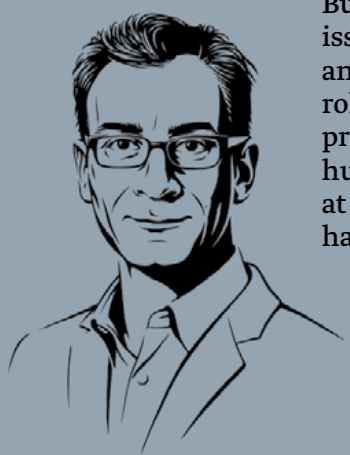
Discovering *Homo digitalis*

Science has adopted the digital age with open arms, and even the humanities are starting to embrace its powerful tools: digitisation, databases, statistical analysis, cartography. Of course, this change means scholarly research will be more effective, but it also paves the way for new research fields.

What's important to remember, however, is that we're discussing a new tool and not a magic wand. Researchers know all too well that correlations uncovered within a large chunk of data provide neither proof nor explanation on their own. All that can be taken from them at face value is an indication. Giving any meaning to it — and linking it to anything else — will always require a subjective, qualitative interpretation. As Bruno Latour wrote back in 1993, data does not fall from the sky, it is always "obtained". It may seem objective, but it is never neutral. And this is an interesting point that seems to escape the attention of the ruling class, who thirst for objective and unassailable proof.

So, with this change in direction comes the need to re-examine the practices of the humanities, because every new tool modifies our perception of the world. Faced with such all-powerful algorithms, researchers must carefully think about how to remain consistent in their understanding of complexity and ambiguity.



But the impact of the digital shake-up on the humanities goes beyond issues of effectiveness. After all, it is down to them to study *homo digitalis* and analyse how the digital era has affected society as a whole: its role in the redefinition of social relationships, in the evaporation of privacy, in the assimilation of information by new means. To do this, the humanities must - without fail - appropriate these new tools, because, at the end of the day, we cannot clearly understand something unless we have tested and experienced it ourselves.

Daniel Saraga, Editor-in-chief

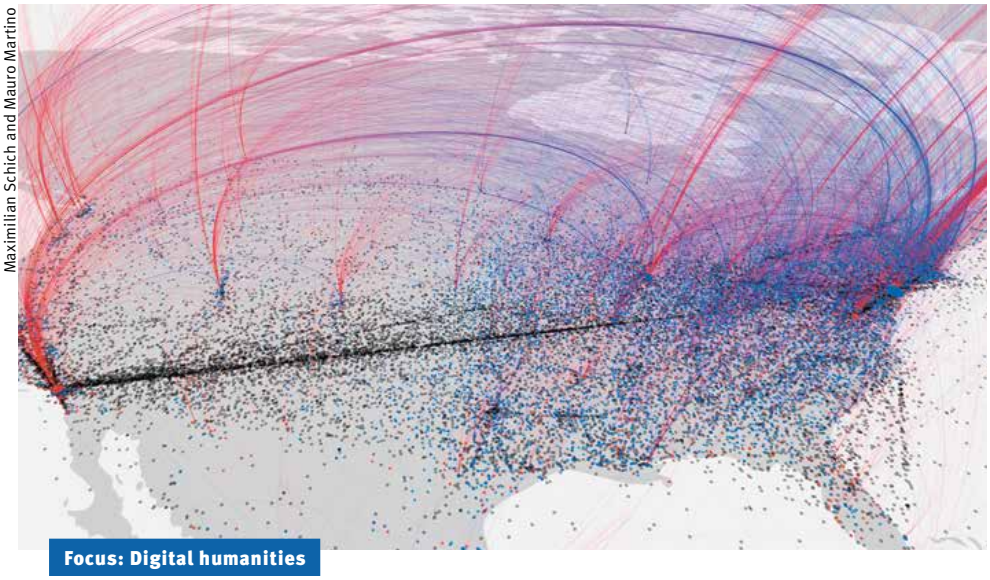
FNSNF
Swiss National Science Foundation

Swiss Academies
of Arts and Sciences

Horizons – the Swiss magazine for scientific research No. 105, June 2015

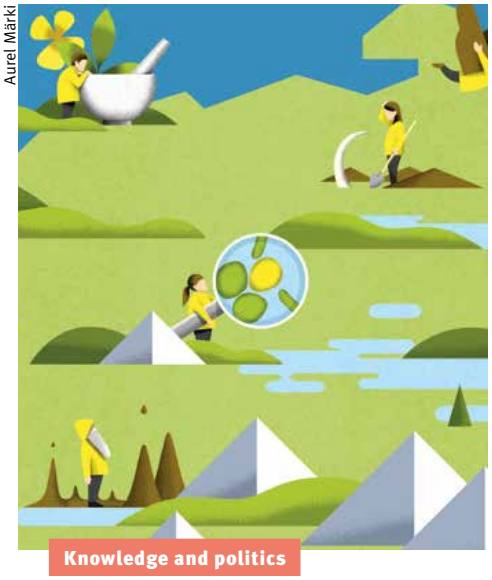
horizons

Contents



Maximilian Schich and Mauro Martino

Focus: Digital humanities



Aurel Märki

Knowledge and politics

◂ Cover: A postcard message from the beginning of the 20th century. "Dear Miss, Greetings to you and to your mother and your brother. Best wishes!" Whether this romance blossomed, we'll never know!
Photo: Keystone/Interfoto/Pulfer

◂ Inner cover: A wordcloud created by researchers in Zurich, Bern and Neuchatel. These university teams have taken messages sent in Switzerland using WhatsApp, a messaging service. Relative word frequency is indicated by size and colour. Picture: Simone Ueberwasser, whatsup-switzerland.ch

34

Keystone/Science Photo Library/Professors P. Motta & T. Naguro

Biology and medicine

40

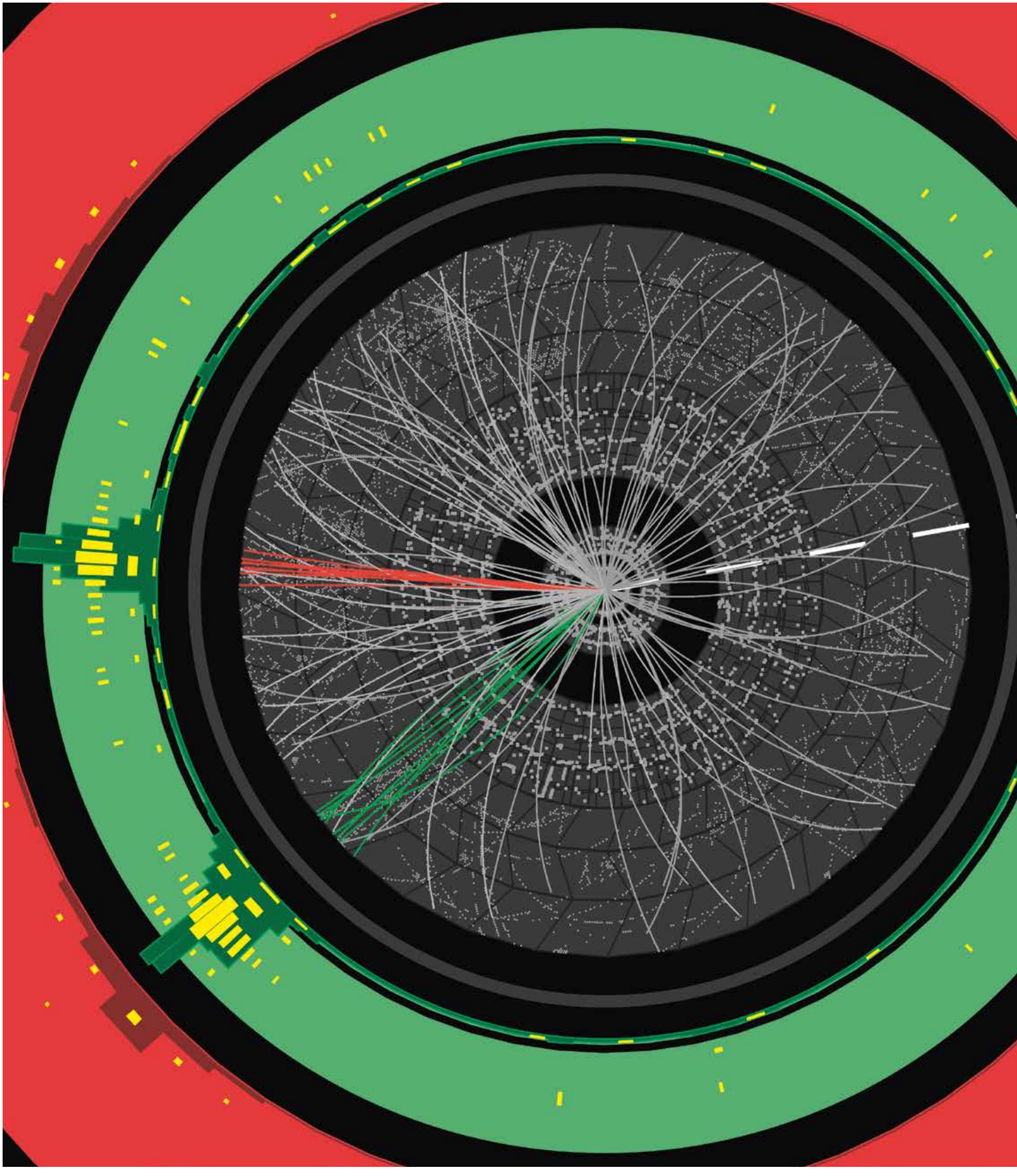
Keystone/AP Photo/Thanassis Stavrakis

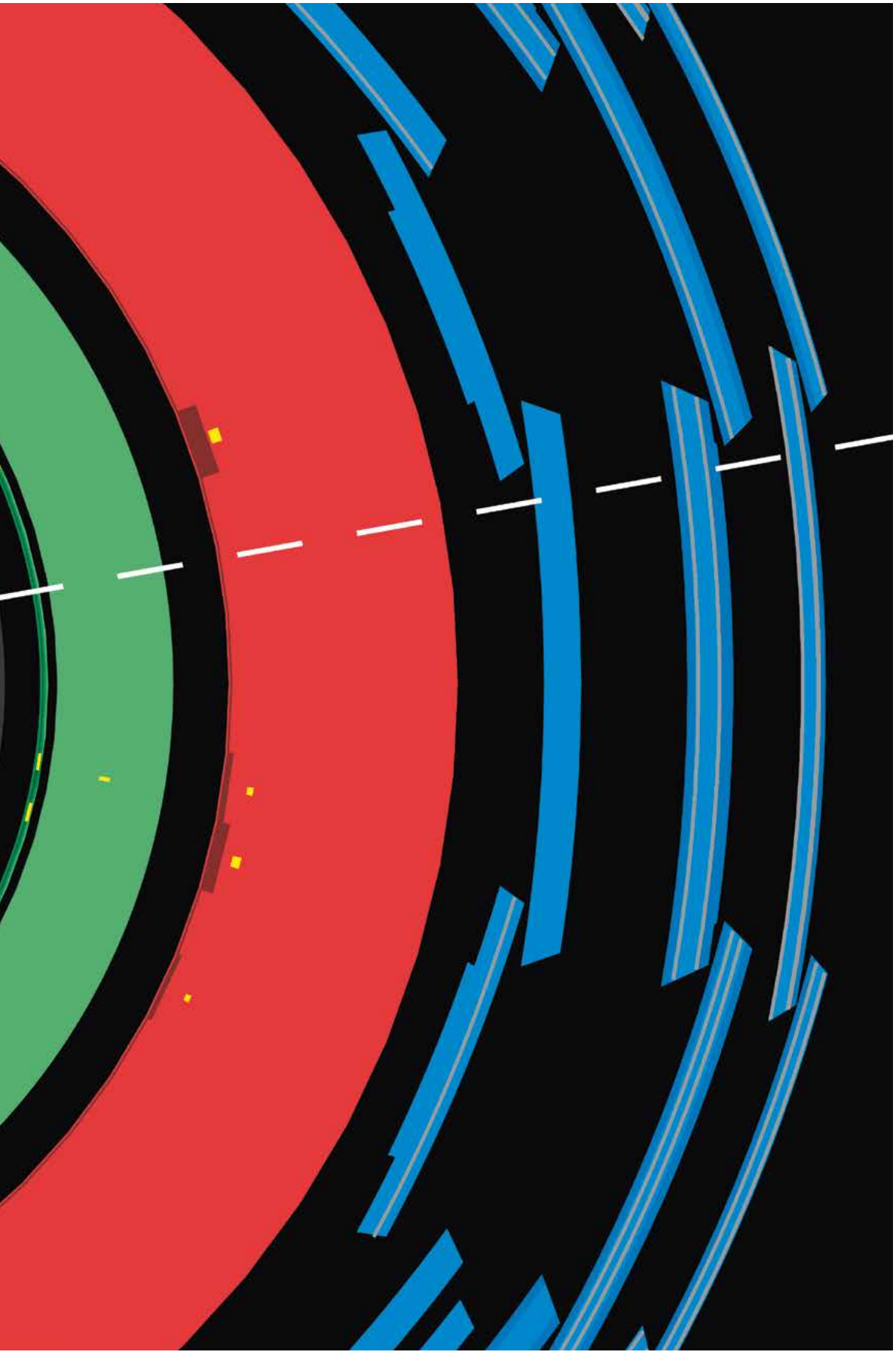
Culture and society

44

Wikimedia Commons

Environment and technology





Beyond the Higgs boson

In April 2015 the giant particle accelerator at CERN, the LHC, was fired up again to find new particles. It is now working at 60% higher energy.
The adjacent image shows the paths taken by particles created during a collision. The curves in the grey region have been recreated using a computer on the basis of information collected by an 80-million pixel sensor. The red and green curves represent the measures taken by calorimeters, shown here in orange and green. These ring-shaped detectors stop certain particles to measure their energy.
"There is nothing exceptional about this in itself", explains the physicist Steven Goldfarb. "The Standard Model predicts that it will happen from time to time. But to observe them with an increased probability could give us an indication in favour of one of the models of supersymmetry". Supersymmetry theory was developed to answer remaining questions surrounding the unification of the fundamental forces and dark matter, which makes up 80% of the universe's total mass.
The grey dotted line to the right is an indication of a missing particle: a neutrino, a neutralino as predicted by supersymmetry, or another candidate particle for dark matter. The Higgs boson particle may have been discovered in 2012, but the universe has not yet given up all of its secrets. *dsa*

Picture: ATLAS Experiment © 2014 CERN

Should universities profit from their start-ups?

Every year in Switzerland, dozens of start-ups entering the market do so holding the results of scientific research most often financed exclusively by the state. Should universities be able to cash in on the success stories?

Valérie Chételat (photomontage)

Yes

says the politician Jean-François Steiert.

In the past 20 years, Switzerland has experienced considerable success in setting up some 1,000 firms. While most of them may be small, most are also successful. And this is despite the fact that investors willing to take real risks are fewer in number in Switzerland than in the USA, for example. Swiss start-ups are mostly supported by universities using taxpayers' money – offering scholarships, coaching services and helping with their infrastructure and social networks. The aim of such public investments is primarily to promote Switzerland as a workplace and as a centre of research.

If support from public monies means that innovative patents can be sold for a profit counted in the double-digit or even triple-digit millions, then the public investor has to be able to claim a portion of this back, not just so that the state or the university can earn money, but so that it can reinvest the appropriate funds in the work of the next generation of researchers. This is especially true in times when the federal government and the cantons are having to introduce austerity programmes because of excessive tax cuts. The commercial exploitation of these innovations can generate additional finances to help other young researchers.

When selling such patents, it shouldn't be about maximising returns, nor about siphoning off profits according to any fixed formula. Universities need room for manoeuvre in order to optimise how they go about levying profits. Getting start-up companies off the ground and managing them can be an attractive proposition, but we also need a commensurate reinvestment in the next generation of researchers. What we lack today is transparency. If universities want to earn the trust of the taxpayers, then they have to be open about how much money they get back from successful start-up companies. The universities owe this to taxpayers, because they rightly want to know how efficiently their taxes are being used, even in the field of research, which is so existentially important for Switzerland.

> "Public investors have to be able to claim back a portion of the profits".
>
> Jean-François Steiert

Jean-François Steiert (Socialist Party) has been a member of the Swiss National Council since 2007. He is also a member of the Committee for Science, Education and Culture.

No

says Hervé Lebret, start-up fund manager at EPFL.

In 1993, when Marc Andreessen launched Netscape, it was one of the first web browsers. But the 22-year-old American chose starting from scratch over signing a license agreement with the University of Illinois, because he judged their conditions to be abusive. The University of Stanford, however, maintained less tense relationships with the founders of Google, holding a modest 2% of its stock (worth $336 million, six years after the company's stock market debut). It also admits that the founders of Yahoo developed the site in their own free time and so the university has asked them for nothing. Some years later, and after one of the founders of Yahoo saw fit to donate $70 million to Stanford, Andreessen still doesn't want to have anything to do with his alma mater.

These examples show clearly what happens when the relationships between universities and companies become tense because they do not hold the same perception of value in the transfer of knowledge. It is often free in the area of education; but when it comes to creating a company, the overwhelming majority of people think it shouldn't be. Yet there is already an indirect return: first, in the form of taxes, and, even more importantly, through the hundreds of thousands of jobs that are created by start-ups. At the end of the day, the value of this is much greater than the tens of millions of dollars brought in every year by the best universities in America thanks to their range of licenses.

> "Abusive conditions can destroy the entrepreneur's motivation at the outset".
>
> Hervé Lebret

So how can we best repay universities in a manner that's fair? It's a touchy subject, but one that is also poorly understood, particularly because transparency is lacking across the board. In 2013, I published an analysis of the terms of public licences for some 30 start-ups[1]. It shows that, on average, universities take a 10% share in the stock of a start-up, which dilates down to 1 to 2% following the first rounds of financing.

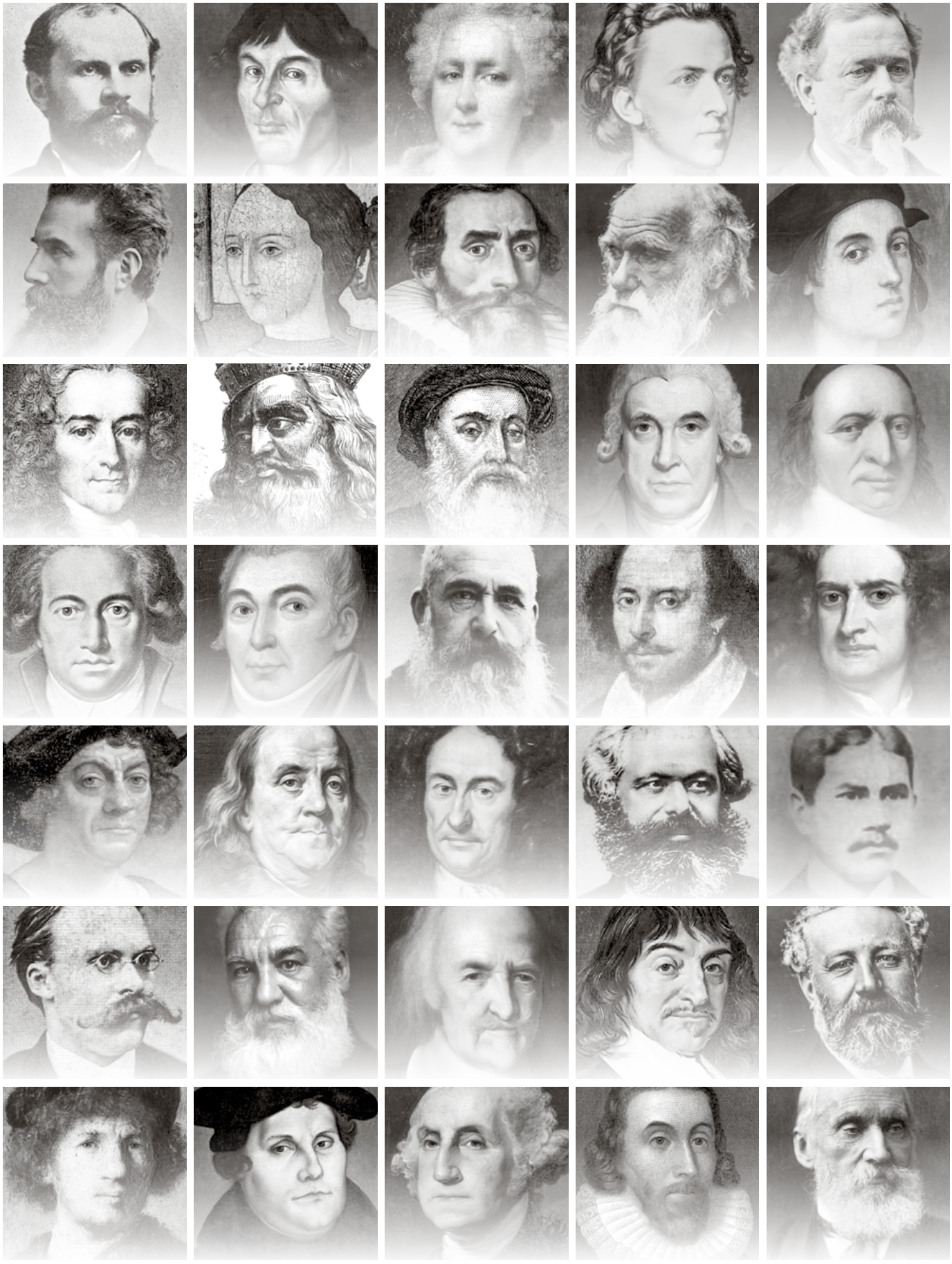
But it is impossible know the potential of any given technology on the market ahead of time. What's most important is not to penalise the company by using excessive licensing terms. Abusive conditions can destroy the entrepreneur's motivation at the outset and put off investors.

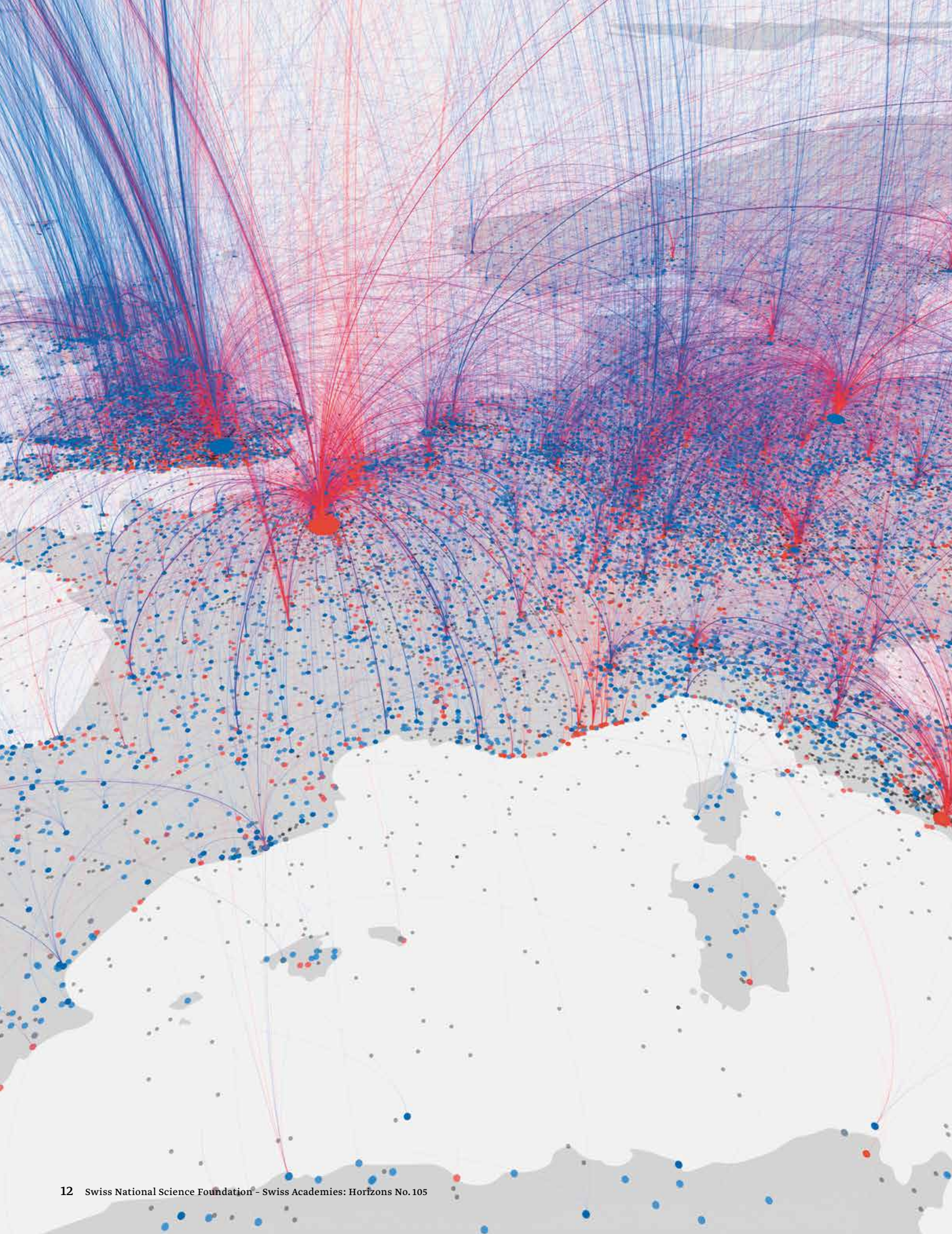
Hervé Lebret is a member of the Vice-Presidency for Innovation and Technology Transfer at the Ecole Polytechnique Fédérale de Lausanne and a director at Innogrant, an EPFL innovation fund.

1 http://bit.ly/1Fc4do9

Using numbers for letters

The humanities are embracing new technology. With its tools, researchers are being offered a new window on culture and being forced to redefine their fields of expertise.





Digital history

Historians and archaeologists are learning to master computer tools. This unavoidable change has the potential to reinvent these fields.
By Fabien Goubet

Everything is becoming digital. No exception is being made for the humanities. They are also transforming under the weight of computers and algorithms. Note that we are no longer talking about word processors or instant messaging but about structural mutations that are emerging at all steps of the process: knowledge creation, digitisation of sources, analysis and so on. New practices are also emerging, even new careers. University teaching cannot hide either. In fact, digital humanities now have everything they need to level the humanities' playing field.

According to Claire Clivaz of the Digital Humanities and Culture Laboratory of the University of Lausanne, the term 'digital humanities' only officially appeared in writing in 2004. "We used to talk about 'humanities and computing', as if the two concepts were opposed". The semantic change shows how intimately linked they are today.

Computers drawing borders

The work of Sylvian Fachard of the University of Geneva shows clearly the new possibilities that the digital era is bringing. Fachard is an archaeological geographer who wants to establish the exact placements of the borders between the different communities of Attica, the region encircling Athens, between the 10th and the 1st centuries BC. "The few scarce texts that we have were all analysed at the beginning of the 20th century and do not allow us to move any of the borders already on the map", says Fachard. Given this difficulty, he has opted for a spatial model of the region. This is composed of other objects, e.g. ruins, tombs etc. that were discovered during digs, and which are indexed according to their location and age. He takes this information and links it with available geographical data such as the topography of the land. All of this data is fed into an algorithm which estimates, with a certain probability, the exact location of the borders for a given year.

Of course, such computer tools do not prevent the archaeologist from working on the ground, as Fachard points out. With the predictions of his model in hand, he can return to his role of archaeologist to seek the evidence needed to confirm or refute them. "All the data must be interpreted if you want a relevant result. Digital technology creates even more data which still needs to be connected. This means taking the analysis to the next level of complexity".

Collective history

Another of the digital era's greatest changes is that of scale. "The digital culture has taken us from the solitary to the collective, as it did in the hard sciences", says Clivaz. "Articles these days are signed by teams of researchers and no longer by single authors".

Timescales have also changed, adds Fachard. "When we leave on a dig these days, we take with us touchscreen tablets that allow data collected to be centralised in real time. This means we can adapt our strategy on a day-to-day basis, giving us an incredible flexibility". Clivaz adds: "Science's rhythm is changing. We now have continuous production, particularly in the form of blogs written by researchers".

> "There is no longer a single text in a single version, but a real genealogy of all the versions".

Clivaz is studying manuscripts from the New Testament, and the digital era is finally giving her access to part of the 5,800 manuscripts written in ancient Greek. Furthermore, it is also changing the way that the historical document is perceived. "There is no longer a single text in a single version, but a real genealogy of all the versions", she says. "The text has therefore become multiform. This completely changes our way of looking at things. Our highest priority used to be to find the very oldest version of the document; today, however, we see a document as having changed throughout the history of reading".

She refers to the book historian Roger Chartier, insisting that computer tools are

◂ Pages 11 & 12. It's one thing to recreate the life of Newton, Washington or any other historical figure using a series of portraits, but what about using a map? Dirk Helbing's team at ETH Zurich traced journeys from places of birth, via centres of intellectual development, to final resting places, spanning 120,000 personalities and 2,600 years.
Pictures: Wikimedia Commons, Wellcome Library (p. 11); M. Schich and M. Martino (2014) (p. 12)

moulding the way we think, adding, "it's greater than the printing press; the digital revolution is the most important leap forward since we moved from the scroll to the codex (Ed. a book bound from handwritten sheets).

A tool to generate hypotheses

One of the effects of this leap has been the change in the relationship between historians and their sources. Martin Grandjean is a doctoral student in history at the University of Lausanne who is looking at the collaborations between scientists and the League of Nations during the period between the two World Wars. One particular aim of his work is to understand how German researchers managed to continue to work on the European stage despite having effectively been pushed to one side. To do this, he is creating a spatiotemporal map of their correspondence.

> "One of the challenges is knowing how far we can take collaboration with other disciplines without losing our own identity".

"I'm less interested in the content of the letters than I am in the metadata, i.e., who wrote to whom and when", he explains. This information is then used to sketch out schematic representations of the metadata with the hope of finding information that has so far eluded historians. But as rich as his map may be, it does not constitute a result in itself. "Visualising data gives me ideas and suggests hypotheses, but as with any historian, I must then consult with the archives if I am to verify them".

These complex data visualisations are also at the heart of a research project between the universities of Bern and Giessen, the Repertorium Academicum Germanicum (RAG). At the project's core is a database of 50,000 academics and intellectuals who attended universities in the Holy Roman Empire between 1250 and 1550. In principle, nothing has been stopping anyone from creating such a "Who's Who" in the absence of digital tools, except the much more difficult process of interpreting the results. The RAG researchers have chosen to present this information as a function of time, an original choice that may also lead to new hypotheses. "It allows us to rethink the role of mediaeval universities with a much wider perspective", says Kaspar Gubler, deputy director of the RAG. "The digital nature of our index also allows us to create more links between other research projects".

The data of the past

Digital solutions and all their power may be the stuff of dreams, but emphatic promises can also attract criticism. Take, for example, the Venice Time Machine, a media project at EPFL that hopes to recreate the Venice of the last 12 centuries using the archives of the Venetian state. The first step is scanning millions of extant documents (some 80 km of archives). "It would be just impossible for human beings to analyse so many documents" says Frédéric Kaplan, leader of the project and professor at the Digital Humanities Laboratory of EPFL.

These machines will decode written manuscripts and extract data such as the price of cinnamon imported from the East, the salary of the condottieri or even a list of apprentice masons for a given period. "In brief, this project is about getting the big data of the past to create the Google Maps and Facebook of Venice", says Kaplan, who compares his project to the sequencing of the human genome. "Creating this large infrastructure is a way of providing assistance to many future researchers". Along with his partners in Venice, he also hopes to create a virtual tour guide of the city for smartphones.

This great vision is attracting scepticism, and even distrust, amongst many historians – though they prefer not to be named. "This project has almost zero framework", says one of them. Another thinks that "history needs large-scale approaches just as much as it needs individual approaches". Kaplan, however, continues to have confidence in himself and his project. "Soon we will publish a complete model of the first district of Venice, the Rialto", he says.

Keeping one's identity

Will digital humanities continue to be simple tools amongst the many others already at the historian's disposal, or are they going to create an entirely new discipline? "I think they will, but the question is still being debated within the community", says Kaplan. Fachard, on the other hand, thinks that he "will continue to be an archaeologist above all". Clivaz says: "for me, it's neither one nor the other. I think that 'digital humanities' is just a way of describing the transition, because, at the end of the day, human and social sciences will become digital whatever happens. Even though adjectives such as 'digital' may soon disappear on their own, through mere redundancy".

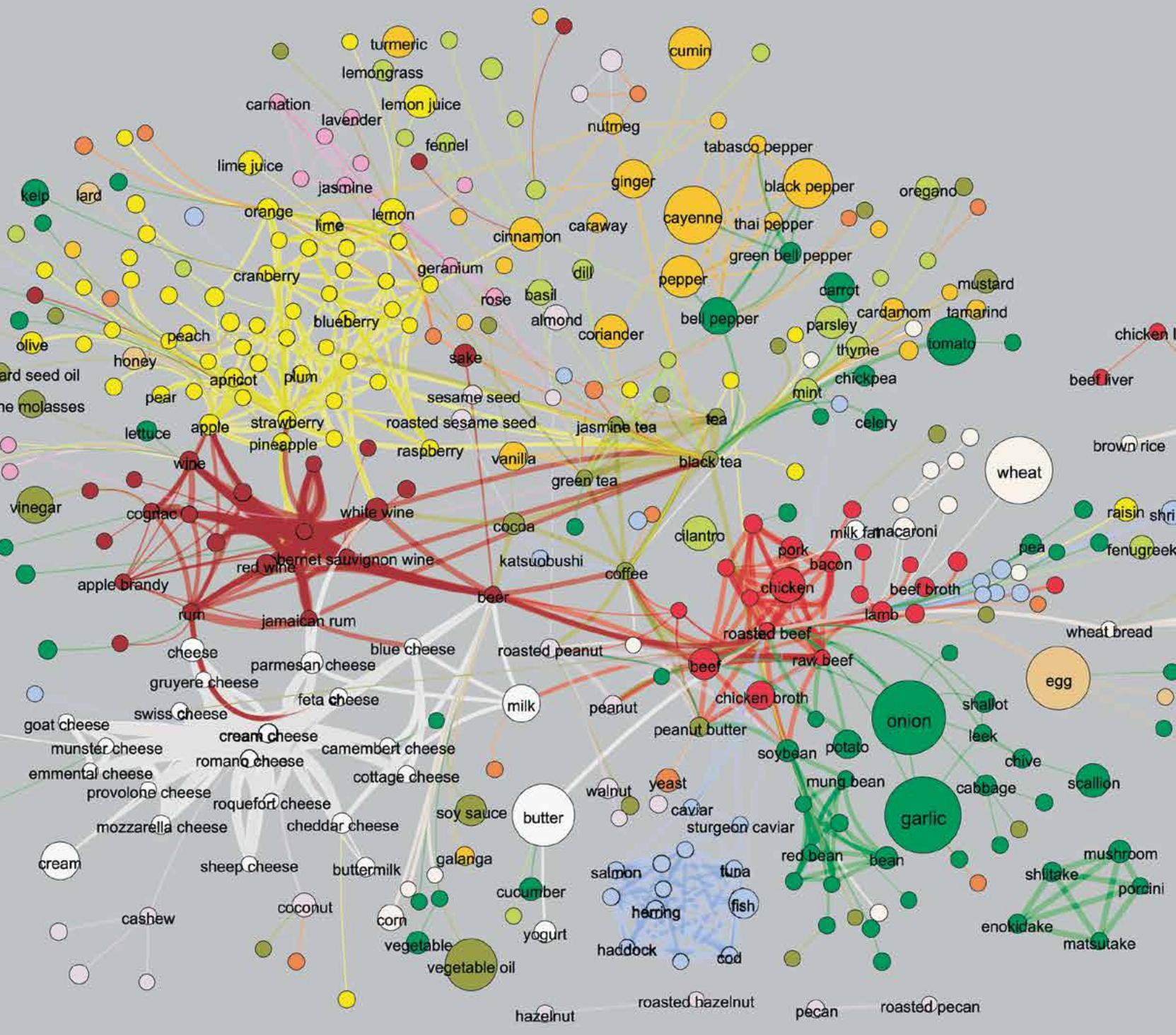
The digital age may be building bridges, but they are not always easy to cross. In the corridors of new centres, historians meet with sociologists, computer technicians and statisticians. "We need people who are able to create the ties between these different universes" says Bella Kapossy, also of the Digital Humanities and Culture Laboratory of the University of Lausanne. Any change in a discipline will lead to the potential redefining of its identity. As Clivaz says, "one of the challenges is knowing how far we can take collaboration with other disciplines without losing our own identity".

Fabien Goubet is a science journalist at Le Temps.

Swiss universities incorporate change

Some 11 years since the term appeared, 'digital humanities' has started to find its place in academic curricula. In Switzerland, students and researchers can take one-off courses, workshops and seminars. Starting this year, the Faculty of Letters of the University of Lausanne (UNIL) is also offering 30 specialist credits in digital humanities for Masters students. The European network known as Dariah also maintains a list of courses – available online, of course. Amongst this list there are a dozen courses in Switzerland, at the universities of Geneva, Lausanne, Bern, and Basel, who are all partners in this project. And things in Switzerland are set to change even more in the coming months, particularly with the up-coming proposal for an inter-faculty Master of Digital Humanities at UNIL.


Meerrettich
KARLSBRAU
PATAK'S
500 g
BIO
Mozzarella


Categories
fruits
dairy
spices
alcoholic beverages
nuts and seeds
seafoods
meats
herbs
plant derivatives
vegetables
flowers
animal products
plants
cereal
Prevalence
50 %
30 %
10 %
1 %
Shared compounds
150
50
10
turmeric
lemongrass
carnation
lavender
lemon juice
fennel
cumin
nutmeg
tabasco pepper
lime juice
jasmine
ginger
black pepper
oregano
kelp
lard
orange
lime
lemon
cinnamon
caraway
cayenne
thai pepper
green bell pepper
cranberry
geranium
dill
pepper
carrot
mustard
rose
basil
cardamom
tamarind
blueberry
almond
coriander
bell pepper
parsley
olive
peach
thyme
tomato
honey
sake
chickpea
beef liver
apricot
plum
mint
pear
sesame seed
molasses
lettuce
apple
strawberry
roasted sesame seed
jasmine tea
tea
celery
pineapple
raspberry
vanilla
brown rice
wine
black tea
wheat
green tea
vinegar
cognac
white wine
cocoa
cilantro
milk
macaroni
raisin
pork
pea
fenugreek
bacon
red wine
cabernet sauvignon wine
katsuobushi
coffee
apple brandy
chicken
beef broth
beer
rum
lamb
jamaican rum
roasted beef
wheat bread
cheese
blue cheese
roasted peanut
parmesan cheese
beef
raw beef
egg
gruyere cheese
feta cheese
milk
chicken broth
shallot
swiss cheese
peanut
onion
goat cheese
peanut butter
leek
cream cheese
soybean
potato
munster cheese
camembert cheese
chive
romano cheese
emmental cheese
cottage cheese
mung bean
yeast
cabbage
scallion
provolone cheese
walnut
roquefort cheese
caviar
garlic
soy sauce
butter
mozzarella cheese
cheddar cheese
sturgeon caviar
cream
sheep cheese
buttermilk
galanga
red bean
bean
mushroom
salmon
tuna
shiitake
cucumber
porcini
coconut
herring
fish
cashew
corn
enokidake
yogurt
vegetable
haddock
cod
matsutake
vegetable oil
hazelnut
roasted hazelnut
pecan
roasted pecan

200 years of world literature in 0.4 seconds

Slow reading is out. Today, computers comb through millions of books and analyse their content in a flash. *By Mirko Bischofberger*

It all began with data. Too much data. Back in the 1940s, the Italian Jesuit priest Roberto Busa was trying to cope with unmanageable amounts of data, his goal being to create a complete index of all 11 million words in the writings of the theologian Thomas Aquinas. It was a mighty task that he felt would surely never be completed in his lifetime. But then Father Busa had an idea: a machine could help him. He got support from Thomas Watson, the founder of IBM in the USA, with whose help the index was finished in just a few decades. The Index Thomisticus became a pioneering, 56-volume work of 70,000 pages. It was the first-ever to enable a user to perform a rapid content search through a complete corpus.

Digital world literature

Today, digital methods have entered all fields of the humanities. "These days, it's above all literary studies and linguistics that are keen on getting digital access to their data", says Martin Volk, a professor of Computer Linguistics at the University of Zurich. "This allows them to use numbers and statistics to prove or disprove certain research hypotheses". In his research project Text+Berg, he scanned all the books published by the Swiss Alpine Club since 1864. That's 250 volumes. "This material is a treasure trove of information on the Swiss mountains", explains Volk. "It shows, for example, how our understanding of the mountains has altered over the course of time. Where the mountains used to be described as objects of exploration, today they're seen more as a kind of sporting equipment. The word 'contest', for example, occurs far more often today than it ever did".

Another Swiss project is being carried out by the University of Geneva, where a portion of the Bibliotheca Bodmeriana is being digitised. This extraordinary collection of books and manuscripts comprises more than 150,000 works in eighty languages from three millennia. These include the oldest-known manuscript of the Gospel according to St John and the original copies of the Grimm Fairy Tales.

Citizen science offers a helping hand

But scanning books is laborious. "The books first have to be cut open by hand and every page entered separately", says Volk. He has processed over 120,000 pages in the course of the Text+Berg project, so he knows what he's talking about. "After scanning them, you have thousands of computer images but no text". To address this, software is used to recognise the letters in the images and to transform them into characters and words. "The error rate for this process is still relatively high, especially for the older 19th-century texts". Volk's project was producing roughly 12 mistakes per page that would otherwise have had to be checked by hand.

> "Google's Ngram plays a pioneering role in the humanities".

His team took an inventive approach to get around the problem, developing an online correction system cast as a kind of 'game' that enabled volunteers to eradicate the mistakes by hand. This citizen science project proved very popular with the members of the Swiss Alpine Club. "With their help, we were able to carry out more than 250,000 corrections over the space of half a year", says Volk proudly. Now the digital 'mountain' of text is almost 100% correct. Once documents have been scanned, they can be archived and retrieved simply. "Especially in the case of documents that are old, rare or difficult to access, this is something that is otherwise impossible", says Volk.

Freud, Einstein, Darwin

The world's best-known archive of this kind, and probably the most comprehensive, is Google Books. Using a full-text search, the holdings of the university libraries of Harvard, Stanford and New York can be searched in a matter of seconds.

◂ Pages 15 & 16: Two different ways of saying you are what you eat: a quick look in the fridge versus an infographic that analyses aromas. In the latter, colour shows different categories, size the prevalence in recipes and links the number of shared aromatic compounds.
Pictures: Valérie Chételat (p. 15); Yong-Yeol Ahn (p. 16)

Even European libraries such as those of the University of Oxford or the Bavarian State Library have already joined Google Books and undergone digitisation projects.

Taking Google Books as its starting point, in 2010, Google set up Ngram, a web application for calculating the frequency of a word or a series of words in all the books published since 1800 that have been scanned by Google. For example, this allows us to investigate historical events such as the abolition of slavery or to observe the way in which specific words in a language have changed. It also lets us observe the shifting popularity of historical figures over time. Scientists such as Sigmund Freud, Albert Einstein and Charles Darwin all appear often in the books, but since 1950 Freud has been mentioned at least twice as often as the other two.

Textspeak, albeit shorter, is governed by the same rules as spoken language.

"Ngram is just one example of what is possible today with digitised cultural data", says Jean-Baptiste Michel, a data scientist from Harvard and the author of the Google application used by millions of people. The digital humanities today would be unthinkable without Ngram. Volk confirms that "Ngram was pioneering in the digital humanities, especially because it made the methods broadly known".

More than 100 million texts each day

Uploading existing literature is just one approach in linguistic analysis. "Today, via our phones and computers, we're sending out more digital texts than ever before", says Elisabeth Stark from the Institute of Romance Languages at the University of Zurich. In Germany in 2013 alone, more than 100 million text messages were sent every day. "Almost none of these texts are ever printed, but they are nevertheless part and parcel of our linguistic culture", says Stark. In her SNSF project 'Sms4science' she is investigating the linguistic characteristics of text messages in Switzerland, and how the Swiss communicate in this medium.

In order to access this data, Stark and other researchers invited all Swiss users of cell phones to send a copy of their text messages to a free number. "In this way we were able to collect some 26,000 texts from Switzerland", says Stark. One of the things of interest to her is the empirical analysis of linguistic ellipses, i.e. leaving out words. Typical examples of ellipsis are "leaving now" and "what you doing?". In order to find out why the subject is absent in these cases, Stark's team analysed all the text messages in French and German. They discovered that these ellipses are far rarer than we assume, and that they follow the same laws as everyday spoken language. "This contradicts the impression that you get from observing individual text messages", says Stark. "And that's why we need a large volume of data – so we can track down what actually happens in text messages".

Insufficient resources in Switzerland?

The digital humanities allow us to analyse literature and language using numbers. And numbers have always been the trademark of the hard sciences. They allow us to describe quantitative patterns and relationships with a precision largely impossible with words. The next generation of scholars in the humanities will therfore work in a data-based manner, just as bioinformaticians have been doing since the end of the 20th century. "The field is being driven above all by the immense increase in the volume of digital texts", says Volk. "Just as sequencing the human genome led to bioinformatics, the digitisation of our language and literature will soon, inevitably, become integral to the humanities".

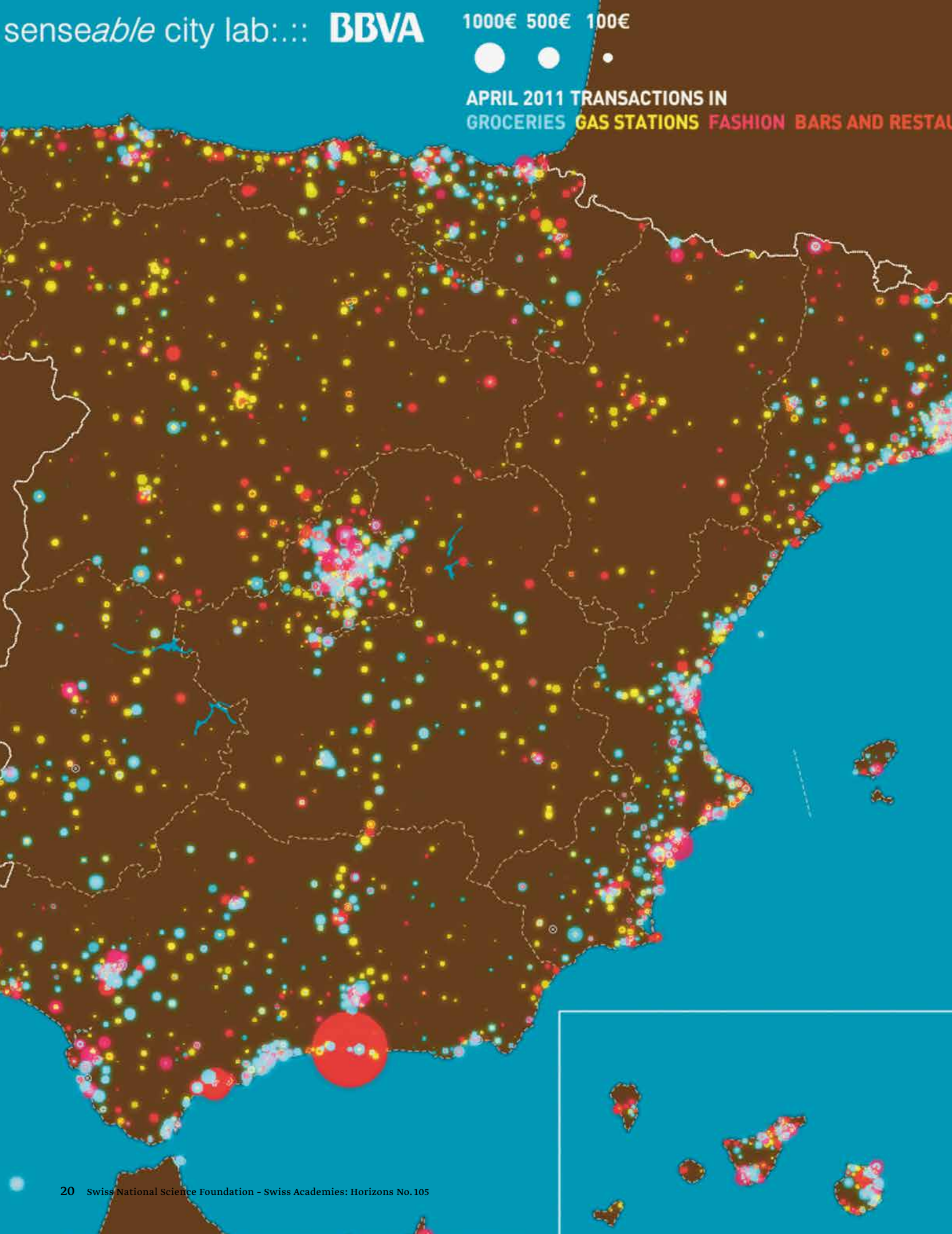
Researchers such as Volk and Stark are at just the beginning of a new era of research in the humanities. "Regrettably, resources for the digital humanities are still meagre in Switzerland", says Volk. Stark is of the same opinion: "At the University of Zurich, for example, there isn't a single professorship in the digital humanities, even though it's high time there was". Both researchers think it's even more important to get access to bigger data consortia. "Although there are important initiatives on a European level, it's sad to say that Switzerland often doesn't take part in them at the moment", says Stark. And Michel, who has been able to use the incredible reservoir of data at Google Books, says that "access to data is the most important driver!"

Mirko Bischofberger is a science contributor at the SNSF.

—

Jean-Baptiste Michel et al., Quantitative Analysis of Culture Using Millions of Digitized Books. Science, 2011


PORTUGAL
ESPAÑA
VALLADOLID
SALAMANCA
MADRID
TOLEDO
CORDOBA
SEVILLA
GRANADA
MALAGA
ALMERIA
CADIZ
Gibraltar
TANGER
Ceuta
TETOUAN
Algeciras
Marbella
Badajoz
Evora


senseable city lab:.:: BBVA
1000€ 500€ 100€
APRIL 2011 TRANSACTIONS IN
GROCERIES GAS STATIONS FASHION BARS AND RESTAU

Digital archaeologists

Just because a historical artefact has been uploaded doesn't mean it won't disappear. A Swiss project is aiming to save research databases.
By Daniel Saraga

The Web never forgets". At least, this is what experts warn us about the overlap between the Internet and our private lives. But actually nothing could be further from the truth. The continual changes in digital media and file formats are leaving in their wake veritable mountains of increasingly illegible information. And if nothing is done to save it, it will all be consigned to oblivion.

It's actually scientific research that's bearing the brunt of this problem, as its favourite form of expression is the database. And ageing is a very quick process for databases. Programming languages quickly become obsolete, and operating systems are soon incompatible with new servers.

"It's a real problem", says Lukas Rosenthaler, head of the Data and Service Center for the Humanities (DaSCH), a project that aims to guarantee the longevity of results from humanities research (see "Save the saviour"). "Once a project has come to an end, and its financing with it, it's very unusual for researchers to continue maintaining the infrastructure. And an inaccessible database is unusable. Not maintaining it is the same as destroying it and any scientific value it has. Paradoxically, this type of research artefact can be more fragile even than a published article".

◂ Pages 19 & 20: By adding data to maps, we create a form of augmented reality. With this bird's eye view, it is possible to identify hidden information in an instant. Here for example, we see restaurants on the Costa Tropical and consumer spending before Easter.
Pictures: Valérie Chételat (p. 19); MIT Senseable City Lab – Carlo Ratti, Director – Pedro Cruz: Visualization (p. 20)

Scribes of the third millennium

Rosenthaler has been able to save one of the most important international databases on Greek mythology, the Lexicon Iconographicum Mythologiae Classicae, which was written off in 2009 after 30 years of work. "It was completely out of service, and the company that had programmed it had gone bankrupt", says Rosenthaler. "We eventually had to make a pirate copy of the site, because all the passwords had long since been forgotten. Our work sometimes seems more like a form of digital archaeology...". At any rate, it gives research results a new lease of life. Harvard University, for example, is now looking at integrating the Lexicon in its commentary on Homer, by using 'linked open data', a component of Web 3.0 that allows information to be linked online directly and dynamically.

Along with his modestly sized team, Rosenthaler, a former physicist and director of the Digital Humanities Lab of the University of Basel, has resorted to using semantic technology to create a generic platform able to structure data coming from a wide variety of different platforms. "I think that we'll be able to bring on board 99% of the databases used in the humanities, and perhaps even some projects from biology. In three years, we have translated some 30 projects, stretching from Greek mythology to a collection of historical photographs of mountains".

The DaSCH has taken the Open Archival Information System to inspire its work, systematically copying data and then re-transcribing it in a state-of-the-art format. It's a difficult and expensive process and one that must be repeated regularly. It's pretty much the digital equivalent of what monks did during the Middle Ages. "Most research groups don't have the means to create stable tools", says Rosenthaler. "Ideally, we would work with them from the beginning to create long-lasting databases that could then be easily updated and migrated".

Daniel Saraga is the Head of Science Communication at the SNSF.

Final report for the pilot project "Data and Service Center for the Humanities", SAHS (2015)
Le patrimoine culturel à l'ère numérique, Nike Bulletin (June 2014)
http://openresearchdata.ch/

Save the saviour

The Data and Service Center for the Humanities (DaSCH) is dedicated to preserving digital archives, but actually finds itself on the brink of disappearing. "Since 2008, we have been fighting to implement a stable platform", says Markus Zürcher, Secretary-General of the Swiss Academy of Humanities and Social Sciences and project pen holder. "Everyone supports this platform. The only thing that needs fixing is financing".
As it happens, the DaSCH is still a pilot project, and it is close to the end of its trajectory. "In March 2015, we filed a request with SERI (the State Secretariat for Education, Research and Innovation) asking for 2 million francs to cover 2017 to 2022. We're ready to keep financing it until 2017, because any interruption to the project would be very detrimental". By way of comparison, some 30 million francs are spent annually on humanities databases.

“We haven’t got recourse to any kind of secure methodology”

The digital humanities don’t just offer us new research methods; they also enable us to ask new research questions, says the literary scholar Gerhard Lauer. Although he describes himself as ‘conservative’, he’s one of the leading thinkers in the field of computer-based analysis. *By Urs Hafner*

Our cultural heritage should not be defined by Google, says Gerhard Lauer.

Prof. Lauer, ‘digital humanities’ is a broad umbrella. What does it mean in your eyes?

Quite simply: the use of computer-based methods for realising digital editions and for the quantitative analysis of large corpora.

Has your research been changed by the digital humanities?

Yes, but not suddenly. The digital humanities are beginning to change our research by gradually expanding our range of methods and the questions we ask. To take my own field, literary studies, as an example, we’re beginning to apply quantitative terms to the analysis of literature, such as Goethe’s *Werther* or Kafka’s novellas. The demand for computer-based methods is increasing among students, and I’m now supervising the first bachelor theses in this field.

The ‘text’ is traditionally at the heart of the humanities. Scholars analyse the manifest and latent meanings of documents, and offer up their findings for discussion in a narrative, argumentative format. But the digital humanities bypass this dimension of the text.

At first glance, you’re right. Above all, the digital humanities count words. But their distribution in texts actually says something about those texts themselves. We can learn a lot about people through their word profile or, rather, the word profile of their texts. We tend to think that the use of articles or pronouns would tell us very little – but the opposite is in fact the case.

What new findings have you made thanks to the digital humanities?

Let me give you an example: we’re now looking at how many long and short words Kafka uses in comparison to other authors of the time, and how he used specific function words. The statistical distribution of word frequencies in his novellas allows us to identify what is special about his style. Words that are frequently used also tell us something about the period in which a work was written. And we’re no longer just exploring the canon – not just Goethe’s *Elective affinities*, for example – but the many other books that were also read at the time. This brings into focus the cultural history of what was read, not just the canon itself. These are initial insights, not earth-shattering findings. What’s new at the moment are the methods we’re using.

Isn’t historical, hermeneutic analysis superior to just counting words?

That is perhaps the case at the moment, but it’s changing bit by bit as we make new findings. It’s becoming increasingly clear that the text patterns we’re recognising allow us to read the development of the human ability to tell stories. This allows us to ask new questions, such as with regard to differences between European and Asian narrative styles.

How do you proceed when you want to find out what people in Europe read in the early 19th century?

We evaluate different sources and metadata made up of library catalogues that have been gathered together. This allows us to deduce what books were printed, bought, borrowed by people, and thus probably read too. Or we use Google’s Ngram viewer, which allows us to search through almost five million books in different languages.

But the Ngram analysis is actually selective. And we don’t know what criteria Google applies when deciding whether to scan a given book.

That’s true. The corpora with which we work have often not been created in a systematic, statistically balanced manner. Google Books is especially problematical because Google has gone through whole libraries from start to finish, digitising them indiscriminately. Although that doesn’t constitute a recognisable corpus, the company is using it to define our cultural heritage. This is why universities and libraries have to stand up and insist on our cultural heritage being kept from privatisation. We have to be able to analyse it according to the criteria of source criticism. But in the humanities, we aren’t active enough when it comes to these matters of cultural politics.

Many adherents of the digital humanities talk of a 'revolution'. Do you?
Digitisation is a revolution; the digital humanities aren't. The humanities are being transformed just like chemistry, physics, medicine and biology were transformed when they integrated computer-based methods. Biology has changed radically since people began using computers, without the discipline itself ceasing to exist. The same will happen in the humanities. Archaeology and linguistics have already taken this step. The digital humanities are a kind of revolution of feeling. Something new is coming – numbers and statistics in particular – and in many subjects, people don't yet know how to deal with them.

"Digitisation is a revolution; the digital humanities are not".

You mention the natural sciences as an example, because they've been doing quantitative work for a long time. Are the humanities now copying them so that they can get more research funding?
You have to differentiate between two conflicting interests. On the one hand, funding policies follow trends, favouring what promises to be the next new thing. The digital humanities currently seem to constitute a highly promising field, so money is being invested in them. But on the other hand, it's difficult to find a job in this field within the established faculties. They're often hesitant and prefer to appoint someone who corresponds to the traditional self-created image of the humanities. You could say that the humanities are modernising themselves with the handbrake on. It's different in libraries and in editing and publishing.

Do you feel part of an avant-garde?
No, although along with others I'm being pigeon-holed in such a role. This is despite the fact that I'm actually a rather conservative literary historian. Of course, almost everyone in this new field knows each other, and that gives you the feeling of belonging to a kind of group. I also have contact with the Swiss centres in Lausanne, Basel and Bern. Because of their methods, the digital humanities are more collaborative in spirit than is the norm in the humanities.

"The humanities are modernising themselves with the handbrake on".

Do the digital humanities think enough about how, for example, digital methods can alter the status of a text – that the text itself can seem to 'slip through your fingers' in the process?
The deficiencies here have been due to the basic questions and the practical work often not being brought together, and because of the whole debate about algorithmic criticism and the text as a digital object. But you mustn't forget that we're only at the beginning of things. Often, we stand on the sidelines and haven't even got recourse to any kind of secure methodology.

So the humanities overall are 'on the sidelines'?
If they carry on as they have up to now, then they won't have a brilliant future before them. They're in a difficult position. In Anglo-American countries, public funding for them has all but dried up, and they have to be financed almost completely through study fees.

Do you see the digital humanities as a safety net?
No, they're not that. But in a best-case scenario they're part of the solution. The big question is what the humanities will teach in future. This has to be answered independently of digital methods, but at the same time bearing in mind the dramatic changes that digital modernisation will demand of us.

Urs Hafner is a historian and a science journalist.

Unconventional thinker

Gerhard Lauer teaches German philology at the University of Göttingen. One of his specialisations is the digital humanities. His recent publications include work on Thomas Mann and Joanne K. Rowling as well as on the pupil reaction of readers.

"A non-discriminatory model can still lead to social injustice"

Regula Keller

The top academic positions are mostly in the hands of men, even though there are enough women at the student level. Barbara Keller is a computer scientist at ETH Zurich and is using mathematical models to explore how this barrier to promotion can arise in a dynamic network of people.

What prevents women from scaling the academic ladder?
Our model was able to show that three conditions suffice to create a barrier to progress in a network of people. First, the network is mostly fed with men; secondly, young researchers are drawn more to successful researchers than to the less successful; and thirdly, people prefer to work with those of their own gender. Our model demonstrates that no barriers arise if just one of these ingredients is lacking.

Does this surprise you?
Yes, a lot! It wasn't obvious that a non-discriminatory model, in which both genders act in the same manner, can still lead to social injustice.

But this is just a model. How close to reality are these results?
We have been able to confirm all the results of our model by comparison with existing networks. To do this, we investigated a network of authors made up of over a million researchers. So I think our conclusions also have a certain degree of validity in real life. But of course, reality is far more complex than our simplified model.

—

B. Keller et al.: Homophily and the Glass Ceiling Effect in Social Networks. Proceedings of the 2015 Conference on Innovations in Theoretical Computer Science, 2015.

Specialist journal forbids statistical tests

The international specialist journal *Basic and Applied Social Psychology* has with immediate effect banned the use of statistical p-values in its research articles. As a rule, p-values of under 0.05 increase the significance of statistics, but according to the editors in chief, this threshold is too easy to reach. They hope that the restriction will heighten the validity of the research results they publish. It is the first ban of its kind. *mb*

—

D. Trafimowa et al.: Editorial. Basic and Applied Social Psychology, 2015.

Tiny bias, big consequence

Even minor conflicts of interest among experts can lead to major discrepancies in the choice of projects they support. Researchers at the Children's Hospital of Philadelphia have shown this using computer simulations in which three virtual references per application were modelled with and without conflicts of interest. *mb*

—

T.E. Day: The big consequences of small biases: A simulation of peer review. Research Policy, 2015.

Larger research groups aren't more productive

Large research groups don't publish more than small groups. Adam Eyre-Walker of the University of Sussex in the United Kingdom investigated 398 groups from the fields of biology to determine their size and the number of their publications. Although the number of studies published initially correlates with the size of the group, there is a ceiling effect once the group comprises roughly ten to fifteen people. Adding more people to the group does not guarantee any increase in their productivity. *mb*

▶ What's your opinion on the optimum size of a research group? Tell us at the SNSF World Network on the LinkedIn group of the Swiss National Science Foundation.

—

I. Cook et al.: Research groups: How big should they be? PeerJ PrePrints 3:e812v1.

Too many studies, too little notice

Publications from recent years are cited less often and are forgotten quicker. This is the conclusion reached by a study conducted by authors from the USA and Finland who have investigated more than 23 million publications in the fields of medicine, biology, chemistry and physics. According to these authors, it also means less attention is paid to individual studies. The reason for this phenomenon is the considerable increase in the number of research publications in the past 40 years. *mb*

—

P. Della Briotta Parolo et al.: Attention decay in science. arXiv, 2015.

Withdrawn study was cited 52 times

A publication that was withdrawn in 2008 has since still been cited 52 times. It has now been cited a total of 76 times, meaning only 24 citations were made before the study was withdrawn. Research articles that are withdrawn because of mistakes in them can thus have a major influence on science, even after the fact. *mb*

—

A.S. Fulton: Persistent Citation of the Only Published Randomised Controlled Trial of Omega-3 Supplementation in Chronic Obstructive Pulmonary Disease Six Years after Its Retraction. Publications, 2015.

A summer of science

This spring will see the release of the app ScienceGuide, a leisure guide for the natural sciences. It's an incentive to go on a Tour de Suisse of the sciences. *By Daniel Fehr, Florian Fisch and Daniel Saraga*

On the occasion of its 200th anniversary, the Swiss Academy of Sciences, SCNAT, is releasing an app with more than 500 natural science activities. Horizons is recommending 20 extraordinary offerings across the country, from Geneva to Basel and Lugano, ranging from genetic engineering for beginners to subtropical island adventures in the canton of Ticino.

200 years of the natural sciences in five days

Observing the sky with a space scientist, tracking down dinosaurs, and going on nocturnal expeditions to discover bats: 150 local societies and major science associations are making the 200th anniversary of the Swiss Academy of Sciences an event to remember. Each of the 12 participating cities will host five days of debates, guided tours, guided walks and interactive events to choose from.

- 'Forschung live', starting in Davos on 17 June, thereafter in Lucerne, Zurich, St. Gallen, Aarau, Bern, Neuchâtel, Basel, Sion, Lausanne and Geneva, and closing in Lugano on 20 October. www.forschung-live.ch

A forest for the senses

Nature lovers in French-speaking Switzerland can celebrate all creatures great and small in the company of their favourite magazine La Salamandre. This year's topic is the forest. You can sit in an armchair and listen to an orchestra of animal sounds conjured up by the sound engineer Bosir Jolivet, follow the tracks of the lynx in the photo exhibition of Didier Pépin and Laurent Geslin, and explore the forest with all five senses in the laboratory. And there's also a film about Bruno Manser.

- Festival Salamandre, from 23 to 25 October 2015 in Morges (VD)

Not to be missed · Experience nature · Interactive · Indoors

A summer of science in Switzerland

Snakes and unicorns

Human skulls, mummy powder, sacred amulets and a stuffed crocodile hanging from the ceiling. This curiosity cabinet takes its visitors along on a scurrilous journey through the history of medicine, from Ancient Greece via the alchemists to modern pharmacy.

▸ Pharmacy Museum, Basel

Awaken your inner child

There's not much in the way of reading here, but you can experience astonishing things with experiments that are being constantly redesigned. That's what's in store at Switzerland's unique science museum for children, where adults too can rediscover their youthful curiosity.

▸ Espace des Inventions, Lausanne. 'L'œil nu', until 2 October 2015.

Genetic engineering for beginners

Making bacteria glow through genetic engineering: in the university laboratory, children and young adults can play at being molecular biologists. Researchers take small groups of visitors on a guided tour of modern biology and genetics, right down to the neurosciences.

▸ Bioscope, University of Geneva, reservations required.

Learning by hiking

Book a guided tour in the spectacular mountain landscape of the 'Glarus thrust' between Ziegelbrücke and Chur, to learn how the Alps folded into shape more than 250 million years ago. The old iron mine of Gonzen is also worth a visit, or you can risk a peek inside the 20 metre-wide sinkhole at Hellloch.

▸ Geopark Sardona (GL, GR, SG)

Do-it-yourself microscope

Whether you're after artistic sound installations or electronic jewellery: in the Labor Luzern, inventors tinker away at their projects. At this summer workshop, children build their own USB microscope and investigate organisms from Lake Lucerne.

▸ Labor Luzern, every Wednesday evening, microscopy workshop on 5 August, reservations required.

For botanists and romantics

On Lake Maggiore, a regular boat service will take you to a subtropical island to discover 1,600 exotic plants. It's no wonder that artists used to visit the Baroness Antoinette de Saint Léger on her island residence, which is today a restaurant and a hotel.

▸ Brissago Islands, Lake Maggiore

Editor's choice

The die is not yet cast

In the autumn exhibition by 'L'ideatorio', you can discover anew the world of numbers: you can experiment with the magic square or use the software of the Swiss National Supercomputing Center to make a statistical evaluation of yourself.

- L'ideatorio, 'Diamo i numeri!', from 21 September 2015 to 19 February 2016 in Lugano.

Face to face with a baby mammoth

The Zurich Unterland region also used to be a home to mammoths. The only mammoth museum in Switzerland is displaying the skeleton of a Zurich specimen that was found during building work in Niederweningen in 2003, along with a unique model skeleton of a newborn mammoth.

- Mammutmuseum Niederweningen (ZH), open on Sunday afternoons.

Cave exploration for claustrophobics

They offer everything that a proper cave ought to have: underground gorges, imposing caverns, subterranean waterfalls and 40,000-year-old stalactites and stalagmites. But this kilometre-long path through the Beatus Caves is also very easy to reach, either with a guide or on your own.

- Beatus Caves at Lake Thun, until 25 October.

Back to the future

From robot art to film music, a Jules Verne collection and priceless first editions of famous comics: the exhibitions of the unique European Museum for Science Fiction can't tell us what the future will bring, but they can tell us all the more about the present.

- Maison d'ailleurs, Yverdon-les-Bains (VD). 'Portrait-Robot', from 21 June 2015 to 31 January 2016.

Relax and twitter

Some 260 bird species – many rare, migratory birds among them – live, breed and twitter away in the marshy delta of the rivers Ticino and Verzasca at the northern end of Lake Maggiore. Besides observation points there are also leisurely nature trails through this small-scale nature paradise.

- Le Bolle di Magadino, Lake Maggiore

Pimp your gadget!

Everyone can turn up here to tinker with electronic gadgets, to repair them or develop new ones. Members can build a drone, print in 3D, take part in the next hackathon or learn how to program in Raspberry Pi.

- Fixme Hackerspace, Renens (VD), open to everyone on Monday, Wednesday and Friday evenings.

Free as a bird

Lying on a table with virtual reality glasses on, you can gently flap your wings or swoop down in a sudden nosedive. Whether you're a bird lover or not, the bird flight simulator Birdly is an unforgettable experience that no one should miss out on.

- BirdLife Nature Centre, Neeracherried (ZH). 'Flying like the birds', until 31 October.

Sloth motion

There's a full moon in the middle of the day. In the dark, underneath the dome, you can now see the movements of the nocturnal sloth. And there are also anacondas, night apes, armadillos and, of course, the cute honey bears with their huge eyes.

- Nocturama in the Papillorama, Kerzers (FR).

Weatherproof universe

This new observatory, open since 2012, offers a direct, telescopic view of multi-coloured stardust, distant galaxies and nearby planets. Even a hailstorm won't stop you on your 50-minute journey through space in the Planetarium.

- Sternwarte, Schaffhausen

Journey to the centre of the Earth

You can travel down a thousand feet, in groups of eight, into the Opalinus Clay, This layer of rock is over 180 million years old and is ideal for storing highly radioactive waste. A visit to its research centre will help you form your own opinions.

- Mont Terri, Saint-Ursanne (JU), reservations required.

Zurich rocks

You can experience a magnitude-8 earthquake in a simulator, observe the consequences of climate change on an interactive globe, and admire 160-kilo smoky quartz crystals. The earth sciences look forward to seeing you.

- FocusTerra, ETH Zurich Zentrum, reservations required for the earthquake simulator.

A sideways view of mountain culture

From mountaineering stories in the age of mass media to a fictitious hotel project for Chinese tourists: small is beautiful in the Alpine Museum, which offers an innovative mix of interactive installations and critical reflections on an age-old topic: the Alps from Slovenia to France.

- Alpine Museum, Bern. 'Bivouac' until 28 June; 'Himalaya Report' until 26 July.

200 years of the Swiss Academy of Sciences

On 6 October 1815, a gathering of 32 like-minded persons in the garden of the natural scientist and apothecary Henri-Albert Gosse in Mornex near Geneva led to the founding of the General Swiss Society for all the Natural Sciences, the predecessor of today's Swiss Academy of Sciences, SCNAT. It was the first national association for the natural sciences. Today, SCNAT represents over 130 specialist organisations, regional societies of the natural sciences and commissions, and has a total membership of some 35,000 natural scientists. Exactly 200 years on, the original goals of the Academy remain topical: organising a network that promotes research in the natural sciences and that disseminates its findings.

Illustrations: Aurel Märki

Antonio Loprieno has worked in academia for 40 years, including nine years as the Rector of the University of Basel. Photos: Valérie Chételat

“It’s not a tragedy if you lose a few places in the rankings”

Antonio Loprieno is leaving the post of Rector of the University of Basel before the end of his term of office and will now return to the world of teaching and research. He believes that the Bologna reforms are misunderstood, that private sponsoring is necessary in the academy, and he is also critical of university rankings. *By Roland Fischer.*

"Contracts between universities and companies should remain confidential", says Loprieno.

Prof. Loprieno, when you look back at the last 40 years of your work in academia, would you say that you've lived through a major period of change, or is everything still as it was?

I do think there's been a major change, probably even further-reaching than the changes that came with the student protests of 1968. The turn of the millennium saw a renegotiation of the values of a university.

You're talking about Bologna. But wasn't this primarily about increasing mobility and harmonisation, not about the university as a whole?

That's a marvellous cultural misunderstanding. To be sure, there was a dual aim here: on the one hand to overcome the chasm between Eastern and Western Europe, and on the other hand to bring studies closer to business – students were to be made more 'fit for the market'. At least, that was at the back of the reformers' minds.

And didn't Bologna achieve this?

There is a striking contradiction here. Because in order to achieve these goals, they chose the worst possible curriculum model: the Anglo-American model. With its Bachelor and Master, it really functions along the lines of: first education, then training.

Isn't the Bachelor intended as a rapid passage through to practice?

In essence, no. In the Anglo-American model, the Bachelor was intended to prepare the elite for their future tasks in society – and also, perhaps, in the scientific field. It was about educating people to be 'good citizens'.

And this is what the continental Europeans took on?

In formal terms, yes. But here we were accustomed to a cumulative process in education, not a sequential practice. This was Humboldt's magic formula. This very different model saw education, subject-specific abilities and the preparation for societal tasks all being conveyed at the same time. But what did we do with Bologna? We simply distributed this old content across the Bachelor and Master levels. Especially in Switzerland, where the Masters remains the standard qualification.

So didn't Bologna change anything really?

Oh yes, it did. There was a systematic disturbance that triggered a positive discourse. But as a result of this, many things were turned into problems, things that perhaps didn't really have anything to do with Bologna.

For example?

Along with the Bologna reforms, the European universities also underwent a whole series of structural developments that can be summed up as 'autonomy' and 'globalisation'. They resulted in new challenges and adjustments that are mostly considered to be part and parcel of Bologna because they cropped up at the same time, but that's not actually the case.

With regard to globalisation, you're an Egyptologist, and you've spent a lot of time in the USA researching and teaching. For many people, the USA is the El Dorado of science. Why did you come back to Europe?

You know, it's a little ironic. The reason I returned was because I'd had enough of that very same rigid Bachelor/Master system. And as I was beginning to get involved in things here in Switzerland, the Bologna reform promptly happened. I've since been identified with this Bachelor/Master system myself.

How big is the difference between the USA and Europe today?

It's become less significant, undoubtedly, but not because of Bologna. Instead, you have to recognise that the Anglo-American university model has taken on a hegemonic role – the whole world is orienting itself toward it.

And this is demonstrated by the primacy of the rankings?

You know, taking a stance against the rankings has almost become a sport. But it's not as though they don't have anything to measure.

Just not necessarily the quality of a university?

Not necessarily. Strictly speaking, rankings measure the degree to which a university has adjusted to the hegemonic, Anglo-American model.

Haven't you had difficulty explaining this stance, for example in conversation with education policy makers?

Yes, there's pressure on us to explain this. But it's the duty of good university managers to explain to our politicians that it's not a tragedy if you lose a few places in the rankings. We also have an educational function in this. We have to explain that we also want to have subjects like sociology at a university, even if these don't necessarily help to get you top places in the rankings, like physics or life sciences do.

But we've not yet reached a point where a university could explicitly state its opposition to moving up the rankings, have we? You could also say that we need more pluralism on the university scene, not further adjustments to bring us in line with the Anglo-American model.

That's an interesting thought. The most important value of a university is undoubtedly its strategic autonomy. In this sense, every university is an independent republic. Where contentment is greater, quality

will also be better. And you have to make a decision: Do you want to play with the others in the Champions League, or to stay in your national league? Both are OK, but you'll orient yourself differently, according to which you choose.

What do you think personally about this trend towards less pluralism?

As a citizen I regret it – and in societal terms, it's certainly a loss. But whether or not it's regrettable in scientific terms is a very different question.

What do you mean by that?

Well, to illustrate, let's consider the respective advantages of linguistic diversity and of a lingua franca for science. Naturally, we're proud of our various languages in Switzerland. And just as naturally, it's part of our locational advantage. But the lingua franca of contemporary science is a different language altogether, regrettably.

"They chose the worst possible study model: the Anglo-American model with its Bachelor and Master".

The author and psychoanalyst Peter Schneider recently published a controversial piece in the *Tagesanzeiger* in which he spoke of the 'rampant de-academisation' of the university. What do you say to that?

As a means of describing a general sense of discomfort, it's certainly not incorrect. It's also possible that he's glamorising an old model of what a university is supposed to be. But today the university finds itself in a process of change caused by new developments, such as the digital revolution, which are affecting many aspects of our lives. I'd rather speak of a process of removing localism. Where professors used to have to be there to convey knowledge, today we have direct, digital access to knowledge. Universities have to adapt to this. In any case, the boundaries between school, university and the labour market have become more fluid. And that's a challenge.

This brings us to another current challenge: where the money's supposed to come from. There's more and more private money involved. Doesn't that pose a threat to the autonomy of universities?

To answer this question, I've got to point to another contemporary shift in our vision of the university: the move from having teaching universities to having research universities. Bologna actually targeted teaching – but fifteen years later, everyone's talking mostly about research. The costs of research have also risen. If you want to engage in top-quality research, then you've got no other choice but to seek out new sources of financing it. So the trend is inevitable.

Don't you see any problems in this?

Look, we're all subject to a cultural prejudice: the idea that public money has greater inherent legitimacy than money that comes from private sponsors. I don't really see any difference here, and I believe that we're pursuing a misunderstanding of what Humboldt really meant.

All the same, there have been several disturbing cases in recent years of universities and large companies signing agreements giving the latter a great deal of influence over the former. And these contracts weren't even made public.

Some of the details were indeed questionable. But I'm still in favour of keeping such contracts confidential – for the simple reason that there would otherwise be an even greater degree of privatisation in the research sector. Without confidentiality, there would be fewer collaborations between universities and private companies, and research would be increasingly delegated to the laboratories of private industry.

So in future Switzerland will see a lot more endowed chairs?

I don't really think so, because universities in principle aren't very easy partners for the private sector. The trend is instead towards other forms of collaboration like the so-called hubs where joint research projects are developed by several partners.

You're now moving to the Faculty of Business at the University of Basel in order to pass on your experience of university management. As an academic, aren't you sort of changing sides?

No. I remain a cultural historian. But one who's developed something of a sense for quantification.

So do you think that the cultural sciences are on the cusp of a paradigm shift?

They'll certainly have to undergo a process of renewal along these lines. However, I'm convinced that empirical researchers should undertake excursions into the humanities and their hermeneutic culture. I still believe in the power of qualitative thought.

Roland Fischer is a science journalist based in Bern.

"I still believe in the power of qualitative thought".

Egyptologist, rector and a guiding spirit of the Swiss universities.

Antonio Loprieno was appointed full professor of Egyptology at the University of Basel in 2000. After just six years he was made Rector. To general surprise, he is quitting this position in the middle of this year, although his third term of office is only due to end in 2018. Loprieno was also the President of the Rectors' Conference of Swiss Universities (CRUS). A change in the law early this year has changed this organisation into the association 'Swissuniversities', which incorporates the former three Swiss university conferences: the universities, the universities of applied sciences, and the universities of teacher education. Loprieno is the President of the Chamber of Universities and will continue to sit on the committee of the Association. At the University of Basel, he will move back into research and teaching, both as an Egyptologist and as an expert in university management.

The rapid evolution of aquarium fish

The cichlids of East Africa are more than just popular aquarium fish: their many colours and forms offer a good example of the swiftness of evolution. Fabrizia Ronco is a doctoral student at the Zoological Institute of the University of Basel and is studying their speciation. In order to do this, she collects the DNA of cichlids from African lakes.

"After Lake Baikal, Lake Tanganyika is the second-largest freshwater lake in the world, and it contains some of the world's richest biodiversity. We are researching the results of some 12 million years of fish evolution there. In this relatively short timeframe, some 250 species of cichlids have developed. Such a species explosion takes place when a group of animals settles in a new ecological niche and adjusts to its new environmental conditions. The best-known examples of this are the Darwin finches on the Galapagos Islands and the object of our own study, the cichlids in the East African lakes.

"The cichlids were able to settle in this new ecological niche by developing a new feature: a second jawbone set deep in their gullet, rather like that of the monster in the science-fiction film *Alien*. These pharyngeal jaws are specialised in chewing, which means that their front jaws were able to adapt to catching and processing food in all kinds of ways. There are cichlids with extendable mouths that can eat by going over the sandy bottom like a vacuum cleaner. Others use their round mouths to scrape away the scales of fishes, while the so-called eye-biters go for the corneas of fish eyes.

"I catch cichlids in Lake Tanganyika at least twice a year, then I bring them back to the University of Basel and extract DNA from their fins. Our goal is to get to know the genetic constitution of all the species in the lake and to understand the paths chosen by evolution when developing their different colours and forms. In Africa, we primarily work at 'Toby's place', a former fish farm in Zambia on the southern banks of the lake. Toby was a fish exporter who provided cichlids for the aquariums of fish-lovers all over the world. This site lies roughly an hour by boat from the next coastal town. There are no roads and there is no electricity supply, but there are stone houses with thatched roofs and two hours of electricity each day from a generator. The irrigation system has created an oasis in the dry surroundings, so vervet monkeys come there to feed on fruit. You have to get used to the insects and the other small creatures. Before you get dressed you've got to turn your boots upside down and tap them, so as to empty out any scorpions that might have hidden in them.

"'Toby's place' lies 20 hours by bus and boat from Lusaka, the capital city of Zambia. In order for local researchers to be able to profit from our work too, we work together with colleagues from the University of Lusaka and with the local fishing authorities. This year, we managed to explore the Zambian coast of the lake with a boat. Our captain was Heinz Büscher from Pratteln in the canton of Basel-Landschaft, a retired cichlid expert who makes underwater films and who has discovered sixteen new

species of fish. Büscher always spends the night on his boat. Together with my colleagues Walter Salzburger and Adrian Indermaur, I slept at night on the beach or in the villages. The people live from the lake and the fields. They mostly laugh at our sun lotions and our antimalarial medication. A local said to us: 'Malaria isn't my friend, but it's my constant companion', and almost everyone suffers from malaria for a few weeks each year. The diet there consists of maize porridge or rice and fish. It's hardly worth eating cichlids because most of them are so small; the large ones taste all the better, however. I did see children with bloated stomachs, too. But mostly the people look happy, and everyone is very interested in the work we are doing.

"I'm planning three more expeditions to the shores of the lake in Tanzania and Zambia. Then we can analyse the genome of most of the cichlids. The species in Congolese territory are a problem for us, because the political instability in the country means we can't go there. So, we have to collect whatever we can from the aquariums of the world."

As recorded by Valentin Amrhein.

Top left: Fabrizia Ronco diving in Lake Tanganyika
Above: Holding the common tilapia.
Left: *Ctenochromis horei*, *Lamprologus callipterus* and *Plecodus straeleni*.
Right: *Neolamprologus fasciatus*.
Below: Together on expedition: the captain Heinz Büscher (left), the lead researcher Walter Salzburger and the doctoral students Fabrizia Ronco and Adrian Indermaur.
Photos: Adrian Indermaur

Alana Saarinen (15) is one of about 40 children concieved via a cytoplasmic transplant, meaning she has two genetic mothers. In 2002, the USA banned this procedure, which, unlike mitochondrial transplants, is used in cases of infertility.
Photo: Keystone/Magnum Photos/Alec Soth

The fear of a divided mother

For some people, the child with three parents is a horror-film scenario. Others hope that mitochondrial donation will help to avoid serious hereditary diseases. While the United Kingdom is forging ahead in reproductive medicine, Switzerland is biding its time. *By Florian Fisch*

In February 2015, the United Kingdom became the first country in the world to allow mitochondrial donation. This expansion of *in-vitro* fertilisation means that serious hereditary diseases can be prevented (see 'Replacing defective cell components'). These diseases are transmitted from the mother to the child by means of tiny cell components called mitochondria.

Mitochondrial donation means simply that the pathogenic mitochondria are replaced by the mitochondria of a donor – a spectacular success for reproductive medicine. Although mitochondria only make up 0.1% of our genetic material and have no impact on any known features of our appearance or personality, people still often talk of 3-parent children. Because however tiny this proportion might be, the donation does alter future generations. "Manipulating the germ line is still generally taboo and forbidden by law", says Andrea Büchler, a legal scholar at the University of Zurich.

Different speeds

The British parliament does not regard mitochondrial donation as an alteration of the germ line and so is taking a pioneering role in this matter, as so often before in reproductive medicine. Switzerland, also typically, is lagging behind. "We're in a German-speaking island", says Barbara Bleisch, an ethicist at the University of Zurich. "Countries such as the UK, Belgium, Spain, Portugal and those of Eastern Europe are much more liberal in this".

In Switzerland, artificial insemination and sperm donation are allowed, but egg donation is forbidden – and so mitochondrial donation is banned, too. For Bleisch, who would like to legalise egg donation, this is bound up with a conservative image of the family. "They want to prevent 'splitting up' motherhood at any cost". In contrast to paternity, maternity has until now always been regarded as something secure, but the progress being made in reproductive medicine is raising more and more questions about it, because mitochondrial donation now means a second genetic mother appears on the scene. Whereas people have always had to accept that there are potential uncertainties in issues of paternity, which is why sperm donation is allowed.

The skills of reproductive medicine

In the UK, the first ever test-tube baby was born way back in 1978. Four years ago, the British regulator of fertility clinics and embryo research, the Human Fertilisation and Embryology Authority, convened a panel of experts to review new evidence. The result was an amendment to the law on artificial fertilisation, which was passed in February. Mitochondrial donations are now permitted but only on a case-by-case basis that must be monitored by doctors to ensure the safety of the procedure.

The Catholic theologian and ethicist Markus Zimmermann of the University of Fribourg thinks that all this is going too quickly and with too little reflection. He is especially critical of the piecemeal approach of doctors of reproductive medicine. "We're regularly asked to vote about the next small technical step, but there's never any debate about the fundamental question of whether these things should be allowed at all". His current example is the planned approval of preimplantation genetic diagnosis that will be subject to a referendum on 14 June 2015.

Is it necessary?

"We have to ask ourselves what we mean by 'ill' and 'healthy'", insists Zimmermann. Hereditary mitochondrial disease can also be prevented by simply not having children, by adopting or by an egg donation, he says. For example, he would like to see a research programme set up to look into the social consequences of reproductive medicine.

> "We have to ask ourselves what we mean by ill and healthy".
>
> Markus Zimmermann

The difference between the UK and Switzerland also has its origins in their respective bioethics cultures, says Büchler. "The discussion in Continental Europe is deontological in nature. People are afraid that human dignity will be exploited and injured. In Anglo-American countries, the utilitarian approach that dominates is oriented to how useful something is to the individual".

Bleisch tends to support the Anglo-American approach. "In a liberal society, it's problematic to forbid something". It will certainly be many years before mitochondrial donation will be allowed in Switzerland. But even Zimmermann, a theologian whose approach is more 'continental', is convinced that "there's little time left for discussion".

Florian Fisch is a biologist and a science editor at the SNSF.

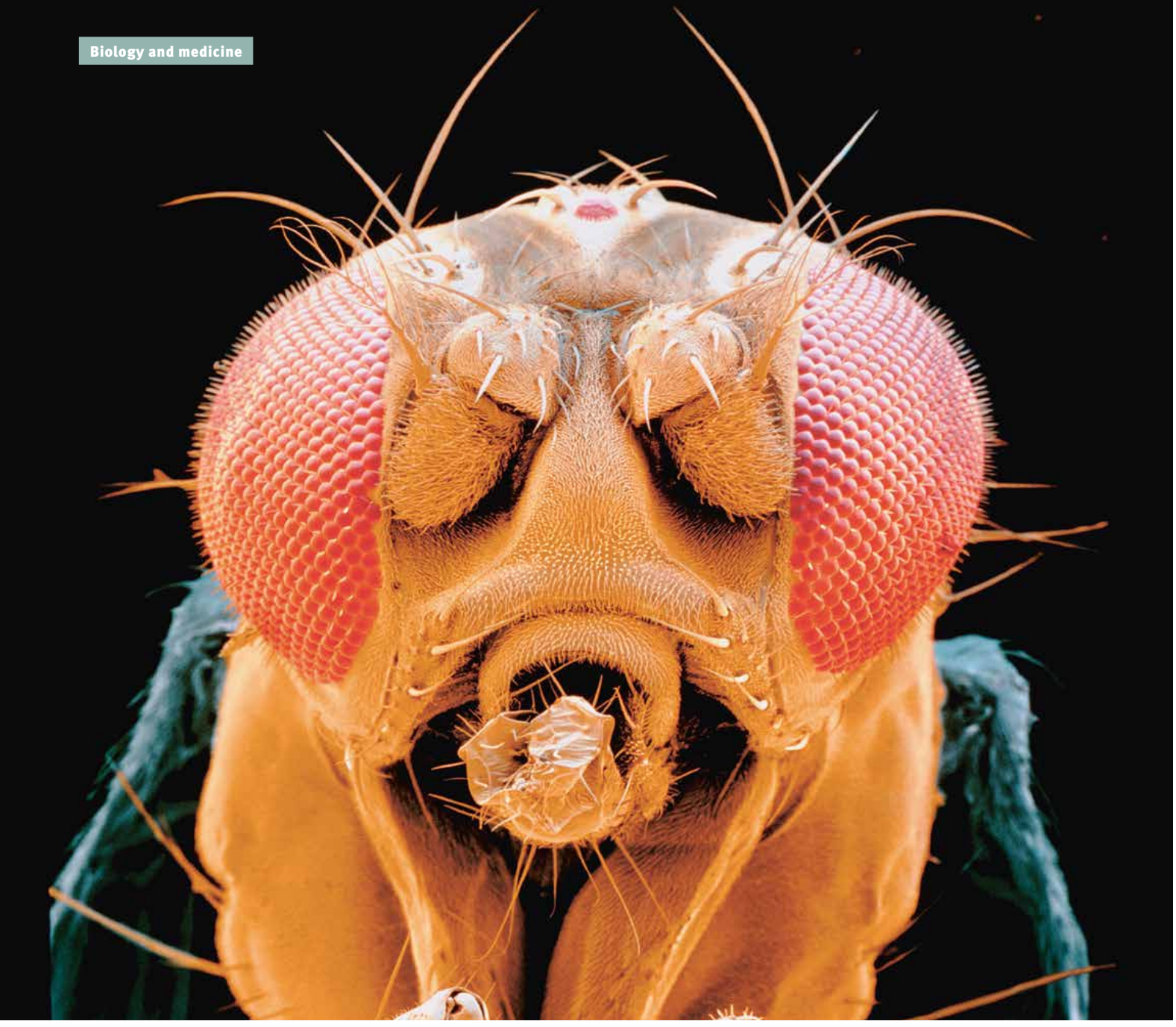
D. Paull et al.: Nuclear genome transfer in human oocytes eliminates mitochondrial DNA variants. Nature, 2013.
Novel techniques for the prevention of mitochondrial DNA disorders: an ethical review. Nuffield Council on Bioethics, 2012.

Replacing defective cell components

Every one of our cells holds over a thousand mitochondria, which are often described as the 'power houses' of our cells. They contain their own genetic material and are passed on from mother to child though egg cells.
Roughly one out of every 6,500 children suffers from a serious, hereditary mitochondrial disease. The organs with high-energy requirements are especially affected. It can lead to brain damage, muscular atrophy, heart failure and blindness. These illnesses are not curable, and most of those affected die during childhood.
In order to prevent these illnesses, the mitochondria in the egg cells can be replaced. In practical terms, this means transplanting the cell nucleus with 99.9% of the mother's genetic material – including the mitochondria – into an egg cell of a donor from which the nucleus has been removed. This can be done either before or after fertilisation; both have been allowed by the British parliament. In strictly genetic terms, the child then has two mothers: a 0.1% mother and a 99.9% mother.

No longer hypothetical dangers

Besides the usual risks involved in artificial fertilisation, mitochondrial donation also brings new ones with it. The mitochondria and the rest of the cell work closely together. Paul Knoepfler, a stem cell researcher at the University of California Davis, fears that the procedure could result in disabled children and stillbirths on account of genetic misunderstandings between the cell nucleus and the mitochondria. However, in tests in mice and rhesus monkeys, the method has until now only produced healthy offspring.
It is also possible, however, that a small portion of the pathogenic mitochondria could be transplanted into the healthy egg cell along with the cell nucleus. That would make the method useless. Dieter Egli of the New York Stem Cell Foundation Laboratory has demonstrated that this portion is extremely small. Nevertheless, this possibility has to be checked by means of genetic diagnosis before the embryo is implanted. He doesn't share any of Knoepfler's fears. For Egli, it's quite clear: "The risks of mitochondrial donation that are being discussed are hypothetical. But the danger of deadly disease, on the other hand, is very real".



Laboratory experiements have managed to extend the life expectancy of the fly by 50 percent. Photo: Keystone/Science Photo Library/Eye of Science

Who wants to live for ever?

No one's ever going to find the Holy Grail. But Swiss researchers are searching for the ingredients of longer life – and they're looking for them in the genes of flies and ants.
By Simon Koechlin

Everyone would like to have a long life, but no one wants to grow old", wrote the Irish writer Jonathan Swift back in 1700. Nothing has changed since then. To be sure, people today live longer than ever before, thanks especially to improvements in nutrition and hygiene and to our immense progress in medicine and healthcare provision. But we still all grow old. As the years go by, the general condition of the body deteriorates. Our susceptibility to illness increases and with it the risk of dying too.

But why? Evolution has brought forth an extremely complex, regulated process of development that takes us from the fertilised egg to the finished individual. Once a body is fully developed, why shouldn't it be possible for natural selection to keep it in a youthful state into old age – or even for ever? Why aren't organisms immortal?

"These questions were already being asked in ancient times", says the biologist Thomas Flatt from the University of Lausanne, who is researching into the evolution of ageing. The Roman poet and philosopher Lucretius, for example, assumed that death serves to make space for new generations. This view was only superseded in the mid-20th century when the modern evolutionary theory of ageing was developed.

Survival of the oldest

The theory explains the evolution of ageing in terms of the natural selection of individuals, not in terms of advantages for the species. It assumes that life is 'life-threatening' in the truest sense of the expression. In nature, sooner or later almost all individual creatures become victims of predators, competitors, pathogens or accidents. This means that natural selection hardly continues to play a role in old age.

Let us suppose that a human being has two deadly mutations in his or her genetic material, of which the first will lead to death after 20 years, the second only after 90 years. Selection means that the first mutation will quickly disappear from the population because those who carry it will hardly have any children. The second mutation, on the other hand, has no impact on how many offspring a human being might have in life. "For this reason, mutations can accumulate in the genome over the course of the generations – mutations that will only cause damage late in life", says Flatt. If living conditions improve (such as better nutrition, for example) and individuals live longer, then this long-term genetic damage can manifest itself, and health will decline in old age.

According to Flatt, this means that ageing is ultimately unavoidable. In fact, experiments and mathematical models all indicate that ageing even occurs in bacteria and other single-cell organisms that were long thought to be immortal. Nevertheless, says Flatt, there are still many unanswered questions, and he himself is investigating several of them. Using the fruit fly *Drosophila melanogaster* as an example, Flatt is trying to find out what genes and what physiological mechanisms contribute to certain individuals living longer than others.

Limited immune system

Flatt's research includes looking into the function and activity of genes in flies. The most long-lived have been bred over a period of more than 30 years. On average they live for 70 days compared to the 45 days that are the norm for laboratory flies. "We found a strikingly large number of differences in the genes responsible for the immune system", says Flatt. He doesn't yet know just what impact these differences have on the life span of the flies. But it's interesting, he notes, that the short-lived flies increase their immune response as they grew old, and this can lead to chronic inflammation. Long-lived flies, on the other hand, seem initially to have a more active immune system, but they reduce it in old age.

> "They can invest their energy either in reproduction or in survival".
>
> Thomas Flatt

It's not just the immune system that influences life span – the reproductive process does so too. Every individual has only a limited amount of energy available. Using up lots of it for reproductive purposes deprives the organism of the energy needed to survive. Researchers have been able to demonstrate this clearly among fruit flies. If one selects fruit flies for their ability to reproduce very late in life, then their life span doubles after a few generations. "But on the other hand, these flies have problems if they're supposed to produce offspring early in life", says Flatt. "They can invest their energy either in reproduction or in their survival functions, but not in both". This 'trade-off' principle, as the experts call it, is ubiquitous. One extreme example is that of the Pacific salmon, which is so exhausted after spawning that it then dies.

However, there are exceptions that give the researchers serious headaches. The queens of several social insects don't just continually produce eggs: they also live much longer than non-social insects. The garden ant (*Lasius niger*), for example, which is widespread in Switzerland, has queens that can reach 30 years in age – that's 500 times longer than the average, says Laurent Keller, an ant specialist at the University of Lausanne. No one knows how queen ants manage to do this. In order to find out, Keller's group is currently investigating the gene activity of queens of different ages.

The price of anti-ageing

However, it would be a bit extreme to hope that the genetic material of an ant might offer up the source of eternal youth. Because for one thing, the queen ant profits from a very special form of protection: the ant state erects a veritable fortress in which she is guarded from enemies and other outside influences. And better protection means longer life – that's proven by studies of various animal species. "Poisonous snakes live longer than non-poisonous ones; turtles with a shell live longer than those without one; and birds that can fly live longer than flightless birds", says Thomas Flatt.

Furthermore, there are many indications that there are always costs involved in living longer – even if they're not immediately obvious. A good example, says Flatt, is a mutation in the roundworm *Caenorhabditis elegans*. Worms with this particular gene variation live for a very long time and have no problems with fertility. But when researchers forced these mutants to grow up in competition with wild worms, they lost the battle for survival every time and died out. "We still don't know why to this day", says Flatt. "But this mutation obviously has some disadvantage too".

Simon Koechlin is a science journalist and the Editor in Chief of the magazine Tierwelt.

Something in the air

Epidemiologists are using increasingly precise means to determine just how much fine dust we inhale. This may help us to find out more about the health risks of these particles. *By Angelika Jacobs*

Centralised monitoring of air pollution says little about individual health risks. Photo: Valérie Chételat

There are hundreds of scientific publications describing the health effects of breathing in the fine dust and chemical compounds that arise principally from combustion processes. It seems obvious to everyone today that air pollution contributes to respiratory illness, but in fact such links are difficult to prove.

One major criticism of epidemiological studies on air pollution is that they rely on data from just a few central measuring stations that don't necessarily reflect the actual exposure of the participants in the study. The concentration of pollutants can vary greatly according to location.

Individual exposure

For some time now, epidemiologists have been focussing particularly on so-called ultrafine particles (UFPs). Their very small size – less than 100 nanometres – means they can enter the bloodstream and quite possibly even advance into the brain. However, the health effects of this fine dust have been little researched until now. UFPs are distributed very unevenly in the air. So when epidemiological studies use data gathered at a central measuring location, there's no way to be sure just how reliable it is.

This issue has been under investigation by Nino Künzli and Reto Meier of the Swiss Tropical and Public Health Institute (SwissTPH) in Basel. They have compared UFP measurements from central reference stations in 80 residential locations. Their research is part of the Swiss Cohort Study on Air Pollution and Lung and Heart Diseases in Adults (SAPALDIA) headed by Professor Nicole Probst-Hensch. "The measurements can differ by a factor of two and more", says Meier. UFP concentrations depend on the distance from the emission source, which is primarily road traffic. This is why attention has to be paid to the proximity to roads and to the wind direction when choosing locations for making representative measurements.

Indoor air, outdoor air

All the same, doubts remain as to just how representative such data really is. Most people spend a large portion of their time indoors, but most measurements have always been made in the open air. This is why Meier and his colleagues have also investigated the connection between the air quality in living spaces and the air quality outside. Exposure inside buildings was generally rather lower, but in fact correlated pretty well with measurements made outside during the course of the day. As Meier explains, this means that data from outside measuring stations could actually allow us to estimate the concentration of indoor pollutants. "But there are also sources of pollutants in people's apartments. UFPs occur while cooking, for example". So there was a clear, corresponding rise in air pollution indoors at mealtimes, namely at midday and in the evening.

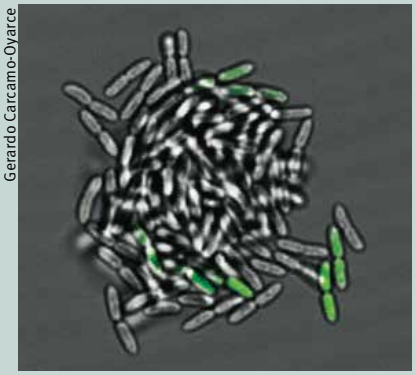
There has already been a series of studies on the relationship between indoor and outdoor air quality, says Josef Cyrys of the Environmental Science Center at the University of Augsburg, who was not involved in the current project. "But the available data is meagre, especially on UFPs, and every new study helps us to get a clearer picture". However, what he finds the study lacks is a perspective on how the new findings might be useful to epidemiologists.

Reto Meier cautions that this question can become exceedingly complex. Particles indoors can also be composed differently from outdoor particles. "These contrasts will probably only become greater in future, as buildings are constructed or renovated according to new energy standards and become more and more sealed off from the outside", confirms Künzli. In future, people will be able to carry out personal pollutant measurements with their smartphones. This, says Künzli, will open up whole new possibilities for matching the impact of particles to their different sources.

Angelika Jacobs is a science journalist and is currently working for the Neue Zürcher Zeitung.

R. Meier et al.: Ambient Ultrafine Particle Levels at Residential and Reference Sites in Urban and Rural Switzerland. Environmental Science & Technology, 2015.

R. Meier et al.: Differences in indoor versus outdoor concentrations of ultrafine particles, $PM_{2.5}$, $PM_{absorbance}$ and NO_2 in Swiss homes. Journal of Exposure Science and Environmental Epidemiology, 2015.



Gerardo Carcamo-Oyarce

Green for go: the coloured bacteria pack their bags and leave (microscopy).

Population density and bacterial emigration

Bacteria are often regarded as no more than primitive single-cell organisms. But even they display social behaviour: these tiny beings communicate with each other by means of chemicals, learning how many sister cells are situated in their proximity. Biologists speak of 'quorum sensing'. Just like decisions in the Roman Senate needed a quorum, i.e., a minimum number of senators present, bacteria also alter their way of life according to their density.

Rolf Kümmerli and Leo Eberl of the Institute for Plant Sciences of the University of Zurich have found out that bacteria of the genus *Pseudomonas putida* move away when they notice that there's too many of them in too small a space. They excrete a soap-like product called putisolvin that dissolves their comfy home – a slimy biofilm – and then set off on their own to find a new place to feed and nest.

Until now, it was thought that quorum sensing primarily steered cooperative behaviour, such as in the case of the symbiotic microbes in the photophore of the bobtail squid. Only when these bacteria, of the genus *Aliivibrio fischeri*, have achieved the necessary density do they use their energy to produce light. Later, this cooperation was discovered in the production of fruiting bodies and biofilms. Now it's clear that population density can also promote asocial characteristics. "This means quorum sensing is actually far more complex than we had suspected", say Kümmerli and Eberl. *Ori Schipper*

—

G. Cárcamo-Oyarce et al.: Quorum sensing triggers the stochastic escape of individual cells from Pseudomonas putida biofilms. Nature Communications, 2015.

More brain cells for tame foxes

Dogs are less aggressive than wolves, and less afraid of people. This tameness has been bred into our domestic animals and is therefore anchored genetically. Researchers at ETH Zurich and the University of Zurich have now shown that tame silver foxes create more brain cells than their wild relatives – and this happens in the hippocampus: the old, phylogenetic area of the brain that serves to control the stress hormone cortisol. Cortisol is responsible for rapid reactions in dangerous situations that have elicited the fight or flight response.

The researchers suspect that forming these new cells reduces cortisol levels in the blood. Precisely why silver foxes were chosen for this study is explained by Irmgard Amrein of the Institute of Anatomy of the University of Zurich: "Some of the foxes were specifically bred to be tame at a research institute in Novosibirsk, Russia, and grew up under the exact same conditions as their untamed relatives". Other animal species don't allow for such a direct comparison. The tame foxes behave rather like dogs, says Amrein. However, it's not yet known whether the increased formation of brain cells is a result of their tameness, or a cause of it.

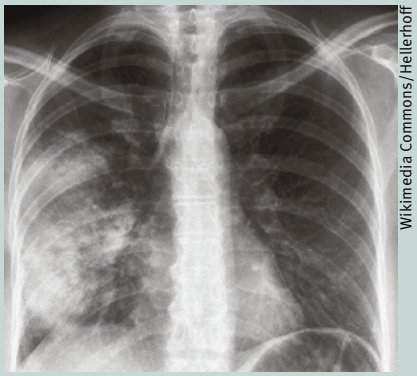
Thanks to newly created cells, the brains of domestic animals clearly adjust quicker to their environmental conditions than do those of wild animals. Even tame mice can create new brain cells, such as when training in a wheel. Wild mice lack this ability to adjust at short notice. *Thomas Pfluger*

—

S. Huang et al.: Selection for tameness, a key behavioral trait of domestication, increases adult hippocampal neurogenesis in foxes. Hippocampus, 2015.

Shihhui Huang

The role of the hippocampus in stress management: no exception for foxes.



Wikimedia Commons/Hellerhoff

Anti-inflammatories may be of help to the lungs.

Healing pneumonia quicker

Pneumonia is one of the world's biggest killers. Despite the availability of good medical treatment, it has still had a mortality rate of ten to fifteen percent in recent decades. Researchers have therefore endeavoured in vain to halt the progression of the disease and reduce mortalities.

But a promising new therapy has been developed by a team of doctors and researchers at the Basel University Hospital. And a clinical trial has been able to reduce the average hospital stay from seven to six days.

For this study, 800 people with pneumonia were given either a placebo or the anti-inflammatory drug prednisone – a synthetic relative of the hormone cortisone. Both have a dampening effect on the body's immune system. "Pneumonia can lead to an overreaction on the part of the immune system, which can damage lung tissue", says Mirjam Christ-Crain, the Head of Studies and deputy head doctor at the Basel University Hospital.

Prednisone was able to neutralise this overreaction, and the patients recovered quicker. It took just three days instead of the usual four and a half for the fever to dissipate and for breathing frequency and blood oxygen levels to return to normal.

Prednisone had no statistically proven impact on the complications that can arise from pneumonia, which in the worst cases can lead to death. "But the trend was to a reduction in these complications. This is why we shall certainly be pursuing this approach further", says Christ-Crain. *Atlant Bieri*

—

Claudine A. Blum et al.: Adjunct prednisone therapy for patients with community-acquired pneumonia: a multicentre, double-blind, randomised, placebo-controlled trial. The Lancet, 2015.

Valérie Chételat

“The European Union must be democratised”

With the victory of Syriza in Greece, the dogma of austerity has once again been called into question. For the political scientist Yannis Papadopoulos, the success of Eurosceptic movements is a warning sign. *By Benjamin Keller*

The European Union is going through a politically sensitive time. Its policies are being brought into question from within its own walls. This January in Greece, the extreme left party Syriza won legislative elections on the back of a campaign against the austerity measures demanded by the European Commission, the Central European Bank and the International Monetary Fund.

Austerity – in the form it has been applied – was not a good remedy, says Yannis Papadopoulos, professor of Political Sciences at the University of Lausanne. He nevertheless uses the words 'irresponsible' and 'Greek political parties' in the same sentence. He argues that given the rise in euro-scepticism, the European Union must lean further towards integration and democratising decision-making processes. In an interview with Horizons, he talks to us about the Greek crisis and discusses its consequences.

With hindsight, how do you see the victory of Syriza at the Greek legislative elections?

The vote against the incumbent government, and for that matter any party identifying with their policies, was fuelled by austerity measures. But voters, often fresh out of hope and feeling frustrated, were also wooed by Syriza's many promises.

So, is this vote purely a reaction against the European Union's policy?

Not only that. It's also a rap on the knuckles for the Greek parties that are widely seen as being corrupt. For example, a non-negligible number of votes has shifted from the right-wing party New Democracy to Syriza.

Syriza has also promised to renegotiate Greek debt, provide free medical care and even hike salaries and pensions. Is this realistic?

Certainly not. They have neither a coherent negotiation strategy with their European partners, nor any serious plan to finance such measures. Greek parties have a tradition of making promises in opposition, which they then forget about when they get into power, precisely because the promises are often excessive. Whilst they were in opposition some years ago, New Democracy made a firm stand against the measures imposed on Greece after it joined the euro. But no sooner than they came into power, they changed the party line. Greek political parties are quite irresponsible.

How do we explain this?

In terms of a somewhat populist political culture. Greek politicians have a strong tendency to scratch the backs of their clients and to blame problems on others. One part of the population will therefore be let down by the inability of Syriza to keep its excessive promises. But there will also be a margin of voters that are not easily convinced and who must have known that Syriza was not going to keep its promises.

"Greek parties have a tradition of making excessive promises".

Has the European Union employed the right strategy?

Greece has a serious public debt problem. It's not the fault of the European Union; it stems largely from poor management by previous governments. This is what needed to be tackled. That said, austerity policies are not the right solution either. They have hit already disadvantaged people in a system that has no real social protection floor. They have also hampered growth.

What were the alternatives?

A certain number of measures were needed, such as the reform and modernisation of the administration. It would have been better to have backed growth-friendly policies. But that's difficult given the Greek economy's structural weaknesses, including its lack of international competitiveness and of genuinely productive activities. There was also a need for more structural reforms, particularly in addressing certain sectors of the economy that still suffer from protectionism under the influence of powerful corporations, including those at the core of Syriza.

Do you mean liberalisation?
Liberalising certain sectors, yes, but developing the social protection floor also. This has been undertaken by neither the European Union nor the Greek authorities. And it is very unlikely that any change will come from Syriza. In fact, when it comes to the topic of reform, it seems it's ready to return to the pre-austerity status quo.

Why have such avenues not been explored?
For a long time there was consensus that austerity policies were the right solution for regulating overspending. Today politicians note that austerity is having significant negative effects. As for the Greek government, no incumbent has been able to bring about reform, nor have they wanted to, out of fear of losing votes in a highly client-oriented system.

> "Austerity policies have hit already disadvantaged people in a system that has no real social protection floor".

Do you think that Syriza can get the European Union to change its approach?
I don't think so. The dogma of austerity has been brought into question, but that was not because of Syriza. It's an isolated party, and it has no real allies.

Brussels is often seen as being intransigent in its negotiations with Member States.
Intransigence is rightly seen when the divergent opinions come from unallied parties that are standing up to a widely homogenous bloc that, in turn, is opposed to them and that wants to re-establish order. This is a little like the problem faced by Switzerland.

Following the referendum of 9 February 2014 on immigration?
The European Union is sticking to the principal that free movement is non-negotiable. This is how they are tackling the separatist tendencies amongst Member States. The United Kingdom, for example, has expressed its reservation with regards to free movement.

Euro-sceptical parties came out of the 2014 European elections well. Can we talk of the European Union collapsing?
This success is a clear warning sign for integrationists. Nevertheless, whilst these parties have strengthened, they are still in the minority. The two large blocs of the centre-right (the European Popular Party) and the centre-left (Progressive Alliance of Socialists and Democrats) continue to form the basis of the system.

What should Brussels do?
There should be more integration, first, but integration needs to be democratised. The elephant in the eurozone is still the co-existence of decentralised economic governance and a common currency. Some steps have been taken to address the democratic deficit, but it seems there is little sign of this filtering into public opinion.
The European Parliament, which is directly elected by the citizens of Member States, has been given much more power in the legislative process. Another example is the current European Citizens' Initiative. But it doesn't have the binding effect of Switzerland's direct democracy, so civil society organisations have their work cut out if they are to breathe life into what is otherwise a 'paper tiger'.

Is the European Union too technocratic?
'Eurocrats' often get the blame, but the bureaucracy in Brussels is actually relatively underdeveloped. If anything, this is more about peoples' perceptions. Citizens think that decisions are made in Brussels by technocrats who are far removed from the issues. But really a large sway of these decisions come on the back of national preferences being voiced by EU members.

Why is there so much misunderstanding with regard to the functioning of the EU?
For a long time, it was possible for things to carry on without there being any real debate on integration. This is no longer a viable strategy. There is also the problem of clarity, because the way the EU works is complicated. This complexity originates in the diversity of the continent. What's more is that the European media are largely orientated towards their respective national landscapes, and therefore focus on national issues. We're still missing a real European public space.

Benjamin Keller is a freelance journalist based in Geneva and Tunis. He holds a degree in International Relations.

Switzerland, Greece and Europe

Yannis Papadopoulos is a citizen of Switzerland and Greece. The 55-year-old is a professor in Political Sciences at the University of Lausanne, a post he has held since 1990. His research focuses on politics in Switzerland and Europe. Since 2012, he has co-edited the *European Journal of Political Research*, a leading international journal on political science. He is also a member of the Research Council of the Swiss National Science Foundation.

Big wide eyes are a life insurance policy

Rosy, chubby cheeks and big wide eyes – no doubt every one of us has at some point cooed at the cuteness of a baby. Evolutionary biology teaches us that it's eminently sensible to pay attention to cute babies, because those that are attractive and healthy have a better chance of survival than sickly children. Today, of course, this effect is no longer a matter of life and death, but having a strong bond with the caregiver still offers a child the best chances for its future wellbeing.

Janek Lobmaier from the Institute of Psychology at the University of Bern has found out that women can recognise subtle differences in baby faces better than men. Women perform even better at this when they're ovulating. Lobmaier suspects that at the heart of this is oxytocin, the so-called 'cuddle hormone' that is released during both ovulation and childbirth. It strengthens the emotional bond between mother and child and is also released in men when they become fathers. Lobmaier's latest research results suggest that when men are given oxytocin, they have the same response as women to the 'cuteness' of babies.

The baby pictures for this study were taken from the Internet and their degree of cuteness was initially judged by experimental subjects. The pictures of the cutest babies and those of the least cute were then averaged out using a computer program and subjected to incremental steps to make them cuter or less cute. So the babies on the photos only display very subtle differences. Nevertheless, you have to admit that they're actually all pretty cute. *Anna-Katharina Ehlert*

—

J.S. Lobmaier et al.: Menstrual cycle phase affects discrimination of infant cuteness. Hormones & Behavior, 2015.

Perception Lab

Small but important: the effect produced by the baby on the right is different.

Wikimedia Commons

Part of Switzerland's 19th-century entertainment industry: Lucerne's Lion monument.

Switzerland in a nutshell

It might have been little more than a sleepy little town in the 1850s, but by the 1880s Lucerne had developed into the main tourist attraction of Central Switzerland. The 'tourism mile' in Lucerne's Wey district offered the Lion monument (inaugurated in 1821), the Glacier garden (1873), the Bourbaki panorama (1889) and the International Museum of War and Peace (1902), and altogether they attracted hordes of tourists from both Switzerland and abroad.

"This 'tourism mile' is unique on the Swiss tourist scene", explains the literary scholar Andreas Bürgi. There is no other place that can boast such a concentration of attractions set up specifically for tourists, with its souvenir shops, its photo studios, its restaurants and evening entertainment. This tourism mile served as a laboratory for the burgeoning entertainment industry. "People tried things out to see what worked and what didn't", says Bürgi. In the process, they hit upon the things that actually attract tourists – and this list still applies today. Tourists love the Alps, idyllic lakeside landscapes, animals and traditions – but not problematical topics such as war and peace.

What was dished up for the tourists – who primarily came from Britain, Germany and France – was "an easily digestible Switzerland", says Bürgi. This was reflected in the choice of backward-looking topics focussing on bygone times, although they were presented thanks to the most modern financing models and using the latest technology. The local population also partly adopted this image of a congenial, contradiction-free, touristic Switzerland. "Certain political parties still enjoy success today with these picture-postcard images of Switzerland", says Bürgi. *Anna-Katharina Ehlert*

—

Andreas Bürgi: Luzern, Löwenplatz – eine touristische Bilderfabrik, Zurich (autumn 2015).

When the wolf fills in for our mother

Mediaeval literature has myths, similar to that of the founders of Rome, about abandoned babies being raised by wild animals. Along with her team, Yasmina Foehr-Janssens, a professor in mediaeval French literature at the University of Geneva, is researching into the meaning of interspecies nursing in the chansons de geste of the 13th and 14th centuries.

In La Belle Hélène de Constantinople, an exiled mother bears two children who are kidnapped by a lion and a wolf. Rather than eat them, the animals decide to adopt them. But as they are unable to provide the right care, they ask a female deer to nurse them and a hermit to watch over them. "These are imaginary elements of masculine maternity, with the character of the mother completely sidelined", says Foehr-Janssens. "This shows the concerns surrounding the transmission of the paternal lineage in the late Middle Ages".

Within the corpus, it is always male babies taken away by animals, just like the baby in the Lion de Bourges, who is adopted by a lion after being kidnapped from his mother. "We clearly see hero worship", says Foehr-Janssens. After all, who can doubt that a child nursed on cervine milk would become a superhuman?

Today we may laugh at these stories, but they are still "powerful levers for reflecting on the complexity of relationships between the animal and human kingdoms", she adds. Interspecies nursing is still a current topic. After all, many newborns receive formula from cow's milk, and nobody seems surprised. *Martine Brocard*

—

Y. Foehr-Janssens et al.: Représentations de l'allaitement au moyen âge: invisibilité ou prolifération matérielle et légendaire. Allaitement et pratiques de sevrage: approches pluridisciplinaires et diachroniques, 2015.

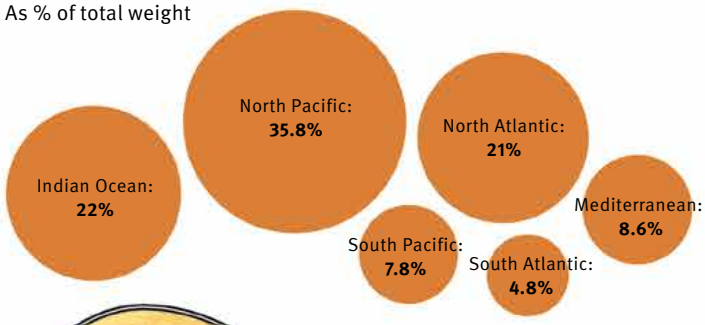
Städel Museum/U. Edelmann/Arthotek

St. Stephen, as depicted by Martino di Bartolomeo (1435), is nursed by a doe.

Soup of plastic

Countless tons of waste float on the surfaces of the oceans with devastating consequences for the environment.

Most affected: the North Pacific
As % of total weight

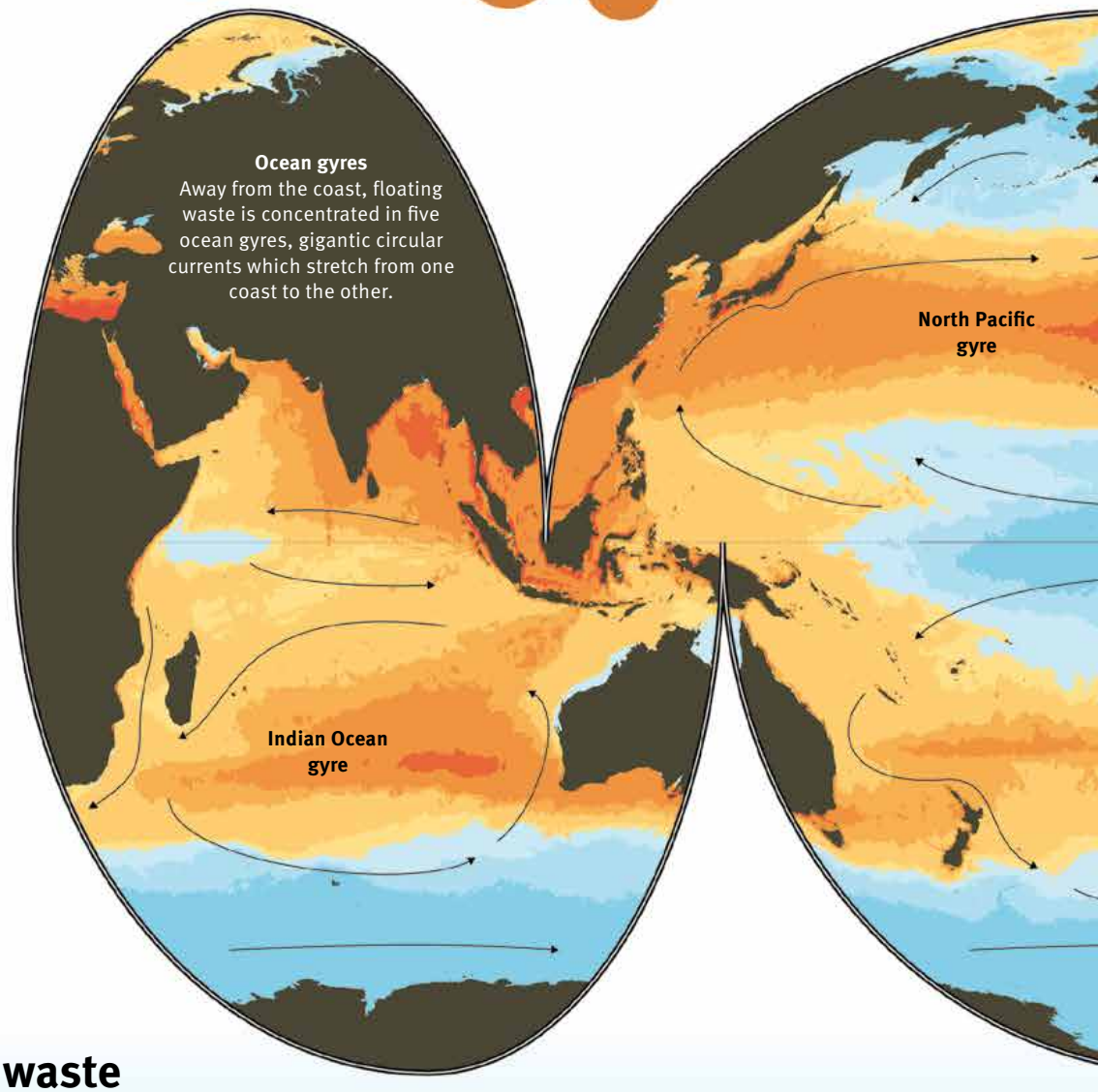


268,940 tons
The estimated total weight of the plastic waste

Floating plastic

- › 10,000 g/km²
- 5,000 g/km²
- 1,000 g/km²
- 500 g/km²
- 100 g/km²
- 50 g/km²
- 10 g/km²
- 1 g/km²
- ‹ 1 g/km²
- → Ocean currents

An international team coordinated by the Californian institute 5 Gyres has developed a model to evaluate the density of microplastic floating in the ocean.[1] Based on 24 sampling and visual information campaigns between 2007 and 2013, this very conservative estimate must be considered a minimum.



The life of a piece of waste

1. Leaving land
Plastic is taken from land to sea by wastewater, rivers and the wind or is thrown directly into the ocean from ships.

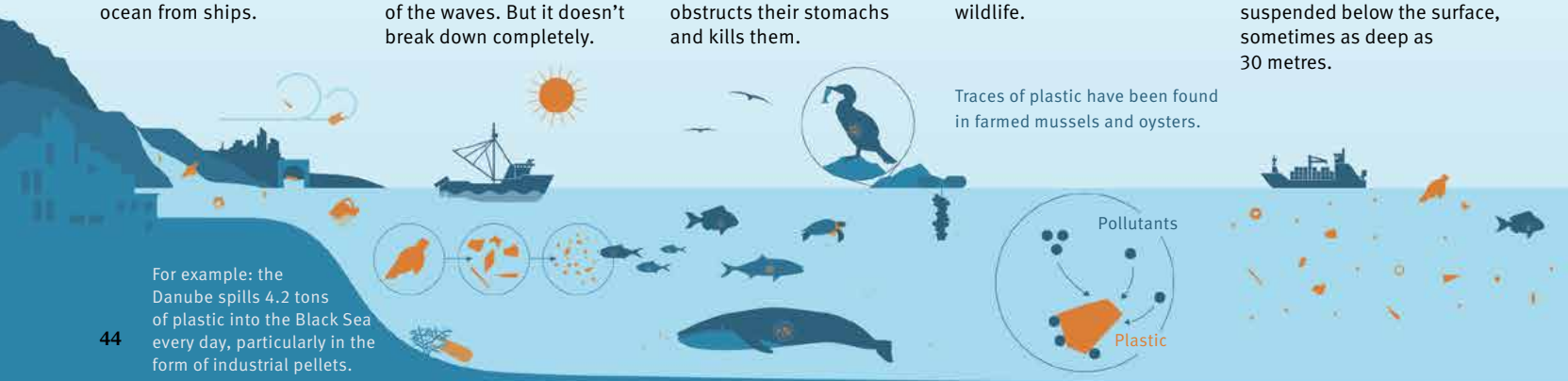
2. Fragmentation
Over the years, plastic breaks down into pieces under the effects of ultraviolet radiation and the force of the waves. But it doesn't break down completely.

3. Threatening animals
Birds, whales and also tortoises are some of the species that ingest plastic, which sometimes obstructs their stomachs and kills them.

4. Toxic sponges
The microplastic absorbs organic pollutants in the seawater, e.g. pesticides, which further poison wildlife.

5. Concentration
There is no such thing as the 'plastic continent' – it's just a myth. Above all, pollution is comprised of detritus suspended below the surface, sometimes as deep as 30 metres.

Traces of plastic have been found in farmed mussels and oysters.

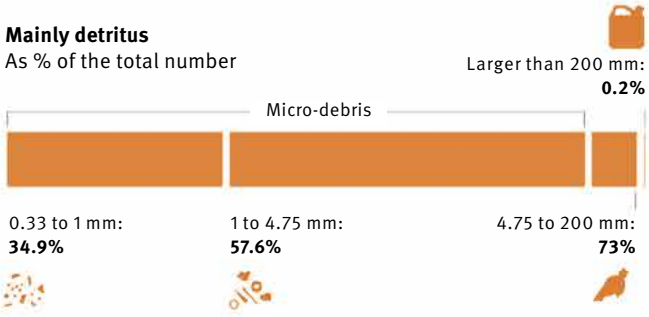


For example: the Danube spills 4.2 tons of plastic into the Black Sea every day, particularly in the form of industrial pellets.

5.25 trillion

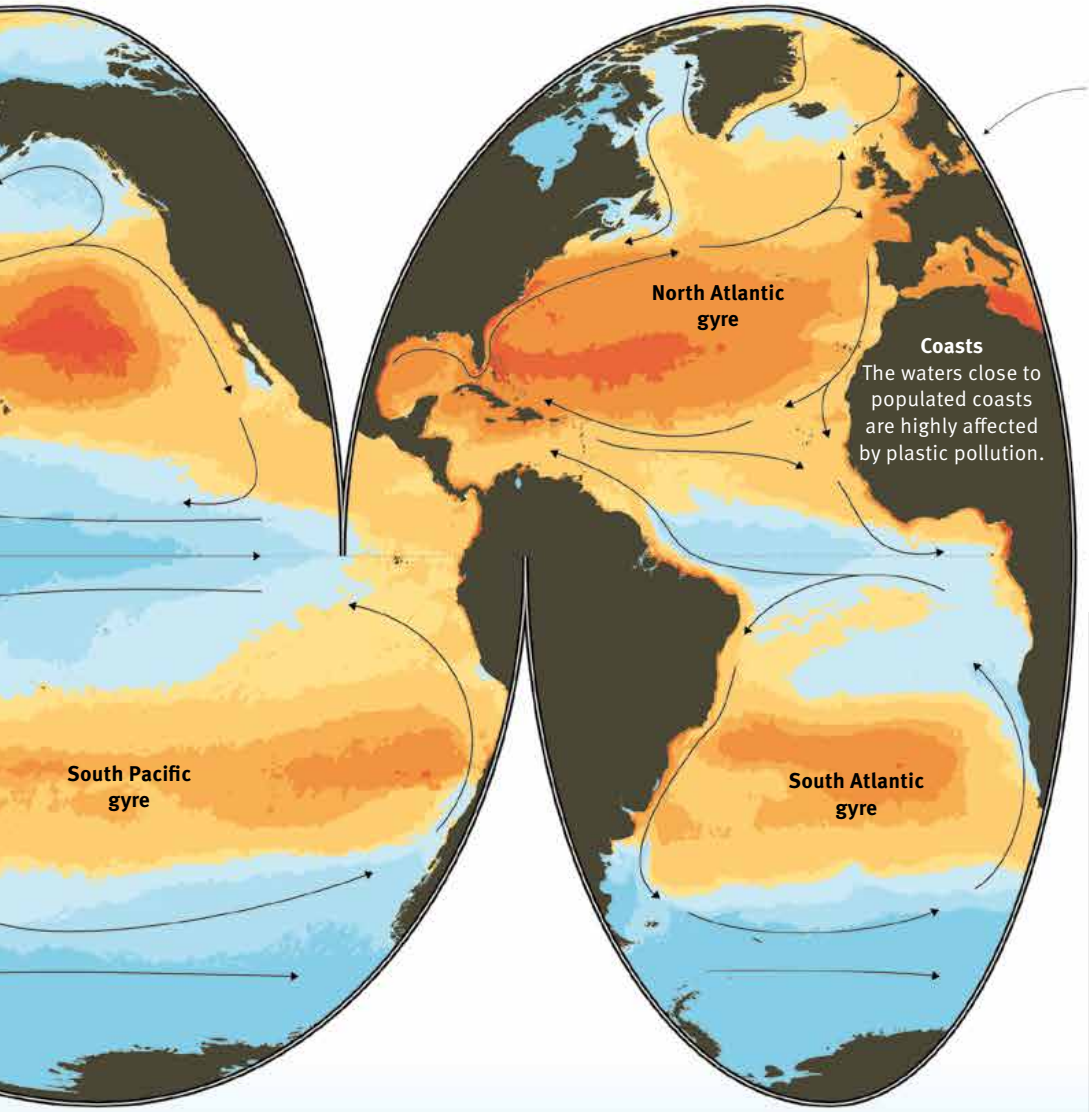
The number of pieces of floating plastic waste

Mainly detritus
As % of the total number



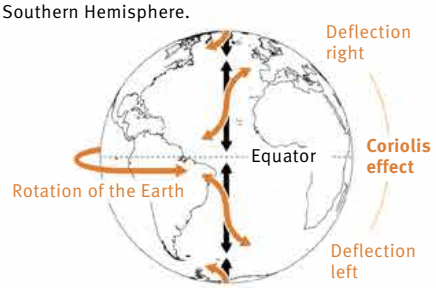
A legal no man's land

"On a global level, there is no adequate legal framework for the fight against plastic pollution" says Thomas Cottier, Professor of European and International Economic Law at the University of Bern. "The high seas belong to nobody. National legislation is often poorly applied and varies from country to country".



To minimise the distortion of the oceans' surfaces, this map uses an interrupted Mollweide projection, centred on the Pacific.

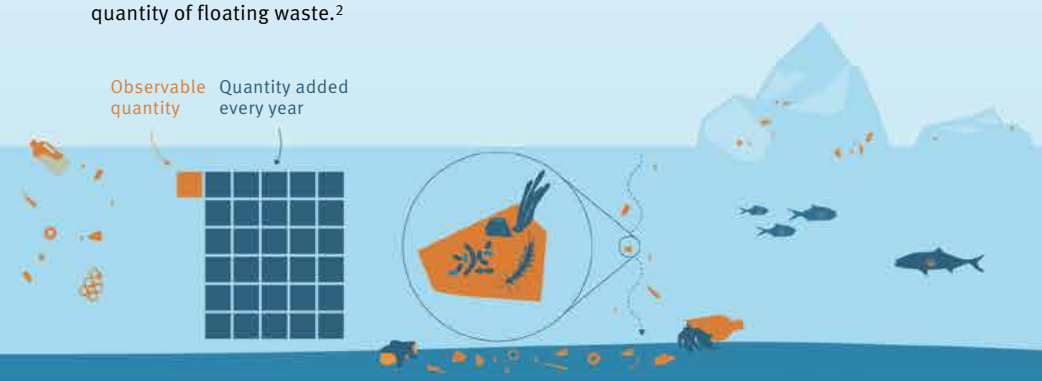
Coriolis force
Currents rotate in a clockwise direction in the Northern Hemisphere and anticlockwise in the Southern Hemisphere.



6. Where does the plastic go?
It is estimated that the mass of plastic carried from land into the oceans every year is in the region of 8 million tons, in other words 30 times more than the observable quantity of floating waste.[2]

7. Sinking to the bottom
The plastic can become hidden in the sediment of the seafloor. Once it is colonised by microorganisms it becomes denser and eventually sinks.

8. Freezing
Another hypothesis is that a large portion of it may be trapped in Arctic ice.



A Swiss expedition to probe the oceans

The Race for Water Foundation, based in Lausanne, is dedicated to preserving water and has launched a scientific expedition to study plastic pollution. A race catamaran left Bordeaux, France, on 15 March 2015 to visit the five oceanic gyres in 310 days. "Samples will be taken from the 12 island beaches most exposed to floating waste, including Easter Island, the Mariana Islands and the Azores", says Florian Faure, a researcher at the Central Environmental Laboratory of EPFL, where the samples will be analysed. The study will be supplemented by three-dimensional cartography of the coastal zones and the waste using a Sensefly drone, made by the Swiss start-up of the same name.

Infographic: Benjamin Bollmann.
Graphics and visuals: Dumpark
1 Source: M. Eriksen et al., Plos One, 2014
2 Source: J.R. Jambeck et al., Science, 2015

The power of self-organisation

Thanks to her work on a new type of solar cell, Rita Tóth has been named a Leading Global Thinker by the US magazine Foreign Policy. A researcher in physical chemistry at Empa, Tóth first thought this was a hoax, but instead she ended up attending a political forum in Washington. *By Florian Fisch*

Valérie Chételat

To capture the power in moth eyes". That is the reason why physical chemist Rita Tóth and four other scientists from the Swiss Federal Laboratories for Materials Science and Technology in Dübendorf near Zurich (Empa) and the University of Basel were listed among the 100 Leading Global Thinkers in the category of Innovators by Foreign Policy, a US magazine specialised in international relations. This also won them the attention of worldwide media such as The Economist and Le Monde.

What impressed the selection committee was the new type of solar cell designed by Tóth and her colleagues. It converts sunlight directly into highly concentrated chemical energy in the form of hydrogen gas – a kind of solar fuel. This would allow us to harness the power of the sun and, at the same time, to store energy that has been produced, when supply exceeds demand.

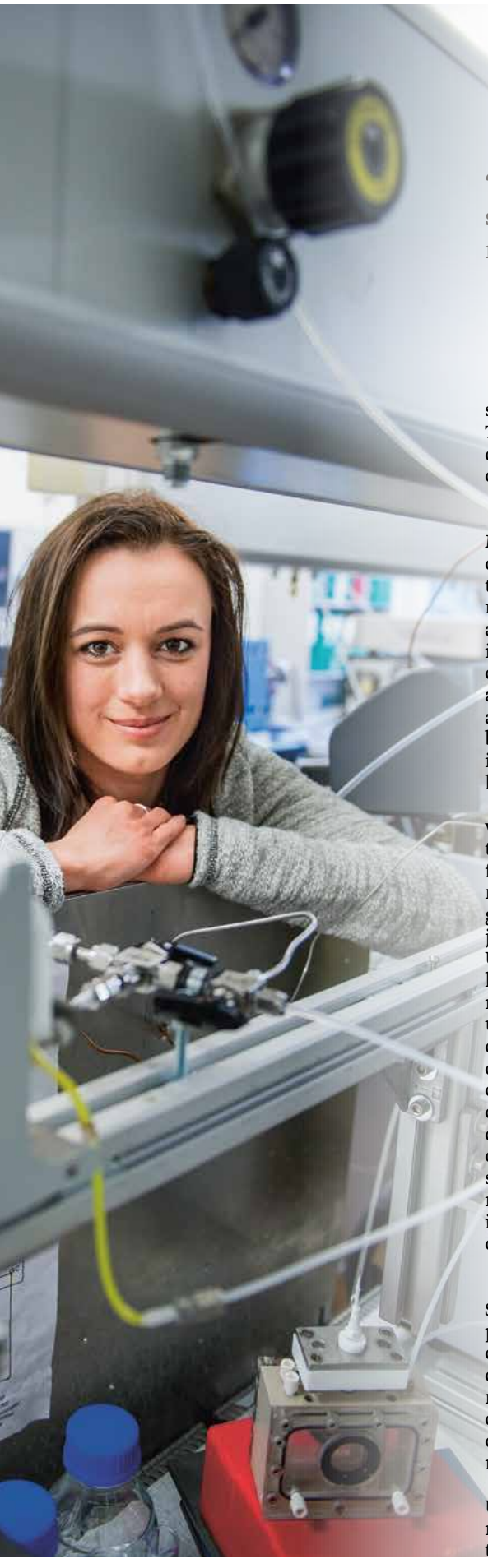
Hydrogen from the Sun

"When we received the letter from Foreign Policy we first thought it was a hoax", recalls Tóth. But then the Empa team indeed took up the invitation to attend a fancy political forum in a luxurious hotel in Washington D. C. By contrast, Tóth's modest demeanour does not really seem to suit someone who was mentioned in the same breath as the German Chancellor Angela Merkel (interestingly, a former physical chemist herself). Tóth is of small stature, is fine-featured and has a soft voice. When she explains her work, she makes it sound so normal that it is sometimes difficult to fathom its actual novelty.

The crucial part of the cell is a glass slide the size of a thumbnail, with a specially treated surface. To test its efficiency, it is plunged into a slightly bigger glass container filled with a salt solution. Here, to mimic sunlight, it's illuminated by a massive lamp the size of a shoe box.

The glass slide looks as if it has been sanded down. In reality, it is a fine layer of rusted iron and tungsten. Negatively charged electrons are struck off it by the photons of the sunlight, which leaves behind a positively charged 'hole'. The art of the physicist is to harness the potential of this separated state before the electrons and the holes can recombine: they have to reach the surface and interact with the salt solution at different locations in order to produce oxygen and hydrogen gas. These gases could subsequently be used to drive cars or to produce electricity.

"The novelty of our strategy is the way we structure the coating and thereby manage the light", explains Tóth. The light is trapped by small domes of rusted tungsten that are less than a thousandth of a millimetre wide. Florent Boudoire, the PhD student working with Tóth, found that trapping this light is also what happens inside a moth's eye. This is what helps it to see better at night while remaining less visible to predators – and this is also a nice story that has served to capture the journalistic imagination. "The size of the domes can easily be adjusted to tune light



"The novelty of our strategy is the way we manage the light".

scattering and light trapping", says Tóth. The additional thin layer of rusted iron on top of the domes further increases the cell's efficiency.

Chemicals as pathfinders

Mastering architectures like that of the coated domes is Tóth's expertise: "I am interested in the self-organisation of materials". This follows a bottom-up approach, as opposed to the top-down strategy that is used, for example, in the production of computer chips. The latter can be complex and expensive, the arrangement of materials being designed on a computer. "In the bottom-up approach, we just mix stuff and it happens spontaneously", she explains in her typical tone of understatement.

The Hungarian researcher warms up when the discussion turns to her core interest. "Self-organisation is everywhere: from flocks of birds and zebra stripes to human social behaviour and the formation of galaxies. It has the potential to have a major impact in technology and economics". Using this self-organisation principle, Tóth has enabled chemicals to find their way magically through a maze. The chemist used tiny channels to represent the streets of downtown Budapest on a device the size of a credit card. She filled them with a special mixture of alkaline and acidic chemicals to create a current, which automatically sucked a dye into the channels that offered the shortest path from the university to the pizza store. The article about this research was the most-read article of 2014 in Langmuir, an eminent journal of physical chemistry.

A self-organised life

Self-organisation also seems to be an appropriate way to describe Tóth's scientific career. She chose the University of Debrecen in the east of Hungary because it was relatively close to her family. As for her decision to do a masters thesis in physical chemistry, she says: "it was really choosing my teacher that led me to the topic".

Tóth later joined research groups in the UK because she had already been collaborating with them at an earlier date. When the time came for her to leave the UK, her options were Brandeis University in the US, where she was offered a position, and Switzerland, where her British partner found a job in the pharmaceutical industry. So this was another self-regulatory choice: "Switzerland was more or less halfway between both our families".

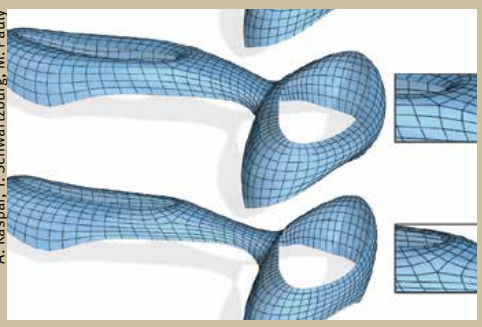
Florian Fisch is a biologist and a science editor at the SNSF.

100 Leading Global Thinkers

The US magazine *Foreign Policy* conducts an annual survey to select 100 Leading Global Thinkers. There are 'Agitators' like the Russian president Vladimir Putin, 'Decision-Makers' like the Indian prime minister Narendra Modi, but also 'Artists' and 'Innovators'. In 2014, Rita Tóth, her group leader Artur Braun, her PhD student Florent Boudoire, her colleague Jakob Heier and Edwin Constable from the University of Basel were distinguished in the 'Innovators' category , along with the inventors of a new gene-editing technique and the founder of the virtual-reality headset Oculus Rift. The Empa scientists were invited to a Foreign Policy symposium where the US Secretary of State John Kerry delivered a speech. Putin did not attend the forum.

Rita Tóth

Rita Tóth was born in Salgótarján (Hungary) in 1975. After finishing her PhD on chemical pattern formation at the University of Debrecen in 2002, she left academia to work in the pharmaceutical industry. Just one year later she was drawn back into research at the University of Leeds and the University of West of England, Bristol. It was there that she met her future partner, and together they moved to Basel when she joined Empa in 2009. In order to pursue her career in research, she has been awarded a Marie Heim-Vögtlin grant from the Swiss National Science Foundation. Tóth has two children.



B. Deng, S. Bouaziz, M. Deuss, A. Kaspar, Y. Schwartzburg, M. Pauly

An interactive algorithm tailors designs to take structural constraints into account.

Accelerating design *in silico*

The modern construction process often begins with a geometric profile on a computer. But these models often need to be changed later if they fail to take into account the restrictions imposed by construction materials and the assembly process. Researchers at the Ecole Polytechnique Fédérale de Lausanne (EPFL) have developed a way of speeding things up by using an interactive algorithm to adjust the design, thereby automatically factoring in building restrictions.

Design software allows architects to create outlines using a mesh model, assembling interlinked segments to define a geometrical frame. "If we add our tool to this software, we can immediately apply building restrictions to a complex frame in the form of a visual representation. This saves time during the design stage" says Mark Pauly, Director of the Computer Graphics and Geometry Laboratory at EPFL.

Using the mouse, the architect can define forces that act on the frame – e.g. those borne by a glass plate façade – and the algorithm modifies the geometry accordingly. There are limits to what this tool can do, says Pauly: "It's the user who must adapt the tool to the design scenario, i.e., define the geometric components and materials so that they can be described by the mathematical model". The medium-term plan for the researchers is to integrate their algorithm into architectural software. *Aurélie Coulon*

—

B. Deng et al.: Interactive Design Exploration for Constrained Meshes. Computer-Aided Design, 2015.

Photovoltaic bacteria

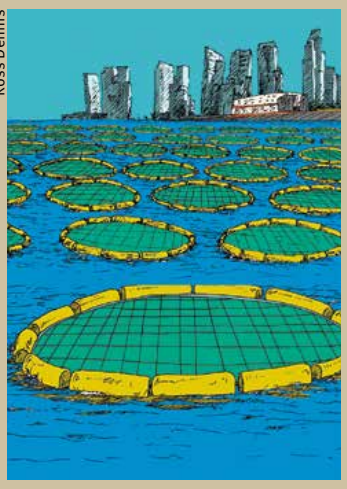
A team of researchers at the University of Cambridge including Thomas Muller, an SNSF-funded physicist from Zurich, has been able to produce electricity from a colony of cyanobacteria. This technology is still in its early days: they were only able to create power equivalent to 100 mW per square metre, a modest result compared to common solar cells but a record for biological photovoltaic cells.

The bacteria involved belong to the species *Synechocystis*, which is capable of photosynthesis. They were placed directly on the surface of a charged electrode that collects the electrons produced by bacteria that are exposed to light. The experimental setup only needs one specific component, a very special alloy for the anode and for the cathode plate; otherwise it runs with just water, salt and these microorganisms.

"The advantage of biological photovoltaic cells over conventional cells is that they are easily available and can repair themselves if they get damaged", says Miller. The device takes up less volume than a drop of water. Therefore no more than a few cells are needed to produce easily measurable electric power. "This will open the way to new horizons", says Jean-David Rochaix, a specialist and Honorary Professor of the University of Geneva. "It will be particularly useful for quickly filtering photosynthetic microorganisms with interesting photochemical properties". *Anton Vos*

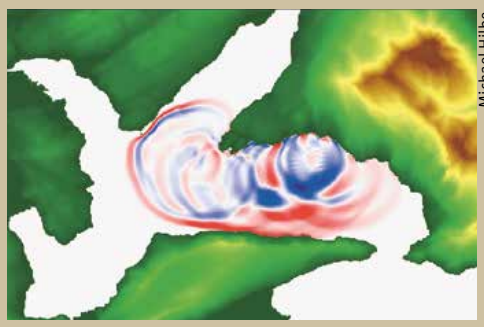
—

P. Bombelli et al.: A High Power-Density, Mediator-Free, Microfluidic Biophotovoltaic Device for Cyanobacterial Cells. Advanced Energy Materials, 2015.



Ross Dennis

Futuristic? Organic solar cells in the ocean light up the power grid.



Michael Hilbe

There could be a ten-metre wave waiting for us just around the corner.

Tidal waves in Lake Lucerne

Monster waves, several metres high, are not restricted to the great oceans of the world; they can also occur in the small lakes of Switzerland. Using the example of Lake Lucerne, researchers have now been able to demonstrate how this happens. The danger, they say, lies beneath the surface of the water. The lake bed has steep slopes covered in sediment, so when an earthquake hits, it can cause large masses of mud to slip deeper into the lake basin. As water is displaced in the process, it can also trigger surface waves of up to ten metres in height.

"In the past, underwater landslides caused repeated tidal waves in Lake Lucerne", explains Michael Hilbe, a geologist at the University of Bern. The last large-scale event happened in the 17th century. Hilbe has used historical and geological data in a computer model in order to simulate the extent of these tsunamis.

Hilbe has found that, "where the banks of the lake are flat, water can gush inland for several hundred metres". Records confirm that this was indeed the case, for example, in the villages of Buochs, Ennetbürgen and Brunnen. But it's not just Central Switzerland that has experienced such waves. Hilbe and his colleagues recently found that there have been at least six tsunamis on Lake Geneva over the past 4,000 years.

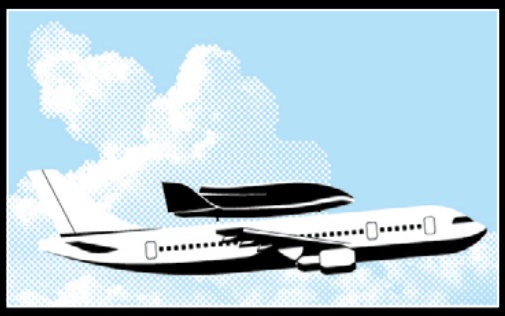
In the worst case scenario, the time between a landslide and the arrival of the wave can be just one minute. So the warning time is extremely short. Luckily, such an event only seems to happen once every 1,000 or 2,000 years. Nevertheless, the researchers now want to embark on a second stage of their research in order to analyse their data systematically, eventually determining where the next tsunami might hit. *Atlant Bieri*

—

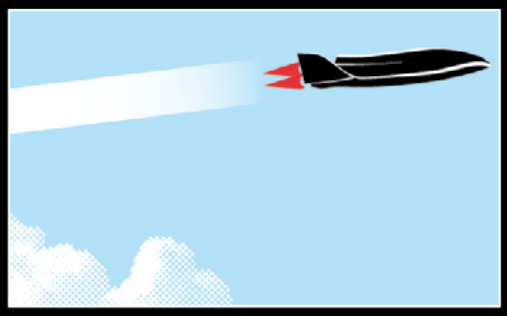
M. Hilbe et al.: Mass Movement-Induced Tsunami Hazard on Perialpine Lake Lucerne (Switzerland): Scenarios and Numerical Experiments. Pure and Applied Geophysics, 2015.

Soar, the Swiss space shuttle

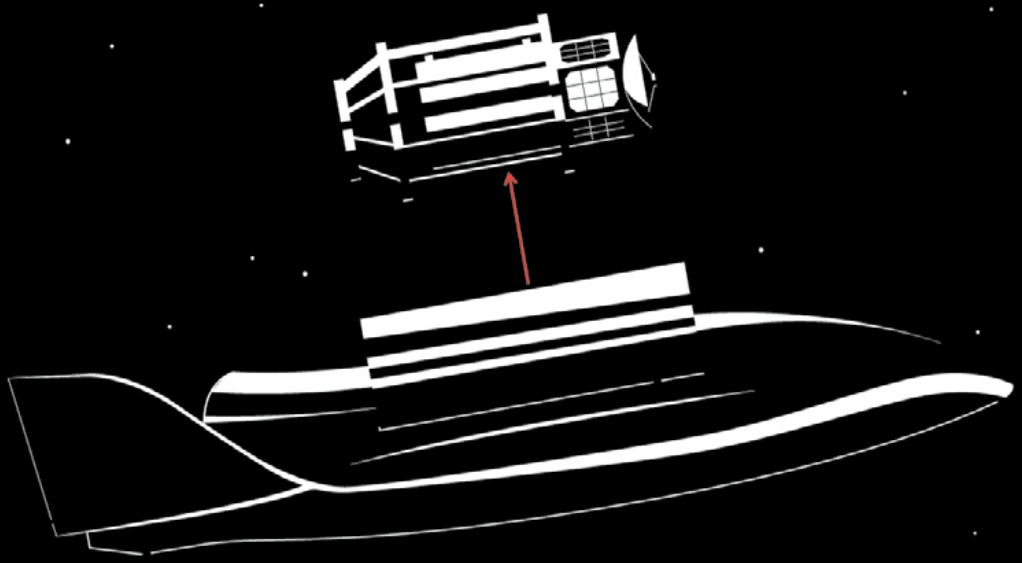
By Benjamin Bollmann. Illustrations by Francesco Muzzi



1 Swiss Space System (S3) has developed a shuttle that will put small satellites into orbit. It will be launched from the back of an Airbus flying at 10,000 m after which it will be controlled from Earth. The first commercial flights are scheduled for 2018. The company itself was set up in 2012 in Payerne, Vaud, and has been working with several dozen international partners to obtain the technology needed to create the shuttle. It will go public in 2015.

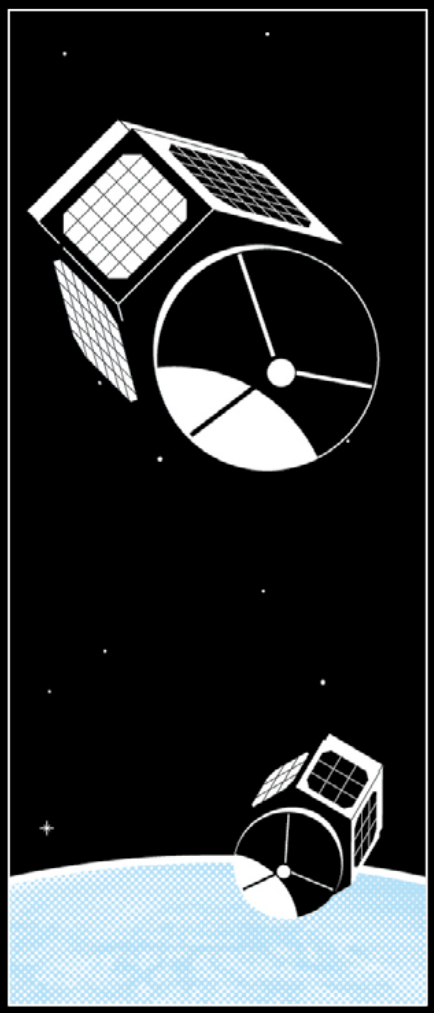


2 The Swiss shuttle, named Soar, is 15 m long and 10 m wide. It will travel at a maximum speed of 7,600 km/h and to a maximum altitude of 80 km. At such an altitude, the effects of the atmosphere are reduced almost to nothing. Its propulsion system is based on a modified Russian NK-39 rocket, part of the family that equipped the third stage of the Soyuz launcher. The French group Dassault Aviation will supply, amongst other things, the ground pilot station, which is based on the station used for flying the stealth combat drone Neuron.

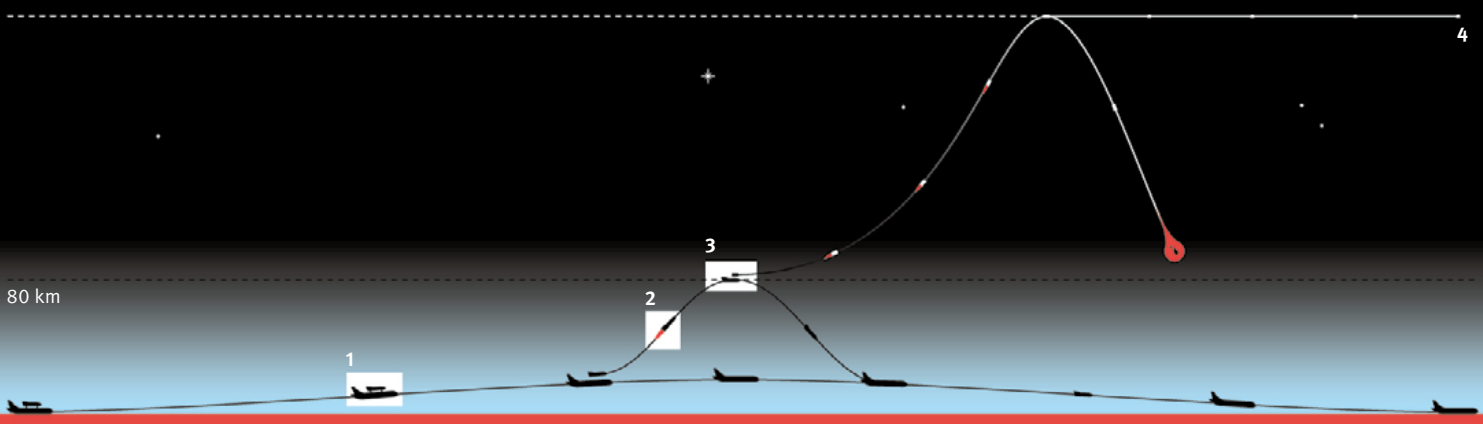


3 Soar will launch satellites into a low Earth orbit, i.e., a maximum altitude of 700 km. Once detached, its launcher stage will fall back to earth, burning up on re-entry rather than adding to the space clutter that also orbits the Earth.

The shuttle itself will be able to return to base by gliding into the atmosphere, meaning it can be reused for later missions. Its shape was inspired by the European space craft Hermes, a project that was abandoned in 1992.



4 S3 is targeting the rapidly expanding market for small satellites, particularly the demand for equipment for climate monitoring, microgravity research, satellite Wi-Fi, and even for keeping an eye on crops. It also aims to develop manned flight over the coming decade, by equipping the shuttle with a pressurised cabin to hold eight people with the long-term goal of offering high-speed intercontinental flights.



Benjamin Bollmann is a freelance science journalist.

Fulfilling the role of responsible scientist

By Thierry Courvoisier

The Swiss Academy of Natural Sciences (SCNAT) is 200 years old. The jubilee year of 2015 is now the occasion to celebrate science across Switzerland (see page 23). It is also an opportunity to underline the role of the Academy in the landscape of Swiss and European scientific institutions.

SCNAT

SCNAT is an association of scientific societies that operate on the cantonal and national levels. It brings together a wide variety of researchers and teachers working in Switzerland. This wide base affords it access to specialists of the highest level in the most varied of fields, not to mention a solid platform in society; it is one-of-a-kind on the global stage.

At its establishment in 1815, the Academy was known as the Swiss Society for Natural Sciences. It was created with a view to uniting the Society of Physics and Natural History of Geneva and the Swiss scientific community, and thereby enriching the latter considerably, at a time when Geneva was acceding to the Swiss Confederation and simultaneously becoming its largest city. This creation came at a difficult juncture, however, as the Napoleonic wars drew to an end and power was restored following the fall of the European ancien régime.

Article 1 of its Statutes read: "The aim of the Society is to encourage knowledge of nature in general and of the nature of our heritage in particular; to spread this knowledge and to apply it in a manner that is of real use to our heritage". Whilst this formulation may today seem somewhat archaic, its spirit is remarkably close to our understanding of the Academy's current role. Our main aim is indeed to bring knowledge and a certain understanding of scientific culture to society in general and to the world of politics in particular. Building this bridge is now essential if decisions that affect our environment are to be made on informed and justified grounds.

We are pursuing this goal by compiling knowledge about the topics of today's agenda (e.g. energy, climate, genetic engineering, biodiversity, etc.) and presenting it in the form of reports and fact sheets that we take to parliament, the federal administration and the public.

Within the scientific community, the Academy plays the role of national coordinator, for example by creating roadmaps for fields receiving large investment sums. It also provides the framework for the representation of different domains at the international level and actively works to build ties between European science and politics.

It is fascinating to observe that the work we carry out is the same as that of the great national academies such as the Royal Society of the United Kingdom or the Leopoldina of Germany, and that the results that we obtain are recognised throughout the world.

Becoming involved in the Academy means fulfilling the role of a responsible scientist in our changing society, and it is an enriching professional experience.

Thierry Courvoisier is President of the Swiss Academy of Sciences and professor of astrophysics at the University of Geneva.

18 June

The power grid of the future

A podium discussion about Switzerland's power supply strategy in an international context.
ETH Zurich

23 June

Marriage and partnership

An interdisciplinary conference of the Swiss Academy of Humanities and Social Sciences SAHS on the future of family law.
University of Bern

25 August

Industry day

Leading researchers discuss current research trends in the fields of sensors, robotics, systems biology and personalised medicine.
www.industryday.ethz.ch
ETH Zurich

23 to 24 September

ScienceComm in Solothurn

The stakeholders in Swiss science communication meet for their annual conference.
Landhaus Solothurn

23 September

Advanced Researchers Day

The SNSF offers information on funding possibilities for advanced researchers from all over Switzerland.
SNSF, Bern

until 29 November

The world of emotions

An exhibition in collaboration with the Swiss National Center for the Affective Sciences.
Natural History Museum, Neuchâtel

until 4 April 2016

Exoplanets

An exhibition on planets outside the polar system, 20 years after the first observations made by two astrophysicists in Geneva.
Natural History Museum, Geneva

Professional secrecy under pressure in the medical world

The crash of the Germanwings Airbus in March 2015 gave added impetus to the current discussions in various cantons about doctors' reporting obligations. Legislators will discuss provisions that would compel doctors to inform the authorities if they found that patients have physical injuries, or if they believed patients may potentially be dangerous. The Swiss Academy of Medical Sciences, SAMW, and the Swiss Medical Association, FMH, have made a joint statement that a relaxation of professional secrecy is neither necessary nor meaningful and stands in contrast to professional, ethical principles. The current statutory regulations already allow doctors to take such action in exceptional circumstances in the interests of safety.

Image Point Fr/Shutterstock

Almost 60 applications for OAPEN

The first submission deadline for OAPEN-CH closed on 15 April 2015. The pilot project for open-access book publications received close to 60 submissions from ten publishers. The SNSF will inform them in June about the book publications that have been chosen. These will be published in autumn 2015.

SNSF sets four priorities for multiyear programme

With its multiyear programme for 2017-2020, the SNSF is confronting the challenges faced by Switzerland as a centre of research. It is a reaction to the rapid changes taking place in the world of scholarship, in other words to the continuing processes of digitisation and internationalisation and to the demands being made for increased transparency. Then there is the question as to how young scholars can be better supported in Switzerland – something that has also been discussed in the Swiss parliament. The SNSF is therefore setting four priorities: excellence and internationalism in research and evaluation; early independence in the careers of young researchers; a contribution to knowledge transfer and innovation, and focus initiatives in selected research areas. www.snf.ch/mjp

Taking part in Horizon 2020

On 16 June in Bern, Euresearch will explain to researchers in Switzerland how they can participate in Horizon 2020. This information day is intended to allay uncertainties that have arisen since the initiative against mass immigration was accepted in a referendum. For details see: www.euresearch.ch/h2020wecandoit

Agglomerations should become cities

The National Research Programme 'New urban quality' (NRP 65) was completed in late May 2015. The results show possibilities for reorganising the city districts that have themselves become 'towns' within agglomerations. NRP 62, 'Intelligent materials', had already come to a close in March. It was a collaboration with the Commission for Technology and Innovation, intended to promote technology transfer. It resulted in 174 scholarly articles, 23 industrial projects, 12 patents and two start-ups.

Valérie Chételat

About Horizons

Since the beginning of the year, a new team has been responsible for science communication at the Swiss National Science Foundation – and thus also for editing Horizons. The new Head and Chief Editor is Daniel Saraga (41), who has a doctorate in physics and previously edited the science magazine Technologist. Florian Fisch (37) joined the team in February. He has a doctorate in biochemistry and formerly worked as a freelance science journalist. Pascale Hofmeier (36), a journalist of ten years' standing, started working for the SNSF in April.

Horizons
The Swiss magazine for scientific research is published quarterly in German, French and English.
Volume 27, No. 105, June 2015.
www.snf.ch/horizonte

Publisher
Swiss National Science Foundation (SNSF)
Jürg Dinner, Communication Department
Wildhainweg 3
Postfach 8232
CH-3001 Bern
Tel. 031 308 22 22
abo@snf.ch

Swiss Academies of Arts and Sciences
Generalsekretariat
Hirschengraben 11
CH-3001 Bern
Tel. 031 313 14 40
info@akademien-schweiz.ch

Editors
Daniel Saraga (dsa), Chief Editor
Florian Fisch (ff)
Pascale Hofmeier (hpa)
Mirko Bischofberger (mb)
Marcel Falk (mf)
Valentin Amrhein (va)

Graphic design, photography
2. stock süd netthoevel & gaberthüel, Valérie Chételat
Illustration: Gregory Gilbert-Lodge

Translation and proofreading
Max Crisp, Chris Walton, Interpreters' and Translators' Association, Zurich

Printer and lithographer
Stämpfli AG, Bern and Zurich
Climate neutral, myclimate.org
Paper: Refutura FSC, Recycling, matt
Typography: FF Meta, Greta Text Std

Distribution
39,600 copies in German,
17,600 copies in French.

ISSN 1663 2710

Subscription is free. Distribution of the paper version is usually restricted to Switzerland and foreign organisations.

The opinions in the articles are those of their authors and do not necessarily reflect those of the SNSF and/or SA. Research presented is generally supported by the SNSF.

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.

“It’s not a tragedy if you lose a few places in the rankings”
Antonio Loprieno page 29

“Self-organisation is everywhere”
Rita Tóth page 46

This stele bears the image of a man as seen by his brother. Whilst it has survived intact for thousands of years, only now is the message becoming clear.
Photo: Keystone/Heritage Images/Ann Ronan Pictures

“Greek parties have a tradition of making excessive promises”
Yannis Papadopoulos page 41