
<td>Semi dry systems</td>
<td>Mini: 10 x 10 cm</td>
<td>Gel blots are stackable for high throughput blotting</td>
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<td>From 595.–</td>
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<td><strong><a href="http://www.biostep.de">www.biostep.de</a></strong></td>
<td>EasyPhor PAGE WetBlot Mini System</td>
<td>Webblotting (tank)</td>
<td>10 x 10 cm</td>
<td>Uniform electric field</td>
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<td><strong>EasyPhor PAGE WetBlot Mini System</strong></td>
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<td>Format</td>
<td>Transfer Time</td>
<td>Miscellaneous, Specialities, Generally</td>
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<td>Biozym Scientific</td>
<td>EasyPhor PAGE</td>
<td>Semi-Dry Blotter</td>
<td>4 gels</td>
<td>(Mini: max. 10 x 10 cm, Maxi: max. 20 x 20 cm)</td>
<td>60 min (RT) to 12 h (cooled, big proteins)</td>
<td>Very even and gentle transfer, even for big-sized proteins</td>
<td>785.--/Mini 1,210.--/Maxi Special prices on request</td>
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<tr>
<td>Carl Roth</td>
<td>Rotiphorese PROClamp Tank Blotting System</td>
<td>Tank Blotting</td>
<td>4 gels</td>
<td>(Mini: max. 10 x 10 cm, Maxi: max. 20 x 20 cm)</td>
<td>60-120 min</td>
<td>Uniform electric field</td>
<td>759.-- (Mini) 1,490.-- (Maxi) Special prices on request</td>
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<td>Semi Dry Blotter</td>
<td>Semi Dry blotting</td>
<td>Mini: 3 gels of max. 10 x 10 cm (piled)</td>
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<td>30-60 min</td>
<td>Fast, steady and efficient transfer</td>
<td>689.-- (Mini) 1,625.-- (Maxi) Special prices on request</td>
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<td>Semi Dry Blotter PROfessional</td>
<td>Semi Dry blotting</td>
<td>Mini: 3 gels of max. 10 x 10 cm (piled)</td>
<td></td>
<td>30-60 min</td>
<td>Fast, steady and efficient transfer</td>
<td>689.-- (Mini) 1,625.-- (Maxi) Special prices on request</td>
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<td></td>
<td>Dot Blotter or Slot Blotter</td>
<td>Vacuum transfer</td>
<td>Dot blotter: 96 samples (8 x 12, 96 well format), 180 µl each</td>
<td>Approx. 30 s Slot blotter: 48 samples (3x16), 360 µl each</td>
<td>Approx. 1 min</td>
<td>Regular transfer without leaking</td>
<td>685.-- (Dot blotter) 709.-- (Slot blotter) Special prices on request</td>
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<td>C.B.S. Scientific Company</td>
<td>EBU-204P</td>
<td>Tank blotting</td>
<td>10 x 10 cm (max.)</td>
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<td>With plate electrode panels, for Western, Southern or Northern Blots</td>
<td>Please contact your local distributor</td>
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<td>EBU-102</td>
<td>Tank blotting</td>
<td>15 x 21.5 cm</td>
<td>3 Gel cassettes</td>
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<td>Tank blotter includes platinum wire electrode panels, internal cooling base, 1 gel cassette and safety cover with attached power leads</td>
<td>Please contact your local distributor</td>
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<td>EBU-102P</td>
<td>Tank blotting</td>
<td>15 x 21.5 cm</td>
<td>3 Gel cassettes</td>
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<td>With planar electrode panels</td>
<td>Please contact your local distributor</td>
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<td>EBU-222</td>
<td>--</td>
<td>20 x 20 cm</td>
<td>2 Gel cassettes</td>
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<td>Tank blotter includes platinum wire electrode panels, internal cooling base, 2 gel cassette and safety cover with attached power leads</td>
<td>Please contact your local distributor</td>
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<tr>
<td></td>
<td>Various Mini blotting systems and Western blotting bundles</td>
<td>Tank blotting</td>
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<td>Please contact your local distributor</td>
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<td>EBU-4000</td>
<td>Semi-dry blotting</td>
<td>20 x 20 cm (max.)</td>
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<td>Includes stainless steel cathode and platinum-coated titanium anode, interlocking power leads with safety-tips and Mylar sheets</td>
<td>Please contact your local distributor</td>
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<td>EBU-6000</td>
<td>Semi-dry blotting</td>
<td>35 x 45 cm (max.)</td>
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<td>Includes stainless steel cathode and platinum-coated titanium anode, interlocking power leads with safety-tips and Mylar sheets</td>
<td>Please contact your local distributor</td>
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<td>EBU-3000</td>
<td>Semi-dry blotting</td>
<td>12 x 34 cm (max.)</td>
<td></td>
<td></td>
<td>Includes stainless steel cathode and platinum-coated titanium anode, interlocking power leads with safety-tips and Mylar sheets</td>
<td>Please contact your local distributor</td>
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<tr>
<td>Dunn Labortechnik</td>
<td>MaGELin Western Transfer System</td>
<td>Wet transfer</td>
<td>2 gels (8 x 10 cm, or 10 x 10 cm)</td>
<td></td>
<td>60-90 min</td>
<td>Complete system with cassette module, vented lid, buffer tank, and power cords</td>
<td>Approx. 900.--</td>
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<td></td>
<td>Semi-Dry Blotter</td>
<td>Semi dry transfer</td>
<td>24 x 30 cm</td>
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<td>Graphite-coated plates to reduce heat and minimize buffer usage</td>
<td>Approx. 1,500.--</td>
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## Western Blotting Transfer Systems

<table>
<thead>
<tr>
<th>Company/Distributor</th>
<th>Name of Product</th>
<th>Transfer Technology</th>
<th>Capacity</th>
<th>Format</th>
<th>Transfer Time</th>
<th>Miscellaneous, Specialties, Generally</th>
<th>Price (EUR)</th>
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<tbody>
<tr>
<td>GE Healthcare</td>
<td>TE 70 PWR Semi-Dry Transfer Unit</td>
<td>Semi-dry blotting</td>
<td>14 x 16 cm (max.) or two mini gels side-by-side</td>
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<td></td>
<td>Electrotansfers proteins from polyacrylamide gels in less than 1 h</td>
<td>Please enquire</td>
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<tr>
<td>Darmstadt, Germany</td>
<td>TE 77 Semi-Dry Transfer Unit</td>
<td>Semi-dry blotting</td>
<td>21 x 26 cm (max.) or four side-by-side mini-gels</td>
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<td>See above</td>
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<td></td>
<td>Amersham WB System</td>
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<td>Fully integrated system for SDS-PAGE and Western blotting of proteins based on fluorescence detection</td>
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<td>The system provides standardised, quantitative, and reproducible analysis of proteins</td>
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<td>Reliable normalization by multiplexing target and control fluorescent signals on the same blot</td>
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<td>Western blot workflow achieved in less than 4 h ensures fast, conclusive data</td>
<td>Please enquire</td>
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<tr>
<td>Hoefer</td>
<td>TE70XP</td>
<td>Semi dry</td>
<td>14 x 16 cm</td>
<td>Up to four mini gels</td>
<td></td>
<td>Intelligent built-in power supply, which automatically monitors the transfer status, stopping the transfer before the stack overheats</td>
<td>Please contact your local distributor</td>
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<tr>
<td>Holliston (MA), USA</td>
<td>TE77XP</td>
<td>Semi dry</td>
<td>21 x 26 cm</td>
<td>Up to 12 mini gels at one time</td>
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<td>See above</td>
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<td></td>
<td>TE42 Standard Transfer Tank</td>
<td>Wet blotting</td>
<td>Up to four gels</td>
<td></td>
<td></td>
<td>Quickly and evenly transfers proteins and nucleic acids from polyacrylamide or agarose gels onto nylon, nitrocellulose or PVDF membranes</td>
<td>Please contact your local distributor</td>
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<tr>
<td>ProteinSimple</td>
<td>Wes</td>
<td>Separation and immunoprobeing in capillary</td>
<td>Up to 25 samples per run</td>
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<td></td>
<td>Separate and detect proteins as large as 440 kDa in as little as 3 hours</td>
<td>Please enquire</td>
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<tr>
<td>San Jose (CA), USA</td>
<td>Sally Sue</td>
<td>See above</td>
<td>Up to 96 samples per run</td>
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<td>Up to 96 samples in one experiment with as little as 0.2 μg/ml protein in the sample</td>
<td>Please enquire</td>
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<td></td>
<td>Peggy Sue</td>
<td>See above</td>
<td>Up to 96 samples per run</td>
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<td>Separate and analyze proteins by size or charge from 12 to 440 kDa either by immunoblot assay or total protein</td>
<td>Please enquire</td>
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<td></td>
<td>Milo</td>
<td>On-chip SDS-PAGE, immunobilisation and immunoprobe</td>
<td>scWest chip partitions the cells and captures ~1,000 individual cells</td>
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<td>Single cell Western</td>
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<td>Serva Electrophoresis</td>
<td>BlueBlot Semi-Dry Blotter SD 11</td>
<td>Semi-dry blotting</td>
<td>11 x 11 cm</td>
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<td></td>
<td>Platinum-covered steel net as anode</td>
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<td>Heidelberg, Germany</td>
<td>BlueBlot Semi-Dry Blotter SD17</td>
<td>Semi-dry blotting</td>
<td>17 x 17 cm</td>
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<td>Stainless steel plate as cathode</td>
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<td>BlueBlot Semi-Dry Blotter SD26</td>
<td>Semi-dry blotting</td>
<td>24 x 26 cm</td>
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<td>Platinum-covered steel net as anode</td>
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<td>Platinum-covered steel net as anode</td>
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<td>Spring-mounted anode for blotting stacks</td>
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<td>Stainless steel plate as cathode</td>
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<td>Stainless steel plate as cathode</td>
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<td>Stainless steel plate as cathode</td>
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<tr>
<td>Thermofisher Scientific</td>
<td>Thermo Scientific Piece Power Blotter</td>
<td>Semi dry</td>
<td>Up to 4 mini gels or 2 midi gels</td>
<td>5–10 min</td>
<td></td>
<td>High transfer efficiency with a broad range of protein sizes (10-300 kDa) compared to conventional semi-dry or wet (tank) transfer methods</td>
<td>2,050.00</td>
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<tr>
<td>Paisley, United Kingdom</td>
<td>Thermo Scientific Invitrogen iBlot2</td>
<td>Dry</td>
<td>Up to 2 mini gels or 1 midi gel</td>
<td>7 min or less</td>
<td></td>
<td>High-quality and more compact transfer stacks</td>
<td>1,534.00</td>
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<td></td>
<td>Thermo Scientific Invitrogen Bolt Mini Blot Module</td>
<td>Wet</td>
<td>1 mini gel per module</td>
<td>30–60 min</td>
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<td>Universal module design — allows modules to fit in either chamber of the tank, simplifying the transfer setup</td>
<td>355.00</td>
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<td></td>
<td>Perfect Blue Sedeck</td>
<td>Semi-dry blotting</td>
<td>1 h</td>
<td></td>
<td></td>
<td>Stainless steel cathode, platinum-covered titanium anode</td>
<td>Please enquire</td>
</tr>
<tr>
<td>VWR International</td>
<td>Perfect Blue Web S and M</td>
<td>Tank blotting</td>
<td>Up to 4 blotting cassettes</td>
<td>Gel sizes: 18 x 20 cm (M), 8.5 x 9.5 cm (S)</td>
<td></td>
<td>Colour-coded blotting cassettes</td>
<td>Please enquire</td>
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<tr>
<td>Darmstadt, Germany</td>
<td>Diverse Western blotting apparatuses from different manufacturers</td>
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<td>Please enquire</td>
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New Products

Fermentation

Product: Mini bioreactor system
Name & Manufacturer: ambr 250 modular from Sartorius Stedim Biotech
Technology: The system consists of a workstation with 2, 4, 6 or 8 single-use bioreactors, with a working volume range of 100 to 250 mL. These mini bioreactors contain impellers, suitable for fermentation or cell culture and show excellent scale up to larger bioreactors. They are also fully integrated with liquid reservoirs and syringe pumps, allowing rapid experimental set up and turn around, thus significantly increasing lab efficiency.
Advantages: By following three easy steps, a bioreactor and all the required accessories can be connected in just a couple of minutes. Once installed, the bioreactor has all the required process services for parameter control, including pH, DO, temperature or agitation. Additionally, feeds can now be delivered with high accuracy from the reagent reservoirs via the syringe pumps into the bioreactor. One control unit is capable of controlling up to eight bioreactor stations independently via an easy-to-use touch screen user interface.
More Information: www.sartorius.com

Protein extraction

Product: Biomolecule extraction platform
Name & Manufacturer: Extractman from Gilson
Technology: The platform leverages Exclusion-based Sample Preparation (ESP) technology. ESP technologies replace the multiple wash and transfer pipetting steps of current paramagnetic bead separation products with a single pass of the magnetic slide of the Extractman device. After paramagnetic beads are allowed to bind the target protein in a sample, an upper magnet captures the beads. They are then moved through a series of wash wells on the single-use bead capture steps. A second, lower magnet can temporarily disengage the upper magnet, allowing beads to gently move through each wash solution. Ultimately, the paramagnetic beads are collected in a final elution well. The innovative design and setup of the single-use bead capture strips and microplates prevent carryover and cross-contamination as the paramagnetic beads are processed.
Advantages: Protein isolation can be performed in significantly less time compared to more traditional tube-based magnetic bead procedures, with up to four samples isolated in parallel in as little as 30 seconds. The protocol is also ideal for capturing weakly bound protein-protein and cell-protein complexes.
More Information: www.gilson.com/extractman

Cell culture

Product: Cell culture vessel
Name & Manufacturer: CELLdisc from Greiner Bio-One
Technology: Each unit is ventilated via a central gas channel, which allows the media within to be either passively or actively gassed. Both incoming and exiting gas lines have integrated air filters, which, along with an optimised surface treatment, combine to support maximum cell growth. The concept requires only a few steps to create a cell culture: fill with cell suspension, close the screw cap, tilt by 90 degrees and wait until the fluid has spread evenly. Then simply turn again by 90 degrees, straighten up and place in the incubator. The vessels are available with 4, 8, 16 or 40 layers.
Advantages: The cell culture vessel offers a growth area of up to one square metre for adherent mammalian cells on a minimal footprint. Its compact, robust and cylindrical design means it is just as suited to smaller test series as it is for automation and the quantifiable scale-up of mass cell cultures in sizes of between 1,000 and 10,000 square centimetres.
More Information: www.greinerbioone.com

Chromatography

Product: HPLC and UHPLC system
Name & Manufacturer: Nexera-i MT from Shimadzu
Technology: The instrument features two independent and dedicated flow lines, one for UHPLC and the other for HPLC analyses. Newly developed Analytical Conditions Transfer and Optimization (ACTO) technology minimises the effect of system volume differences on analytical results. In addition to drastic improvement of efficiency and quality of method development and transfer efforts in quality control departments, the systems’ dual flow lines also maximise operational efficiency. They enable a single instrument to run both HPLC and UHPLC analyses, as opposed to separate dedicated instruments for each analysis.
Advantages: The instrument occupies a small footprint and is equipped with a stable low-noise detector and high speed, highly reproducible injector (especially for low volume injections). It is an ideal solution for labs considering the conversion of existing HPLC to UHPLC separations. It is especially attractive for laboratories requiring both HPLC and UHPLC analysis.
More Information: www.shimadzu.eu
**Bad Statistics or Bad Practice?**

Software packages used to analyse fMRI data are very sensitive to the appropriate setting of statistical parameters.

**Measuring of brain activity**

To understand the problem, we have to look for a moment at the way fMRI is done. Typically, a subject is placed in a scanner and a resting state measurement of brain activity is made. Then the subject will perform a task and the levels of activity across the brain, or perhaps in a determined “region of interest”, is measured, based on the BOLD signal. Once you have got this signal, you have to do some heavy duty statistics to sort out the signal from the noise. There are several ways of doing this. At the most crude level, you can determine a threshold, above which you will accept a signal as having some meaning. More sophisticated analyses involve looking for areas of the brain, whose activity is statistically different from resting background levels or statistically correlated to some parameter of the task. This is usually done using a software package, some of the most popular of which are SPM (“Statistical Parametric Mapping”), FSL, FLAME1, 3dtest and 3dMEMA. These packages require a certain amount of statistical competence but the authors have gone to a lot of pains, to put in routines to take care of the most important procedures, such as correcting for multiple testing. The authors of these packages are not stupid – they know their stats and are committed to sound analysis.

But we are, I hope, empiricists at heart. So Eklund put these packages to the experimental test. The results are not comforting. He took advantage of the large sets of publicly available imaging data, and divided up the control subjects randomly as if they were the experimental groups. Then he simply did standard statistical tests on the resting activity in these controls, to see how many false positives the programmes threw up. Of course, these are controls, so there should be no difference between them and we should expect a false positive error rate of about five per cent.

**Way too many false positives**

He told the programmes to use either cluster detection (a sensitive method of finding faint signals spread out over different parts of the brain) or voxel-wise analysis (analysing point-by-point). Shockingly, at a cluster detection rate of p=0.01 (the default setting for FSL), all the packages except FLAME1 threw between 15 and 50% false positives. Admittedly, this is a high detection rate, and as you would expect, turning it down to 0.001 (the default setting for SPM) reduced the false positives. But they still persisted above 10% in about half of the “experiments”. The exception was FLAME1, which had about 10-20% false positive rates using a cluster detection threshold of 0.01, but when you set it at 0.001 the error rate was well below 10%, suggesting there is a
danger of false negatives. In other words, between 10 and 50% reported results of fMRI experiments are false positives.

What is the problem here? Eklund had a look at the assumptions behind the packages’ analyses. Just like the more familiar parametric tests we use in the lab every day, the fMRI packages assume that the underlying data and the noise follow, at least approximately, simple distributions that can be approximated with a simple set of parameters. When he looked at the data, he found that the statistical test values (the z or t values) didn’t actually vary much from the expected null distribution, so no problem there. The exception was for the FLAME1 data that had a much lower variance than the theoretical distribution, which might explain why it was both insensitive and robust against false positives.

Wrong distributional assumptions?

The root of the problem, it seems, lies in the assumptions made about the way brain signals correlate over space. Random field theory makes it easier to use parametric statistics and there are many good reasons for wanting to do this. But random field theory makes some assumptions that the spatial correlation between signals follows a squared exponential that is constant over the brain. But when you look at these correlations directly, it turns out that brain regions tend to be correlated in different ways, which means that some regions have a natural predisposition to form statistical clusters.

This looks bad, so Lab Times contacted Karl Friston at University College London, the creator of SPM, and Jean Daunizeau at the Brain and Spine Institute, Paris, a major contributor. “Eklund tested random field theory with incorrect calibration,” says Daunizeau. “Their analysis used insufficient smoothing and the cluster-forming threshold was too low.”

Indeed, Friston issued a rebuttal paper (http://arxiv.org/pdf/1606.08199.pdf) that re-analysed Eklund’s datasets with more appropriate settings for smoothing and cluster detection. All the problems went away and the expected five per cent false positives were obtained. The important point here is that the choice of these parameters weren’t chosen to get the result they wanted, but rather were guided in a principled way by an understanding of the underlying theory (random field theory) with its assumptions and limitations.

Know your statistics

There is an important lesson to be learned here. These analysis packages are to be used with an understanding of the underlying physics and statistics. fMRI analysis packages require considerable care in their use. Friston makes the point paccifically, “We did not consider Eklund to be critical of SPM. Rather their contribution is to highlight the failings of inference based on random field theory when distributional assumptions are violated (e.g., violations of the good lattice assumption or using inappropriately low cluster forming thresholds). If people follow good practice, SPM provides (approximately) valid inference.”

STEVEN D. BUCKINGHAM

Neuroimaging authority, Karl Friston, (placed third in the recent Lab Times ranking “Basic Neuroscience”) developed SPM. He re-analysed Eklund’s datasets with more appropriate settings for smoothing and cluster detection.
The idea of fooling Mendelian inheritance with gene drives is not new but has been hampered by inefficient gene drive constructs in the past. With CRISPR-Cas, the idea is acquiring new momentum, envisioning scary scenarios.

A bold idea

Okay, I had better calm down and explain how gene drives work. The basic idea behind a gene drive was suggested by Austin Burt from the Imperial College, London, in the early 2000s. Burt envisaged introducing a sequence into a genome that encodes an endonuclease to cut a target site. If a chromosome containing the construct finds itself paired with a chromosome lacking it, the endonuclease would cut the sequence in that paired chromosome and copy itself into the cut site as the cell responds to the damage. In other words, it can copy itself into the matching chromosome. Natural inheritance would then, of course, pass the inserted sequence on to the next generation, so eventually the construct would make its way through the entire population.

Only almost-rans

But what sort of sequence could be used to accomplish this? At the time Burt made his original suggestion, there wasn’t a known construct that could do this efficiently. There were some almost-rans. They knew about elements called Homing Endonucleases – genes that wander around the genome until they finally end up at a specific preferred site. And of course there were transposons. But none of these was efficient enough to spread through an entire population.

Kevin Esvelt explaining the gene drive concept to students of the Academany program (bio.academany.org) that has been initiated by synthetic biology pioneer George Church.
ed cells, for example. It is also very easy. The CRISPR part of the complex naturally takes care of the binding and activation of the nuclease, so all the experimenter has to do is to supply the appropriate guiding-RNA sequence. And by using a mixture of g-RNAs you can mutate several genes simultaneously.

Dream or nightmare?
So far, so good. But then in 2014, Kevin Esvelt, now at the MIT media lab, suggested that CRISPR could make Burt’s dream – or is it a nightmare? – come true. An element encoding a complete CRISPR construct is inserted into the genome. The element is expressed and it does its work on the target gene. But here is a crucial point: if the element also includes a homology-directed repair sequence, the element will also insert itself into the complementary chromosome. Effectively, we are using CRISPR to insert a CRISPR construct. CRISPR driving CRISPR. Chain reaction. And in one deft move, we have created a homozygotic mutant!

Now, think about what happens when the altered animal mates with a wild-type animal. When the modified chromosome pairs with a wild-type chromosome, the wild-type chromosome will also be transformed, because the CRISPR element in the transformed chromosome will “CRISPR itself” into the wild-type one. Even though one of the parents was homozygous wild-type, all the progeny will be homozygous mutant. The checks and balances offered by Mendelian assortment are completely bypassed.

Driven to extinction
Impressive but scary. It means that for the first time, we have found a way to drive an element through an entire population, raising the possibility of a host of interventions. Take malaria, for example. Two ways have been thought up for using gene drives to solve this major world health problem. One idea was to drive an element that introduces a mutation that makes females sterile. Unless the wild-type gene escapes in some way, the species will be driven to extinction within a few years. Another idea that has been put forward is to introduce an immune response in mosquitoes, making them unable to carry the plasmodium that causes malaria. As well as modify organisms that vector diseases, gene drives could also be used to eliminate organisms that directly cause a disease, such as schistosomes, or perhaps just alter them so that they can no longer infect people.

But having the power to change the genome of an entire species sets alarm bells ringing. Even something that looks good, like eliminating the malarial-bearing mosquito – are we really sure we want to do this? Let’s face it, we have form when it comes to eliminating species, but doing it deliberately? That’s another matter. For one thing, there could be unintended consequences. What if the “malarial” mosquito brings some benefit, of which we are unaware? Perhaps there is some flower that relies on it for pollination. Or what if eliminating a bad species leaves an ecological niche empty for something even worse to take its place?

On the other hand, three billion people live in areas where malaria is rampant and 600,000 will die from malaria this year. I suspect they wouldn’t be quite as timorous as us about the loss off malaria-bearing mosquitoes.

Ecological engineering
The potential applications of gene drives go beyond human health – there is the possibility of an emerging discipline of ecological engineering. For instance, the idea of eliminating exotic species by direct ing a gene drive against some unique sequence in their genomes has been mooted. If the exotic species is isolated geographically, there is no real risk of the drive hitting the organisms that are living where they are supposed to be.

For writers of bio-apocalypses, species-level genome engineering with gene drives is a gold-mine of ideas. Happily, a lot of these cannot ever happen in the first place. For one thing, the rate at which a gene can be driven through the population is dependent on the generation time. In the case of short-lived, rapidly reproducing species like mosquitoes, a gene can indeed work its way through the entire population in a few years. But this won’t happen in slowly-reproducing species like, well, ourselves.

Nature’s resistance strategies
Could a terror organisation drive the spread of a lethal gene through our food supply? Producers of agricultural seed regularly screen for rogue genes and would be able to stop a gene drive spreading. Indeed, Nature has some of her own resistance strategies up her sleeve. For example, the gene targeted by a gene drive could randomly mutate at the site recognised by the CRISPR, which means it will escape the drive. Of course, we could respond by introducing another gene drive but at least Nature has something of a chance. We can also purposefully design safety checks into our gene drive. For one thing, we can balance its power by introducing a second, immunising gene drive. This immunising drive would pre-emptively alter the target sequence, rendering it immune to the original drive.

Another approach would be to use a “split gene drive”, where only some of the components of the CRISPR element are encoded in the genome, with the rest being supplied by the experimenter. And if anything does go wrong, and some overworked postdoc releases something from the lab they shouldn’t have done, as a last resort, we can always release a rescue drive which re-inserts the native sequence.

Urge for regulation
But of course, the simple fact is, we really have no idea at all what would happen should any gene drive stock enter the wild: the potential power conferred by gene drives would give nightmares to anyone who knows anything of the history of our interaction with the environment. So great is the concern that, for once, regulation is being urged before the technology is tried, instead of after our first major ecological disaster.

The USA’s National Academies of Sciences, Engineering and Medicine commissioned a committee to look into the potentials and dangers of gene drives and this year, their Committee on Gene Drive Research in Non-Human Organisms published a 214-page report entitled “Gene Drives on the Horizon: Advancing Science, Navigating Uncertainty, and Aligning Research with Public Values”. While noting that “if the current pace of change in general genetics is thrilling, the pace of change in gene drive research is breath-taking” and acknowledging the unprecedented power of gene drive, the committee recommended that existing regulations are sufficient and that the responsibility falls finally on the shoulders of the lab worker and their adherence to Good Laboratory Practice.

Somehow, I don’t even feel so reassured.

Steven D. Buckingham
Receptors are a bacterium’s eyes, ears and nose. They represent all of its senses, enabling communication and the perception of environmental stimuli. Consequently, receptors are fundamental to the bacterium’s ability to adapt to ever changing environmental conditions and hence survival.

In eukaryotic cells, these functions are mostly retained. Receptors measure the concentration of molecules in the environment, such as that of glucose in the blood, and receptors are required to “listen” to other cells that “speak” via growth factors and hormones. Thus, biological communication via receptors is involved in nearly all the activities of living cells.

Unfortunately, Receptor Biology focusses mainly on eukaryotic cells. Bacteria are only briefly dealt with, and typical bacterial receptor systems, like the two-component systems, comprising a histidine-kinase and its cognate response regulator, or elaborate one-component systems, combining receptor and transcriptional activator function in one single polypeptide, are completely missing.

**Bacteria? Only briefly dealt with...**

Altogether, bacterial receptors are covered mostly in the context of processes in which they are involved (e.g. quorum sensing) instead of in the context of mechanisms like the two-component systems mentioned.

However, this disappointment may be attributed to your reviewer’s expectations as a microbiologist who – given the title Receptor Biology – expected to read something on her own research topic. The book, written by two American college professors, evoked mixed emotions. On the one side, the precise use of definitions, the distinct language and the global approach were pleasant surprises, on the other, the train of thought, albeit in principle elaborated, often remained blurred due to too many subitems.

**From sponges to mammals in 200 pages**

I must confess that as someone, who has studied bacterial receptors for several years and taught eukaryotic signal transduction mechanisms to medical students, I expected to more or less know everything written in this book. However, I soon realised that – to use Socrates’ *homon* that also found its way into *Receptor Biology* – “I know one thing, that I know nothing”. The book covers an extremely broad spectrum of topics and requires of the reader an equally broad knowledge of general zoology, physiology, developmental biology, neurobiology, immunology and so on. Or at least an above-average interest in all of them.

Looking representative at a chapter about the development of a multicellular body plan, we encounter evolutionary history, starting with the Porifera and Cnidaria via the Bilateria until the Protostomes and the Deuterostomes with detailed coverage of the emergence of a mesoderm, the mechanism of egg-sperm-recognition, eye development, nerve growth and apoptosis, to mention just a selection. Another section spans from the development of memory in invertebrates and vertebrates to long-term potentiation to the distribution of depression and social-level actions, thus dipping into sociology and psychology.

All these examples are interesting but often seem rather far-fetched and not necessarily helpful for understanding the principles of receptor-mediated signalling. Naturally, in a book with roughly 200 pages, none of the topics mentioned above can be covered thoroughly and indeed information is often provided rather superficially in order to be brought up again later and thus examined from different sides. In consequence, the main message is diluted by too many irrelevant details and even the choice of the aspects presented sometimes seems arbitrary.

**Less might have been more**

Because of this immense richness of topics and the high density of information, Receptor Biology is definitively not a storybook, as suggested by the literature quotations at the beginning of each chapter and many historical excursions. It is also not a typical textbook, due to insufficient boxes, summaries and easy-to-follow figures. Some of the chapters are quite text-dominated, others feature a lot of figures, albeit of variable quality and sometimes bad resolution. There is a detailed glossary and an index, as well as a reference list, including about 500 references. Altogether, I see Receptor Biology as a kind of encyclopaedia that covers everything connected to receptor-mediated signalling (which in biology and medicine is indeed a lot). From this point of view, it is certainly an important book that I would not want missing in my private library.

However, the Roberts/Krüchten opus was written for, “advanced undergraduate and early graduate students with a fundamental understanding of chemical and biological principles”. I wonder if the target audience will be able to follow to the extent needed to evaluate the significance of the given information. I suspect that as an undergraduate student, the book would have overtaxed me with its dense information.

LARISSA TETSCH

Book review: 100 Chemical Myths – Misconceptions, Misunderstandings, Explanation

Science Made Useful

A band of Hungarian scientists unravels persistent scientific myths. Your Lab Times reviewer was absolutely thrilled.

Every scientist knows the, “... of course, you would know about that” appendix to every-day questions about biology, the human body and chemistry, issued by family members or friends, who outrageously overestimate the applicability of our knowledge to kitchen problems. The usual reactions from scientists (for the shy ones: excusing themselves to the bathroom where they quickly ask Google; for the bold ones: killing the conversation instantaneously by making up a ridiculous story overloaded with chemical terminology) are now supplemented with simply consulting a book. 100 Chemical Myths – Misconceptions, Misunderstandings, Explanation will come in handy for most of the commonly-asked questions. Because, and that is another thing that probably every scientist knows, when it comes to chemicals, usually sane people can become superstitious tree-huggers.

Over approximately 400 pages, the authors Lajos Kovács, Dezső Csupor, Gábor Lente and Tamás Gunda tackled a huge variety of such myths, debunking some of them and explaining others.

The more you know the less you fear

The foreword is primed with a quote from Marie Curie, “Nothing in life is to be feared, it is only to be understood.” Knowing her biography, one cannot help but think that she should not have followed this motto quite so strictly (Curie became chronically ill and eventually died, most likely due to longterm radiation exposure). But it represents the authors’ motivation for writing this book, which is touched upon in the first section of the first chapter, “Fear of the Unknown: Chemicals”. They quote an American opinion poll that revealed that chemophobia and chemical knowledge maintain an inverse relationship: The more you know the less you fear.

If their idea was, however, to inform and (thus becalm) the public about common misbeliefs, they failed. The preface claims that, “This book has been written for open-minded non-specialists (...).” They should have added, “…with a scientific background”, because without that there is no way one can follow, let alone enjoy, the information-rich text complemented by chemical structures, protein models and data illustrations like the phase diagram of water.

That said, for a life scientist it makes a delightful, satisfying read for exactly that reason. The authors did not stop at the stage where pop culture articles end, but dug deep into the hard facts, citing different studies on the same topic and – where applicable – explain myths at the level where a scientist’s heart applauds: the molecular one.

There are four chapters, “Misconceptions in General”, “Food”, “Medicines”, and “Catastrophes, Poisons, Chemicals”. The individual sections then have far catchier titles, like “Fat Matters: Margarine vs. Butter”, “The Resin Wars: Formaldehyde”, or “The question that keeps us all up at night: “What Exactly Does Aloë Cure?”.

Each topic stretches over one to four pages. It adds a likeable touch that almost all pictures are quoted as “copyright-free Wikipedia picture” or “authors’ own work” – and look exactly that way, too. Informative and functional, but with the charm of hobbyist art. The four authors, all university-affiliated researchers, seemed to put a lot of work into this and were working on a low budget. This, however, affected neither the quantity nor the quality of information.

The spinach/iron/Popeye story

Where possible, the history behind a myth is revealed – and this may occasionally surprise even the proudest myth buster. For example, the spinach/iron/Popeye story. While some might still believe that spinach is one giant source of iron, the average scientifically interested person “knows” that this was a misconception, originating from a 1870 article published by Emil Theodor von Wolf, in which the author misplaced a decimal separator. A variation of this tale assigns the error to Gustav von Bunge and places the publication in the 1890s.

So far no news. But is that true? Who would have known that there is no evidence that either of the two ever measured the iron content of spinach? When in 2010 the forensic scientist Mike Sutton searched for the original publication, he could neither find that article nor any mention of Wolf or Bunge in the scientific literature before 1981, when an editorial told the story in the British Medical Journal.

What is more, the Popeye cartoons have never suggested a connection between spinach and iron. Popeye-inventor, Elzie Segar, no doubt wanted to influence children’s food choices, but she was aiming at vitamin A, not iron. Long story short: One of the widest-spread pop culture examples of the importance of consulting original publications is actually the worst. For the full story, check chapter 2.11.

Hungarian specialist knowledge

While reading the book, one cannot help but wonder, “What’s the deal with all these Hungarian examples? Why do I have to know about the mineral water consumption of Hungarians?” I’m sorry, Hungary, but I just do not have any application for that knowledge. Would European numbers and statistics not be a more obvious choice?

The answer lies in the fact that 100 Chemical Myths was originally published in Hungary in 2011. Three years later the translated version was issued. With that in mind, it is easy to ignore the eccentric detail and fully enjoy closing the gaps in everyday applicable (bio-)chemical knowledge. **Julia Eckhoff**

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Lübeck (Germany): MD PhD program
The DFG Research Training Group “Modulation of Autoimmunity” (GRK 1727/2, Spokesperson: Prof. Detlef Zillikens) seeks to employ one medical doctor to obtain an additional PhD degree.

While the incidence of autoimmune diseases is increasing, general immunosuppression is still the mainstay of therapy. This is associated with a significant morbidity and mortality. Therefore, the major goal of GRK1727 is the identification and evaluation of novel therapeutic targets and strategies for autoimmune diseases. We offer excellent research facilities and broad opportunities for interdisciplinary collaborations. The principal investigators involved are from the Institutes of Immunology, Chemistry, Anatomy, Systemic Inflammation Research and Medical Microbiology as well as from the Clinical Departments of Rheumatology and Dermatology at the University of Lübeck and the Research Center Borstel.

Detailed information on the individual projects will be available from Prof. Ralf Ludwig (raulf.ludwig@uksh.de). In addition to their project-related work, students of the GRK1727 will benefit from a structured qualification and mentoring program. Salaries are according to E13 positions (TV-L) for a maximum of 2–3 years. Successful completion of the program also includes obtaining ECTS credit points at the Master's program Molecular Life Sciences of the University of Lübeck, which will enable MDs to either obtain the PhD or the Dr. rer. nat title. We are seeking to recruit candidates with a strong interest in translational immunological research. Preference will be given to candidates experienced in experimental disease models. The University of Lübeck is an equal opportunities employer. Applications from female candidates are strongly encouraged. In case of compatible qualifications, preference will be given to candidates with disabilities.

Applications including CV, certificates, and (if possible) letters of recommendation from 2 previous mentors should be sent in PDF format to Prof. Ralf Ludwig. The positions are open until filled.

Contact: Ralf Ludwig (raulf.ludwig@uksh.de), Lübecker Institut für Experimentelle Dermatologie, Universität zu Lübeck, 23562 Lübeck, Germany, Phone +49 4515002541, Web: www.lied.uni-luebeck.de/home.html
Calendar

2016


4/9–7/9 Ascona (CH) 2nd European Meeting on Phototransduction, Info: www.uni-oldenburg.de/2nd-emp

4/9–7/9 Barcelona (ES) Unraveling Complexity: From Molecules to Ecosystems – 30th Congress of the New European Society for Comparative Physiology and Biochemistry (ESCPB), Info: www.escpb.eu


4/9–7/9 Winchester (UK) 81st Harden Conference: RNA and Disease, Info: www.biochemistry.org/Events


6/9–9/9 Hamburg (DE) 8th International Conference on Protein Kinase CK2, Info: www.ual.de/einrichtungen/fachrichtungen/biochemie/ag_prof_dr_mathias_montenarh/ck2

6/9–9/9 Oxford (UK) 8th Meeting of the European Society for Chlamydia Research, Info: www.escr2016.co.uk


7/9–9/9 Cambridge (UK) Wellcome Trust Conference on Exploring Human Host-Microbiome Interactions in Health & Disease, Info: https://registration.wellcome.ac.uk/conferences.wt

7/9–9/9 Sheffield (UK) 7th European Conference on Tetraspanins, Info: www.biochemistry.org/Events


7/9–10/9 Goettingen (DE) 6th International Conference on Transcranial Brain Stimulation, Info: www.tbs-conference.de


10/9–13/9 Mannheim (DE) The EMBO Meeting 2016 – Advancing the Life Sciences, Info: www.embom.org/events

10/9–18/9 Dubrovin (HR) Microbial Diversity and Specialised Metabolites, Info: www.jic.ac.uk/science/molmicro/Sumserschool

11/9–14/9 Dubrovnik (IE) 44th Annual Meeting of the European Teratology Society, Info: www.etsoc.com


11/9–14/9 Liverpool (UK) Pseudoenzymes 2016: From Signalling Mechanisms to Disease, Info: www.biochemistry.org/Events


12/9–14/9 Berlin (DE) 5th International Conference on Tissue Engineering and Regenerative Medicine, Info: http://tissue-science-regenerativemedicine.conferenceseries.com


12/9–14/9 Berlin (DE) 16th International Conference on Progress in Vaccination Against Cancer (PIVAC-16), Info: www.eacr.org/pivac16

Missing an event? Let us know: subscription@labtimes.org
12/9–15/9 Krakow (PL)  
5th EAAP (European Federation for Animal Science) International Symposium on Energy and Protein Metabolism and Nutrition (ISEP 2016), Info: https://isep2016.pl

12/9–15/9 Oxford (UK)  
The Tissue Issue – Bridging Scales in Models of Cell to Tissue Behaviour: Recent Progress and Future Challenges, Info: www.sebiology.org/events/event/the-tissue-issue

12/9–16/9 Roscoff (FR)  
Protein Misfolding in Disease – Toxic Aggregation-prone Proteins in Aging and Age-related Diseases: From Structure to Pathology and Spreading, Info: www.cnrs.fr/insb/cjm/2016/Buee_e.html

13/9–14/9 Kiel (DE)  
Symposium: New Horizons in Molecular Zoology 2016, Info: www.dzg-meeting.de/programme/scientific-programme

13/9–16/9 Vienna (AT)  
Europe Biobank Week – Biobanking for Health Innovation, Info: http://europebiobankweek.eu

14/9–15/9 Stockholm (SE)  
Nordic Life Science Days 2016, Info: www.nlsdays.com

14/9–15/9 Vilnius (LT)  
Life Sciences Baltics, Info: www.lsb2016.com

14/9–16/9 Cambridge (UK)  
Wellcome Trust Conference on Single Cell Genomics, Info: https://registration.hinxton.wellcome.ac.uk/events/item.aspx?id=596

14/9–16/9 Durham (UK)  
Symposium on Microbial Protein Targets: Towards Understanding and Intervention, Info: www.rsc.org/events

14/9–16/9 Vienna (AT)  
10th Tri-National Arabidopsis Meeting, Info: https://mam.gmi.oeaw.ac.at

14/9–17/9 Brno (CZ)  

14/9–17/9 Heidelberg (DE)  
EMBL-Wellcome Trust Conference: Proteomics in Cell Biology and Disease Mechanisms, Info: www.embl.de/training/events/2016

14/9–17/9 Kiel (DE)  

14/9–17/9 Mumaun (DE)  
6th Mumaun Conference on Structural Biology: Large Molecular Assemblies, Info: www.mumaunconference.de

14/9–17/9 Vianden (LU)  
9th International Conference on Biological Invasions (NEOBIOITA 2016), Info: www.neobioita2016.org

15/9–16/9 Berlin (DE)  
7th International Conference and Expo on Molecular and Cancer Biomarkers, Info: http://molecular-cancer-biomarkers.conferenceseries.com

15/9–17/9 Tuebingen (DE)  
3rd Conference Pathophysiology of Staphylococcus, Info: www.staphylococcus-congress.de

16/9–20/9 Barcelona (ES)  
17th International Conference on Systems Biology (ICSB 2016), Info: http://icsb-conference.com

16/9–21/9 Rhodes (GR)  
International Conference on Human and Translational Immunology, Info: www.aegeanconferences.org/src/App/conferences/view/113

17/9–20/9 Seeon (Munich) (DE)  

17/9–21/9 Laura (Salerno) (IT)  
EMBO Conference on the Molecular and Cellular Basis of Regeneration and Tissue Repair, Info: http://events.embo.org/16-regeneration

17/9–21/9 Portorož (PL)  
15th International Symposium on Proteases, Inhibitors and Biological Control, Info: www.eventgridis/events/2016_XVth_ISP_IBC

18/9–20/9 Munich (DE)  

18/9–21/9 Ghent (BE)  

18/9–21/9 Sitges (ES)  
4th Antivirals Congress 2016, Info: www.antivirals.elsevier.com

19/9–20/9 Heidelberg (DE)  
EMBL/DFG Women in Science Network Conference: From Genes, Cells and the Immune System towards Therapies, Info: www.embl.de/training/events/2016/SFB16-02

19/9–22/9 Cambridge (UK)  
Wellcome Trust Conference on Genome Informatics, Info: https://registration.hinxton.wellcome.ac.uk/events/item.aspx?id=598

19/9–23/9 Paris (FR)  

20/9–22/9 London (UK)  

20/9–23/9 Basel (CH)  
ILMAC 2016 – Trade Fair and Exhibition in Process and Laboratory Technology, Info: www.ilmac.ch

21/9–22/9 Berlin (DE)  
Immunotherapy Europe / Cell and Gene Therapy Europe, Info: www.cgteurope.com

21/9–22/9 Oxford (UK)  
Pharmacological Aspects of Microvascular Cell Signalling and CVS Disease, Info: www.bps.ac.uk/news-events

21/9–23/9 Aachen (DE)  
Aachen Protein Engineering Symposium (AcES), Info: http://users.skynet.be/bs988346/aces

21/9–23/9 Bad Homburg (DE)  

21/9–23/9 Oxford (UK)  
Protein S-Palmitoylation: From Mechanism to Application, Info: www.biochemistry.org/Events

21/9–24/9 Barcelona (ES)  
17th Biennial Meeting of the European Society for Immunodeficiencies (ESID), Info: http://esid.org

22/9–23/9 Amsterdam (NL)  

22/9–23/9 Paris (FR)  
Final International Conference of the EuCellEX Project (Cell-based ReGenerative Medicine: New Challenges for EU Legislation and Governance), Info: www.euCELLEx.eu/final-international-conference

22/9–23/9 Leuven (BE)  
The Brain Mosaic: Cellular Heterogeneity in the CNS, Info: www.vibconferences.be/calendar

22/9–24/9 Hamburg (DE)  

23/9 London (UK)  
Beyond CpG Methylation: New Modifications in Eukaryotic DNA, Info: www.biochemistry.org/Events

23/9–24/9 Vienna (AT)  
Platform for Advanced Cellular Therapies (PACT) Symposium: Designer Cells Go Clinic, Info: www.pact.ac.at
25/9–27/9 Heidelberg (DE)
EMBL–Wellcome Trust Conference: Big Data in Biology and Health,
Info: www.embl.de/training/events

25/9–27/9 Seeon/Munich (DE)
Kloster Seeon Meeting on BACE Proteases in Health and Disease,
Info: www.bace-meeting.de

25/9–28/9 Dubrovnik (HR)
31st International Congress of the International Academy of Pathology and 28th Congress of the European Society of Pathology,
Info: www.esp-congress.org

25/9–29/9 Girona (ES)
2nd International Conference and Expo on Separation Techniques,
Info: http://separationtechniques.conferenceseries.com

25/9–30/9 Rhodes (GR)
51st European Marine Biology Symposium,
Info: www.embs51.org

26/9–29/9 London (UK)
Molecular Biology and Pathogenesis of Avian Viruses,
Info: www.microbiologyociety.org/conferences/focused-meetings.cfm

26/9–29/9 London (UK)
Goodbye Flat Biology: Models, Mechanisms and Microenvironment – Conference of the European Association of Cancer Research,
Info: www.eacr.org/conference-series

26/9–29/9 London (UK)
Unlocking the Potential of Synthetic Biology to Enhance Human Health,
Info: http://lifescienceevents.com/event-listing

26/9–28/9 London (UK)
12th World Cancer Conference,
Info: http://cancer.global-summit.com/europe

26/9–28/9 Montpellier (FR)
14th International Symposium on Rice Functional Genomics,
Info: http://www.bamrco.uni-rostock.de

26/9–28/9 Rome (IT)
3rd European Meeting of the International Society for Microbial Electrochemistry and Technology,
Info: www.euismet2016.com

26/9–28/9 The Hague (NL)
4th International Conference on Responsible Use of Antibiotics in Animals,
Info: www.bastiaanse-communication.com/RUA16

26/9–28/9 Ulm (DE)
13th Confocal Raman Imaging Symposium,
Info: www.witec.de/resources-and-education/symposium

26/9–29/9 Valencia (ES)
EMBL Conference on Cell Fate Diversity in Aging,
Info: www.embly.org/2016

27/9–29/9 Barcelona (ES)
Debate on Plant Proteostasis – Towards a Green Based Industry,

27/9–29/9 London (UK)
Molecular Biology and Pathogenesis of Avian Viruses,
Info: www.microbiologyociety.org/conferences/focused-meetings.cfm

27/9–30/9 Athens (GR)
International Symposium: Regulation of Cell Functions by Transient Receptor Potential Channels,
Info: www.srb-tr152.med.uni-muenchen.de/symposium_2016

28–9/1–10 Kkr (HR)
Symposium on Power of Microbes in Industry and Environment,
Info: http://hind-cms.hr/power2016

28/9–1/10 Munich (DE)
International Symposium: Regulation of Cell Functions by Transient Receptor Potential Channels,
Info: www.srb-tr152.med.uni-muenchen.de/symposium_2016

28/9–30/9 Paris (FR)
International Conference on Nanomedicine and Nanobiotechnology,
Info: http://premc.org/iconan2016

29/9–30/9 London (UK)
5th International Conference on Microbial Physiology & Genomics,
Info: http://microbialphysiology.conferenceseries.com

29/9–30/9 Bilbao (ES)
EMBO Conference on Translational Research in Cancer Cell Metabolism,
Info: http://events.embo.org/16-cancer

2/10–5/10 Berlin (DE)
Goodbye Flat Biology: Models, Mechanisms and Microenvironment – Conference of the European Association of Cancer Research,
Info: www.eacr.org/conference-series

3/10–4/10 Cork (IE)
8th pan-European Science Conference,
Info: www.eupatqbd.org

3/10–4/10 Copenhagen (DK)
EMBO Conference on Retinal Proteins,
Info: http://events.embo.org/16-retinal-proteins

3/10–4/10 Krakow (PL)
EMBO Conference on Translational Research in Cancer Cell Metabolism,
Info: http://events.embo.org/16-cancer

4/10–6/10 Leipzig (DE)
7th Annual Symposium Physics of Cancer,
Info: http://conference.uni-leipzig.de/poc

4/10–7/10 Amsterdam (NL)
Cilia 2016,
Info: www.cilia2016.org

4/10–8/10 Biarritz (FR)
DNA Polymerases: From Molecular Function to Human Diseases,
Info: www.dnapolymerases-biarritz2016.com

5/10–7/10 Estoril (PT)
4th International Conference on Acute Myeloid Leukemia “Molecular and Translational”: Advances in Biology and Treatment,
Info: www.esh.org/conferences

5/10–7/10 Ghent (BE)
Antimicrobial Resistance in Microbial Biofilms and Options for Treatment – Annual Meeting,
Info: www.biofilmresistance.be
5/10–8/10 Heidelberg (DE)
EMBO/EMBL Symposium on Complex Life of mRNA, Info: www.embo-embli-symposia.org

6/10–8/10 London (UK)
2nd Global Summit on Plant Science, Info: http://plantscience.global-summit.com

6/10–8/10 Luxembourg (LU)
Meeting of the Genetic Epidemiology of Parkinson’s Disease Consortium and 3rd International Parkinson’s Disease Symposium, Info: https://parkinson2016.uni.lu

6/10–9/10 Bonn (DE)
RNA Biochemistry Meeting 2016 of the German Society for Molecular Biology and Biochemistry (GBM), Info: www.rna-biochemistry.de/wp

9/10–14/10 Cambridge (UK)
Wellcome Trust Conference on Molecular Pathology and Diagnosis of Cancer, Info: https://registration.hinxton.wellcome.ac.uk/Conferences.wt

10/10–11/10 Hannover (DE)
Beyond Amyloid: Widening the View on Alzheimer's Disease, Info: www.unimedizin-mainz.de/beyond-amyloid

10/10–11/10 Manchester (UK)
World Digital Pathology and Pathologists Congress, Info: http://digitalpathology.conferenceseries.com

10/10–12/10 Amsterdam (NL)

10–12/10 Ebsdorfergund (DE)
2nd Discussion Meeting Microbial Cell Biology, Info: www.synmikro.com/en/current-events.html

10/10–12/10 Karlsruhe (DE)
Max Rubner Conference 2016: Food Metabolomics, Info: www.mri.bund.de/de/aktuelles/veranstaltungen

10/10–14/10 Roscoff (FR)
Evolutionary Genomics and Systems Biology: Bringing Together Theoretical and Experimental Approaches (Conferences Jacques Monod), Info: www.cnrs.fr/insib/cjm/2016/Vekemans_e.html

11/10–12/10 Barcelona (ES)
Immune Profiling World Congress, Info: www.terrapinn.com/conference/immune-profiling-world-congress

11/10–12/10 Saarbruecken (DE)

11/10–14/10 Groningen (NL)
5th International Conference on Novel Enzymes, Info: www.rug.nl/research/gbb/education/novelenzymes

12/10–13/10 Dundee (UK)

12/10–13/10 Goettingen (DE)

12/10–15/10 Heidelberg (DE)
EMBO/EMBL Symposium on Organoids: Modelling Organ Development and Disease In 3D Culture, Info: www.embo-embli-symposia.org/symposia/2016/ees16-07

12/10–17/10 Estoril (PT)

13/10 Berlin (DE)
Metabolomics in Translational Medicine, Symposium of the Berlin Institute of Health (BIH), Info: https://www.bihealth.org/en

13/10–14/10 Cambridge (UK)

13/10–14/10 Manchester (UK)
International Conference on Genetic Counselling and Genomic Medicine, Info: http://genomicmedicine.conferenceseries.com

13/10–15/10 Munich (DE)

16/10–19/10 Nice (FR)

16/10–20/10 Marseille (FR)

17/10–20/10 Cambridge (UK)
Wellcome Trust Conference on Computational RNA Biology, Info: https://registration.hinxton.wellcome.ac.uk/conferences.wt

17/10–20/10 Juan-les-Pins (FR)
19th International Congress on In Vitro Toxicology for Safety Assessment, Info: www.estiv2016.com

18/10 Braunschweig (DE)
Imaging Neural Dynamics – 1st Brainswick Symposium, Info: www.tu-braunschweig.de/brainswick

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