MAP PIECE

Draw a map to get lost.

1964 spring y.o.

Elections 2015: How the parties view science page 26

Reinventing science

Science is taking a hard look in the mirror, and it's for the best. The problems it faces are increasingly clear: reproducibility, fraud and statistical bias, to name but a few. Back in 2013 the news magazine The Economist featured the front-page headline "How Science Goes Wrong". For sure, it may be somewhat alarmist to talk about 'a crisis of science', but it does embody the idea behind the critical, unwavering view of the scientific community on the state of affairs in its own house.

It is time then to welcome the wide variety of new solutions that are being proposed by researchers. There's the DORA declaration, which veers away from the quantitative appraisal of research proposals, the Journal of Negative Results in Biomedicine, which encourages the publication of insignificant studies, and the new Swiss platform ScienceMatters, which allows researchers to publish simple isolated results free of the temptation to embellish them (see p. 22).

Science has everything it needs to change. After all, it's already in a day's work for a researcher to question hypotheses and explain erroneous results. And now there are also the right tools. One no longer needs a publisher to ensure that news of discoveries is spread; it is now sufficient to upload manuscripts to free publication servers or online lab books. There's even talk about replacing the peer-review system – target of so much criticism – with a quick, transparent and participatory online system for comments.

But these new tools will not change anything on their own. They need to be used, and technology is nothing without humans. At any rate, it's more a case of 'peer pressure' than peer review, as social pressure leads us to mimic the behaviour of our colleagues … for better or for worse. To change this, science must radically transform its practices: both in the laboratory and in the field. It is therefore also down to you, dear researcher, to redefine the science of tomorrow's world.

Daniel Saraga, chief editor

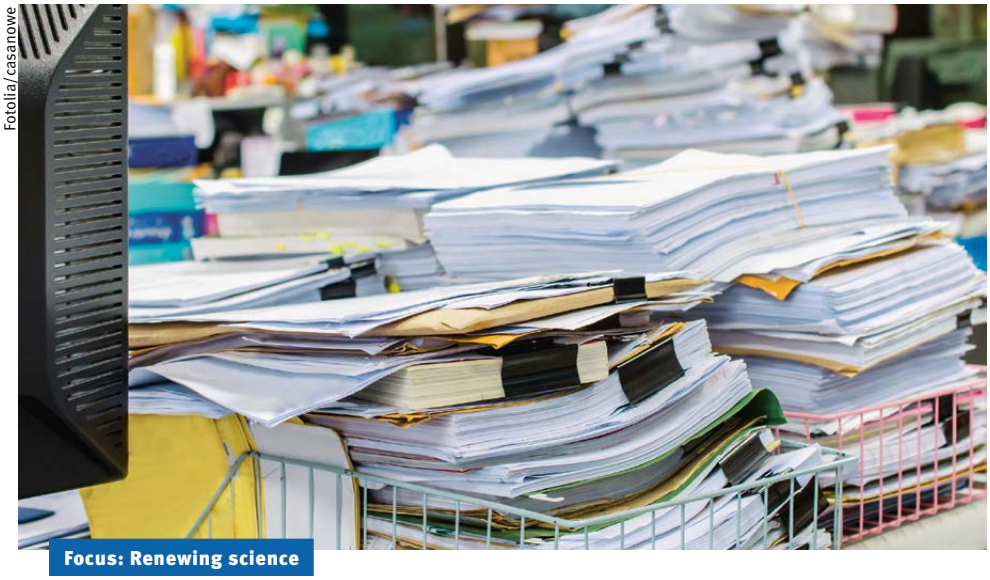
FNSNF
Swiss National Science Foundation

Swiss Academies
of Arts and Sciences

Horizons – the Swiss magazine for scientific research No. 106, September 2015

horizons

Contents



Fotolia/casanowe

Focus: Renewing science

25

Photomontage, Parliamentary Service, 3003 Bern

Knowledge and politics

◂ Cover: Research offers us an ever more detailed, increasingly complex view of the world. Mistakes are an important part of the process and can also generate new knowledge. Image: Yoko Ono "Map Piece" 1964, © Yoko Ono

◂ Inside cover picture: It seems as if these peculiar little animals left their enclosure to explore the world outside it. This ought to remind researchers that they too must think outside the box. René Zäch "Suchfinder" 2003, Sammlung Kunstmuseum Olten. Photo: Bernhard Schrofer

31

Jungfrau Zeitung

Biology and medicine

38

Alfred Wegener Institute for Polar and Marine Research

Environment and technology

44

Giulio Piscitelli

Culture and society

Dancing colours

The hem of her rose-red dress billows higher and higher, though her petticoats chastely keep her knees covered. Joy is written over her companion's wraithlike face; he can truly feel the 'spring air' – hence the name of the colour film made in 1908 that offers these slightly saucy images.

It was coloured by hand, runs at 16 frames per second, and is just one of thousands of such documents in the archive for historical film colours run by Barbara Flückiger, a professor of film studies at the University of Zurich. "Most of the early films were in colour", she explains. It took until the 1960s before such hand-coloured images were completely replaced by colour films that could be chemically developed.

Flückiger has been researching into historical colours in film for several years. When she began her work, the films could no longer be shown in the cinema because they were made of highly explosive nitrocellulose. So they had to be digitised before they could be allowed to circulate again. But digitising them in turn caused problems with their colour reproduction. Professional scanners have a specific light source and a specific sensor.

"In many ways, this makes them colour blind", explains Flückiger. Furthermore, many of the chemical film colours have since disintegrated. Flückiger and her team carried out material analyses to try and find out how the colours might have originally appeared, and their investigations also mean exploring the aesthetic of the time. Last June she was awarded an Advanced Grant by the European Research Council (ERC) for her new project 'Film Colors. Bridging the Gap Between Technology and Aesthetics'. *hpa*

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Timeline of historical film colours:
http://zauberklang.ch/filmcolors/

Photo: Courtesy of Stiftung Deutsche Kinemathek, Berlin. Photograph of the nitrate print by Barbara Flueckiger, Timeline of Historical Film Colors, University of Zurich. Film: Frühlingsluft (1908).

Should ethicists give advice?

Politicians and authorities consult ethics commissions about moral issues such as euthanasia, pre-implantation diagnostics, and gene technology in agriculture. Is it legitimate for ethicists to give answers to such questions as if they were scientists?

Valérie Chételat (photomontage)

Yes

says Klaus Peter Rippe, an ethicist at the Karlsruhe University of Education.

When ethics commissions advise parliament, the Federal Council and other authorities, they don't do so unprompted, but on a sound legal basis. Ethics reports are the result of official commissions. One important reason for consulting the opinion of ethicists is that ethical issues are raised in politicised areas such as medicine, the environment and data protection. It would simply be unwise to commission expert opinions from scientists, lawyers and economists, but not ethicists.

> "Ethical recommendations lead to better decisions"
>
> Klaus Peter Rippe

When an expert opinion is requested, we're asked to give both a careful analysis of the state of debate and our own recommendations. Politicians don't just need a summary of the literature to make their decisions; it's also helpful for them to know what their experts and commissions think is the right course of action. Why should ethicists and ethics commissions ignore this very aspect of their consultancy mandate? There's no reason for it.

A sound ethical recommendation contains the arguments for and against one of the options on the table. These are assessed and judged on the basis of their respective strengths. As a result, there are better reasons for recommending certain possibilities than there are for others. So reasoned recommendations may be given.

Yet it's not just about whether we 'can', but whether we 'may'. If ethical questions are answered unambiguously – such as saying, 'sperm donation should be permitted for unmarried heterosexual couples', then it is tantamount to handing out a moral directive. But by their very nature, recommendations and advice are not directives. Politicians and authorities are free to reject the reasons laid out before them and to refuse the recommendation.

To issue such imperatives would mean entering the realm of morality, not ethics. In ethics, like in the sciences, demonstrable reasons must be presented as to why one particular answer is supposedly the right one. If this is done, then the people involved are in a position to consider the reasons given and, if they wish, to reject them. And even if they do agree with those reasons, they are still free to reject the recommendation, whether it's because they wish to place an emphasis on something else, because they have considered additional aspects of the case, or because they have reached a different opinion after examining the arguments submitted.

When ethical recommendations are made following a transparent process, then everyone is served: it takes the discourse forward, and leads to better decisions.

Klaus Peter Rippe is a professor of Practical Philosophy. He was the Chairman of the Swiss Federal Ethics Committee on Non-Human Biotechnology, has been a jury member of the Public Eye Awards and is co-founder of the private consulting company Ethik im Diskurs.

No

says Christoph Ammann, an ethicist at the University of Zurich.

A couple has to decide what to do when a pregnancy screening reveals an anomaly. They ask friends for advice, including an ethicist. Should they take the ethicist's opinion particularly seriously – more seriously, let's say, than the opinion of a friend who already has a child with trisomy 21?

'No', is my opinion as an ethicist. And I remain sceptical even when it's not individuals wanting to solve an ethical dispute, but society as a whole, as it were, appointing an ethicist to a committee of experts. If a problem has a moral dimension, I believe it affects ethicists not just as 'experts', but also as human beings.

Whether or not a specific drug will work is something that an expert can judge better than a layperson. But whether preimplantation diagnoses are inadmissibly injurious to the dignity of an embryo is not a question that could be answered authoritatively by the newest research into the moral status of prenatal life. Real ethical disagreements can't be solved by expert knowledge.

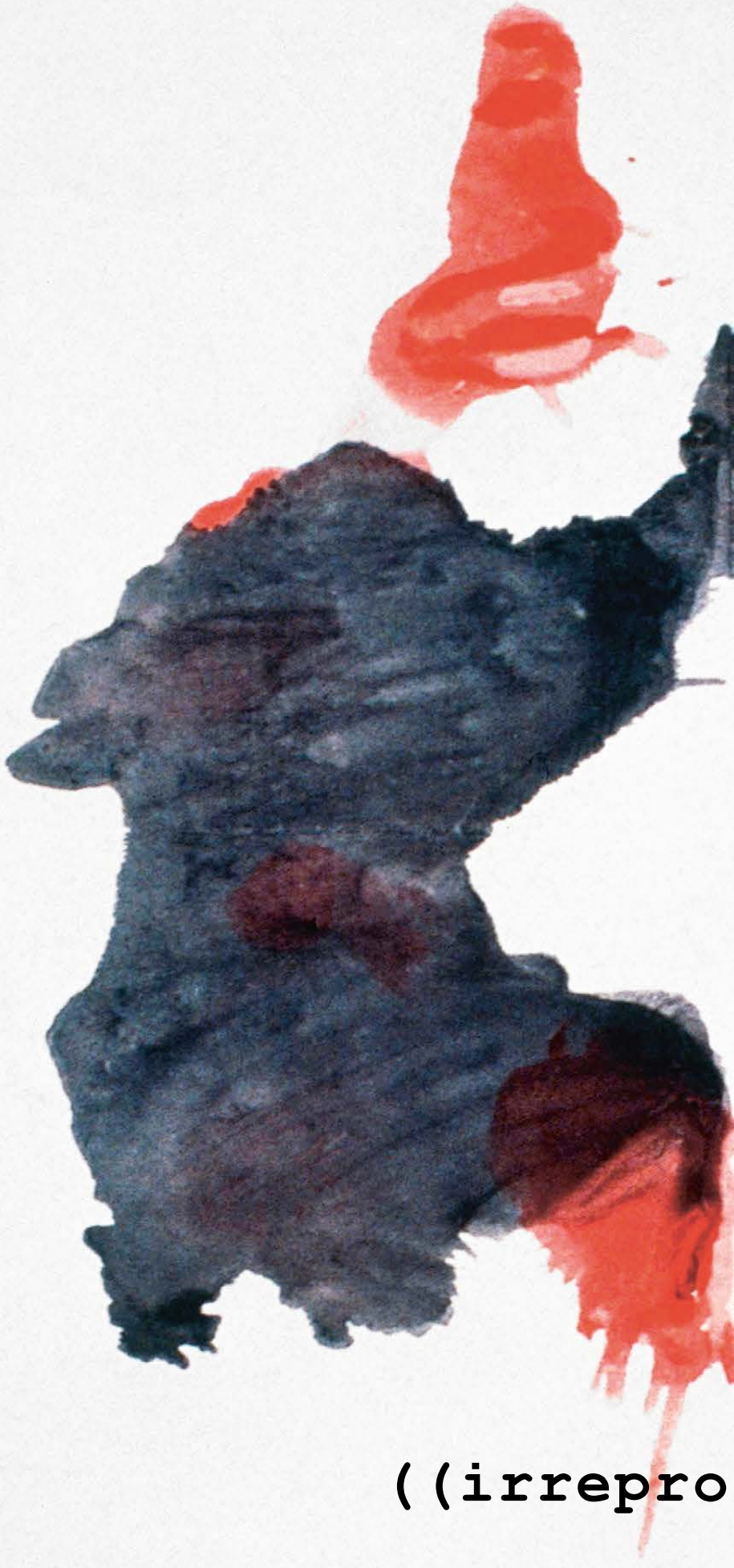
What is right and good is that ethicists don't leave this field to all those stakeholders and other experts who are keen to suppress the moral dimensions of a problem. That's why one of the principal duties of ethicists is to fight in such commissions against all attempts to reduce ethical conflicts to mere technical or empirical questions.

> "Ethicists aren't there to salve consciences and remain impersonal"
>
> Christoph Ammann

But the fact remains: if an ethicist has something important and just to say about an ethical question, then it's not because he's an academic expert, it's because he has a disciplined engagement with ethical issues that has allowed him to give a more differentiated, wiser opinion. Furthermore, he should have maintained a sense of independence and freedom of thought that should not be mistaken for ideological neutrality. What matters is not a theoretical knowledge of ethics, which can be academically tested, but a moral power of judgement that one acquires in the never-ending process of self-formation.

Ethicists shouldn't act as a last port of call, as if society were a quiz show and the ethicist were the friend sitting at home by the telephone, waiting for a contestant to use one of his 'jokers' and ring up for an answer. It's neither the duty of ethicists nor in their competence to solve ethical conflicts in a manner that both salves consciences and remains impersonal. They have to make explicit how they see things, in the knowledge that others – experts and laypersons alike – might see things very differently. In ethics, that's not the result of a lack of expertise, but in fact the very proof of it.

Christoph Ammann is Deputy Head of the Institute of Social Ethics, co-editor of the volume 'Müssen Ethiker moralisch sein?' and the author of one of its chapters, entitled: 'Wider die ethische Expertokratie'. Since 2011 he has been a member of the Cantonal Commission on Animal Experiments in Zurich.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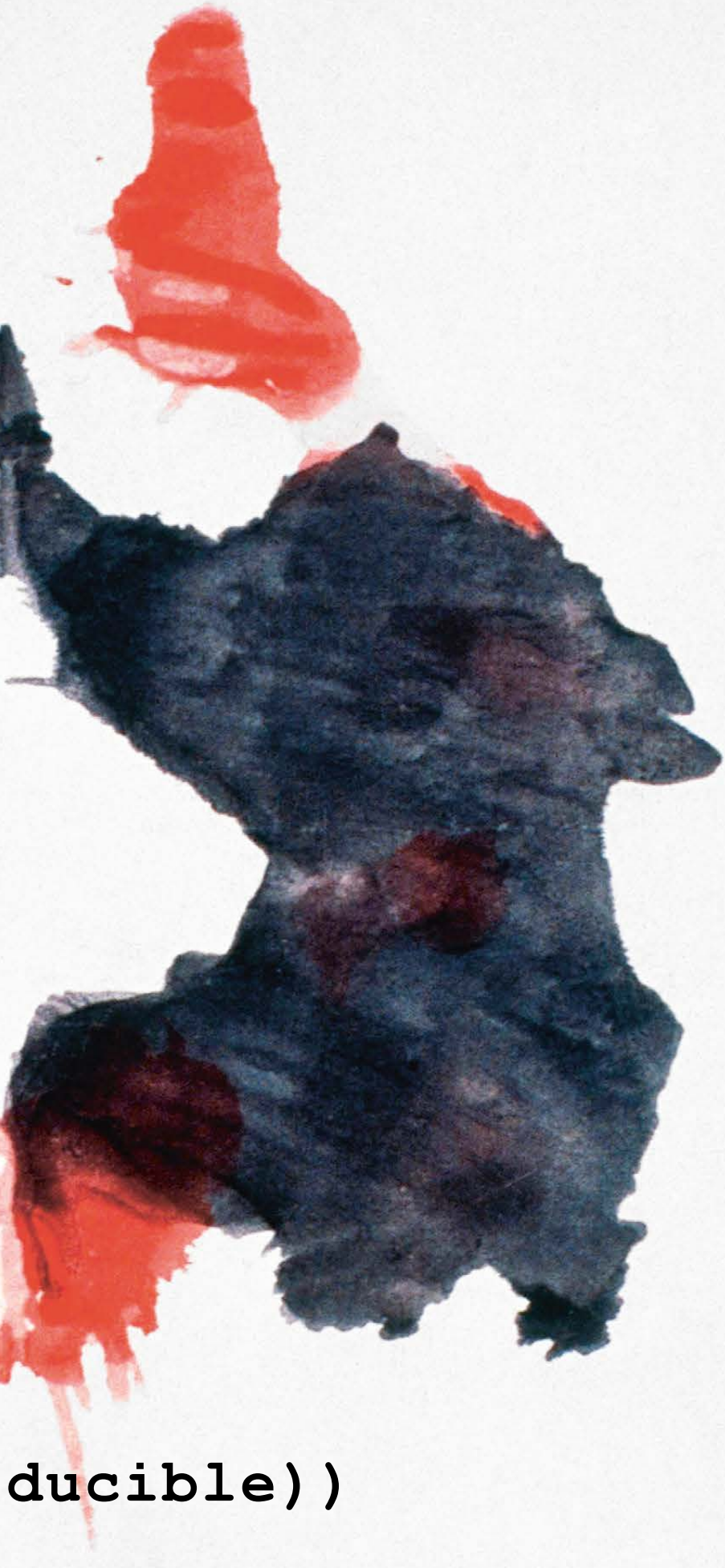

Fixing science

Too many publications and too many mistakes? Scientists are questioning research practices and establishing new ways of publishing their findings.


((irrelevant?))

Peer review under review

Online discussions, transparency, credits for experts: the scientific community is exploring ways to improve the peer-review procedure.
By Sven Titz

Cancer can now be combatted using a chemical substance derived from lichen. That's the result of a study submitted to 304 journals two years ago by the science journalist John Bohannon, writing under a pseudonym. More than half accepted the article for publication. But in October 2013, Bohannon admitted in the journal Science that it was a 'spoof paper', penned so as to expose journals. So to a large extent, the peer-review process had completely failed.

Complaints about shortcomings in peer review are as old as the process itself (see 'Problems with peer review'). Falsifications are overlooked, original work refused, and shoddy work accepted. Some peer reviewers give full rein to their own prejudices towards the background or gender of the authors. And last but not least, the often lengthy peer-review process eats up valuable time. Today, however, several new models and trends in peer reviewing promise to remedy the situation – or at least to provide some relief.

◂ p. 11: Two garden gnomes or a screeching cat? Everyone sees a Rorschach test differently – and sometimes science is like that, when one scientist tries to reproduce and verify the results of another, but keeps seeing a different picture.
Photo: Keystone/Science Source/Spencer Grant

◂ p. 12: Dog fleas jump higher and farther than cat fleas: this is the result of an experiment carried out in 2000 that won the IgNobel Prize. Its measuring methods were remarkable, but its societal relevance is as yet unproven.
Photo: Keystone/Cultura/ISTL/Max Bailen

Digitisation has made possible a plethora of models for a transparent, discursive culture of assessment. Peer review is traditionally anonymous, but today reviewers have started putting their name to their reviews, and an increasing number of new, interactive forms of discussion are being tried out across the whole process of publication (see 'Possible solutions', p. 14).

A journal fond of discussion

A typical example of this development is the open-access journal Atmospheric Chemistry and Physics (ACP). ACP's publication process has two steps. First, studies submitted are quickly checked for their plausibility and then placed online in the forum 'ACP discussions'. Besides the regular expert reviewers, other interested scientists may participate in the ensuing public debate provided they're registered users. The authors' answers are also published straightaway. The expert reviewers take the whole debate into consideration when writing their reports. If the study survives this process, it's taken up to the second level and published in the actual journal as a 'final paper'.

An open-review process means several birds are killed with one stone, explains the chief editor, Ulrich Pöschl, an Austrian citizen who works at the Max Planck Institute for Chemistry in Mainz, Germany. New findings are not held up by a slow peer-review process that can otherwise end in several rounds of reviews. Instead, the discussion papers go straight into scientific circulation. The ensuing interactive peer review then adds lustre to the 'final papers' that are judged to be of higher quality. To Pöschl, the most important aspect is the post-evaluation step. New key figures are a real breakthrough in achieving better quality assurance, he says, referring to the frequency of downloads and of comments on articles. These new measurement parameters allow the journal to compete with the Science Citation Index, a well-known article database.

Meanwhile, 15 journals have come together under the auspices of the European Geosciences Union with a model similar to that of ACP. "We'll see what the competition brings with it", says Pöschl, with an eye on these other journals.

The pitfalls of transparency

Up to now, only a few journals have been working with an open peer-review process. It's primarily the humanities and social sciences that prefer anonymous reviewing. "There's a widespread tendency to more transparency, however", says Martin

Problems with peer review

- **Too long:** It can sometimes take months.
- **Mistakes slip through**: Reviewers overlook many unintentional mistakes in the studies.
- **Inadequate detection of fraud:** Rigged data is hardly ever spotted.
- **Conformist:** New research methods are rejected more often than well-known methods.
- **Danger of corruption:** Secret collusion between reviewers and authors is hard to prevent.
- **Prejudice:** The author's background, gender or other elements can influence the review.

Reinhart, a Swiss sociologist and assistant professor for Sociology of Science and Research on Evaluation at the Institute for Social Sciences at the Humboldt University in Berlin. But he doesn't just see this as something positive. Transparency, he says, doesn't automatically increase quality. When there is a mutual dependence between the reviewers and the authors of studies, there is a danger that people won't be as critical as they need to be. This is why he believes that anonymous peer reviewing should remain legitimate. Reinhart argues that it's in the interest of science to have a great variety of peer-review systems.

On the PubPeer website, studies are sometimes subjected to harsh criticism

It's not just the editors of journals who are trying out new models, but independent companies too. The Finnish start-up company Peerage of Science, for example, offers to take on the peer-review process for journals. One important aspect of their system is 'open engagement', explains Janne Seppänen, one of its founders. The identity and competence of the reviewers is checked once, right at the beginning of the process. Afterwards, they can decide freely which of those studies submitted they would like to review – in other words, they're not chosen by editors to review specific articles. Furthermore, the reviews themselves are assessed. "Of course, it's important to ensure that this assessment is independent of the decision on the article itself", says Seppänen.

At present, some 20 journals are participating in this model, most of them from the life sciences. In return, they get access to a pool of studies that have already been reviewed. All the journals of the Springer publishing house also have limited access to the pool. If the authors of a study are offered publication by a journal, they can either accept or refuse. The fact that several journals have access to the pool can improve the authors' chances of publication. Furthermore, they avoid their article having to go through several rounds of peer review – which could mean that their article might land with the same reviewer several times. The journals only have to pay if they accept an article.

The Peerage of Science model reduces the number of reviews needed. But the same effect can be achieved by other means. For example, articles are often rejected on formal grounds – such as for being too long, or because the focus of the article doesn't suit the journal to which it's been submitted. In these cases, some editors hand over the reviews to similar journals. This practice was adopted by the association of journals Neuroscience Peer Review Consortium in 2007, and it has been successful too. After assessment, it transfers some 200 reviews per year to other journals.

Open debate

Besides these attempts to reform the classical review process, there are more and more experiments taking place with a kind of peer review after publication. On the website PubPeer, for example, scientists exchange views about the value of different studies. "Very interesting discussions take place about the reliability of the research", says Reinhart. Until now, these discussions had often taken place behind closed doors. Of course, such discussions can also get out of hand – a public platform can in principle also serve to discredit people, not least in the case of PubPeer, as it does not compel the participants to give their names. But Reinhart has the impression that the research community is able to address this problem itself through self-regulation.

Whereas studies are occasionally subjected to harsh criticism on PubPeer, things are less controversial on the platform Faculty of 1000 (F1000). One of the things it offers researchers in the life sciences is a kind of selection service. Exceptional articles are recommended on the platform by a fictitious 'faculty' of a thousand experts. This second level of peer review is intended to provide a guarantee that important articles won't sink without trace in the current flood of publications.

What does the reviewer get out of this?

All these new variants have one thing in common: peer review remains dependent on the collaboration of the specialist community. Because the number of journals has increased with digitisation, editors get more and more refusals when they ask a researcher for a review. One of the reasons for this is that reviewers get little recognition.

In principle, every science author profits from his or her peers and should at some point give back what he or she has gained, says Erik von Elm of the Institute of Social and Preventive Medicine at the Lausanne

Possible solutions

Networks:
- F1000 (experts recommend articles)
- Equator (an initiative for more reliable health studies)

Outsourcing:
- Peerage of Science (performs peer review for a pool of journals)
- Pre-Val (quality label for validated peer review)
- Rubriq (peer reviews paid for by the author before submission)

Encourage reviewing:
- Elsevier certificates, CME credits
- Orcid (identifier for researchers)
- Publons (online credits for reviews)
- R-Index (proposal for quantifying reviewing activity)

Preprint servers without peer review:
- arXiv.org, bioRxiv.org
- Figshare
- Peer J Preprints

Interactive peer review:
- EMBO Journal
- eLife

Discussion forums and post-publication review:
- PubPeer, ResearchGate

EU research project:
- Peere (New Frontiers of Peer Review, May 2014–May 2018)

((fake))

((error!))

University Hospital. But some don't show solidarity and refuse to take part in peer reviewing. This is why incentives are needed. "What we still lack is recognition within the system for what reviewers do". Up to now, he says, it's been publishing articles yourself that's been important in furthering your career.

> "The system has weaknesses. But no one has yet invented a better one"
>
> Erik von Elm

In medicine, the problem has already been partly solved, says Ana Marusic, a professor at the School of Medicine at the University of Split, and a member of the Board of the European Associations of Science Editors. So-called CME points (Continuing Medical Education points) are now being awarded for carrying out peer reviews. Medics have to collect a certain number of these points every year in order to keep their licence. But many other scientific fields lack such a system.

It is possible that other initiatives might provide the answer here. Several journals publish an annual list of their best reviewers. Elsevier awards exceptional reviewers with certificates. And the reviews that appear on the F1000 platform have recently begun to be given the digital identifiers of the Open Researcher & Contributor Identification Initiative (ORCID). This ensures that the work of reviewers isn't forgotten.

But what is also lacking is any kind of training to become a reviewer. Young scientists are often thrown into the deep end, writing their first reviews without any guidance at all. "At university, there are compulsory courses for teaching, but not for peer reviewing", says von Elm. Initiatives to remedy this are still few and far between. Basically, the peer-review system is like democracy, says von Elm. Everyone knows that the system has weaknesses, but no one has yet invented a better one.

Publishing on different levels

It was partly because of the problems with peer review that researchers in some fields began placing their studies on open publication servers several years ago. Researchers in physics, mathematics and data analysis have been avidly using the arXiv.org server to publish review-free studies since 1991, and since 2013 bioRxiv.org has served the same purpose in biology. They do this primarily because these servers allow for the swift exchange of information. Many of the studies archived there have later been published in reviewed journals.

According to Pöschl, it is already clear that we shall in future have three basic levels for scientific publications. First, there'll be publication servers such as arXiv.org without any peer review. Second, there'll be open-access specialist journals such as BMC Medicine or ACP, which are characterised by transparency and a discursive culture. Third, there'll be interdisciplinary journals of top quality such as Nature and Science. These last two will perhaps only serve as a showcase, their function being to boost studies of public relevance from levels one and two and to raise them up above the general mass of publications. Ultimately, what will count is the variety of publication models, says Pöschl, because they fulfil different tasks and complement each other.

The science journalist Sven Titz lives in Berlin and writes regularly for the Neue Zürcher Zeitung, the Tagesspiegel and Welt der Physik.

Controversy surrounding open-access publishing

Putting studies at everyone's disposal free of charge (i.e., on open access) is no universal remedy. For example, in May 2015 there was a scandal surrounding the Swiss open-access publisher Frontiers. A group of 31 editors of the journals Frontiers in Medicine, Frontiers in Surgery and Frontiers in Cardiovascular Medicine criticised their own journal's peer-review practices and demanded reforms. The Frontiers review process, they complained, undermined scholarly standards and instead served the interests of the publisher in establishing lucrative growth for the journals. And the publisher was indeed growing rapidly: Frontiers founded its first publication in 2008, and today already runs 50 journals. It disputed the editors' accusations and eventually removed them from their positions.

Does anonymity offer effective protection against prejudice?

Prejudice is also rampant in science – be it directed against the background, the gender or other aspects of an author. But fighting prejudice is not easy. A double-blind peer review, which guarantees the anonymity of both the authors and the reviewers, is regarded as one of the best approaches for avoiding bias. But Ulrich Pöschl from the Max Planck Institute in Mainz, Germany, is sceptical. Reviewers can often recognise where an author comes from on the basis of linguistic characteristics, especially in small specialist fields. Pöschl prefers open-review procedures in order to combat prejudice. This isn't a catch-all remedy, he says, but at least it would let us see when a negative development emerges.

◂ p. 15: Spectacular results can bring fame and funding. So it can be tempting to pimp up your results. This flying dinosaur from the Chinese province of Liaoning was exposed as an artificial aggregate of several fossils by the National Geographic Society.
Photo: O. Louis Mazzatenta/National Geographic Creative

◂ p. 16: Mistakes and errors are part and parcel of research. Science is constantly correcting them with new findings. For example, the Sahara Desert was probably formed about seven million years ago, not three million, as was long believed.
Photo: Keystone/imagebroker/Egmont Strigl

“We should get away from orchestrating artificial competition”

Publish or perish is an incentive system that produces too much nonsense, says economist Mathias Binswanger.

Mathias Binswanger believes that today’s incentive system hinders real scientific progress.
Photo: Bob Bigelow

Prof. Binswanger, you write that science is engaged in the production of ‘nonsense’. Just how much nonsense, exactly?

I fear it’s producing more nonsense than sense. This has to do with the perverse incentives that are supposed to create ‘excellence’.

What’s wrong with researchers striving for excellence? What’s wrong with competition?

There’s nothing wrong with it, as long as competition is linked to a functioning market. If that’s the case, there’s an incentive to produce what consumers want. In science, however, there’s no direct demand – at least not in basic research. So artificial indicators are defined instead. Behind this is the idea that there has to be a means of measuring good science in quantitative terms, such as by the number of publications.

> “It’s an illusion to think you can manage science by using measurement data”

But we’ve got to measure things somehow, so that we know who to fund.

I have my doubts about that. As it stands currently, we have to ask the fundamental question: Why should we measure anything? It’s always being claimed that the public sphere wants it. But does the public really want ever more publications in scientific journals that are mostly written just to get a good ranking? It’s an illusion to think you can create good science from above by using measurement data. I’m convinced that today’s system of incentives is a hindrance to genuine scientific progress.

In what sense?

The incentive system has a negative impact on researchers’ motivation – there’s hardly any incentive left to work for a long time on something or to pursue a ‘big idea’. It’s actually natural for a good researcher to want to find out new, fundamental things and to seek original approaches to problems. But in order to support this natural drive, above all we have to create the proper conditions.

So now we’ve recognised the problem, all we’ve got to do is adjust the incentives and find a better balance between quality and quantity, is that right?

If we took that to its logical conclusion, we’d end with a kind of black box – an opaque system that no one can understand anymore, least of all the researchers themselves. What we have to do, I believe, is to stop orchestrating artificial competition in science completely.

Is the situation equally bad in all research fields?

It’s actually different from one discipline to another. But the principle is the same everywhere. For example, large sections of the social sciences – including economics – are so far removed from reality that much of their research can only be described as ‘art for art’s sake’. This is also the case with supposedly empirical research and experiments. At best, the system of incentives serves only to increase the number of publications. But rarely do they offer results that are interesting or profitable.

Interview by Roland Fischer

Mathias Binswanger is an economist at the University of Applied Sciences of North-West Switzerland. He will deliver a keynote speech at the conference ScienceComm on 25 September 2015.


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((outliers))

((publish or perish))

Yearning for slow science

Ever more quantity, ever more frequency, but also ever more unreliability? Is science in crisis? Some researchers are urging us to take the pace of things down a notch. ***By Roland Fischer***

The credit crunch! The housing crisis! The Greek crisis! But is there perhaps also a science crisis? Science is supposed to be an engine of success, but we're hearing more and more that it's running into major problems: scandals, data manipulation, downright fraud, and a publications roundabout that's turning ever faster. Could it be that there's something fundamentally wrong with the world of science today?

One thing is certain; scientific production has skyrocketed. The number of research publications has been growing exponentially – from roughly 700,000 per year in 1990 to 1.3 million in 2006. And the attention received by each publication is dwindling accordingly. Furthermore, in 2014 alone, some 400 articles had to be withdrawn after publication, because they contained sloppy work. At the beginning of the millennium, that figure was still only 30.

John Ioannidis, the bad boy of science statistics at Stanford University, demonstrated plausibly in 2005 that more than half of all published findings are wrong. And in 2014, he estimated that across the whole world, some 85% of research subsidies – USD 200 billion – were being invested in bad research and thus wasted. Perhaps the most disturbing warning sign is that more and more research results get past all quality controls, but then can't be reproduced by other researchers. Here, too, spot checks have shown that in many research fields, only a minority of results are based on solid work.

> "A lack of time is creating a feeling of crisis"
>
> Ulrike Felt

This calls into question one of the theoretical foundations of the natural sciences in particular: the reproducibility of a result, independent of place, time or person. Ultimately, this notion of reproducibility is the bedrock upon which we found all our claims to anything along the lines of objective 'truth'. If cracks appear in this, then it's understandable to fear that the whole edifice could collapse around us.

Faulty mass production

So is science today producing only background noise instead of clear signals? In many fields, this truly seems to be the case – and the exponents themselves don't hesitate to admit it. Until recently, Peter Jüni was the Head of the Clinical Trials Unit at the University of Bern, and he estimates that some 80 to 90% of current studies in the health sector are too small in scale, and/or suffer from methodological deficiencies that make them essentially unusable. But he would prefer to view this from a different perspective. Within this flurry of research results, he says, at least 10 to 20% of findings provide a substantial impetus to the field. And this is an "immense gain" compared with 1950, when "our medicine was often a kind of voodoo". Jüni still sees a certain degree of "naiveté in the medical research community", which lets itself be too easily deceived by the supposed significance of research results. But he doesn't see this as a fundamental problem: "If you know what you're doing, you will still find your way easily amidst this barrage of activity".

Antonio Ereditato is a professor for experimental particle physics and the spokesman of the Opera team at CERN, and he has also had to deal with the hazards of science. Three years ago, he announced a sensational discovery. Neutrinos had been observed travelling faster than light. The news went through the international media like wildfire. Ereditato stresses that his team had always been very specific about calling this result an 'anomaly', and had published their findings as a pre-print article on the arXiv server. The correction came eight months later. The measurement had been a result of faulty equipment. Even with hindsight, Ereditato still thinks that the Opera team acted correctly – they had waited for a long time to go public, and had also eventually only done so in order to invite colleagues to discuss this "rather improbable event".

For Ereditato, it's quite normal that experimental findings can't always be reproduced. He thinks that the publication of research results should always follow strict statistical rules and should be labelled accordingly – for example, as 'indications', 'proofs' or 'discoveries' – according to the quantitative reliability of the data. Dealing with the complexity of data is a normal part of research activity in particle physics, he says.

Like Jüni in his field of medicine, Brian Nosek doesn't believe that all fields of research are equal in the reliability of their results. He is a professor of psychology at the University of Virginia, and in 2013 he founded the Center for Open Science. Recently, he set up the 'Reproducibility project: psychology', in order to keep a check on his own field. He believes that the problem lies in "hyper-competition" and false incentives. "As a researcher, you're not

◂ p. 19: When he proved Poincaré's Theorem, Grigori Perelman solved one of the great problems of mathematics. But scientific fame doesn't interest this exceptional Russian: he refused the Fields Medal in 2006. Since then, he has actually turned away from science.
Photo: Wikimedia Commons

◂ p. 20: The avalanche of books rolling out of the University of Mons is just installation art. But researchers are under real pressure to produce their own flood of publications. It doesn't just make them suffer, it often also impinges on the quality of their work.
Photo: Keystone/Branko de Lang

rewarded for proving the reproducibility of the results you've achieved. It's far better for your career to produce as many results as possible and to publish them".

Creating the right incentives

And so people happily keep on publishing, ever more and ever more often. The number of publications has been growing exponentially. Lutz Bornmann is a sociologist of science at the Max Planck Society in Munich, Germany, and together with Rüdiger Mutz from ETH Zurich, he has recently shown that the number of sources cited in publications has also been growing exponentially, and that since the 17th century, the growth rate has jumped considerably on three occasions. Today, the volume doubles every nine years. Whether this generates a similar growth of knowledge itself is something on which the empiricist Mutz prefers not to comment. "You'd first have to determine criteria by which to measure it".

> "As a researcher, you're not rewarded for reproducibility"
>
> Brian Nosek

Nosek has nothing against growth per se. But transparency and reproducibility should be rewarded, not just quantity. The incentive to produce as much as possible isn't just going to disappear. And other efforts at reform have taken this as their starting point, too. For example, one initiative that has recently acquired a certain level of popularity is the San Francisco Declaration on Research Assessment, or DORA. It aims at a state of affairs in which research is evaluated by placing a greater emphasis on the quality of each individual project instead of on the indices of the scientific journals in which the results are published.

In the Netherlands, a number of renowned researchers have called for a 'Science in transition' that is intended to be nothing short of a fundamental reform of science. Science, they say, has been reduced to a self-referential system in which quality is determined almost solely by bibliometric parameters, and in which societal relevance is not emphasised enough. The European Commission welcomed the Dutch initiative and, after a process of consultation, it recently proposed guidelines for an 'open science' that is intended to be both more transparent and better anchored in society; digital means are to be utilised to achieve these goals. It is also hoped that the initiative will help us to keep up with the current exponential growth, and in the process attain quicker, more efficient means of knowledge production.

Slowing down

But do we really need to go even quicker? There's a growing resistance to this. In analogy to the slow food trend that aims to increase our enjoyment when we eat, a 'slow science' movement has taken off in recent years, with manifestos and articles appearing in different countries arguing for a more cautious, more sedate approach to science. However, there's no real unity about what such slow science would essentially entail. None of its exponents yearns for a nostalgic return to some putative perfect world of yore. What's certain, however, is that many researchers today feel that they can't fulfil their proper mission any more. Ulrike Felt, an Austrian social scientist at the University of Vienna, believes that this is an expression of a phenomenon that's taking place in society as a whole: it's a different approach to time itself. "It is fundamentally a lack of time that creates a feeling of crisis", says Felt. In recent decades, our temporal structures have changed, she says, and this is perceived in the form of stress and acceleration.

This is also something that has been observed by Fortunato Santo from the University of Helsinki, whose group recently published the article 'Attention decay in science'. They claim that research projects are being forgotten at an ever quicker rate because they are quickly submerged by the next wave of publications. Santo would also like research authorities to change their views, and he would like ways and means to be found so that we might place quality above quantity once more. Felt makes a more general observation, namely that politics should also be about tending the temporal landscape. There is too little time for reflection today, and knowledge production suffers consequently from the loss of our ability to spend longer periods of time on one task.

Just how the goal of slow science might be achieved, however, remains unclear. In this regard, Ereditato poses a fundamental question, "even if we ultimately decided that we need a slower science, where's the brake?"

Roland Fischer is a science journalist who lives in Bern.

▸ p. 23: Lots of money for a small plant with uncertain chances of success. The Wendelstein 7-X nuclear fusion plant at the Max Planck Institute for Plasma Physics in Greifswald, Germany, cost EUR 1.06 billion – more than twice as much as planned when the project started back in 1997.
Photo: Keystone/apn Photo/Frank Hormann

Every result is a publication

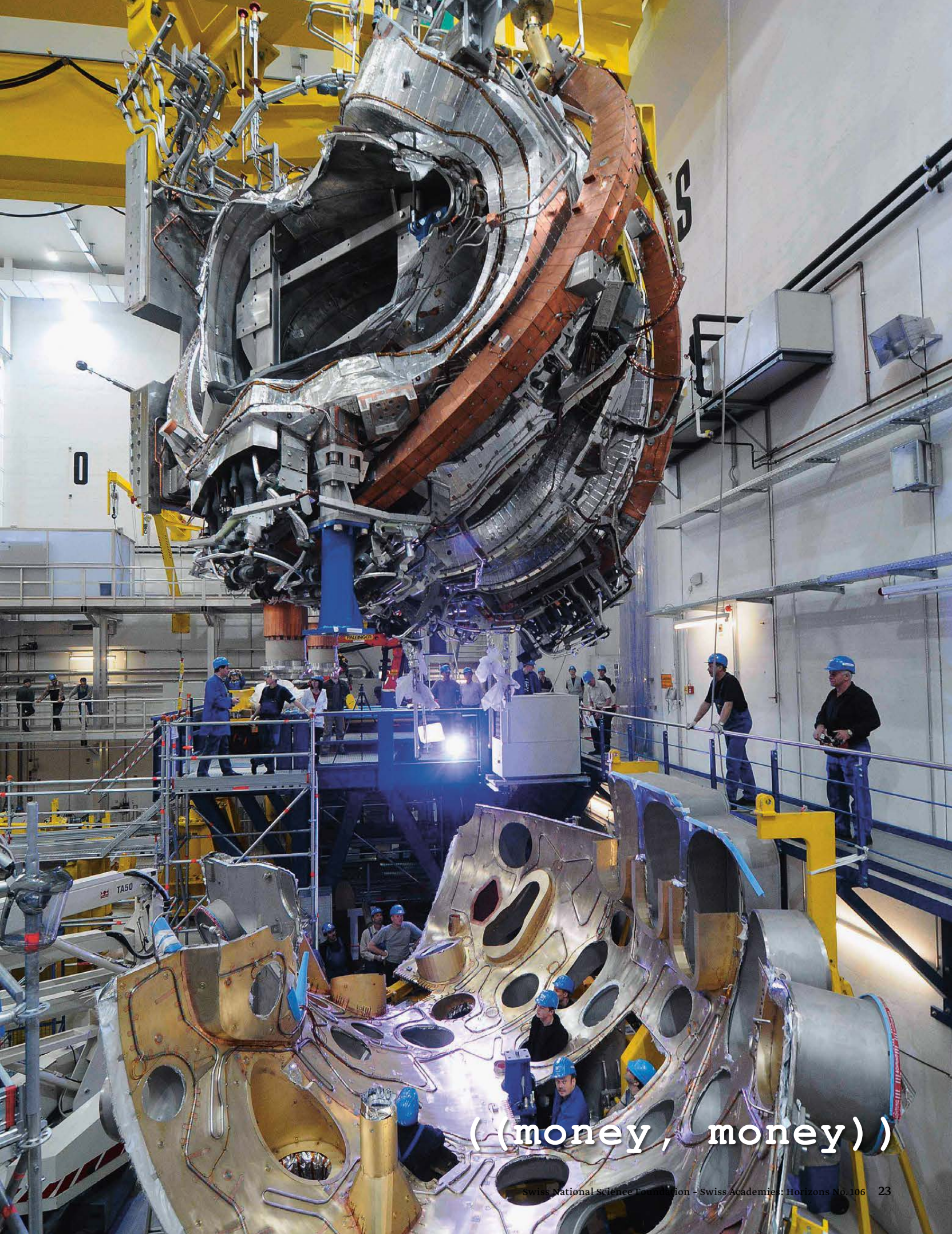
"Stories can wait. Science cannot". This motto sums up a plan to revolutionise the ways and means of publishing scientific results. The platform ScienceMatters has been devised by Lawrence Rajendran, a systems biologist at the University of Zurich, and it's due to come online in September 2015.

The idea behind this completely digital network is that researchers should no longer wait until all the individual elements of their work come together to produce a complete picture, or until they can derive a neat conclusion from it. The individual components of an article – in other words, individual observations – should be placed before the international research community for them to examine. The researchers could then get valuable feedback from other experts while they are still busy with their actual research. This should allow them to bring their scientific 'story' to its conclusion in peace, and with much better arguments.

Rajendran also hopes that this will help to counter scientific misdemeanours. Researchers would feel less tempted to squeeze data to fit their arguments, even when it doesn't really do so properly.

Publishing on ScienceMatters will be as easy as registering with a Facebook profile. Rajendran believes that there is a large, potential pool of able researchers in developing countries who could contribute individual components to a large digital science network such as this. Others will perhaps write the 'story', but even people without a university degree could help with data collection. ScienceMatters could thus contribute to a diversification of the research profession – and also lead to better reproducibility. "Many scientists are good at seeing the big picture and are born discoverers, while others are meticulous in checking the work of others. Everyone should do what he or she does best – and get proper recognition for it".

Quality control is to be organised accordingly. Just as in a social network, everyone will be able to like, evaluate and comment on contributions and thereby influence the status of the user. In this manner, important observations will reliably float to the surface, believes Rajendran. The only 'upstream' measure will be a check, carried out by the editorial team, that will weed out everything that does not meet the necessary standards.



((money, money))

INTERVIEW

“We want surprises”

Luc Henry, co-founder of the community laboratory Hackarium near Lausanne, hopes to develop crowdfunding for Swiss science.

Catherine Cattin

Why finance science through crowdfunding?

For many reasons. For example, it’s very difficult to find quick financing for scientific studies needing less than CHF 50,000. Most proposals to the SNSF have a budget of between CHF 100-500,000. And the allocation of funds can take up to a year.

What kind of proposals are suitable for crowdfunding?

Above all, quick studies testing whether ideas are well-founded. Crowdfunding also creates a new kind of dialogue among the public and researchers. Researchers must communicate with people who provide funding, keeping them up-to-date on how things are going and on the difficulties encountered. But it’s not as easy to promote science as it is a technological gadget, particularly in terms of giving the public something in return for their money.

The system runs the risk of funding popular, or even fanciful proposals.

The risk is minimal but accounted for. We want there to be surprises, by also allowing people on the fringes of universities to carry out their own original research. Crowdfunding will also allow for the financing of studies that are too politically sensitive - a neuroscience project in England, for example, studied the effects of LSD on creativity - as well as crowd-led science projects set up by amateurs. And of course there will always be common sense. Not all of the proposals put forward actually end up on crowdfunding platforms.

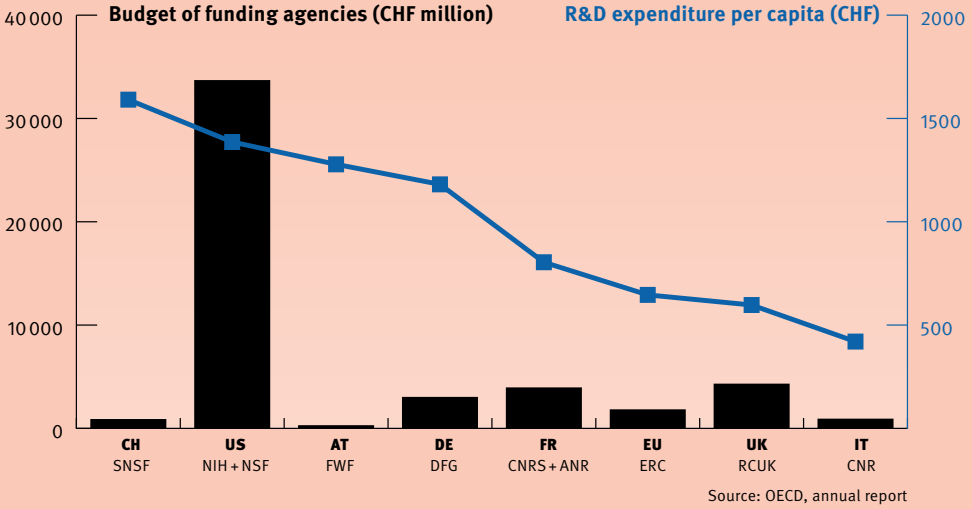
At what stage are you currently?

We are now negotiating with a Swiss platform for general crowdfunding to help them include scientific proposals, as well as with a foundation that might, for example, match the sums raised by the public. We hope to have the first proposals on track before the end of 2015.

GRAPH

Money is the lifeblood of research

The United States allocates CHF 32 billion annually to the NIH and to the NSF - almost 10 times more than German and French agencies receive. But per capita, research and development spending is higher in Switzerland.



Source: OECD, annual report

NEWS

Turbulence in Russian science

Some 3,000 Russian researchers took to the streets at the beginning of June 2015 to protest against a reform of financing and the introduction of competitive funding allocation. They fear that the latter will be done in a haphazard and opaque manner and will lead to the closing of institutions. At the end of May 2015 the oligarch Dmitry Zimin announced that he no longer wanted to finance his Diversity Foundation, the first Russian private organisation to fund research, after it was labelled as a ‘foreign agent’ by the government. The analysis agency Stratfor predicts a continued decline in Russia’s capacity to innovate, including in their space programme.

Europe replaces an adviser with councillors

The European Commission will replace the post of Chief Scientific Adviser (held by Ann Glover until it was axed in November 2014) with a council of seven scientists. Contrary to the previous role, whose incumbent reported directly to the President of the Commission, the new council will go through the Commissioner for Research, Science and Innovation, Carlos Moedas. Scientists writing in the online magazine Euroscientist expressed their concerns regarding the new structure and particularly the principle of a militia of councillors.

Wheat vs. chaff

The publication Journal Citation Reports has deleted 39 titles from its annual analysis of the citations in 11,149 scientific journals. The reason behind this move is an unusually high level of suspect citations: i.e., of articles published in the same journal or in one of a “cartel” of related journals.

Double data

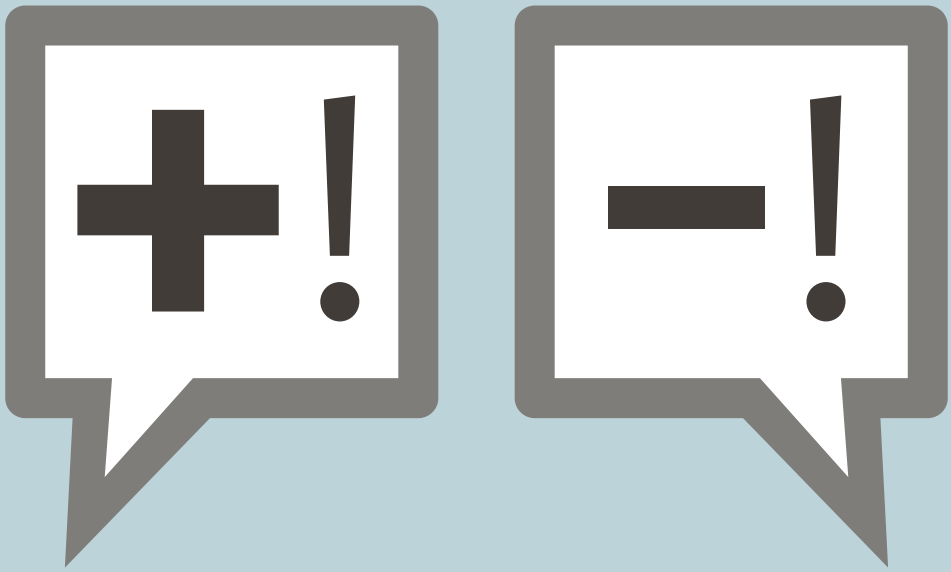
Almost a quarter of 120 cancer research articles contained duplicated data, says a study published in June 2015. Also of note is that, over a six-month period, none of the publishing journals replied to correspondence from the author of the study.

M.P. Oksvold: Incidence of Data Duplications in a Randomly Selected Pool of Life Science Publications. Science and Engineering Ethics, 2015

DEFINITION

Sleeping beauty

A scientific study that suddenly draws the attention of the community after years of indifference.



The 2015 elections: how the political parties view science

Political parties vote two-dimensionally, says the political geographer Michael Hermann. This fact is also reflected in the answers party bosses gave to four questions on science policy that Horizons asked them. *By Valentin Amrhein and Daniel Saraga*

When it comes to science policy, where do the front lines lie in our party-political spectrum? Primarily along two dimensions, says the political geographer Michael Hermann. The first dimension involves science funding. Here, the left says invest, while the right says economise. The second dimension no longer functions according to the left/right pattern, and Hermann describes it as the 'Physicists' dilemma', in reference to the play by Friedrich Dürrenmatt. Should scientists do what's doable, just because they can? When deciding whether political decisions should be made according to scientific possibility or the needs of society, often those on the far right join up with those on the far left.

Some two-thirds of the politicians in the National Council and the Council of States have a university degree. "But given today's state of permanent election fever, it's not academic politicians who're in demand in parliament, but communications experts", says Hermann. "Furthermore, there's a shift taking place away from facts and towards opinions".

In order for our readers to form their own opinions, here are the answers party executives gave to four questions asked by Horizons, along with the results of four votes in the National Council.

Politicians offer their opinion

ScienceDebate is a joint initiative of the Swiss Academies of Arts and Sciences, the SNSF and the online electoral assistance organisation Smartvote. ScienceDebate drew up 13 questions on science policy and put them to Swiss politicians. Its website www.sciencedebate.ch features the arguments of party chairpersons and their executive committees, along with answers from all candidates standing for seats on the National Council in 2015, listed according to their respective parties.

Science policy in 200 characters

The presidents of the seven biggest Swiss political parties

	Should the economic usefulness of research projects be given greater consideration when federal subsidies are being awarded?	Should the government and the authorities have a greater influence on the type of research that is publicly funded?
 Martin Bäumle Green-Liberal Party (GLP)	**Economic considerations should be an important criterion when awarding federal subsidies, although the funding of pure research may be excluded from this requirement.**	In defining the criteria for allocating research monies, politicians already have sufficient influence on what research is subsidised today.
 Toni Brunner Swiss People's Party (SVP)	**Research shouldn't be an end in itself; it should be applied research. The societal and in particular the economic use of research projects should be given greater consideration.**	Research is not a core responsibility of the state. The state should rather provide favourable conditions for researchers instead of pouring too much taxpayers' money into it.
 Christophe Darbellay Christian Democratic People's Party (CVP)	**Research and innovation can and must serve economic progress and enhance our level of knowledge. In this sense, the economic usefulness of research projects should be borne in mind.**	No. The federal government gives roughly a quarter of its research and development funding to the SNSF, which then uses it to subsidise research. That shouldn't change.
 Martin Landolt Conservative Democratic Party (BDP)	**By definition, research projects don't demonstrate their concrete economic usefulness right from the start. Any other criteria would impose too great a limitation on the breadth of research.**	The BDP welcomes research programmes in the field of renewable energies, for example. But we have to guarantee the right balance between state influence and research freedom.
 Christian Levrat Social Democratic Party (SP)	**The distribution of federal subsidies for research purposes is well balanced today. A greater orientation towards economic usefulness would call research freedom into question.**	There are already sufficient instruments to implement research focus programmes that are democratically legitimate and that respect the current and future needs of society.
 Philipp Müller Free Democratic Party (FDP)	**There is usually no recognisable economic use in pure research, which is why scientists, not politicians, should decide which research projects have the greatest potential.**	The independence of research (and teaching!) is a precious asset and must be guaranteed. All political influence must be prevented.
 Regula Rytz Green Party (GPS)	**No. But research must help us to confront the challenges of our century. These include our dwindling resources and climate change with its far-reaching consequences.**	Today, the Federal Council is already able to initiate national research programmes and research focus areas that investigate the core problems of our society. That's how things should remain.

Should nationality play a role when appointing professorial chairs?	Should scientific findings play a greater role in politics?
When appointing professors, the candidates should be judged on their expert knowledge and their pedagogical skills, not their nationality.	Evidence-based policy is to be recommended. Science can help to show politicians the reality of circumstances and possible paths to solutions.
A constitutional article was approved last year that confirms our right to manage immigration by prioritising Swiss nationals and by means of quotas. This must also apply to universities as employers.	Science, as part of society, should continue to bring us its findings, its concerns and its proposed solutions, though in the knowledge that there is no such thing as a uniform scientific opinion.
Fundamentally, nationality should not play any role. But if professors are available who are of Swiss nationality and who possess the desired qualifications, then they should be given preference.	Scientific findings should play a role in politics, but they must be discussed in a societal and economic context. This is where the role of politics begins.
It is fundamental that research institutions should not be hindered by rigid quotas when recruiting personnel.	It would be good if politics made more use of scientific findings in order to find sustainable solutions.
Rather not. The goal must be to have the best people working at our universities.	Scientific findings are an important prerequisite of political decision-making. The freedom of politicians to take decisions is just as important as freedom in research and teaching.
Teaching autonomy must also apply to the appointment of teaching staff. If Switzerland wants to retain its leading position in research, then it should appoint the best, most suitable people.	More science and less ideology would do parliament good. But science itself has to enter into a far more intensive dialogue with the people – for they are sovereign under the Swiss Constitution.
No. Research and teaching are international today. Only the job profile and the applicant's qualifications are relevant. But we must invest in young talent and the better representation of women.	Scientific findings are already important today and are included in politics. But many questions don't have a clear scientific answer.

For more extensive answers and other questions, please go to www.sciencedebate.ch

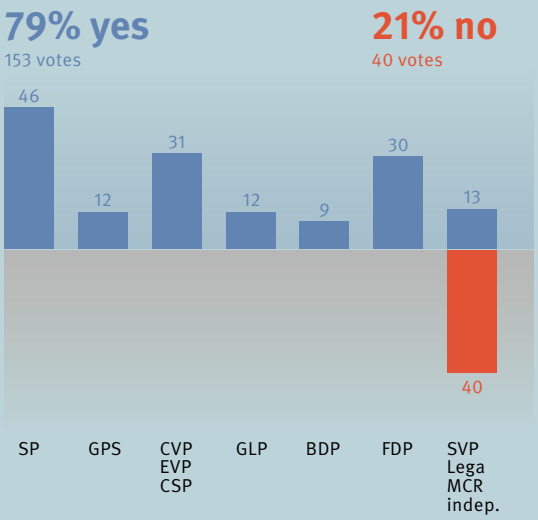
Photos: Parliamentary Service, 3003 Bern

Votes in the National Council on science policy matters

In the last legislative period, ending in spring 2015, there were 106 votes in the National Council in the field of science and research. We have chosen four votes that were particularly relevant for Swiss scientists.

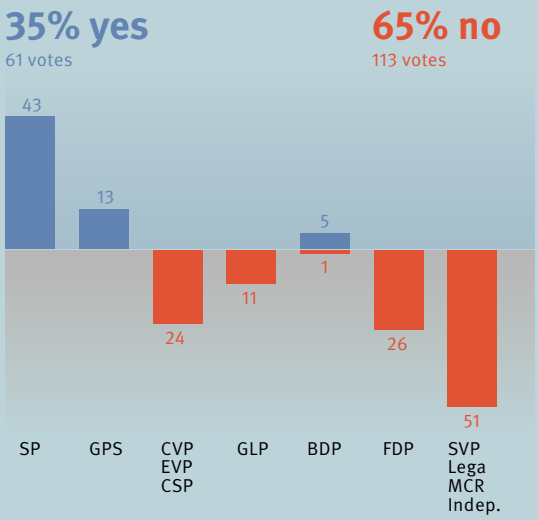
PARTICIPATION IN HORIZON 2020

Swiss participation in the EU research programme, to the tune of CHF 4.4 billion, means that Swiss researchers can apply for EU grants.
Supporting research and innovation in the years 2014–2020 (27. 9. 2013, reference 13.022-2)



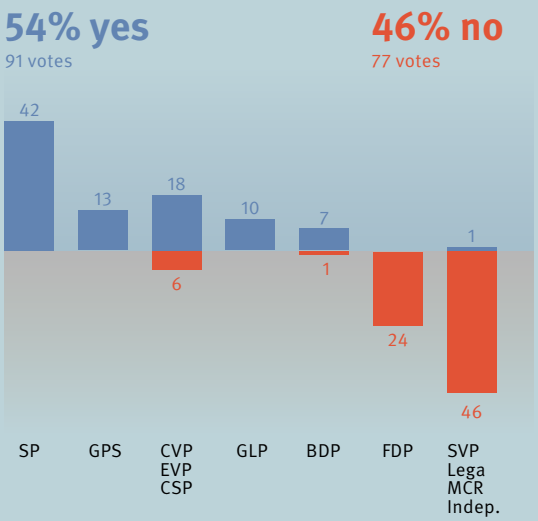
MODERNISATION IN THE SOCIAL SCIENCES

A national action plan will help to modernise research facilities in the social sciences and create longer-term research positions.
Modernising and developing research in the social sciences (19. 3. 2014, reference 12.3217)



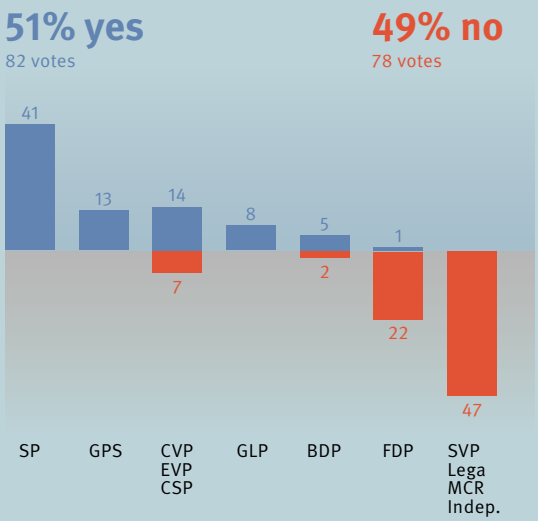
RESEARCHING OFF-PATENT DRUGS

Funding for studies on drugs for which the patents have expired and which are therefore no longer the subject of research.
Reliable decision criteria for pharmaceutical therapy (9. 3. 2015, reference 14.4007)



REMODELLING ACADEMIC CAREER STRUCTURES

A programme should be developed for remodelling career structures for scientific and scholarly staff at Swiss universities.
Funding for emerging researchers in Switzerland (9. 3. 2015, reference 15.3000)



The details of these legislative proposals can be found by entering the respective reference number on the following website: http://bit.ly/parlsci

“The right to science can be used as the foundation for dialogue”

At the end of 2015, Switzerland will start to apply the Nagoya Protocol on Access to Genetic Resources. This issue is part of the universal right to science, promoted with renewed intensity by the United Nations since 2012. *Interview by Florian Fisch*

Negotiations on patenting on seeds have given new impetus to the right to science, explains Samantha Besson.
Photo: Valérie Chételat

The human right to science aims to protect scientists living in authoritarian systems and to ensure that scientific progress benefits all citizens. From the 1960s and up to 2012 this right was no more than words on paper. Then new consultations were held by the UN Special Representative on Cultural Rights. For Samantha Besson, professor of international public law at the University of Fribourg, there can be concrete consequences from considering science as an integral part of cultural rights, for example during international negotiations on the patenting of seeds.

Isn’t access to the results of scientific research already included in our universal rights?

It can be found in almost all other rights. Scientific knowledge is necessary for producing food or for developing medicines. That’s why we havn’t really noticed the right to science until today. However, therein lies the interest in a period of reflection, not just to see what science does but also who it benefits.

What is the advantage of it?

Let’s take the example of international seed policy, the ramifications of which travel as far as the work of biologists and agricultural scientists. The double-edged aspect of the right to science receives widespread sterile opposition that can be found in debates on the right to food, where scientists’ rights to intellectual property are often used to oppose the rights of farmers to access seeds and to develop new varieties. The right to science can set out a new foundation for dialogue and for finding innovative solutions.

Doesn’t this movement bring with it the risk of increased bureaucracy?

Nations may be tempted to create new regulations in the field of research. But I think there are already enough and that we shouldn’t fear a new avalanche of restrictions.

Do you think that the right to science can weaken research?

In and of itself, more democracy is of course good news. However, the relationship between science and democracy is relatively sensitive. Increased democratic participation in science could result in a form of threat to researchers. But researchers’ autonomy is one of the most precious victories of today’s science. We must therefore remain vigilant.

—

F. Shaheed: The right to enjoy the benefits of scientific progress and its applications. A/HRC/20/26, HRC (2012).

Samantha Besson

Samantha Besson is the human rights delegate at the Swiss Academies and has taught international and European law at the University of Fribourg since 2004, having previously spent time at the universities of Oxford and Columbia.

Accessible and shared advantages

Biodiversity is essential for agriculture and livestock, as well as for the development of new medicines. The Nagoya Protocol, ratified by Switzerland, facilitates access to genetic resources in different countries for scientists and entrepreneurs. In exchange, states that hold these resources must be able to gain from the advantages that come from their use. The Nagoya Decree, which complements the Federal Act on the Protection of Nature and Cultural Heritage, will come into force most likely towards the end of 2015.

Putting patients first

Clinical research costs a lot of money. New financing models are needed to answer questions that are of importance to patients, but that are of lesser economic interest. *By Oliver Klaffke*

Whether it's new drugs or new forms of therapy, they all require the same degree of attention from researchers.

Photo: Keystone/Science Photo Library/Jim West

The pharmaceutical industry likes to invest in the development of profitable drugs. However, wealthy investors are lacking when it comes to researching new forms of treatment. "Studies that focus on the patients, not commercial interests, still play an important role in improving the treatment and care of the sick", says Stephanie Tan. She's a doctor who works for Quintiles Asia, a company that carries out clinical trials. Early in 2015, Tan and her colleagues published a handbook for clinical studies set up by researchers, appropriately titled Investigator Initiated Trials Made Easy. Such studies have been on the rise since the mid-1990s. In these cases, medics choose their research topics independent of economic interests.

A new, special SNSF programme is now offering funding to help realise independent studies in Switzerland: 'Investigator initiated clinical trials'. There will be two bidding rounds offering CHF 10 million each, which will suffice for four or five studies. "We would like to encourage researchers to carry out clinical studies on issues that they think are relevant", says Ayşim Yılmaz, the head of the Biology and Medicine Division of the SNSF. The type of therapy involved and the illness to be investigated are of no consequence whatever. The design and quality of the project alone will decide whether the study gets the go-ahead or not. "It's a bottom-up approach", she says. This is what distinguishes the SNSF programme from those of other European countries or the USA, where investigator-initiated studies are also given special funding, but in general only when the topic has been decided in advance.

Money from the industry

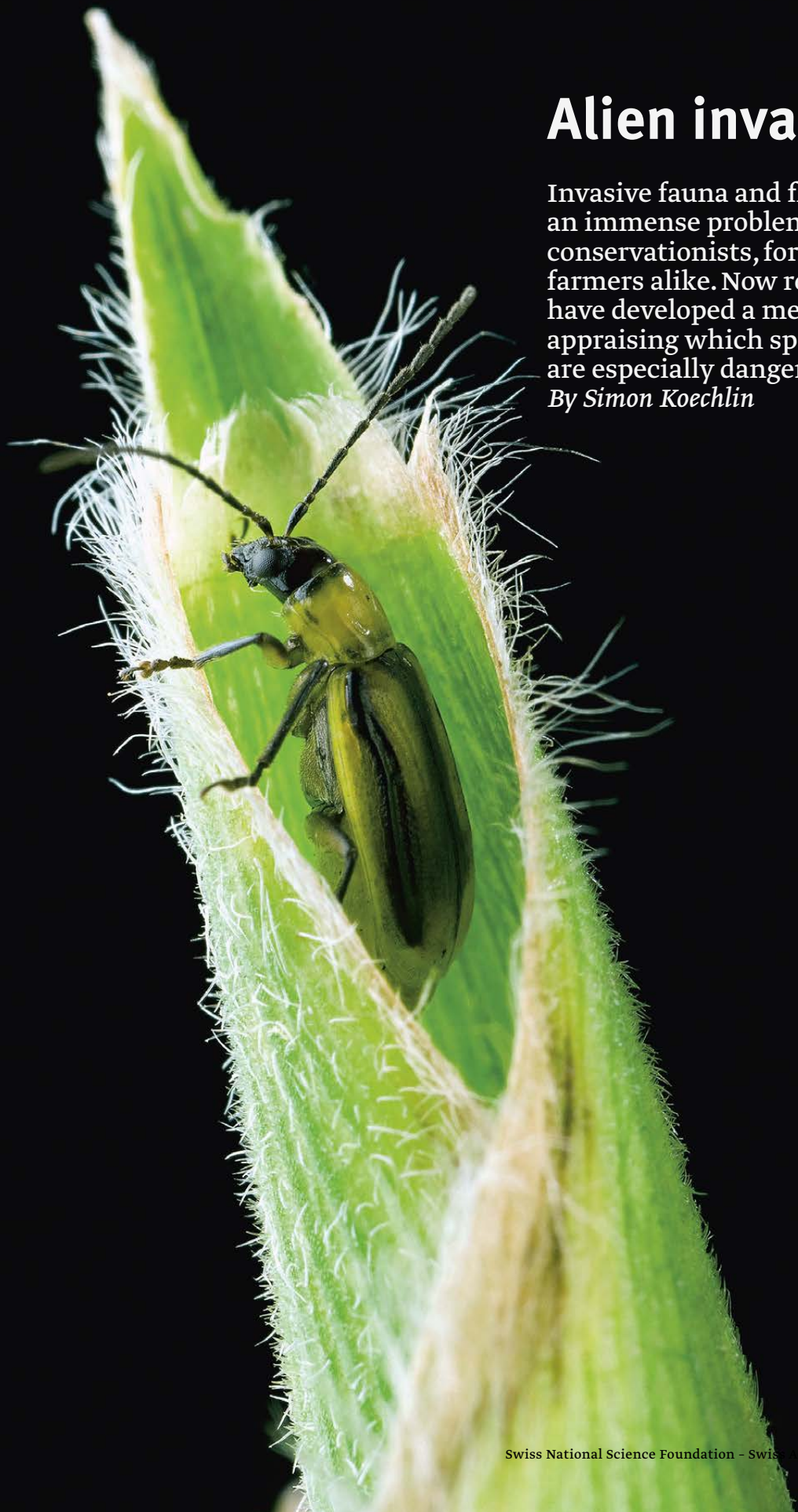
"In Italy, where I work, such research is funded by the AIFA Fund of the national medicines approval authority", says Giuseppe Traversa of the public Istituto Superiore di Sanità in Rome. The Italian programme is financed by a fee that the pharmaceutical industry has to pay, equivalent to 5% of their marketing expenses flowing into independent clinical research. This means that some EUR 40 million are available every year for research topics such as drugs for rare diseases or comparisons between different treatment strategies. As Traversa wrote in an article in Annals of Oncology, a specialist journal for cancer research, this kind of funding is an opportunity that you have to grasp with both hands.

Viviana Muñoz from EPFL proposes financial support from foundations. Along with the researchers of the Chair of Economics and Management of Innovation at EPFL, she believes that philanthropic funding has proven itself worthwhile in fields that are not economically lucrative, such as tropical diseases or the use of off-patent generic pharmaceuticals.

One such example is the aid organisation Doctors without Borders. It invested the money from its 1999 Nobel Peace Prize, and in collaboration with five other organisations used it to help set up a foundation in Geneva called the Drugs for Neglected Diseases initiative (DNDi). In 2013 DNDi had a budget of CHF 30 million, of which half came from private patrons, and it fills a gap in the development of drugs. Together with industrial partners, it produces drugs for weak markets that help to combat diseases such as leishmaniasis, malaria and HIV in children. Such sources of income are essential if we are to make clinical progress in niche areas that are not economically lucrative but medicinally important.

Oliver Klaffke is a freelance journalist in Zurich.

Y.-J. Ban et al.: Investigator Initiated Trials Made Easy. Quintiles, 2014.
V. Muñoz et al.: Can medical products be developed on a non-profit basis? Exploring product development partnerships for neglected diseases. Science and Public Policy, 2015.



Alien invaders

Invasive fauna and flora are an immense problem for conservationists, foresters and farmers alike. Now researchers have developed a method for appraising which species are especially dangerous.
By Simon Koechlin

Their names sound exotic, even auspicious. There's the red-eared slider, the Asian long-horned beetle, the tree of heaven and the giant hogweed. But these species of fauna and flora all belong to the most 'persecuted' in Switzerland. Customs officials, municipal gardeners and conservation societies all over the country are trying to ferret them out, trap them or dig them up, because they're on the list of species that are known as 'invasive'. And yet they are animals or plants that at one time were introduced here by us (in some cases intentionally, in others not) and that spread naturally. They are displacing native species, damaging land and forests, and even leading to human health problems.

12 billion euros per year

These problematic species are so great in number that the ecological and societal consequences are literally unimaginable. The Swiss Federal Office for the Environment (FOEN) has so far counted more than 800 alien species that have established themselves in Switzerland. More than 100 are regarded as being invasive. In Europe as a whole, the number of non-native species is reckoned to be more than 12,000, of which 10% are invasive. Earlier this year, the EU enacted a new regulation against them. The EU already spends more than EUR 12 billion a year, both in combatting invasive species and in repairing the damage they do. And the costs are rising.

Given this order of magnitude, one has to ask what priorities our politicians should be setting. Should our money and resources be spent combatting the zebra mussel that's displacing native mussels and blocking our water pipelines and sluice systems? Or would it be better spent in the fight against the corn rootworm that can destroy whole fields of maize? What's more important: that a nature reserve isn't completely overgrown with giant hogweed, or that a city park isn't littered with the droppings of Canadian geese?

Comparing mammals and plants

These are questions that the authorities everywhere find difficult to answer, including in Switzerland. In a position paper published in late 2013, the conservation association 'Pro Natura' wrote, "current approaches often lack clear priorities about combatting invasive, alien species, just as they fail to specify the habitats where the scarce financial means available might be deployed on a priority basis". Wolfgang Nentwig shares their opinion. He's an ecologist at the University of Bern and one of the best-known researchers in the field. "Regrettably, too little is being done", he says.

However, it's been difficult to set priorities until now, because there's been no means of appraising the impact of invasive species accurately or of allowing us to compare the influence of different groups of organisms, such as mammals and plants. A consortium of scientists from across the world has been developing such methods, and Nentwig and his colleagues at the University of Bern are involved in it. They have developed a kind of damage rating that functions as follows. They hunt for existing studies on the impact of alien species, which can range from studies on quantifiable effects to estimates made by experts. Then, on the basis of this quantitative and qualitative data, the impact of every individual species is assessed and allocated to one of twelve different categories, such as their impact on animals, vegetation, agriculture, forest management and human health.

Fish less harmful than birds

In a recently published study, Nentwig and his colleagues have used this method to examine and compare 300 alien species that have taken root in Europe – mammals, birds, fish, arthropods and plants. It transpires that, on average, alien mammals have the most serious impact – on the environment, on the economy and on society. The least damage, they suggest, is done by fish. Mammals are often of particular importance in an ecosystem because of their size and their adaptability, and also because they have a broad diet, says Sabrina Kumschick, the lead author of the study. She wrote her doctoral dissertation at the University of Bern and today works at the Centre of Excellence for Invasion Biology at the University of Stellenbosch in South Africa. "For this reason, we weren't really surprised by the position that mammals assumed in our assessment".

> "Current approaches often lack clear priorities"
>
> Pro Natura

This assessment tool will in future allow authorities to carry out a better comparison of the consequences of invasive species. This in turn can help them to focus their resources better when trying to protect native species. Gian-Reto Walther is responsible for alien species at FOEN, and he is grateful for such practically oriented research. What's especially valuable is that this new method allows for comparisons between different groups of organisms. Previous systems allowed you to compare

◂ page 31: Introduced to Europe from Central America, the corn rootworm *Diabrotica virgifera virgifera* destroys whole fields of maize.
Photo: Keystone/Science Photo Library/Peggy Greb/US Department of Agriculture

The poison of the giant hogweed can cause severe burns. This ornamental plant came to Central Europe as a gift from Tsar Alexander I, but today it is eroding our river banks.
Photo: Konrad Lauber, Flora Helvetica @ 2007 Haupt Bern

plants with plants, he says, but not plants with mammals. Walther doesn't think that Switzerland is doing too little, however. "There are already lots of measures underway to combat invasive species", he says. Often, however, they're not well enough coordinated. But that is going to change, he says. FOEN is currently developing "a strategy to combat alien species".

Someone has to decide

Fighting uninvited intruders is going to be a Herculean task, but all the experts are aware of this. Not least because no one quite knows how to proceed. "According to the information we have at present, it's already too late to exterminate many species", says Nentwig. One example is Japanese knotweed, which comes from East Asia and has spread rapidly across Europe since the mid-20th century. In Switzerland, only the Upper Engadine is still free from this robust plant that is so quick to proliferate. And because Japanese knotweed can sprout from the tiniest piece of shoot left in the soil, it's almost impossible to cope with it.

> "Measures are not coordinated well-enough"
>
> Gian-Reto Walther

Damage ratings are at least a further piece of the jigsaw helping us to bundle our strengths and prioritise properly in the battle against invasive species. That's why Nentwig and Kumschick are planning to develop their method further. But these assessment lists will never be more than an aid to decision-making. Because whether it's more important to society to keep a park free of goose droppings or a nature reserve free of hogweed is something that will still have to be decided by someone on the spot.

Simon Koechlin is a science journalist and the chief editor of Tierwelt.

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S. Kumschick et al.: Comparing impacts of alien plants and animals in Europe using a standard scoring system. Journal of Applied Ecology, 2015.

Male marmosets are not less intelligent than the females. They're just less motivated. Photo: Keystone/Science Photo Library/Visuals Unlimited/Ken Lucas

Observing the observers

The behaviour of laboratory animals often depends on the person carrying out the experiment. This could explain why many animal tests can't be reproduced. ***By Ori Schipper***

For several years now, behavioural scientists have been investigating themselves. Before this, they rarely paid much attention to the influence of people on laboratory animals.

Indeed, since 2004, several independent investigations have suggested that female common marmosets are superior to the male of the species when it comes to solving problems, such as picking out a raisin from an empty film container. The females did not just find more varied ways of opening the container, but they also reached their goal quicker and more efficiently than the males. So are female marmosets simply cleverer?

> "Animals behave differently when they're under stress"
>
> Maria Emília Yamamoto

As Judith Burkart and her team from the Anthropological Museum of the University of Zurich have shown in a recently published study, it's probably not quite so simple. In this new test, the males were still the less efficient gender, but the researchers were able to show that the male marmosets were more often distracted from their task than the females.

Burkart's team recorded the behaviour of 14 common marmosets that watched from their cages how four different people carried out tasks such as pouring sand from one glass into another, or placing a grasshopper – a delicacy to marmosets – under one of three black cups on the table in front of the animals' cage.

Of the four researchers, two of them, both women, were known to the marmosets from previous experiments. But they had never before seen the other two researchers. As expected, the unknown visitors unsettled the male monkeys far more than the females. This was why the male marmosets were worse at guessing correctly which cup hid the grasshopper. Instead of watching what was happening, they were trying to get out of their test cage to return to the other group of primates.

Lack of motivation

But when the males did concentrate on their task, they were as competent as the females in finding the grasshopper. "The fact that the males perform their task less well is not because they're less intelligent than the females. They're just less motivated", says Burkart.

Maria Emília Yamamoto of the University of the Rio Grande do Norte in Brazil is the behavioural scientist who was the first to demonstrate that female marmosets solve problems better than the males. But the idea that the males are less attentive is an explanation that she, too, finds compelling. Yamamoto finds the new study important because it shows "that animals behave differently when they're under stress". For Burkart, the well-being of the marmosets is also a primary concern. For this reason, she defined abort criteria that would enable the animals to be taken back to their group as soon as they no longer showed any interest in the experiment.

"The smaller the laboratory animal, the greater the probable influence exerted by the person carrying out the experiment; and the greater is its fear of people", says Burkart. For example, a study by researchers in Montreal in Canada in 2014 proved that even the scent of male researchers is enough to put mice under stress – which means that they display less signs of feeling pain than when they are examined by female researchers. We have to become aware of this kind of influence, says Burkart, so that we can do our best to avoid research results being unreproducible, or even falsified.

Ori Schipper works for the Swiss Cancer League and as a freelance journalist.

M. N. Schubiger et al.: High emotional reactivity toward an experimenter affects participation, but not performance, in cognitive tests with common marmosets (Callithrix jacchus). Animal Cognition, 2015.

RNA against heart attacks

Researchers are hoping to be able to use non-coding therapeutic RNA – snippets of genetic information – to allow cardiac muscle to regenerate following a heart attack.
By Caroline Ronzaud

Arteriograms, like this historical photo from 1904, can reveal blockages in coronary arteries. Photo: Keystone/Science Photo Library

One of the manifestations of a heart attack is the death of sections of cardiac muscle. Over a certain limit, this sometimes leads to heart failure. According to Thierry Pedrazzini, professor in experimental cardiology at the Vaud University Hospital Centre (CHUV) in Lausanne, the heart of adult mammals is unfortunately incapable of auto-regeneration. Whilst it does contain progenitor cells, which are similar to stem cells and necessary for regeneration, the quantities are not large enough. Furthermore, these cells are not naturally inclined to produce new cardiac muscle cells.

To get the heart to create new cells and hence restore cardiac function, regenerative medicine has for a long time placed its chips on cellular therapy providing the solution through the use of injected stem cells. But results in human and mouse experiments have let them down, showing improvements in heart functioning but not any production of cardiac muscle – except in a recent study in primates with embryonic stem cells. We also need to show that this method does not lead to tumours, says Mauro Giacca, Director of the International Centre for Genetic Engineering and Biotechnology in Trieste, Italy. "It's also slow and difficult to set up", he says.

Reprogramming heart cells

A new approach, however, involves reprogramming cardiac muscle cells to activate the molecular mechanisms in the heart that are responsible for creating muscle. The CHUV has set out to study this, using non-coding RNA: short segments of genetic information that do not produce proteins. "RNA are like switches for the genes, allowing proteins to be produced at the right time and in the right place, for example during stress or to differentiate stem cells", says Pedrazzini. "There are different types of RNA in every type of cell, making them excellent therapeutic targets".

The researchers have identified the non-coding RNA molecules that control the differentiation of stem cells in cardiac muscle. They have since been able to stimulate the regeneration of an adult mouse heart following a cardiac arrest. They were also able to produce a culture of muscle cells using progenitor cells taken from the hearts of patients suffering from heart failure. "For a long time we believed that adult muscle heart cells could not divide," explains Pedrazzini. "However, this ability can be reactivated through the manipulation of non-coding RNA, without having to use stem cells".

Thomas Thum, director of the Institute of Molecular and Translational Therapeutic Strategies in Hanover, Germany, also sees the interest in non-coding RNA therapy. "What still needs to be resolved, however, is increasing the efficacy and finding a way to administer active substances into patients' hearts".

Caroline Ronzaud is a science writer based in Lausanne

U Patrick Meister

This limestone was excreted by bacteria.

Ancient methane-makers

Three and a half billion years ago, the first-ever micro-organisms dwelled in self-built, mat-like limestone structures called stromatolites. They used photosynthesis to produce the first oxygen, and thereby created the basic prerequisites for higher forms of life on Earth. Patrick Meister, a geologist at the University of Vienna, has now shown that the stromatolites at times also emitted methane, which is a potent greenhouse gas.

In order to gain insights into the very beginnings of life, Meister and his colleagues at ETH Zurich and the University of Zurich have been investigating carbon in the limestone of prehistoric stromatolites from Australia. Although photosynthesis primarily traps the lighter isotope carbon-12, the proportions of it in the stromatolites don't correspond to expectations. "There is a lot of the heavier carbon-13 in the stromatolites. That's unusual", says Meister.

According to these researchers, the micro-organisms that produced oxygen, sugars and lime must have lived in the stromatolites alongside a second bacterium, which ate the sugar, releasing carbon dioxide and methane. In the process, the lighter carbon was taken up into the methane, and the tiny residue of the heavy carbon into the carbon dioxide, which after further reactions precipitated as limestone. The researchers found confirmation of their theory in a modern stromatolite from a lagoon in Brazil, where the microbes to this day produce both oxygen and methane. *Atlant Bieri*

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D. Birgel et al.: Methanogenesis produces strong 13C enrichment in stromatolites of Lagoa Salgada, Brazil: a modern analogue for Palaeo-/Neoproterozoic stromatolites? Geobiology, 2015.

An organ system on a chip

Liver damage is one of the most frequent reasons for the failure of new drugs during the development stage. In order to recognise problems as early as possible, and to avoid unnecessary animal testing, a research group led by Oliver Frey at ETH Zurich's Department of Biosystems Science and Engineering in Basel has developed a new cell-culture system in collaboration with the start-up company Insphero. It offers an intermediary step between testing on cells and animals: a miniature organ system that comprises spheres half a millimetre in size that are made of cells – such as liver cells or tumour cells, for example.

These 'spheroids' replicate the functions of organs better than normal cell cultures can, because there is more intra-cellular contact than on the two dimensions of the bottom of a petri dish. All manner of tissue-type combinations can be used for these spheres. They are then placed in recesses on a chip developed by Frey's team, which is linked to others like it by narrow little channels. By slowly swivelling the chip, the nutritive solution flows around the different mini-organs and allows the exchange of messenger materials and metabolites.

This allows the team to test the anti-tumour effect of new substances that only become active after they have been metabolised by liver cells. "It's the simplicity of our system that makes it so beautiful", explains Frey. The miniature scale of the chip saves material, it's easy to use, and in its present design it allows up to a hundred experiments to be conducted in parallel. *Angelika Jacobs*

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K. Jin-Young et al.: 3D spherical micro-tissues and microfluidic technology for multi-tissue experiments and analysis. Journal of Biotechnology, 2015.

J.Y. Kim

The micro-tissues in these chambers are provided with metabolites and messenger materials through the coloured channels.

Christoph Grüter

These marked ants have found their own way to this food source.

Ants make a beeline

Ants are perfect examples of the social insect, and their behaviour is very complex. When faced with the choice between different sources of food at equal distance from their nest, the common black garden ant, *Lasius niger*, will choose the source of food that lies at the end of the simplest path. And it uses visual landmarks to help it get there, as has been shown by Christoph Grüter and his colleagues at the Department of Ecology and Evolution of the University of Lausanne.

They created two mazes with bifurcating T-shaped paths. The first was the simpler to memorise: worker ants had to turn twice in the same direction (either twice left or twice right). In the second maze, they were required to turn alternately (left then right). Having tested both paths, the ants tended to take the first.

In a second experiment, the researchers laid out visual markers along another maze, which was yet more difficult to memorise. The worker ants preferred this to a labyrinth without the visual guides. "Thanks to the visual markers, they can move around more quickly and, when they take the wrong path, they correct their mistakes more quickly", says Grüter. This shows us then that when it comes to finding sources of food, ants don't just follow the pheromone trails left by scout ants, as was previously thought; they also use their visual memory. *Elisabeth Gordon*

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C. Grüter et al.: Collective decision making in a heterogeneous environment: *Lasius niger* colonies preferentially forage at easy to learn locations. Animal Behaviour, 2015.

Ringed by the flat horizon

The physicist Hubertus Fischer braves arctic temperatures to reconstruct past climates using ancient ice. This allows for better predictions about the climate of the future.
By Daniela Kuhn

On this radiant summer's morning, sitting in the main campus of the University of Bern, your gaze naturally wanders to the snow-capped Alps in the distance. Just next door, in an office of the Department of Climate & Environmental Physics, the 49-year-old Hubertus Fischer explains how he became so passionate about polar exploration and climate research.

When he left school, Fischer already felt drawn to the natural sciences. Nevertheless, he decided to study architecture instead. But soon missing "the stringent mathematical approach", he began attending lectures in physics on a trial basis, and the subject fascinated him right from the outset.

The climate lies embedded in the ice

"After my intermediate examinations, I wanted to get out and taste the big, wide world", says Fischer, laughing. So he went to study for a year at the University of Oregon, then returned to Germany and switched to Heidelberg to finish off his degree in physics. When he was hunting for a topic for his thesis in his final year, his fellow students recommended that he go to Dietmar Wagenbach. He did, and in their first conversation, Wagenbach asked: "Can you ski and cook? I might have something for you to do in Greenland". Wagenbach went on to supervise both his undergraduate dissertation and his doctoral thesis.

Fischer didn't need to think twice about his proposal, because he'd always loved the far north. Equipped with snowmobiles, snow groomers and tents, he and seven colleagues trekked into the interior of the world's biggest island. The goal of their expedition was to use ice cores to reconstruct the climates of past centuries and measure the state of the air pollution in northern Greenland caused by aerosol particles from the USA and Europe.

Those weeks were an overwhelming experience, says Fischer. Nor would it be his last arctic expedition. After completing his doctorate, he first travelled to San Diego in California on a postdoc. It was there that he familiarised himself with his current special field, namely investigating gases in ice cores. Once he was back in Europe, he developed new methods for isotopic investigations of greenhouse gases in ice, first at the Alfred Wegener Institute for Polar and Marine Research in Bremerhaven, Germany, then later also at the University of Bern. These methods allowed him to quantify the sources of these gases. To get the measurements, he and his team had to drill several kilometres into the ice. The challenge was to be able to take ultra-precise measurements using the smallest possible air samples extracted from the ice. Just a few millilitres of air can offer up information about changes in the climate, the concentration of CO_2 and the carbon-13 isotope content. This isotope reveals the source of the greenhouse gas – whether it comes from the ocean or from the decomposition of land bio-mass.

Experts with opinions

His results show that the concentration of CO_2 is greater today than it has been for the past 800,000 years. The greenhouse gas methane is also present in higher quantities today than at any point in that same period – in recent centuries it's risen by 150%.

"This is all a result of human activity and it's already having a significant impact on our climate system today". Hubertus Fischer says all this quite objectively, without any hint of outrage, and without any


Valérie Chételat

"I never wanted to save the world"

hint of a call to arms. But when asked about the political relevance of his research, he says, "like all climate researchers, I have my own personal stance and I'm aware of the drastic consequences of man-made climate change. But I am also able to keep my professional role as a scientist separate from my role as a citizen". The two roles don't contradict each other, because Hubertus Fischer's research results are acting as a stimulus to the societal debate that's so necessary. "At the beginning of my professional career it wasn't my desire to save the world", he says. "But as an expert you have to stand up and put the clear facts in front of everyone". And that's what he's doing. Ever since an incident where climate sceptics misused one of his findings in order to draw illogical conclusions – namely that CO_2 supposedly doesn't have an impact on the climate – he is entirely more careful about his information superiority.

Flying ruins his CO_2 footprint

Fischer has been living in Bern for the past seven years. His move to the University of Bern made sense twice over. He has long had contact with researchers there through drilling projects in the Alps and Greenland, and his partner of many years also lives in Bern with their two children. So getting a professorship in Bern was like "winning the jackpot". He only needs ten minutes to get from his home to the office by bike. He doesn't have a car, which he says is his contribution to the climate. But he regrets that his job means he often has to fly, as it ruins his own carbon footprint. He compensates for his many flights through the organisation Myclimate, which invests the money in sustainable climate-protection projects.

But the roles of scientist and citizen aren't always so easy to keep separate. After the mass immigration initiative was accepted last year, Fischer launched an online petition demanding that "Switzerland must remain part of European science", emphasising that the exchange of knowledge and experts is imperative in today's international scientific network. He got several thousand signatures, and gave the petition to the Federal Council and the European Parliament. There's a pillar in Fischer's office that's covered in nameplates listing different university towns, illustrating the success of his petition. On international polar expeditions, the teams always set up just such a 'tree' of names, he says.

It's been a long time now since Fischer was himself in the far north. In 2019, as part of the 'Oldest ice project', an ice core is due to be bored in the Antarctic that for the first-ever time should cover the climate history of the past 1.5 million years. For this project, Fischer is planning to go back into the field for three months – into those endless, flat, icy wastes that extend out to the horizon. "In such extreme situations, I can get away from the whole terror of emails and I become perfectly calm inside. In that unending silence I become aware of little things of beauty, such as the variety of the glittering snow crystals or the nuanced shadings that you see as the sky changes colour".

Daniela Kuhn is a freelance journalist.

Recognised ice core researcher

Hubertus Fischer (49) is a Professor for Experimental Climate Physics at the University of Bern. He was recently awarded a prestigious ERC Advanced Grant by the European Research Council, for the second time.

Playing the palm plantation game

Researchers at ETH Zurich want to use board games to help cultivate oil palm trees more sustainably. The goal is to find a balance between environmental impact and economic efficiency.
By Atlant Bieri

To cultivate oil palms, huge areas of rainforest are cleared and groundwater reserves are overused. Photo: Jaboury Ghazoul

The spread of oil palm plantations is one of the main reasons for the loss of rainforests in South America, Africa and Asia. But a world without palm oil is unthinkable. It is the most important lipid used in the food industry and is also an ingredient of many creams and beauty products. Now an international team of researchers under the auspices of ETH Zurich hopes at the very least to make the production of palm oil more eco-friendly.

In order to achieve this, they're resorting to unusual means. They're using board games in the regions affected to try and show farmers, landowners, companies and politicians just what consequences can arise if they don't take care of their natural resources. The project is called 'Oil Palm Adaptive Landscapes' (OPAL, see 'The science of development cooperation'). It began in May this year and is expected to last for six years. It is focussed on three countries: Indonesia, Cameroon and Columbia. "Indonesia is the biggest palm oil producer in the world, but the plantations in the other two countries are also growing rapidly today", says the project head, Jaboury Ghazoul, who is an ecologist at ETH Zurich.

In the first phase of their project, the researchers measure the environmental parameters of the rainforest: the loss of biodiversity, the availability of groundwater and its carbon storage capacity. Using this data, the researchers enter their second phase, designing a simple board game to reflect reality.

Interest groups around one table

On the board, the jungle stands next to the oil palm plantation. Both are traversed by waterways and irrigation channels, and they are divided up into different plots of land. Each of the different interest groups will be invited to several rounds of the game. Every participant will be given a playing piece along with money and land, and can cultivate the natural resources of rainforest, water and biodiversity.

"Using such a game, we can run through processes in minutes that in real life take years", says Ghazoul. The researchers will make a note of all the moves and their impact. They will then pass this information to the interest groups, along with the participants' own feedback. "Knowledge transfer in these countries isn't simple. A board game is an ideal form of communication for it", says Ghazoul.

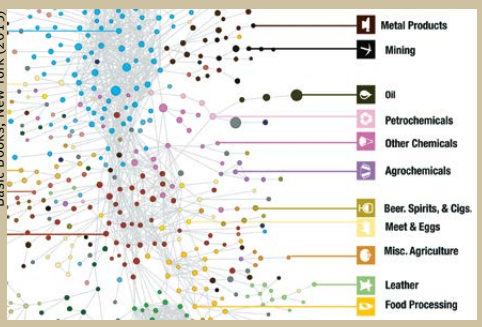
The researchers also want to compare the mechanisms in the three countries – Indonesia, Cameroon and Columbia – in order to be able to recommend universally valid measures for managing oil palm cultivation. The Director of the Palm Oil Research Center at the Technical University of Malaysia, Sune Balle Hansen, thinks that the board game is a good idea: "If this game includes people from the value chain, then it could truly lead to a collaboration that might improve the sustainability of palm oil production".

In the past, such games have proven their worth several times. In the 1990s in Senegal, for example, farmers and irrigation planners decided on the course of an irrigation channel after using a board game devised by the French research institute CIRAD.

Atlant Bieri is a freelance science journalist.

The science of development cooperation

The 'Oil Palm Adaptive Landscapes' project, OPAL, is one of the first Swiss programmes for research on global issues for development (the 'r4d-Programm'). The Swiss Agency for Development and Cooperation (SDC) and the SNSF are together supporting research on food security, public health, ecosystems, work and social conflicts. Between 2012 and 2022, almost CHF 100 million will flow into transnational research projects with developing countries. *ff*



Hidalgo CA. Why Information Grows: The Evolution of Order from Atoms to Economies. Basic Books, New York (2015)

Models can estimate international trade.

Netflix predicts the economy

Is it possible to predict international trade? Alexandre Vidmer of the University of Fribourg is working on it using digital models and complex systems theory. The physicist and his team have been delving into a United Nations database on the trade of 65 countries covering some 770 products for the years 1996 to 2000. "Our aim was to estimate trade in 2001 using a variety of predictive models", he says. He did this without resorting to economic models based on supply and demand, instead using just data from the past. One of the new models was inspired by an algorithm developed by Vidmer for establishing recommendations from the 9,000 films and series that are available in the Netflix catalogue. This new model, for example, accentuates already popular items.

Of the trade in 2001, the model's predictive success rate was 7-8% on average. This is a modest score, but one which rises to 12%, "if we take a longer period into account", says Vidmer. Although Didier Sornette, a professor of entrepreneurial risk at ETH Zurich, qualifies these results as "reasonable", she regrets that the study does not go into further detail, for example by identifying "specific findings in terms of wealth, a key factor for economists and decision-makers". This may be an idea for further studies. Vidmer is now trying to apply these results to predicting the price of shares on the stock market. *Fabien Goubet*

A. Vidmer et al.: Prediction in complex systems: The case of the international trade network. Physica A, 2015.

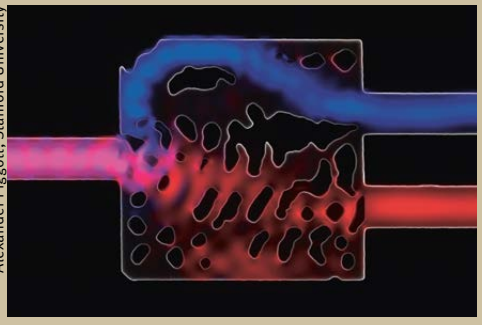
Creating bespoke optoelectronic components

A team at the University of Stanford has developed software that automatically generates designs for optoelectronic components. "This is an important step towards creating computers based on not only electrons but also photons", says Konstantinos Lagoudakis, who, thanks to an SNSF grant, joined the University of Stanford having defended his thesis at EPFL. The idea of applying light and optoelectronics to computing aims to get around the disadvantages of current microprocessors. Electricity is subject to both slow speeds and heat dissipation, neither of which affects light particles. Photons are, however, difficult to manipulate.

"Our method makes it easier to create optoelectronic devices", he continues. The team, led by Jelena Vučković, has developed a new algorithm – using an inverted design – to create a nanoscopic demultiplexer from silicon. The device separates a single incoming light signal into several outgoing signals, depending on the wavelength of the light.

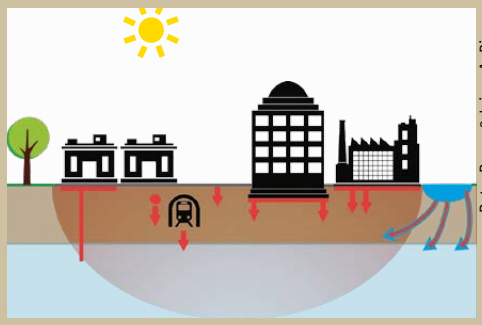
"The demultiplexer is a passive element. What we want to do next is to create active components, such as transistors. For that, we must find a way of controlling photons using light, the same way we use electricity to control an electric current moving through a traditional transistor". Such a device could serve as the basis for tomorrow's optoelectronic microprocessors. *Pierre-Yves Frei*

A. Y. Piggott et al.: Inverse design and demonstration of a compact and broadband on-chip wavelength demultiplexer. Nature Photonics, 2015.



Alexander Piggott, Stanford University

By separating light, these components could function as a new kind of computer.



Peter Bayer & Jaime A. Rivera

Buildings and tunnels warm up the groundwater.

Groundwater as a heat reservoir

The warmth of cities increases the temperature of groundwater by several degrees. This has been proven by a study carried out by ETH Zurich, the Karlsruhe Institute for Technology and the University of Cambridge. Normally, groundwater has roughly the same temperature as the annual average temperature of the air - which at our latitude is circa 10 degrees Celsius. But directly under the centre of the German cities Karlsruhe and Cologne, the groundwater is five degrees warmer.

Geoscientists have now begun charting underground water temperatures by making hundreds of different measurements. They have found that it is primarily buildings and asphalt streets that heat up the groundwater - though district heating pipelines and tunnels also do their part. This phenomenon can also be observed in Zurich. The deeper the groundwater, the less it is heated up by the city infrastructure. But the heating effect is all the greater, the further north the cities lie. In Moscow, for example, the groundwater is nine degrees warmer than the air at the surface.

These "urban, underground islands of warmth" offer great potential for geothermal energy. "In Karlsruhe, the warmth of artificially enriched groundwater could deliver a third of our heating needs every year", says the hydrogeologist and study co-author Peter Bayer from ETH Zurich.

But this effect could also have negative consequences. "The increase in temperature puts a stress on the underground ecosystem", says Christian Griebler, a groundwater ecologist at the Helmholtz Centre in Munich. "It means more oxygen is used up, and many organisms can't survive this". *Anne-Careen Stoltze*

S. A. Benz et al.: Spatial resolution of anthropogenic heat fluxes into urban aquifers. Science of the Total Environment, 2015.

In the bowels of the city

The sewers of Zurich provide us with important data about the drug consumption of its citizens. As part of her doctoral thesis, the environmental engineer Ann-Kathrin McCall has been developing a method that uses samples from our sewers to help us assess trends in the use of cocaine and ecstasy.

"No, there are no rats down there. They'd have nowhere to run because the pipes are knee-deep in water, right up to the walls. And yes, it stinks, but you get used to it. Sometimes weird things float past you – like dentures, for example. More often it's toilet paper and faeces, but I just ignore all that. What matters is that the sewer is an incredibly exciting place! In scientific terms, of course.

"It's very slippery down there. But nothing's ever happened to me. I've only once landed on my behind. I'm well equipped with waders, a protective suit, a helmet and a facemask, and I'm secured by means of a wire cable that's fixed above the manhole cover. I also have a small device with me to warn me if carbon monoxide or hydrogen sulphide fumes reach a level where they're poisonous. What's really exhausting is that I'm 1.8 metres tall, but the sewers are often less than 1.5 metres from top to bottom. So I have to work bent over most of the time, and my back really hurts after collecting samples for half an hour.

"The basis of my work, to put it crudely, is that every drug-user has to go to the toilet at some point. The residues and metabolic products of their amphetamines, ecstasy and cocaine enter the sewers through their urine. You only have to do a chemical analysis of the wastewater to know what a city is flushing away. Theoretically, everything humans excrete can be measured – even alcohol, caffeine, pregnancy hormones and stress hormones. The sewer offers you a fingerprint of society.

"The problem is that illegal drugs and their metabolites are altered by microorganisms and other chemical and physical processes on their path from the toilet to the sewage treatment plant. My research is about trying to find out exactly what happens. Then we would be able to offer a more reliable interpretation of the samples from the treatment plants. What's especially important in these transformation processes is the so-called biofilm that grows along the sewer walls, especially where the wastewater flows constantly. The biofilm is about a centimetre thick, very slimy and slippery. It is home to the bacteria, algae, fungi and other microorganisms able to metabolise drugs and other substances.

"I go into the sewers mostly to take samples of this biofilm. Most of my actual work takes place in the laboratory at Eawag, the Swiss Federal Institute of Aquatic Science and Technology. I've built a kind of artificial sewer there that I can observe under controlled conditions, and where I can measure what the biofilm does with standardised drug samples.

"All the countries in Europe are interested in assessing trends in drug consumption. In 2014, our international work group presented its first large-scale study. We'd measured the values of five different drugs in the sewers of 42 European cities for one week at a time. The results showed, for example, that Zurich has the third-biggest consumption of cocaine after Antwerp and Amsterdam. What was less surprising

was that there's an ecstasy peak in Zurich at weekends, or that we find rather exotic drugs after the Street Parade. Wastewater analysis has already improved when it comes to assessing trends in drug consumption. Above all, it offers quicker results than anonymous surveys.

"That's why, when I give a paper at a conference, I often start with a joke. I ask everyone in the audience to put up their hand if they've used cocaine. Usually, no one responds. Then I say, "you see, that's why we need my method"!

Recorded by Christian Weber, science journalist at the Süddeutsche Zeitung

The researcher Ann-Kathrin McCall climbs into the Glattstollen sewer, a 5.3 kilometre-long tunnel running from the north of Zurich to the Werdhölzli sewage plant. Here she collects samples of wastewater (top) and of biofilm (bottom). This lets her determine the drug consumption of the people living in the city above her.

Photos: Aldo Todaro © Eawag, Ann-Kathrin McCall

Coming to Europe means huge expense and risk to life, but they're not welcome when they get here.
Photo: Massimo Sestini

Legal escape routes could prevent suffering

The EU and Switzerland would prefer to close their borders to the growing flood of refugees. Migration experts propose the exact opposite – that we should open up the borders instead. *By Pascale Hofmeier*

In 2015 the EU expects to have to cope with a total of 900,000 refugees from war zones and crisis areas. That's 50% more than last year. The boat people who try to cross over to Italy, Greece and Malta in flimsy boats have been a main source of headlines. Because they don't want to stay in those countries, they try to move elsewhere without registering in their country of arrival.

This increasing flood of asylum seekers and economic refugees has made the idea of closing Europe's borders increasingly popular. "The EU's main problem is that its member countries only agree on a common policy when it's about trying to strengthen their outer borders", says Alberto Achermann, professor of migration law at the University of Bern. This means it's only by taking illegal, highly dangerous routes that asylum seekers can actually get to Europe and apply for asylum.

Concentrating on securing our borders is done for reasons of state and is based on the assumption that yet more refugees would arrive if the borders were open. "But no one knows if that is true or not", says Achermann. There is evidence that emigration increases from certain countries when freedom of movement is instituted, but that the opposite is the case in other countries. "It's rarely the legal situation that determines the flow of refugees. It's economics". This suggests that border controls are not an effective instrument, because such controls can often be circumvented in some way or other.

For example, there has been an investigation into the impact of increased border security between Mexico and the USA. The results suggest that this doesn't lead to less immigration, but to less return migration, because it's become more difficult for people to get back home again across the border. Achermann says that studies into the public administration of western European countries have actually come to a different conclusion, namely that less stringent border controls would indeed lead to more immigrants.

The dangers of rejection

If we look at things from a historical perspective, we see that national borders remained open for a relatively long time. "Until the early 20th century, the whole world recognised the free right of residence", says Achermann. One of the first countries to restrict that right was the USA, which began to control access to its land in 1875. From 1917 onwards, this also applied to economic migrants coming by boat from Asia, and later also from Europe. "These immigration controls were the beginning of the refugee problem", says Achermann. Now the state was faced with the tasks of registering arrivals and of finding ways to accommodate them.

> "No one knows whether more refugees would come if we opened the borders"
>
> Alberto Achermann

After the USA, it was Europe that adopted the principle of immigration control. In Switzerland, for example, free immigration ended with the First World War. But selective immigration criteria were only introduced in 1931 with the Federal Law on Temporary and Permanent Residence, which was intended to protect the country from being 'overwhelmed' by foreigners. Whoever sought asylum in Switzerland on grounds of belonging to a specific race was now simply turned away.

This practice was widespread in Europe and, as we know, it had devastating consequences after the Nazis assumed power in Germany. "At the Evian Conference of 1938, which was supposed to settle the matter of Jewish emigrants, no country showed any desire to accept them", says Achermann. And when the Nazi machinery of extermination was set into motion, all countries – including Switzerland – turned away Jews at their borders, sending them back to certain death instead. "It was the Second World War that created an awareness that refugees need rights", says Achermann. These rights are governed today by a multitude of national and international laws and conventions. The Geneva Convention on Refugees of 1951 states a core principle: that of 'non-refoulement'. This principle of non-rejection forbids a country from sending people back to where they are threatened by torture or by other grave violations of human rights.

How a country deals with asylum seekers is a domestic issue that's dealt with very differently across Europe. The EU has

agreed on basic principles and on various instruments for a 'Common European Asylum System'. But those principles are applied only sporadically, and often not at all. So it's actually impossible speak of any 'common' European asylum policy today. Instead, countries are busy haggling about an allocation formula according to which the boat people could be distributed among all the countries of the European Union.

The same approach, again and again

Achermann is convinced that this isn't a proper attempt at a solution. "People don't function according to the way technocrats think". Overall, it is striking that it's the same solutions that are propagated, again and again. These include closed borders, camps in transit countries and protected zones in the countries of origin. The fact that these ideas are problematical is proven once again by history, as in the case of Western Sahara. In the border area between Algeria, Morocco and Mauretania, some 200,000 refugees have been waiting for a solution for 30 years. Meanwhile, a third generation of refugees is growing up in the camps. "And since the war in Bosnia, we all know what can happen in protected zones", says Achermann, referring to the massacre of Srebrenica.

People-smugglers will always find new ways to get across borders.
Photo: Keystone/AP Photo/Emilio Morenatti

> "People would wait for their legal opportunity to come, instead of spending immense amounts of money on a very risky endeavour"
>
> François Crépeau

François Crépeau has a different solution. He is the Special Rapporteur on the Human Rights of Migrants to the UN, and the incumbent of the Hans and Tamar Oppenheimer Chair in Public International Law at the Faculty of Law of McGill University. He proposes applying the completely free movement of persons to migrants. Whoever registers voluntarily in a country on arrival should be able to travel on afterwards into his or her country of choice. "Whoever has personal reasons to go to Sweden won't stay in Estonia", says Crépeau. He is thus proposing the exact opposite of the current situation, in which rigorous border controls have essentially turned the Schengen Agreement into waste paper.

Creating legal channels

And instead of continuing to invest huge sums into securing borders, Crépeau proposes controlled mobility and controlled migration channels. For example, he suggests that teams should go to the migrants' home countries and choose a certain number of people every year to be allowed to come to Europe. "I'm convinced that people would wait for their legal opportunity to come, instead of spending immense amounts of money on a very risky, illegal endeavour", said Crépeau recently when he visited Bern to give a lecture. And he also pointed out that people smugglers will always be one step ahead of border authorities.

This conviction is shared by Achermann. He points to the refugee catastrophe that helped coin the phrase 'boat people' in the first place. At the end of the war in Vietnam in 1975, 2.5 million people tried to flee from the communist regime there, using rickety boats to try and get to Laos, Cambodia or China. Some 200,000 people died in the process. In the late 1970s, the USA established the Orderly Departure Program, which offered people an opportunity to emigrate through legal channels. More than 600,000 people were allowed to leave as a result. "This would be a good approach for Europe - only it's politically unpopular, and there isn't a single country that would support it", says Achermann.

Pascale Hofmeier is a science editor at the SNSF.

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Movements, Journal for Critical Migration and Border Studies.

Europe: a childhood dream

What are the reasons and the expectations that drive asylum seekers to risk their lives? David Loher, a PhD student at the University of Bern, has investigated this in the project 'How does border occur?'. His research focusses on the question of how migrants and state authorities deal with borders. "Borders are constantly being created anew, subverted and reformulated by those on all sides", says Loher.

He has been examining the biographies of Tunisian asylum seekers who came to Switzerland shortly after the fall of the dictator Ben Ali. The 'harraga' – their clandestine journey across the Mediterranean – is an important collective topic among the Tunisian youth, says Loher. "In contrast to refugees from failed states such as Eritrea, or crisis zones such as Syria and Iraq, young Tunisians fled from high youth unemployment, an authoritarian regime and rigid family structures". In most cases, however, the harraga remained imaginary. It was different during the turmoil of the revolution when the state security apparatus was weakened: tens of thousands seized the opportunity to get out. But in many cases – some voluntary, others involuntary – this only ended in a return journey home.

The terrorist who became a victim

Forty years ago, the Italian-German terrorist Petra Krause was arrested in Switzerland. She went on a hunger strike to protest against her solitary confinement, and this caused a major storm in the media. *By Urs Hafner*

When she was extradited to Italy, Petra Krause looked more like an anorexic model than a confirmed terrorist. Photo: Keystone/AP Photo/Gianni Foggia

The 1970s were the era of left-wing terrorism in western Europe. Armed groups carried out a struggle against capitalism. The goals of the Red Army Faction (RAF) and the Red Brigade were world revolution and the establishment of a 'just' society. Anti-fascist revolutionaries were active in Switzerland too. In 1975 the police arrested the 'Petra Krause Group'. Petra Krause was a young anarchist of dual Italian and German nationality. After taking part in an arson attack in Italy, she had fled to Switzerland. Here, she had linked up with Zurich-based anarchists and continued her struggle, stealing weapons from Swiss Army depots to pass on to like-minded comrades in southern Europe.

Krause spent nearly three years in solitary confinement before being extradited to Rome in 1977. She went on hunger strike three times in Switzerland to try and achieve the following demands: the abolition of solitary confinement for all those in detention while awaiting trial, permission to get exercise in the prison yard for one hour every day and the right to choose one's own doctor. These hunger strikes proved a major source of controversy in the Swiss media. Just how this controversy came about is something that the historian Dominique Grisard from the Center for Gender Studies of the University of Basel has been investigating.

A woman on the offensive

Grisard's doctoral thesis, published in 2011, dealt with 'The gender history of left-wing terrorism in Switzerland', and she sees the gender aspect of the Krause case as the key to it all. On the one side there was a woman who was becoming increasingly frail and who only weighed 35 kilos at the end of her third hunger strike, which lasted from 19 June to 16 July 1976. Krause had survived Auschwitz as a child, and when she became an adult she had resorted to using violent, implicitly 'male' means to attack the state. On the other side was the Swiss state, essentially a centuries-old male club that demanded obedience from all its members, and that had only deigned to offer political rights to its female population five years earlier, in 1971.

Krause was supported by feminist and left-wing groups, and Grisard believes that she came to be seen as a threat to the binary order of the genders. With her body – a woman's body, emaciated by prison and hunger – she made visible the repressed vulnerability of the male citizen and his dependence on the state.

Shifting perceptions

This shift in perceptions is striking, says Grisard. First Krause was a terrorist, someone depicted as an irrational perpetrator who was using her body as a weapon. But then she became stylised as a fragile victim. "The left-wing press saw her body as a victim of state oppression, while the right-wing press saw it as a means of blackmail", says Grisard. When confronted by the concept of 'terrorism' in the form of a woman's emaciated body, the general public was unsettled, because this seemed to blur the conventional demarcation between the legitimate force of the state and the illegitimate force of terrorists. The figure of Petra Krause was transformed from a capricious culprit into a vulnerable victim, while the notion of a sovereign state that protects its citizens from terrorists was increasingly replaced by the image of an impotent state that injures those entrusted to it.

Did Krause's hunger strike have any real impact? Hardly, says Grisard. Several questions were asked in parliament about prison conditions, but no laws were changed. All the same, Krause achieved a certain improvement in the conditions of her imprisonment. Before her protests, she had been harassed in prison, apparently even being denied tampons by the guards when she asked for them. But her actions brought about no changes in the practice of solitary confinement.

Urs Hafner is a historian and a science journalist.

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D. Grisard: The spectacle of the hunger-stricken body: a German-Italian terrorist, Swiss prisons and the (ir)rational body politic. European Review of History, 2015.

Tracing places

Rosshäusern is a district in the municipality of Mühleberg near Bern. But where does its name come from? 'Ross' means 'horse', while 'Häuser' means 'houses' – so it sounds like the place should at some point have had something to do with stables. But in fact its name is derived from a certain Rudolf who lived there long ago. The earliest proof of this dates back to 1261, when Rosshäusern was a little hamlet that our ancestors called 'de Rodolfhüsern' ('Rudolf's houses'). Over the ensuing centuries, the dialectal abbreviation 'Ross-' established itself. This example is one of many in the latest volume of the Ortsnamenbuch des Kantons Bern – the Book of place names of the canton of Bern – which has been prepared by the research unit in onomastics at the Institute for German Studies at the University of Bern. The unit is supported by the SNSF, and it has been documenting and interpreting names in the German-speaking part of the canton of Bern since the 1940s. The staff of the unit investigate the origins of the names of places, mountains, valleys, rivers and forests. "In the process, we evaluate all the sources that we can find", says Thomas Franz Schneider, the head of the unit.

The unit's researchers are interested in the structure of naming. Besides people and ownership issues, it is often the conditions of the ground and the types of terrain that are at the origins of names. The names also testify to the cultivation of the land, as in 'Sang/Gsang', which is derived from the process of scorching and burning in order to clear the land. "The people made the world their own by naming it", says Erich Blatter, who has worked at the research unit for many years. If you look into names, he says, you gain insights into the settlement history and the economic history of a region. The unit has already meticulously researched tens of thousands of Bernese names, in alphabetical order. The new volume of the set covers the letters Q to S. *Susanne Wenger*

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Ortsnamenbuch des Kantons Bern, volumes 1–4 (already published); volume 5 will be published in autumn 2015 by A. Francke Verlag, Basel and Tübingen. www.germanistik.unibe.ch/namenkunde.

Susanne Wenger

This place has nothing to do with horses ('Rosse') – it's named after a man.

Valérie Chételat

Role models and our social environment determine who drives quietly.

Campaigning for quiet

What could prompt motorists to drive quietly? This has never before been properly investigated by scientists. But many people suffer from noise pollution, and driving more quietly could help to reduce the negative effects of noise on our health and wellbeing.

First of all, a moral sense of obligation can increase our willingness to drive less noisily or buy less noisy tyres. This is a conclusion drawn by Elisabeth Lauper from a survey of more than 1,000 German-speaking Swiss drivers, both men and women. She carried out this survey in the course of her doctoral research that was co-funded by the SNSF with monies from a Marie Heim Vögtlin grant. Lauper complemented her data with the noise pollution figures compiled by the Swiss Federal Office for the Environment.

Of course, some drivers get angry about traffic noise themselves when they're sitting at home, but perhaps surprisingly, this doesn't translate into different behaviour when they're back behind the wheel. Similarly, the amount of noise pollution they experience where they live has little impact on their driving. The sense of personal obligation to drive differently is influenced only in part by an awareness of the problem of noise, but most of all by a sense of respect for the environment.

So how could a campaign convince drivers not to rev their engines? Lauper is researching into this at the Institute for Psychology and at the Centre for Development and Environment at the University of Bern, and she recommends focussing more on the environment and less on the suffering that noise creates. Another relevant psychological factor is the social norms of those questioned. For example, drivers are more willing to drive quietly if others in their social environment commit to reducing traffic noise. Combating noise pollution can thus be promoted via social processes – for example, if prominent celebrities were to issue a call to reduce noise levels. *Anna-Katharina Ehlert*

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E. Lauper et al.: Explaining Car Drivers' Intention to Prevent Road-Traffic Noise: An Application of the Norm Activation Model. Environment and Behavior, 2015.

Giving the boot

The 'people's shoe', produced in a uniform design by state decree, is the kind of thing one might associate with the command economy of the Soviet Union, not with capitalist Switzerland. And yet, during the First World War, the Swiss Federal Council used its plenipotentiary powers to have shoes produced for the broad population, as explained by Roman Wild of the Research Centre for Social and Economic History at the University of Zurich in his as yet unpublished doctoral dissertation. The Volksschuh-Zentrale AG ('People's Shoe Headquarters Ltd') drew on nearly 25 shoe factories to manufacture three series of uniform leather shoes for men, women and children: 100,000 of each model, plus 20,000 wooden shoes. All of them were to be sold at 'people's prices' – in other words, cheaper than the other shoes on the market.

The reason for this state interventionism was the massive rise in prices during the war – rent, coal and clothes all became far more expensive. Thousands suffered as a result, and even the more right-wing newspapers complained about 'extortionists' and 'war profiteers'. The Federal Council saw itself compelled to act. It began with shoes because these had great symbolic value. In many German cities, people were protesting against the misery of the war by marching through the streets as well-dressed as possible, but with bare feet. The 'shoe policy' of the Federal Council was intended to be a visible act to help the poverty-stricken and to combat the profiteers in the shoe industry.

But the plan didn't work. The shoes were somewhat crudely manufactured and were supposed to have been sold in 3,000 shops. But only 900 participated, and the 'people's shoes' were left on the shelves, looked down upon as a poor man's shoe that hardly anyone wanted to be seen in. In the end, they were all sold off at a loss. *Urs Hafner*

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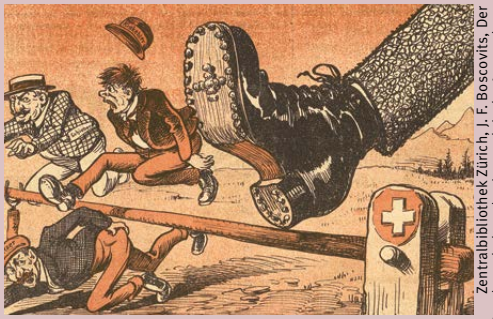
R. Wild: Volksschuhe und Volkspreisen. Zur Bewirtschaftung lederner und textiler Bedarfsartikel im Ersten Weltkrieg in der Schweiz. Schweizerische Zeitschrift für Geschichte, 2013.



Zentralbibliothek Zürich, J. F. Boscovits, Der Bundesschuh und seine praktische Anwendung in: Nebelspalter 44 (1918), No. 11.

The Nebelspalter magazine suggested a less complimentary use for the 'people's shoe'.

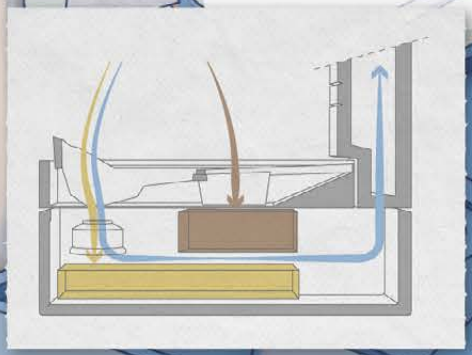
Clean toilets for slums

The Blue Diversion Toilet developed by Eawag may resolve the problem of inadequate sanitation in developing countries.
By Daniel Saraga, Infographic: Ikonaut

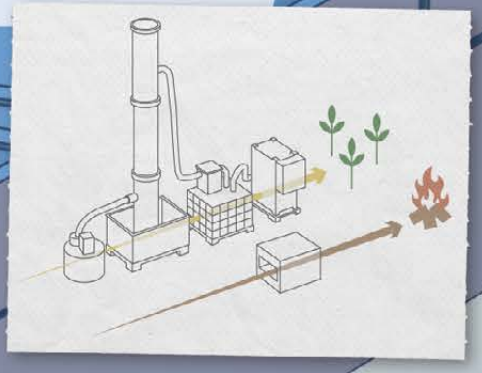
1. The problem
More than 2.5 billion people go to the toilet in either the open air or unsanitary toilets. The lack of proper sanitation facilities leads to polluted waterways and cases of severe diarrhoea, which kills 1.8 million people annually.

2. The project
The water research institute Eawag near Zurich has been developing the Blue Diversion Toilet since 2011, thanks to a contribution of USD 4.5 million for the "Reinvent the Toilet Challenge" by the Bill and Melinda Gates Foundation. In March 2015 the toilet was nominated as one of the Designs of the Year 2015 by the London Design Museum.

3. An automatic toilet
The Blue Diversion Toilet works without access to water, sewer or electricity networks. Urine and faeces are separated and stored in containers to be recycled later. Water used for washing hands and for flushing the toilet is recovered, sterilised on-site and then reused. Disinfection is done through an ultra-filtration technique developed at Eawag and powered by a small 60 W solar panel.



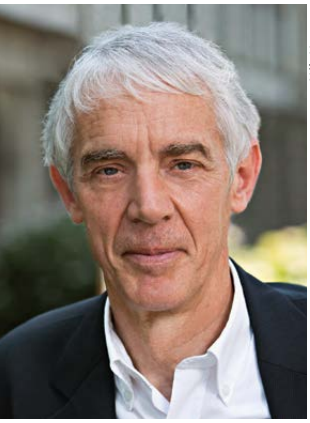
4. The economic model
Waste is collected twice a week and taken to a processing plant. The urine undergoes nitrification and is transformed into concentrated ammonium nitrate, a common agricultural fertiliser. Faeces are partially burnt, formed into bricks and used as heating fuel. The trade of these two products constitutes a viable economic model for the owner of the toilet. And with the cost of using the toilet at around five cents, it is acceptable for local populations. Autarky, a new project at Eawag, aims to introduce on-site transformation of the waste into tradable products, particularly by stabilising urine using lime.



The young, who else?

By Martin Vetterli

Ignorance is a very important driver of research. It is said that the 12-year-old Albert Einstein asked his mother what he would see if he travelled at the speed of light holding a mirror in front of him. And in the early 17th century, Pierre de Fermat asked himself if the equation $a^2 + b^2 = c^2$ would have integer solutions for powers greater than two. More recently Michel Mayor from the University of Geneva decided to build an instrument to find out if there were planets outside our solar system, thinking he might not see them in his lifetime – reality contradicted him in 1995.



Nik Hunger

Thus, many relevant questions in science are the result of a naïve and sometimes slightly ignorant mind-set. But when combined with intelligence, curiosity, creativity and a bit of luck, these ignorant questions can generate new knowledge, new artefacts and eventually new tools to benefit society at large.

From the science funding point of view, the question that obviously arises is, where can one find this innocent scientific ignorance in today's science? The answer is – and probably always has been – in young researchers, as is nicely illustrated by the example of Albert Einstein. In fact, we know scientists are often most productive at a young age. And it is thus the young that generate breakthroughs by asking bizarre questions and coming up with strange new theories.

Unfortunately, however, academia does not seem to have enough space for young researchers today. The magazine Nature showed recently that retirement-age investigators of the US National Institutes of Health have outnumbered those under 36 for a few years now – and the trend is getting worse. Furthermore, the average age at which a young life scientist in the US receives his or her first independent grant – not even a professorship – has increased from 36 in 1980 to 42 today.

In Switzerland, the trend points in a similar direction. While in the 19th century, the average age of becoming a (full!) professor at the ETH Zurich's Chemistry department was around 35 years, today scientists can consider themselves lucky if they manage to get some independence at that age. It has thus become very difficult for young scientists to realise their own ideas and to achieve an independent academic career. Many bright young minds are therefore leaving academia and looking for opportunities elsewhere.

This is a very delicate situation. Because losing these minds also means losing the very engine for ignorant innovation and discovery. Or, to put it in the words of Sydney Brenner, a Nobel Laureate in medicine, "I strongly believe that the only way to encourage innovation is to give it to the young. The young have a great advantage in that they are ignorant. Because I think ignorance in science is very important. If you are like me and you know too much, you cannot try new things."

Martin Vetterli is President of the National Research Council and a computer scientist at EPFL.

23 September 2015

Advanced Researchers' Day

The SNSF offers information on funding possibilities to researchers from all over Switzerland
SNSF, Bern

11 to 14 October 2015

World Resources Forum 2015

Conference for a sustainable economy through technology and education
Congress Centre, Davos

15 to 17 October 2015

Future Economic Systems

14th Dialogue on Science
Academia Engelberg
Engelberg Monastery

until 19 November 2015

Stem cells – the origin of life

Touring exhibition of the National Research Programme 63
Natur-Museum, Lucerne

until 31 January 2016

The crocodile in the tree

Exhibition about evolution and biodiversity
Zoological Museum, University of Zurich

until 19 June 2016

Faces of violence

Exhibition about the many forms of violence
Musée de la Main, Lausanne

Letters to the Editor

Caution, please
I always read Horizons with great interest, and find the quality of articles very good. I was all the more unpleasantly surprised then by the phrase 'Slow reading is out' in the lead text for the article '200 years of world literature' (Horizons 105, p. 17). In order to get to know the literature and to be able to assess it, 'slow' reading remains indispensable. Data processing is helpful only when researching into specific topics; then indeed it opens up new possibilities. So please be careful with sensational phrases!

Martin Steinmann, Binningen

Corrigenda

In the article 'The fear of a divided mother' in Horizons 105 (June 2015, p. 34), the incorrect impression was given that Barbara Bleisch, an ethicist at the University of Zurich, adopts a utilitarian position. However, she is in fact arguing from a deontological background. Furthermore, she does not regard bans as 'problematic', as we wrote, but 'in need of justification' in a liberal society.

The solutions to the puzzle

Here are the names of the people featured on page 11 of the last issue of Horizons.

1st row: L. A. Thurston, N. Copernicus, Catherine II., F. Chopin, J.R. Hawley **2nd row:** W. C. Röntgen, Jeanne d'Arc, J. Kepler, C. Darwin, R. Sanzio **3rd row:** Voltaire, C. Magno, Vasco da Gama, J. Watt, P. Stuyvesant **4th row:** J. W. von Goethe, J. M. Good, C. Monet, W. Shakespeare, I. Newton **5th row:** C. Columbus, B. Franklin, G.W. Leibniz, K. Marx, J. P. Parker **6th row:** F. Nietzsche, A. G. Bell, T. Hobbes, R. Descartes, J. Verne **7th row:** Rembrandt van Rijn, M. Luther, G. Washington, J. Winthrop, W. T. Kelvin

Back to the top

The postdocs Anna Nele Meckler and Armelle Corpet are being awarded the Marie Heim-Vögtlin Prize in Bern on 23 September 2015 on account of their brilliant return to research after each taking a break to start a family. Meckler used to be a paleo-oceanographer at ETH Zurich, investigating past climates by means of sedimentary limestone. Today she is building up a new research group at the University of Bergen (Norway). Corpet used to be a cancer researcher at the Zurich University Hospital and is studying the impact of the herpes virus on genetic structure. She is now an assistant professor at the University of Lyon 1 (France).

SNSF: H. Lütcherath/A. Guillemaud

More flexible project funding

The SNSF is reforming its policy as of autumn 2016: the maximum possible length of its projects will be increased from three to four years, while the funds provided may be utilised more flexibly. Researchers should in future concentrate where possible on one project only. With these innovations, the SNSF aims to promote the diversity of research. The Sinergia programme is also being repositioned. In future it will give grants for collaborative and interdisciplinary research that has the potential to make breakthrough findings.

Three new research programmes

In June 2015, the Federal Council approved three new National Research Programmes (NRPs). NRP 72, 'Antimicrobial resistance', will develop strategies against the increasing resistance to antibiotics in hospitals and livestock farming. NRP 73, 'Big Data', will investigate the technological and societal questions raised by the increasingly huge amounts of data we produce. NRP 74, 'Smarter Health Care', is dedicated to finding improvements in the Swiss healthcare system. The first studies are due to begin in autumn 2016 and will last four to five years.

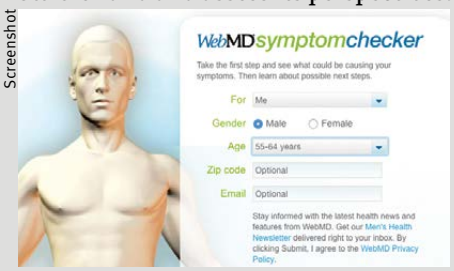
Better representation for life sciences

Three societies for experimental biology joined up to form Life Sciences Switzerland (LS2) in June 2015. Besides now having greater political clout, LS2 is also being awarded the Friedrich Miescher Prize. Their next annual meeting takes place in Lausanne in February 2016.

Health literacy in Switzerland

Many people find it difficult to orient themselves in the health system, to understand their doctor or to grasp the symptoms of their disease. The Swiss Academies would like to combat this lack of 'health literacy' with their roadmap 'A sustainable healthcare system for Switzerland'. As one of their measures, the Academies decided in September 2015 to publish a report entitled 'Health literacy in Switzerland'. For the first time ever, it will sum up the state of health literacy in Switzerland and assess its perspectives.

Screenshot



Focus on science culture

Education and furthering young talent, a sustainable use of limited natural resources, and campaigning for a sustainable, effective, affordable health care system: these are focus areas in the multi-year planning of the Swiss Academies. The new focus 'Science culture' intends to tackle the following problems: poor quality research articles; the precarious situation of young academics and of the work-life balance in academia; the low proportion of women in academic leadership positions; and false incentives resulting from today's forms of research evaluation.

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The SNSF
The SNSF is the principal body for the promotion of scientific research in Switzerland. It is mandated by the Confederation to promote basic research in all fields and disciplines and each year distributes some 755 million Swiss francs amongst more than 3,500 projects involving about 8,750 scholars.

The Swiss Academies
Also mandated by the Confederation, the Swiss Academies of Arts and Sciences are committed to an open dialogue between science and society. They are on the side of science, each specialising in a respective domain, yet also acting in an inter-disciplinary way. Being anchored to the scientific community rewards them with access to the expertise of around 100,000 researchers.

"There's a shift taking place away from facts and towards opinions"

Michael Hermann page 25

"The males perform their task less well, not because they're less intelligent than the females, but because they're less motivated"

Judith Burkart page 35

"I am able to keep my professional role as a scientist separate from my role as a citizen"

Hubertus Fischer page 38