Anti-stress

We like to think in binary opposites: light and dark, war and peace and so on. They help us to order our thoughts and to clarify our concepts. But what is the binary opposite of stress?

We pay good money for today's anti-stress remedies, but they hardly live up to their sales pitch. Far be it from us to criticise anti-stress massages or medicinal plant extracts – but how often do they really alleviate stress on a long-term basis? We ought perhaps to be seeking the opposite of stress in a state of perfect calm: in an absence of any pressure of time or performance, in an absence of all anxiety and conflict. A state, perhaps, that would be akin to the Buddhist concept of 'nirvana'.

But human nature doesn't seem to be suited to such a state of mind. Often, we can't even cope with quiet. In fact, researchers from the USA recently reported in the journal *Science* that many people would rather suffer an electric shock than be alone with their own thoughts for just a quarter of an hour. It seems that even stress-free moments can be stressful. Over 450 years ago the mathematician and philosopher Blaise Pascal declared that there is nothing more unbearable than having nothing to do, and having no distractions. It causes a feeling of inadequacy to rise within us, from the bottom of our soul: a feeling of emptiness, of nothingness, of boredom.

Because stress evades binary logic and because we can't identify a counterpole to it, all that remains for me to do is wish you, our readers, the very opposite of boredom: a leisurely, cheerful, pleasantly diverting time reading this magazine, including the 'Focus' section (from page 10 onwards) which illuminates different aspects of stress.

Ori Schipper, editorial board

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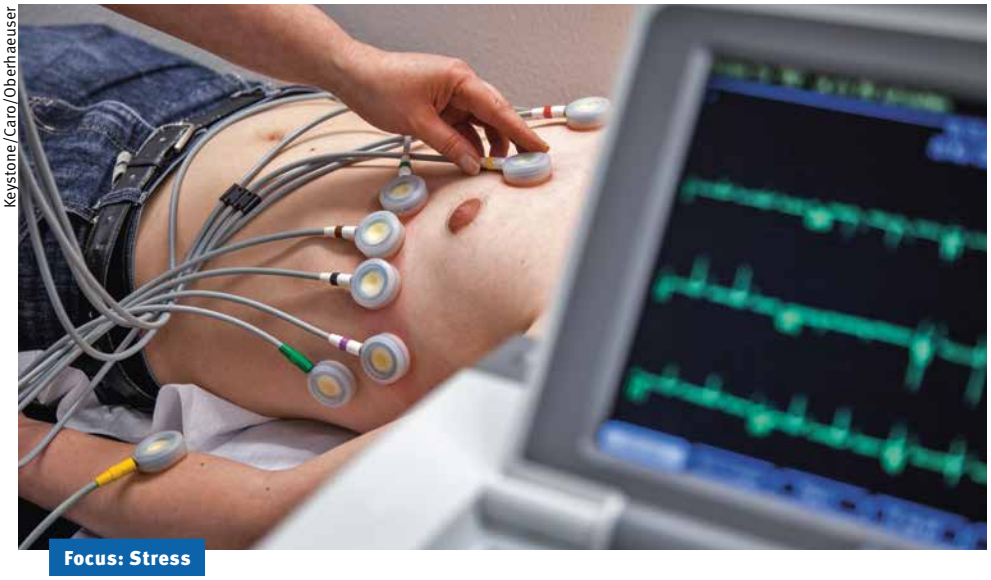

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Focus: Stress

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Stress is a socio-psychological concept. It's something humans have in common with rats. It makes us sick and violent, but it's also supposed to be healthy. So what is stress?

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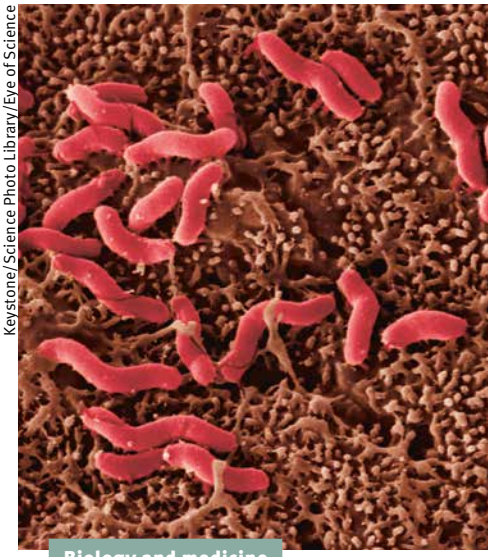

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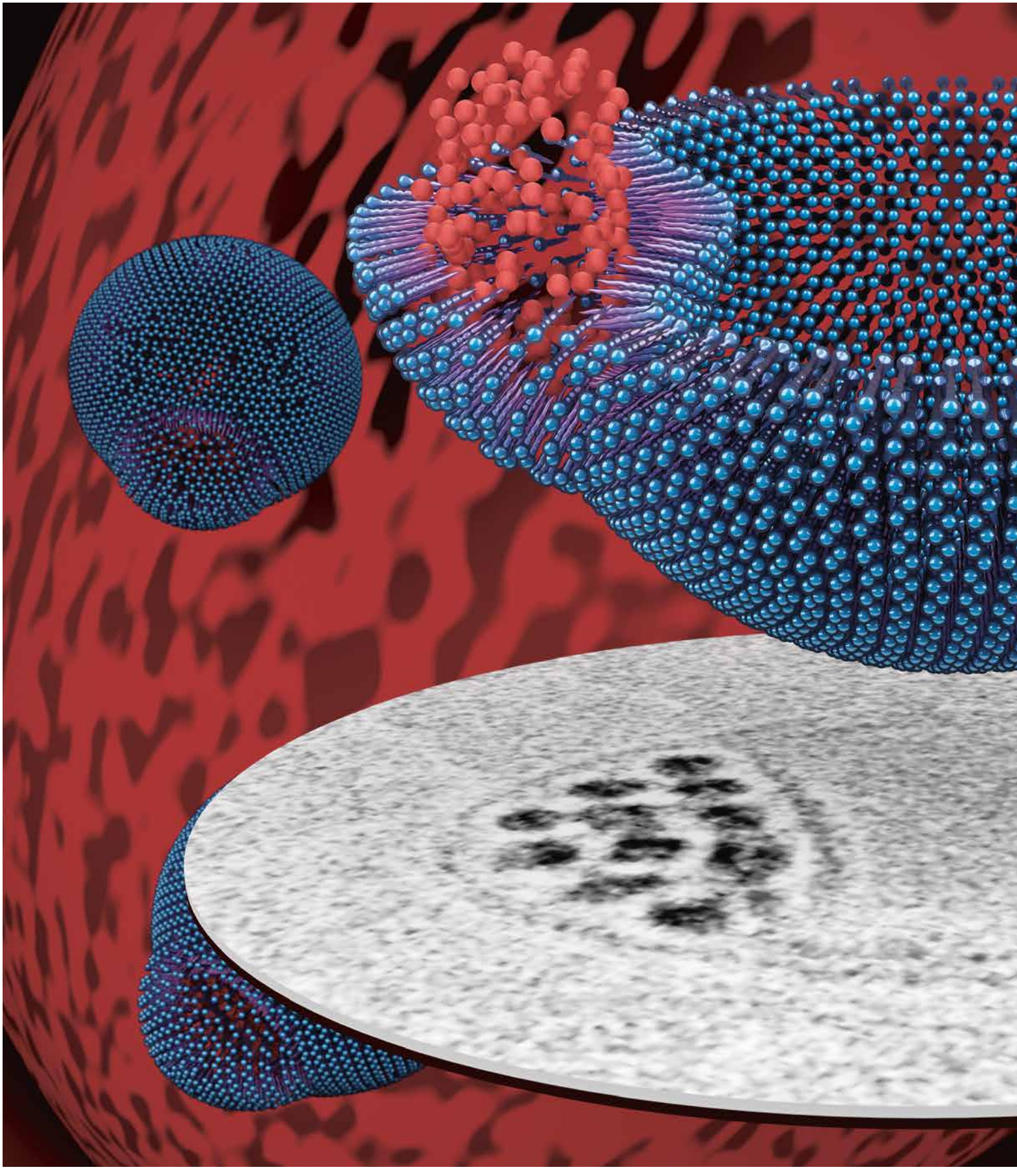
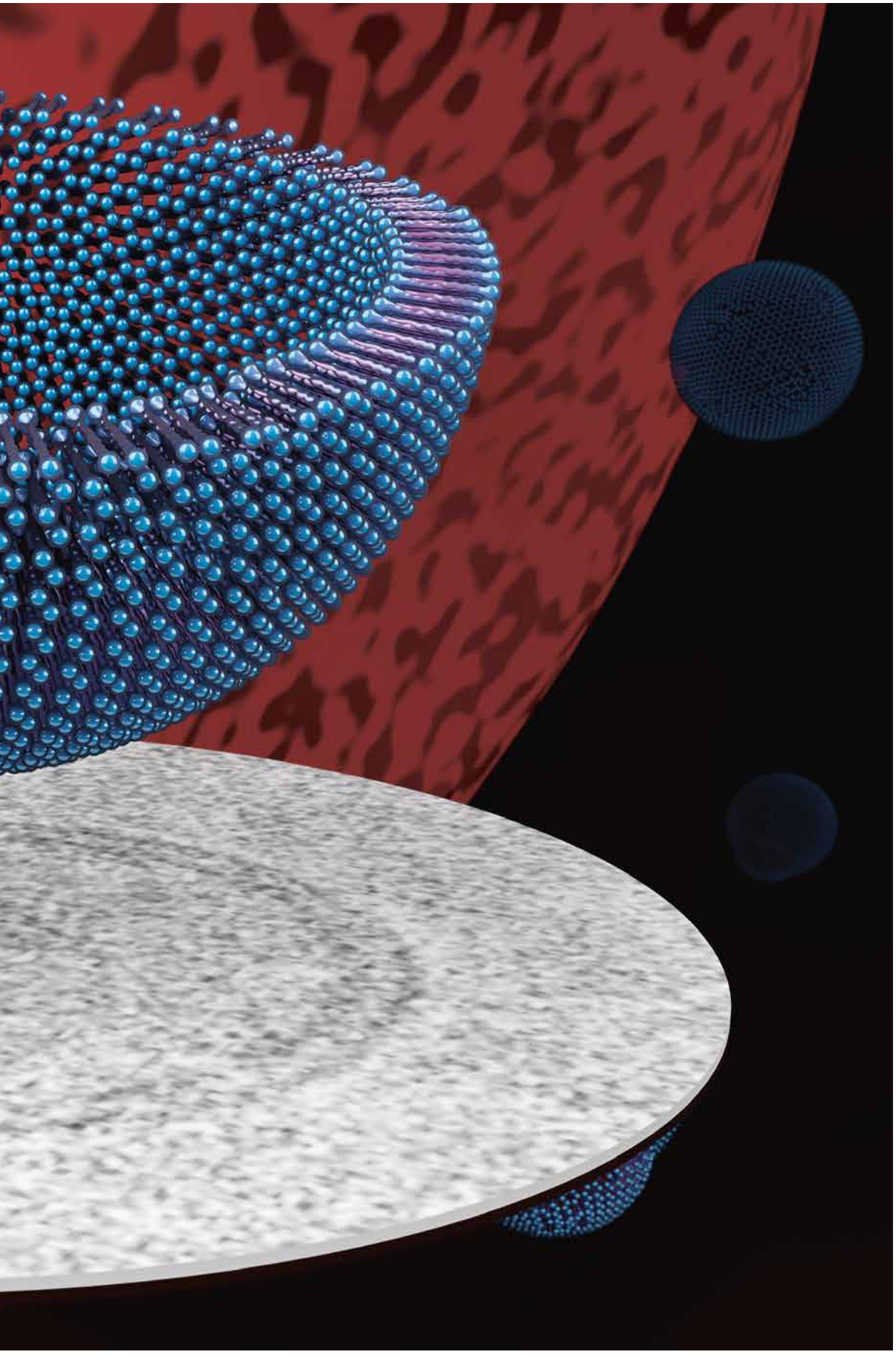




The liposome: an effective vehicle

The ability to release a medication with precise timing and at a precise target means being able to reduce both doses and side effects. The challenge then is to find a good means of transport. Amongst the field, liposomes are very suitable candidates. Just like cells, they have a spherical membrane, within which it is possible to encapsulate a payload. So much for the vehicle. Now for the journey and the unloading. To do this, researchers at the Adolphe Merkle Institute (AMI) have integrated superparamagnetic nanoparticles inside the liposome membrane. These are then heated through the application of a magnetic field, which breaks the membrane and releases the drugs. For this to work, sufficient heat must be created, and this means concentrating all the nanoparticles in one place. The AMI researchers were able to demonstrate that the liposome membrane, with a thickness of 6.5nm, is flexible enough to accommodate a cluster of nanoparticles with a total diameter nearly ten times its own thickness, i.e., approximately 60nm. The image shows a computer model of a liposome (blue) with its aggregate of nanoparticles (red), and below, in black and white, a cross-section of the actual liposome under a cryo-transmission electron microscope. *pm*

Picture: Alke Fink und Christophe Allan Monnier

Can democracy be too direct?

In the aftermath of the initiative against 'mass immigration', discussions about direct democracy have flared up once again. Is there too much of it in Switzerland? Andreas Auer believes that direct democracy is being misused, while Anna Christmann would like to see it subject to legal boundaries.

Valérie Chételat, Uli Regenscheit (photomontage)

A harsh wind is blowing in the land of direct democracy. After a handful of referendum decisions that have been problematical in terms of human rights, and in view of a never-before experienced flood of referenda both imminent and pending, more and more voices are being raised at home and abroad that are demanding limits on civic rights.

Does Switzerland have too much direct democracy? No. Neither on a federal nor a cantonal level are the institutions of direct democracy dictated from above. They are initiated from below and have prevailed in different ways with regard to the constitution, the legal system and international treaties. Plebiscites can neither be instigated nor prevented by the authorities. We all vote on changes to the constitution that are proposed either by parliament or through valid referenda, just as we vote on laws and treaties when the people initiate a referendum against them. Different proposals for expanding civic rights with regard to legislative initiatives, financial referenda and consultative votes have been rejected, as have proposals for expanding the referenda affecting international treaties.

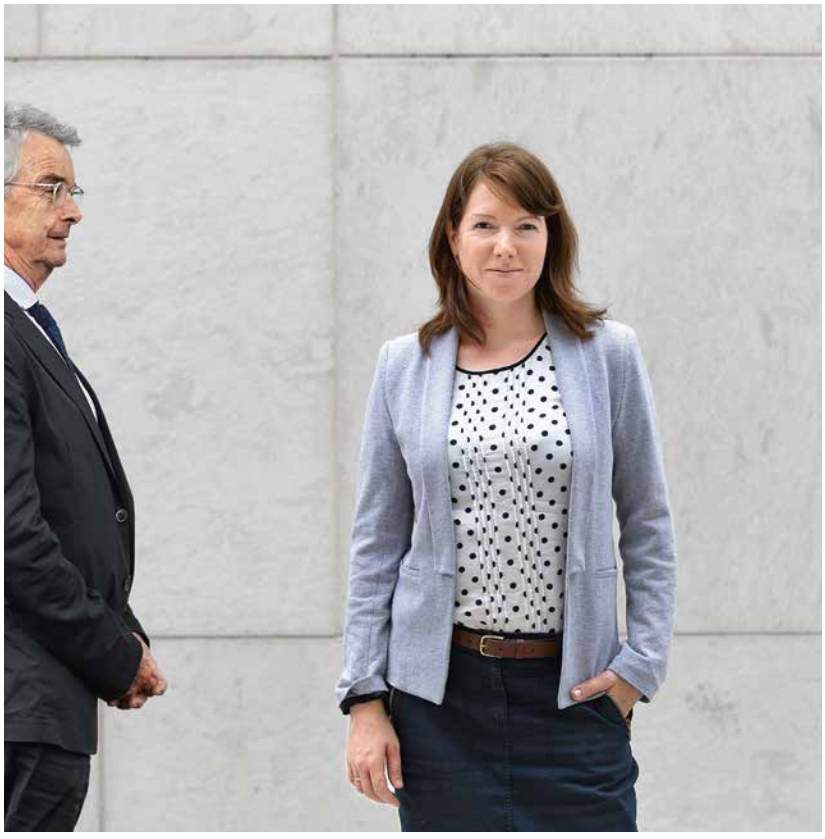
If the institutions of direct democracy are to survive, they have to be utilised. Do the Swiss utilise them too intensively? For many decades that was not the case. At present, it cannot be denied that there is occasional misuse of the right of initiative. The big opposing parties already have enough influence in both parliament and government, and they have no inhibitions about hogging the people's attention by launching whole series of popular initiatives to keep their core supporters on track – especially when elections are looming. So-called 'enforcement initiatives' have damaged the Federal Assembly's indispensable role in implementing popular initiatives, while at the same time they have aided those who wish to denigrate those same elected authorities. Would-be moral prophets appeal to our instinctual aversion to everything that is foreign, unfamiliar or unloved, and they compel the authorities to indulge in knee-jerk action that in constitutional terms is simply undignified. They flatter the 'will of the people', assigning it an absolutist status supposedly even superior to that of the constitution.

> "Can direct democracy be limited? Yes, but only by the people themselves".
>
> Andreas Auer

Does this then mean that direct democracy should be restricted? No. Most suggestions for reform boil down to giving parliament greater powers to declare popular initiatives invalid. That would make direct democracy a plaything for the politics of the day in matters for which parliament is simply not responsible. An abstract decision by the political majority cannot determine authoritatively whether or not a popular initiative infringes human rights, or whether it contravenes or is incompatible with international law. Those decisions can only be made by judges in concrete, individual cases. But parliament, self-willed as it is, is not prepared to give more power to the judges. The fairy tale about 'judges running the country' merely helps those in power to keep their grip on it.

Lastly: can direct democracy be limited? Yes, but only by the people themselves. Swiss direct democracy – as Friedrich Dürrenmatt once nearly said – is a prison in which the people are the jailers.

Andreas Auer, professor emeritus in public law at the University of Zurich and co-founder of the Centre for Democracy Studies Aarau (ZDA), is a consultant at the legal firm Umbricht Rechtsanwälte.



Mass immigration, deportations, the ban on minarets – why are people abroad, along with a large number of Swiss, so concerned about decisions that have been legitimated by a popular majority? Is it perhaps possible to have too much democracy?

Direct democracy, rightly, is a very popular instrument. Our European neighbours generally look on with envy when reminded of the comprehensive rights of participation enjoyed by citizens on all political levels in Switzerland. Some recent referendum decisions, however, have tarnished the good reputation of Swiss 'semi-direct' democracy, which is unique in the world. Why are these results of democratic referenda regarded as 'bad' and as a discredit to the very institution of referendum?

There are no right or wrong decisions in a democracy. It's the proposal that gets a political majority that is implemented – not the one that's supposedly 'right'. This is essentially the same for a representative democracy as for a plebiscite. After hundreds of years of experience, however, a quite specific form has crystallised in the established democracies: the 'liberal democracy', also known as the democratic constitutional state. Such a state today is not constituted alone by majority decisions, but also by guaranteed basic rights that according to John Locke protect citizens from each other and from the state. They also prevent the 'tyranny of the majority' that Theodor Heuss used to fear. So what is at stake here can't be about getting ever 'more' democracy. What is crucial is establishing a balance between majority democratic rule and the protection of basic rights.

This equilibrium can be upset by an expansion of direct democracy coupled with weak constitutional control. The impact can be seen when we compare Switzerland with the State of California in the USA. In both states, referenda that curtail basic rights or the rights of minorities receive an above-average rate of acceptance. Direct democracy can thus pose a latent threat to basic rights. This is why, in California, a large number of initiatives are rejected by the courts after having been accepted by the people. The most recent example was the introduction of same-sex marriage. In Switzerland, on the other hand, the people famously have the last word. There is no constitutional court that can adjudicate these matters in a way that would be binding.

> "We need to show more courage in this respect – such as by establishing a mandatory constitutional jurisdiction".
>
> Anna Christmann

A more stringent assessment of the compatibility of popular initiatives with our basic rights, human rights and international law would pose no threat to direct democracy. Switzerland has too long a tradition of civic rights for there to be any danger of that. And we need to show more courage in this respect – such as by establishing a mandatory constitutional jurisdiction.

If there were greater control it would also solve an image problem. At present, both the Federal Council and the parliament have a tendency to stick merely to a partial implementation of initiatives where they prove problematical. The 'Alp Initiative' of 1994, for example, is still waiting to be brought into effect. When parliament handles the result of a plebiscite according to political considerations instead of legal obligations, then frustration is bound to result.

Putting legal boundaries in place would not weaken direct democracy – it would merely guarantee its functionality and its effectiveness.

Anna Christmann, a political scientist, was engaged in research at the National Center of Competence in Research (NCCR) Democracy at the University of Zurich until 2013. Today she works in Stuttgart at the Ministry of Science of the German state of Baden-Württemberg.

Under pressure

What is stress? Everyone complains about it, yet no one wants to be without it. It makes us sick but is also supposed to be healthy. It weakens our bones, and in rats it causes aggression.

Hustle and bustle

Without soldiers at war and rats in laboratories, we wouldn't have our modern concept of stress – nor would we feel 'stressed' either. But then according to recent research, stress is supposed to be healthy. *By Urs Hafner*

The popularity of a concept – its rise, its spread and then its eventual and inevitable decline – also says something about the collective mental disposition that makes use of it. For example, take the German concept 'Waldsterben' – 'forest dieback' – which today serves as a testament to the power of the media and to the public hysteria of the 1980s. But we can go beyond this simplistic analysis. Even if the forests didn't 'die back' to the drastic extent that was feared at the time, the use of the word demonstrates that there was great concern about the destruction of basic aspects of our existence – and that concern was hardly unfounded. The forest, as a kind of natural 'place of yearning', acted as a magnet for collective fears during the era of the atom bomb when many felt that the apocalypse was imminent.

Today, 'stress' is a terminological front-runner. It's almost the done thing to feel 'stressed' and to fight it – with yoga, for example. Stress is regarded as unhealthy and a cause of illness. Whoever feels stressed today testifies to the fact that he or she is heavily in demand and very busy. 'Stress' is a symptom of our time, a time that tells us from kindergarten onwards that we're in a struggle for survival ("You'll see, life isn't a bed of roses", we're told early on). The superlative of 'stress' is the related word 'burnout'. This illness is socially acceptable today, unlike depression. A man who has a burnout has temporarily broken down, primarily because too much has been demanded of him, not because he himself has failed in any way. He is the victim of a world of work that has run amok, as it were. But at the end of the day he's a high-class victim; when we take a road worker suffering from exhaustion, we no longer talk about 'burnout'. He simply has the physical (or perhaps psychosomatic) symptoms of backache.

In the sociological diagnosis of our times, legion are the findings about the increasing pace of life, the diminishing sense of solidarity and the increasing degree of flexibility and individualisation that have all been characteristic of our society since the 1990s. Richard Sennett, Axel Honneth and Alain Ehrenberg, for example, draw a picture of a society characterised by a dynamic, aggressive capitalism in which there is an increasing pressure placed upon the individual, primarily the individual who possesses little economic, social or cultural capital. In this sense, the current discourse about 'constant stress' is determined not just by the endeavours of the 'stressed' to prove their undiminished competitiveness, but also by a general unease about living in a society that places 'achieving' above everything else, and that has no place for those who cannot meet the demands made of them, whatever their reasons.

Suspicious calm

Neologisms such as 'density stress' and 'stress test' serve to expand the phenomenon. It is no longer just work or family life placing pressure on the individual, but the sheer presence of lots of other people. And it's no longer just people that can be 'stressed', but also institutions and materials. The trajectory of the 'stress' concept means that our lives are determined by constant processes of testing and selection. We are subject to permanent pressure – or at least we have to act as if that were the case. In a time that is fixated on hustle and bustle, nothing is more suspicious than someone who is calm or leisurely.

To be sure, people felt under pressure in earlier times too and showed physical

symptoms of stress – for example, when the neighbour had just died of the plague, when the enemy was at the gates, or when rain had destroyed the year's crops. It is the turn of the 19th and 20th centuries, however, that is regarded as the embodiment of a 'nervous' epoch (and it was seen that way even by those alive at the time). But given that in pre-modern times no one knew either the concept of 'stress' or the symptoms associated with it, no one felt 'stressed' – not even about the prospect of an infernal afterlife. The general fear of the supernatural among the rural populations of pre-modern times was a different emotional state that we can hardly reconstruct today; perhaps it was more of a dull, gut feeling of unease that gave way to a sense of relief during prayer or religious ceremonies.

Stress death

Just as every era has its own illnesses, so every era also has its own emotions. And if emotions such as fear, joy and rage are widespread, then they are always embedded in social connections that afford them meaning, as the historian Ute Frevert writes in his book *Vergängliche Gefühle* (Wallstein, 2013). In the 19th century, for example, any good German maiden would have turned red in the face had the word 'trousers' been mentioned in her presence. She was meant to feel painfully embarrassed, perhaps even 'stressed'. And if she didn't, then her moral integrity would be in doubt.

The 'inventor' of the stress concept is regarded as being the medical doctor and chemist Hans Selye, as the historian Patrick Kury writes in his history of stress (*Der überforderte Mensch,* Campus, 2012). In the 1930s Selye came across the so-called adaptation syndrome in experiments with rats. When he injected rats with poisonous substances or had them run non-stop in a treadmill, he found that they died a 'stress death' on account of hormonal reactions. During the Second World War, English military doctors used the concept to describe the high degree of pressure to which pilots were subjected. Without the rats tortured in the laboratories and without the pilots in the war, we would not have the 'stress' from which almost everyone suffers today (or at least claims to suffer).

Selye's concept of stress, to be sure, was physiological and endocrinological. In the 1950s, the concept was expanded by the Swedish psychosocial doctor Lennart Levi. He identified a connection between illness and psychological, social and culturally induced stress. The concept of stress still retains this sense of ambiguity; it originated in the natural sciences, moved into the social sciences, and from there was diffused into everyday speech. It can be used to describe both external pressure and reactions brought forth by all kinds of stimuli, along with the physical and psychological illnesses that are caused by it. Almost anything can cause 'stress' today, even boredom, and conversely almost every illness has elements of 'stress' in it. Today, psychologists speak of stress, but so do sociologists, medical doctors, biologists, and even physicists and economists – and, of course, so does everyone who feels 'stressed'.

In recent years, the concept of 'good stress' has gained currency in research in the natural sciences. Unlike in everyday speech or in today's sociological diagnoses, the concept of 'stress' in the natural sciences has both a negative and a positive aspect. Hans Selye already distinguished between 'distress' and 'eustress'. Negative stress is regarded as the cause of cardiovascular dysfunction, autoimmune diseases, depression and cognitive decline. Good stress on the other hand is created when our organism is influenced positively by 'stressors'. We use the excitation potential of stress in order to recognise dangers and to bring ourselves into safety. In evolutionary, biological terms, this has always been the case – it applied, for example, if one of our ancestors was faced with an approaching lion.

Healthy stress?

Researchers have reached the conclusion that stress can even be 'healthy' – under the condition that it does not constitute a chronic burden but a short-term stimulant. In patients who have endured stress on account of an operation, it has led to immune cells being activated. This leads to their wound healing more rapidly, or to their cancer cells being contained. And an experiment carried out on rats (one that was not just stressful to them, but which ended in their death) has given reason to suspect that the increased distribution of the stress hormone cortisol increases the plasticity of the brain. This, in turn, would mean the affected person would learn more effectively.

We must be cautious about the results of this research. Good health is a relative thing. If someone learns efficiently and is a successful pupil but acts destructively towards fellow human beings or is tortured by unconscious fears, then the term 'healthy' could hardly be used. Perhaps these results could aid us to accept what is required of us in the world of work with a greater degree of equanimity, to see it even as a stimulant – if one's work actually allows one the necessary space for it. Or is the renaissance of 'good stress' simply an ideal concept for a society in which nothing is regarded with more contempt than doing nothing? – unless, of course, one is in the midst of one's (naturally stress-free) holidays!

Urs Hafner is a science editor at the SNSF.

Praising away stress

Praise from your boss, or a gesture of recognition from your company – such things are balm to the soul. Employees who feel appreciated can deal better with stress. *By Susanne Wenger*

Promoting good health at the office is regarded as an aspect of modern business strategy. A whole industry of advisers lives from it. But there is a pretty simple method of keeping your staff fit and productive: expressing your appreciation for them. The fact that a company's employees are its most valuable asset is written into the mission statement of every business, says Nicola Jacobshagen from the Institute for Psychology at the University of Bern. "But in reality, there is often a 'zero-feedback culture'". Employees think: *As long as I don't hear anything, then everything's OK. They only react when I make a mistake.* Jacobshagen knows that this does not necessarily reflect a general attitude in which employees are insufficiently appreciated: "But perhaps managers just don't notice how they come across".

This is a missed opportunity, as a new study by the Institute for Psychology proves. When employees are actively shown that they are appreciated, it becomes an important long-term factor in well-being at the workplace. Stress researchers are already familiar with connections between a lack of appreciation and well-being. When people only ever give of themselves and hardly get any reward, they suffer ill health. There's been little research into the reverse effect but it also holds true, as these psychologists have now proven with their research based on six companies in four different cantons. When people are praised at the workplace, it lowers their experience of stress and helps them to deal better with stressful situations on a long-term basis.

"A powerful resource"

Because being praised gives wings to our feeling of self-worth, it is "a powerful resource" in managing stress, says Jacobshagen. It is at least as effective as other cushions for stress at the workplace, such as giving people autonomy in how they structure their work. Some 200 employees of a hospital, a union library, an industrial company, a telecommunications company and two cantonal offices were involved in the study. The researchers conducted three surveys of these employees over a period of half a year, asking about their experiences of being appreciated. Furthermore, questionnaires on working conditions and well-being were filled out. It became clear that there were undoubtedly tendencies towards a culture of appreciation and that these had a reliable impact: there were increases in motivation, in contentedness and in the feeling of belonging to the company. Employees' overall performance also improved.

But Jacobshagen sees a need for optimisation. The most appreciation was shown to those who performed extra tasks – and she warns that this is a "dangerous spiral" that can climax in employees being subjected constantly to excess demands. And the company does not always have to engage in large-scale gestures of thanks such as an excursion for personnel or a hefty bonus. Line managers can find sufficient opportunities to express their appreciation during their everyday work. The time that this costs is invested well, says Jacobshagen. And it's not just about praising people, either. Showing appreciation can also mean giving an employee a new, interesting task to fulfil. Or helping to solve their computer problems quickly.

Another great source of motivation is being appreciated by one's colleagues at work, not to mention praise from clients. Even managers themselves thirst for appreciation, though they get it rarely. One can only embolden employees to praise their boss once in a while, says Jacobshagen. "In return, you get a stress-resistant boss".

Susanne Wenger is a freelance science journalist.

The biology of violence

In their reactions to stress, rats and humans are more similar than we might usually expect. This is also of significance for our understanding of acts of violence.
By Ori Schipper

Stress is a slippery concept, difficult to grasp. Biology took it from physics, and in its broadest sense uses it to describe a body's unspecific reaction to any kind of demand. This definition encompasses, for example, the water stress found in desert regions. Cacti and other succulent plants can withstand it well because they have adapted to aridity over the course of their evolutionary history.

In the case of animals – such as man – the emphasis is on physical and mental responses to impending danger. When it's a matter of life or death, the body shifts into a different gear. Hormones place the organism in a state of alarm, the pulse quickens and the pupils dilate. The question, ultimately, is: fight or flight?

"Stress mobilises energy reserves" says Carmen Sandi, who runs the Laboratory of Behavioral Genetics at EPFL. This extra energy helps us to perform at a higher level than normal and to master difficult situations. Stress can stimulate us and give us a feeling of success, and all this has a positive impact (here we mean not just our productivity at the workplace but, for example, the fact that bowel cancer spreads less rapidly in mice that are kept in a varied environment than in mice that are kept in bare cages). We don't all need the positive effect that a sense of achievement can offer, however. "There are people who can very easily take failures in their stride", says Sandi.

Energies exhausted

It is still largely unclear why some rats and human beings can deal particularly well with stress, while others are especially susceptible to it, and this is currently the subject of intense research. What is clear, however, is that too much stress causes damage. We suffer when we gradually exhaust our energies on account of long-term exposure to stress, or when we cannot fully put to use the energy that stress generates. "The result of chronic stress is depression", says Sandi.

People suffering from depression often have fits of rage, she says, and she has observed similar tendencies during the experiments that she carries out on rats to try and shed light on the impact of stress on social behaviour. Her research interests have in recent years shifted from the impact of stress to how we think about the origins of violence. People who in their youth have experienced traumatic events have a greater tendency to violence than those who have grown up in a loving, caring environment – and the behaviour of rats is similarly affected by stressful experiences.

In Sandi's experiments, rats aged between four and seven weeks – i.e., during puberty – are exposed to two different types of stress for a total of half an hour spread over seven days. The researchers either place the rats on an open platform almost a metre high, or they put a small cloth in their cage that has been impregnated with drops of trimethylthiazoline – a scent found in fox droppings. The former causes stress because rats are afraid of heights and have an innate aversion to exposed spaces; the latter also triggers an inborn fear response.

Abnormally aggressive

When compared with rats that were stroked for half an hour over seven days, the rats subjected to stress showed less interest in their own kind when they reached adulthood. They also showed less interest in objects and were shyer and less social. At the same time, however, they behaved far more aggressively to intruders placed in their cages by the researchers. The rats that had grown up in a stress-free environment became involved in conflict with the newcomers just under 60% of the time, but the rats that had been subjected to stress fought with them more than 80% of the time. Furthermore, it was noted that the stressed rats displayed "abnormally aggressive behaviour", demonstrated by biting their opponents on particularly vulnerable parts of their anatomy more often than was the case with the 'non-stressed' test group. They even did so when the newcomers behaved submissively, or were placed into the cage in an inert, anaesthetised state.

"The behaviour of stressed rats is similar to human psychopaths in one other respect", says Sandi. As adults, these animals reacted only marginally to renewed stress (for example, to the smell of fox faeces). "They have become blunted", she says, like

many people who have an aggressive personality disorder and who also lack empathy and compassion.

Naturally, we have to be cautious when comparing rats and people, says Sandi. But she is convinced that the commonalities observed are not accidental, and instead show that violence triggered by traumatic events during youth can also be traced back to biological components. "The prevailing psychosocial explanatory models have to be expanded and complemented by the biology of violence", thinks Sandi.

This perspective would make it easier for society to see perpetrators as victims. "Such as Anders Behring Breivik, for example", says Sandi. The right-wing extremist placed a bomb in the government quarter of Oslo in 2011 and then, dressed as a policeman, drove to a holiday island and shot 69 youngsters at a holiday camp being run by a social-democratic youth organisation. He was 32 years old at the time. But back in 1983, when Breivik was four years old, a child psychiatrist, called upon to examine him after the early divorce of his parents, found that he was "so neglected that there is a danger that he will develop a severe mental disorder".

Hereditary behavioural patterns

Sandi does not believe that conflicts can always be solved by a rational approach. "Aggressive behaviour is linked to fear. And fear is often irrational", she says. But perhaps her most disturbing finding is the fact that aggressive behavioural patterns are hereditary. The offspring of stressed male rats are just as asocial and aggressive as their fathers, even if they have had no contact with them (and thus have not been able to learn from them by observing them). For Sandi, problems of violence are therefore not just a matter of the cultural environment, but also have to do with adjustment mechanisms in the brain.

"In the brain, there is a balance between stimuli and inhibitors for nerve impulses. Chronic stress shifts this balance towards the stimuli", says Sandi. She and her team have shown that treating the adult stressed rats with an anti-depressant can alleviate abnormal behaviour. This cure allows the circuits in the brain that have been damaged by trauma to be reprogrammed, she says.

Recently, however, Sandi's team has been pursuing another track. If stress results in more stimulation than inhibition in the brain, it would mean that the brain would need more energy – because stimuli make the nerve cells more active. But nerve cells are dependent on small, specialised cellular components for their energy supply. These so-called mitochondria are often described as cellular batteries or cellular power plants.

Is it possible that a susceptibility to stress might depend on the efficiency of these 'power plants', and thus on how well the brain can produce energy? And could acts of violence ultimately be triggered not by stress alone, but also by the biophysical capacity of the brain? Sandi has found initial proof for this supposition in the work of other research groups who have examined prison inmates. The aggressive behaviour of prisoners was reduced when they were given dietary supplements – pills with vitamins, minerals and essential fatty acids.

But it remains to be proven whether such pills can one day help to prevent violent excesses. It also remains uncertain just how desirable this would be.

Ori Schipper is a science editor at the SNSF.

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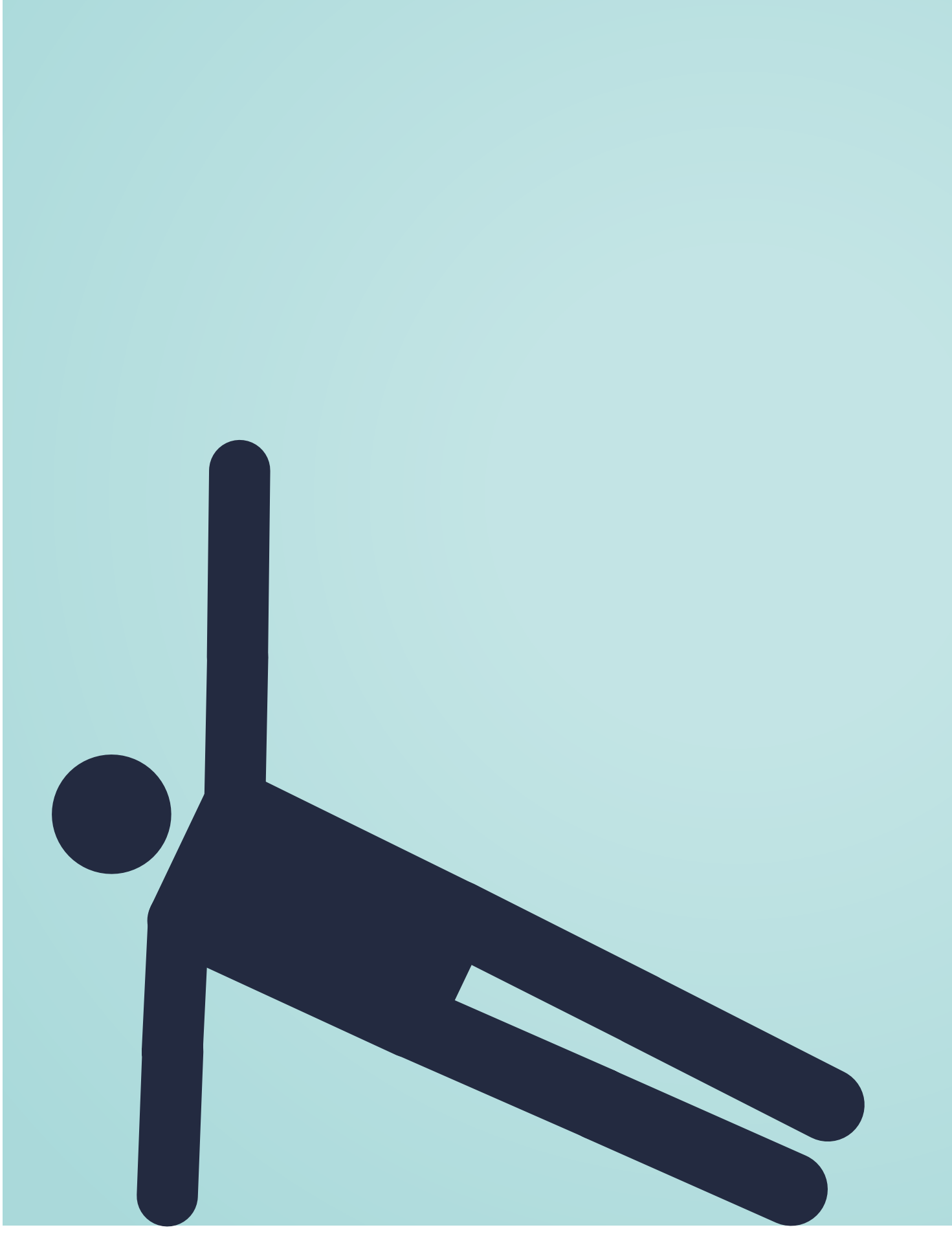


Bone fatigue fractures

Hairline fractures appear in bones when they are subjected to repeated mechanical stress. As this microscopic damage is often imperceptible unless the bone actually breaks, it is important to find a method capable of detecting, preventing or even treating it. *By Anton Vos*

Stress fractures account for almost 20% of all sports injuries. They are caused by chronic mechanical stress imposed on the skeleton and present a specific problem: the precursory injuries are extremely fine cracks which are virtually undetectable using medical x-rays prior to an actual fracture. To learn more about their occurrence and the mechanisms that lead to them spreading in the bone tissue, Claire Acevedo, a post-doctoral researcher at the Lawrence Berkeley National Laboratory (Berkeley University) in California, recently tested a mouse model capable of reproducing and investigating the phenomenon. A publication on the subject is in preparation.

It is in weight-bearing bones such as the tibia, the fibula and the metatarsals that micro-cracks usually appear. They are as fine as a hair and spread slowly. "These stress fractures are particularly insidious because they affect healthy bones and occur in the absence of severe shock", explains Acevedo. Those most susceptible to them are elite athletes (runners, dancers, etc.) and members of armed forces subject to intensive training. In this case, the process of self-healing of the bone is not fast enough to prevent the accumulation of these cracks".

It's not restricted to athletes, however; incidence increases with age, the risk of osteoporosis, the presence of certain diseases such as *osteogenesis imperfecta* (also known as brittle bone disease) or, paradoxically, long term medication against osteoporosis.

Self-repairing

As they are undetectable under traditional medical x-rays, little is still known about the mechanisms of stress fractures in the complex micro-structure of bones. The only way to study their origins and their evolution as well as the ability of bone to resist and to repair itself is to conduct experiments on live animals. For this, Acevedo has chosen the mouse. "The micro-structure of the bones of pigs or dogs would be more similar to that of the human bone", she says. "But those experiments would have been much more complicated to set up and would take more time than working with rodents".

The animal tests were conducted in collaboration with the AO Foundation in Davos and the EPFL. The first series of tests on dead mice concentrated on evaluating the parameters of resistance of the tibia, by subjecting it to cyclic loads which mimicked the daily forces exerted on an athlete's skeleton.

Acevedo used synchrotron x-rays, which offer a significantly higher resolution than medical imaging. This method made it possible to observe the initial stage and the propagation of micro-cracks. At the same time, she has also developed a digital three-dimensional model of the mouse tibia. Using this, she deduced that the origin of preference for stress fractures corresponds with areas of concentrated stress determined by the shape as well as the micro-architecture of the bone.

She was also able to identify another point of origin for micro-cracks: irregularities in the surface of the compact bone, including small channels (containing nerves or blood vessels). From there, they propagate through the most fragile areas, via other channels and small cavities. But, thanks to its complex micro-structure, the bone has an ingenious device to stop or deflect the advance of micro-cracks.

In a second test, Acevedo subjected a dozen live – and anaesthetised – rodents to mechanical stress conditions similar to those resulting in a fractured bone. Well before any bones would break, the animals entered a rest period (varying between 0 and 14 days), after which their skeletons were analysed. "As laboratory x-rays cannot render the microscopic lesions, it was difficult to know if the tibia started to fissure while the mice were alive", she points out. "Fortunately, we gathered the results we wanted at the first trial".

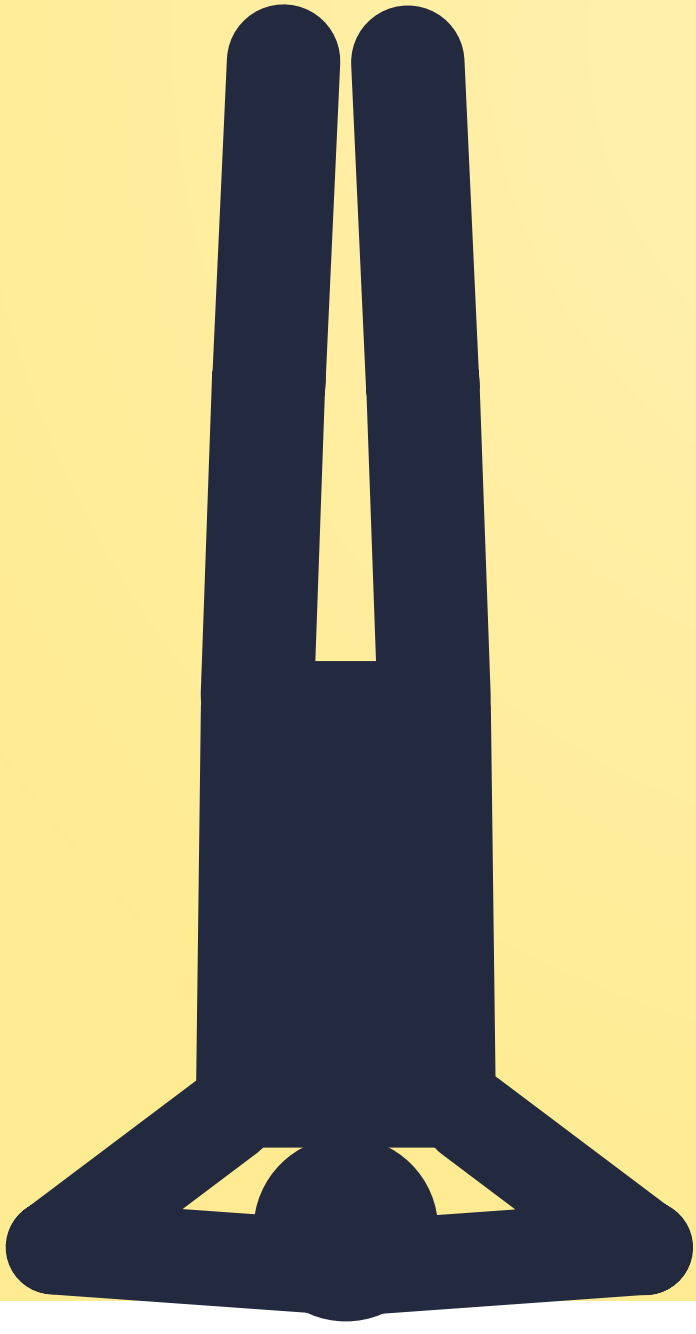
Tomorrow's world

Using measurements from a laser scanning confocal microscope, she was able to observe not only the presence of diffuse damage – the kind that would lead to hairline fractures - at different stages of development but also the process of self-healing in the form of bone material production. "This is one of our main findings", she says. "It suggests that even diffuse damage, usually considered as too insignificant to signal to the bone to repair itself, does actually play a role in the activation of self-repair mechanisms".

The aim of these studies is to develop a method of detecting, preventing or even treating these stress injuries before they cause actual fractures in humans. Whilst this goal still belongs to tomorrow's world, Acevedo was able to prove her mouse model capable of reproducing a certain number of bone fatigue effects and in a reasonably short period of time. Such a tool will allow her to continue her scientific work and to improve our understanding of the phenomenon.

"Today, one of the only effective treatments available is total rest to allow the bone to heal itself", she says. Not one or two days but at least several weeks. A person suffering from micro-cracks will at some stage feel considerable pain, which should be seen as a kind of warning. "If that person takes a pain reliever and continues their training programme, instead of stopping and resting, then any micro-cracks will accumulate only to end in a full fracture".

Anton Vos is a science journalist and works at the University of Geneva.



The dual burden of malnutrition

How can it be that overweight people take in too many calories but at the same time too little iron? The food scientist Isabelle Aeberli has been looking for answers in the growing middle classes of Bangalore in India.

Full of colour, and low in calories: a market in Bangalore, India. Isabelle Aeberli (top right) lived in a gated community in the city (top). Obesity is primarily a phenomenon that occurs among the women of the burgeoning middle classes
Photos: Isabelle Aeberli, Philip Herter

"The differences between poor and rich are extreme in Bangalore. During the fourteen months of my research visit I lived in a gated apartment building with a swimming pool in the middle of it. There was even a fitness centre. But there are people there who clean the streets by hand every day for just a few dollars. Not even a technical assistant in the lab can earn nearly enough to be able to afford an apartment in a complex like mine.

"Overall, however, the wages of the Indian middle classes are growing in cities like Bangalore where the economy is flourishing. At the same time, the proportion of overweight and obese people is rising dramatically. That used to be a problem that you only encountered in countries with high living standards. Many obese people are taking in more calories than they use up, but they also often lack nutrients such as vitamins, zinc and iron. This dual burden is what interests me – how people can be overweight and yet lacking in micronutrients. It has been investigated before in the West, but what interests me is how overweight women in India are affected.

"I tackled this issue together with Anura V. Kurpad, Professor and Head of the Division of Nutrition at St. John's Medical College and Hospital in Bangalore. We had worked together before on joint projects, so I already knew him. With the help of his team we were able to examine 150 women, mostly students or staff at the hospital.

"We indeed found that obese women display an increased risk of iron deficiency compared with women of normal weight. But this is presumably not because the food they eat contains too little iron, but because overweight people absorb it less well. Normally, the body controls exactly how much iron it absorbs because it cannot eliminate any excess, and too much of it is harmful. This control function is carried out by a protein which is produced by the liver and which puts a brake on iron absorption from the diet when there is already enough present. But in cases where the liver is chronically inflamed on account of prolonged stress or excess weight, larger amounts of this protein are produced. Obese women therefore probably absorb too little iron from their diet because their liver is producing too much of the controlling protein.

"We actually wanted to measure how much iron the women took in with their food. But regrettably this was impossible because the test subjects often underestimated their daily calorie intake, omitting things like having a cup of coffee with three sugars or the biscuits that they ate in between meals. In a second study we wanted to clarify whether a balanced diet could solve two problems at once – in other

words, whether the women's iron absorption improved when they lost weight. We hoped that a loss in weight would lower the inflammation values in the women's blood and that their iron absorption would then function normally again. Sadly, we had to abandon this test because it again proved more complicated to carry out than we had expected.

"It took a long time to evaluate the samples, and I only received the final results after my return to Switzerland. My stay in Bangalore made me aware of how some things just don't work in emerging and developing countries, no matter how carefully you plan them. This realisation helps me in my work at the Laboratory of Human Nutrition at ETH Zurich, where I am a Senior Scientist. Even though it sometimes required a lot of patience, I wouldn't have wanted to miss my time in India for anything!"

Recorded by Anna-Katharina Ehlert, Academic Assistant at the SNSF.

Valuable dung: workers gather the droppings of sea birds that are rich in phosphates and nitrates. Ballestas Islands, Peru, 2011.
Photo: Keystone/Laif/Dado Galdieri

False alarm

Phosphorus can pollute the environment, but it's also an element essential to human beings. Even if reserves of phosphorus might last longer than has sometimes been claimed, we should still rethink how we deal with this valuable commodity. *By Felix Würsten*

It wasn't long ago that phosphorus was creating nasty headlines here in Switzerland. Following the Second World War, the phosphorus content of lakes and rivers increased continually, with alarming ecological consequences in some cases. Only towards the late 1980s did the degree of pollution decrease, thanks to the expansion of waste-water treatment, a ban on phosphates in detergents and a greener approach to agriculture.

Meanwhile, phosphorus has been causing a stir for other reasons. In recent years, the media have resorted to headlines such as: "The elixir of life is dwindling", "The phosphorus crisis: the end of humanity?" This has been in response to a seemingly new idea put forward forcefully by various researchers, namely that phosphorus – an essential commodity to mankind – will run out in the foreseeable future. As in the case of crude oil, which has prompted lively debate about when global production will peak, these researchers have sketched a scenario for rock phosphate – the source of phosphate fertiliser – suggesting that production will already peak some twenty years from now.

In contrast to crude oil, which can be replaced by other energy sources, the situation with phosphorus would be far more critical if reserves were indeed about to be exhausted. Because phosphorus cannot be replaced. It is an essential element without which neither animals nor plants can exist. Apart from anything else, it also determines the efficiency of crop yields in the agricultural sector. If farmers cannot fertilise their fields with phosphate, food production in its present form would no longer be possible.

But just how serious is this supposedly impending crisis? "The situation isn't as dramatic as it's sometimes described", explains Andrea Ulrich of ETH Zurich. She has examined the problem in her doctoral thesis at the Institute for Environmental Decisions. It turns out that in the 1930s and 1970s there were already discussions about how long reserves of rock phosphate would last.

85% of the world's reserves are held by just four countries: Morocco, China, Algeria and the USA. Calculating exactly when those reserves will dwindle is not so simple because there are many different factors that determine how long they might last. Price, supply and demand play a role, but so do the political environment and technological innovation in the mining sector. What is decisive for these calculations is not the amount of rock phosphate that actually exists, but the economic conditions under which it is mined. Because this decides whether a deposit is worth extracting.

Unhelpful discussions

It is precisely for this reason that the current debate about the point of peak production is somewhat unhelpful. It simply gives a wrong picture of things. "If we want to deal with the problem seriously, then we have to keep an eye on the whole system and take account of the phosphate deposits that exist in the ground, for example", says Ulrich. A step in the right direction would be to improve our data so that the discussion can be placed on a more solid footing. All the same, the current literature already offers reliable figures, and these show that today's deposits should last for some 350 years.

A glance into the past can also be helpful for another reason: "In earlier years, people were already talking about possible measures that might become necessary. But regardless of how important it might be to find new solutions, we shouldn't reinvent the wheel every time. Instead we should use the knowledge we have already gained, but in a more goal-oriented manner", believes Ulrich. What is remarkable is that the repeated discussion about the limited amount of phosphate has ultimately led to an expansion of reserves. Other suggestions, however, have not been pursued – such as curbing its use. The consequences for the environment have been fatal, for in many places farmers still use phosphates wastefully, resulting in the unnecessary pollution of rivers and lakes.

And yet there are in fact various approaches that would be feasible. If people in industrialised countries were more conscious about their eating habits, less food would be thrown away. And a more targeted use of extracted fertilisers, coupled with a more effective use of organic fertilisers (i.e., from plants or animals), would not only let us reduce their use and but also reduce environmental pollution. And last but not least, Ulrich sees recycling as a necessity: "If we can recover phosphates from sewage sludge and waste water, then we can create an important contribution to a sustainable use of phosphorus".

Manure and nuclear power plants

But Ulrich also argues in favour of a better use of rock phosphate, and one of her suggestions is controversial. Some rock phosphate contains considerable amounts of uranium. If we were to separate the uranium during processing, we could both produce a more environmentally friendly fertiliser and also secure a longer-term uranium supply for nuclear power plants. This would make sense because there are also only limited reserves of uranium that can be easily mined. The amounts involved are considerable too. In 2010 alone, it would in principle have been possible to gain 11,000 tonnes of uranium from rock phosphate – which is equal to a fifth of the world's total uranium production. This possibility was also discussed in the 1950s and 1970s, and the necessary processing plants were even built. But when the Soviet Union disintegrated, large amounts of surplus uranium suddenly flooded the markets, so the idea was put on the back burner.

In Ulrich's opinion, we now need an approach that tackles the problem on different levels. "It would be ideal if all those involved – industry, authorities, NGOs and scientists – were to come together in a dialogue". This would also be important because fundamental questions pertaining to distribution have to be clarified. In certain parts of the world, local agricultural potential cannot be properly realised because there is a short supply of phosphate fertilisers. Various initiatives have been started recently that aim to tackle the problem on a national and international basis. Nevertheless, Ulrich sees an institutional gap here: "Both the United Nations' Environment Programme and its Food and Agriculture Organization only see themselves as partially responsible. Ultimately, we are lacking a single institution that would bring everything together and focus existing knowledge on the issue".

Felix Würsten is a freelance science journalist.

A young mountain range: the Greater Caucasus crosses Azerbaijan (here at Istisu, 2004). Photo: Jon Mosar

Seismic studies

With a detailed map of the tectonics of the Greater Caucasus, it should be possible to predict earthquakes. *By Pierre-Yves Frei*

> "We have a common interest in the geology of this region which prevails over any political disputes"
>
> Jon Mosar, geologist

The peaks of the Greater Caucasus are of rare beauty. They also contain the highest summits in Europe. Mount Elbrus (5,642m) is considerably taller than Mont Blanc, as is Mount Kazbek (5,033m). But the region is also known for its instability: not only political instability – given the many regional tensions and the relative difficulty in crossing borders – but also seismic instability. Some areas of the Caucasus Mountains are prone to frequent, violent earthquakes. These tremors have brought with them uplift in several parts of the range, greater even than in the Alps.

"Our work is to understand better what is happening in the region: what is the exact result of collisions between the Arabian and Eurasian tectonic plates, how seismicity is related to the complex system of major fault lines, how these fault lines have influenced the topography and of course how the various tectonic elements organised themselves during the fold and thrust process".

It's been 12 years since the first scientific expedition of Jon Mosar, a professor of geology at the University of Fribourg. That was to Azerbaijan. "Today our team is made up of Azerbaijanis, Georgians and Russians. We have a common interest in the geology of this region which prevails over any political disputes. Thanks to this Scopes project, we can apply our measure of support to research, cruelly in need of funding in these countries. In this way we help to recruit young scientists".

Fifteen million years young

Like the Alps, the Caucasus Mountains are geologically young, dating back some 5–15 million years. The Alps, however, emerged following the subduction of the African plate under the Eurasian plate, whereas the Caucasus Mountains are the result of a collision with the Arabian plate. Another difference is that, while the Lesser Caucasus were a direct result of this subduction, the formation of the Greater Caucasus also involved the closure of a huge sedimentary basin more than one hundred million years old. The geologists are particularly interested in this tectonic unit. They are trying to map what happened to it and how it become part of the range, so as to understand better how the range itself formed.

To do this, they are combining new surveys with compilations of earlier work led independently by the individual countries. This tectonic synthesis represents the core of Jon Mosar's new Scopes project. He is currently recruiting master and doctoral students to carry out the painstaking homogenisation of data acquired from different partners. "The result will be the most precise tectonic map ever published for the area".

This map will also highlight all the major fault lines that scar the area. And this will be valuable information for those interested in the prevention of geological hazards, especially given the high seismicity of the territories concerned.

Pierre-Yves Frei is a freelance science journalist.

Michael Schmidt

Even the tiniest residues of burnt wood can tell us much.

Dating forest fires precisely

In certain regions of the world, such as Australia or North America, forest fires and bush fires are a crucial element in the development of vegetation. From the perspective of environmental research, the question arises whether climate change or human influences have caused an increase in the frequency and extent of such fires. This question can be answered if we examine the residues of burnt wood that have been deposited, for example, in the sediments of lakes. However, there is a catch: until now it has only been possible to analyse particles discernible to the naked eye. There was no way of examining finer particles, such as those left by the frequent grass fires in Australia.

In collaboration with researchers from ETH Zurich, Michael Schmidt's group at the Geographical Institute of Zurich University has developed a method that can provide a far more accurate picture. They can now analyse individual particles just a few micrometres in size, such as fine soot particles that are invisible to the eye. With the help of high-resolution mass spectrometers and carbon-14 dating, they can identify the type and age of particles. This means that they can better reconstruct the course of forest fires. It also allows them to date archaeological findings that no one had been yet able to classify reliably, and to identify residues in lake sediment deposited by burning fossil fuels. *Felix Würsten*

A simple and ecological process to store hydrogen

Hydrogen may be considered to be the fuel of the future, but this very light gas has one major disadvantage: it is highly explosive, making its storage and transport complicated. Together with his team, Gabor Laurenczy, head of the Group of Catalysis for Energy and Environment at EPFL, has nevertheless found a way around this obstacle.

These chemists have been reacting hydrogen with CO_2 in the presence of a catalyst. In these attempts they've managed to create formic acid, which is a liquid and therefore readily storable. They were then able to reverse the operation, turning the formic acid back into hydrogen.

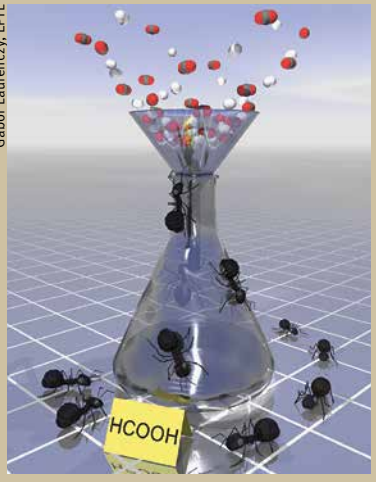
This method is not as complicated as others used so far, nor does it generate unwanted chemicals. In addition, the team has killed a second bird with the same stone. As Laurenczy explains, it becomes possible "to suck up CO_2 and make use of it, rather than emitting it into the atmosphere as a greenhouse gas".

The hydrogen obtained can be used to power electricity-producing fuel cells. "With one cubic metre of hydrogen, it is possible to generate approximately 1 kWh of electric power. So even a small quantity of formic acid, transformed into hydrogen, could be used to charge a telephone or small electronic device".

It is also possible to use formic acid directly to synthesise organic molecules of use to industry, particularly in the field of chemicals and textiles. Indeed, there won't be any shortage of applications for this astute and ecological process. *Elisabeth Gordon*

S. Moret *et al.* (2014): Direct synthesis of formic acid from carbon dioxide by hydrogenation in acidic media. Nature Communications 5:4017.

Gábor Laurenczy, EPFL



Formic acid (HCOOH) is ideal for storing hydrogen.

CERN

CERN's 'Cloud' chamber: here the ingredients of pine needles are analysed.

Essence of pine in the clouds

The molecule that gives pines trees their unique smell plays a crucial role in the formation of clouds, according to a study led by CERN's 'Cloud' consortium. "Alpha-pinene is an oxidation product emitted by pine trees, and which acts as an adhesive maintaining the stability of aerosols formed from molecules of sulphuric acid", explains Urs Baltensperger of the Paul Scherrer Institute. "The expanding aerosols allow the formation of water droplets and, from there, clouds. This phenomenon explains the bluish fog sometimes seen in forests".

The role played by alpha-pinene was confirmed by experiments conducted in the artificial 'Cloud' chamber and by quantum chemistry calculations. A numerical simulation also supports this model. By taking into account the fact that pines release more alpha-pinene in the spring and summer, it correctly reproduced the seasonal variations observed in aerosol concentration.

Baltensperger's work has already highlighted the importance of the dimethylamines in cloud formation. These molecules, however, are only present near decaying organic matter and therefore cannot contribute to the formation of all clouds. The essence of pine, however, can travel hundreds of kilometres before oxidising completely and acting as an adhesive. Little by little, the puzzle of cloud formation is coming together. Soon, the consortium will study the role of volatile organic compounds emitted by means of transport and combustion. *Daniel Saraga*

Riccobono *et al.* (2014): Oxidation Products of Biogenic Emissions Contribute to Nucleation of Atmospheric Particles. Science, vol. 344, nº6185, pp. 717–721.

Beneath the veil

The veil today seems representative of a backward-looking Islamism. But we also find it in Western culture. At the close of the 16th century, for example, it was part and parcel of the seduction games of Venetian courtesans.
By Susanne Leuenberger

We only see her from behind: a well-proportioned bathing belle by the seaside at sunset, clad in a yellow thong. "Kisses from Italy" says the 1970s picture-postcard. The sun always shines south of the Alps, it seems to tell us – and more to the point, the sender wants to let us know that he already has his place in the sun, in full enjoyment of the voluptuous, sensual Mediterranean pleasures to be had by the petit-bourgeois adventurer from the North.

Long before mass tourism came to the *bel paese*, there were already saucy pictures of southern beauties adorning the diaries of students and sojourners to the south. In the outgoing 16th century, Venetian ladies revealed their *décolletés* even though their faces remained veiled in accordance with the societal customs of the day. "Just as we bring holiday snaps home today, students in the Renaissance documented their journeys with pictures. Particularly popular were flirtatious, exotic depictions of Italian women", says Henri de Riedmatten of the Institute of Art History at the University of Zurich.

In the mid-16th century, the *alba amicorum* began to make an appearance. One example of these 'friendship albums' belonged to a Breton student who in 1575 went to study in Padua. Like many of his fellow students he had been given his album by his family before leaving home. The young man used it to document his friendships, experiences, and things that interested and astonished him. Co-students made drawings of their family coats of arms in it, and his professors entered handwritten dedications.

This album also contains 105 pictures in which we see Italian clothing fashions – local trends from Venice and Padua. These watercolours were offered at markets by local artists. Sometimes students commissioned the miniaturists to draw a particular scene. So some of the pictures were made on the street. They show priests and professors in their respective clothes and, above all, women: unmarried girls (*donzelle*), married ladies (*gentildonne*), widows and old women. And courtesans.

Veiled faces and bared breasts

The *alba amicorum* enjoyed its boom years from the 1580s onwards. Today, the pictures of local women we find in them are being analysed by Riedmatten together with the art historian Victor I. Stoichita from Fribourg. "Fashion back then used to change quickly. Black was not necessarily a sign of mourning, but referred to the Venetian origins of the woman wearing it". The extent to which women covered or exposed themselves signified their respective social status.

Position in the social hierarchy was signified by revealing or hiding one's face. Unmarried women wore dark, thick veils over their faces; women in mourning covered their faces with a bright, transparent cloth, but married women showed their full face when they went walking in the streets. "When a woman married, she gained public status. That is why she was able to show her face". Despite their veils, the young women shown in the pictures still reveal a lot. "There are even written sources that describe how some women wore clothes that exposed their breasts", says Riedmatten.

Nevertheless, these stereotypical images depict more wishful thinking than they do reality. "The owners of these books stylised themselves as adventurers, and this also meant constructing an idealised Italy". Besides the 'misses' and the elegant ladies, the courtesans were another popular subject in travel diaries. A raised veil, flirtatious gestures or a mischievous smile behind the semi-transparent mourning veil betray that the women depicted were girls of 'easy virtue'.

In around 1600, the university city of Padua drew more than 1,500 students from 22 nations. They came from France, Germany, Scandinavia and England to study not just law, but also subjects like astronomy, which was taught by Galileo Galilei, for example. Nor were physical needs ignored. There were many prostitutes at that time in Padua, Bologna and nearby Venice, says Riedmatten. "When students were banned from Padua for several months in 1582, the prostitutes complained loudly about having too little work", he says. Among the prostitutes themselves, the courtesans formed a kind of elite.

Waywardness and innovation

Riedmatten is particularly interested in the dressing-up games of the courtesans. "These pictures don't show any subjects. Those depicted are models: faceless, stereotypical and interchangeable". Of course, says Riedmatten, the illustrations testify to the male viewpoint of the man who commissioned and owned the pictures. The seductive woman whose gaze remains hidden to the male observer is a "common Western modality of beholding". But his primary research interest is not a critique of the gaze from a gender-theory perspective, though his methodologies do include aspects of gender studies.

What he's seeking in the serial nature of these bare-breasted, faceless women in their deindividualised depictions is traces of waywardness and cultural innovation. The courtesan was a figure without any clear status in mediaeval society, says Riedmatten, and so she was not bound by any dress rules. Instead, high-class prostitutes made use of all the other styles of dress and disguise. Sometimes they would wear the robes of a *donzella*, another time they might imitate a *gentildonna*, a noblewoman, or a woman in mourning. "With their games of disguise, courtesans varied the norms of dress". And by transgressing sartorial norms, they sometimes made a fashion statement.

It was the precarious, uncertain status of the courtesans that prompted individualism in fashion and cultural change, says Riedmatten. "Some courtesans attained prestige and fame as muses of the nobility. Some of them lived in palaces on the Grand Canal", he says. To be sure, the *cortigiane* were a small minority among the prostitutes. Most of them were poor and died young, often of the plague, which was rampant at the time.

Susanne Leuenberger is an editor at the *Reformierte Presse*.

Flirting with a veil and without: Venetian women from the *Mores Italiae* (1575), watercolour and gouache.

Pictures: Maurizio Rippa Bonati/Valeria Finucci (eds.), *Mores Italiae. Costume and life in the Renaissance/Costumi e scene di vita del Rinascimento* (Yale University, Beinecke Library, Ms. 457), Cittadella: Biblos, 2007

Politics can wait

In Switzerland, becoming a citizen is cause for celebration. Yet the festivities don't seem to be drawing young people towards political life.
By Dominique Hartmann

A team of three researchers at the *Haute Ecole de travail social* of the HES-SO is looking into the impact of events organised to mark the accession to the right to vote and eligibility on later political commitment. Their study focuses on young people from middle or upper social classes, as these two categories represent the majority at public civic ceremonies.

All celebrations "try to appeal to the emotions", says Laurence Ossipow. One even resembled an initiation ceremony with its nocturnal trail game that included a scramble up the Marly-Fribourg bridge. The main feature, however, is variety. In Asnières (Geneva), the approach is educational: the young person is accompanied by a political mentor to file a first motion at the local council. In Guin (Fribourg), there is a speech by the chair of the local authority. Games are also held, pitting elected representatives against young people. And while European, Swiss and Geneva flags fly above the city of Calvin, in Marly (Fribourg), interest leans towards regional emblems.

At these ceremonies, "it is the State under the spotlight, not young people", says Ossipow. "It's as if politics wants to make its mark on the minds of the young". But another category of politician defends a very conventional vision of citizenship, mainly based on civic participation. Dissenting causes are little valued, despite being paradoxically adopted as models. And there's another paradox linked to the order to vote. Some politicians highlight that it is not yet time to 'take command'. Others guide the youth in the direction of social or community engagement, which is an indispensable move in areas popular with foreigners, given that they have no political (or partial) rights and therefore remain minors from a civic point of view.

Records for Geneva show that, between 1924 and 1944, ceremonies related to the obligation to serve were intended only for young men. In 1942, however, the *Centre de Liaison des Associations Féminines* spoke up, saying that as young girls carried out complementary social work they too must attend such events. Yet until 1960 – when women won the right to the communal and cantonal votes – separate discourses existed, one calling young men to public affairs, the other calling girls to the education of children.

From hip-hop fashion to traditional Swiss costumes – a civic ceremony for young citizens in the Théatre du Léman, Geneva. (2009). Photo: Isabelle Csupor

Fewer and fewer

With time, political stakes have had their influence on these calls to citizenship. Between 1942 and 1944, there was the idea of strengthening patriotism. Then with the economic boom of the 1960s, the issue of a united Europe crept into the speeches. Later still, there was more controversy.

Another of the researchers, Isabelle Csupor, takes up the story. "In 1971 a young woman gave a very critical speech aimed at economic imperialism and the Church's intolerance of contraception". But young people had already started ignoring these kinds of events. It's worth noting that since 2011 Geneva has begun efforts to encourage early school leavers to join the public sphere.

Concluding their study, the researchers esteem that such ceremonies "miss the point". Even if Swiss politicians are ready to help young people to engage socially or politically, the youth are not really interested in voting. When questioned about this, they argue that they are committed, but in an essentially social way (youth clubs, responsibilities in the running of sports clubs, etc.). Politics will come later (maybe).

Dominique Hartmann is an editor at *Le Courrier*.

Deficits in the mother-child bond

The attachment between a mother and her child can develop flaws as soon as the pregnancy is over, even for mothers with no psychological disease. This is the result that has emerged from recent research by Antonella Carassa and her team at the *Università della Svizzera italiana* in Lugano. The study involved 90 mothers-to-be living in the canton of Ticino who agreed to the long-term study on the intergenerational transmission of attachment. Their affectional bond style was evaluated during their last trimester. Then their bond with the children was followed until their second birthday.

Given that the population sample was in good mental health, researchers thought they would discover a majority of mothers with secure attachment. But a surprise lay in wait for them. "Astonishingly, we detected more women showing an insecure style", explains the postdoc Martina Cussino. These mothers have an avoidant profile, i.e., they try to minimise the negative aspects of their lives and curb their emotions. They also show unresolved trauma. Their children display a disorganised-insecure attachment, which is a known risk factor affecting the quality of psychological development. These results highlight the importance of very early prevention and intervention strategies to detect these dysfunctions and to encourage a better cognitive and emotional development of children. Even for the average mother. *Fleur Daugey*

Timof/Shutterstock

Still firmly attached: a seven-month-old foetus.

Simon Stähli

Discrete, not intrusive: a transformed waiting room at the citizen's registration office in Bern.

Making waiting agreeable

Whether as a customer or a patient, we often have to wait in line. That costs time and nerves. We twiddle our thumbs and feel powerless. But the act of waiting can be influenced positively by means of artistic interventions that address all the senses. This is the conclusion reached by a research project at the Bern University of the Arts. The researchers involved spent three weeks investigating the impact of 'holistic room design'. They transformed – "discretely, not intrusively" as the sociologist Harald Klingemann puts it – the waiting rooms at the outpatient clinic at the Bern University Hospital and at the citizen's registration office of the City of Bern into 'waiting oases'. First, they erected stimulating 'bubble columns' and shadow plays, then calming video installations showing nature films, as well as ornamental fabric panels. Suitable scents served to intensify the overall impression.

The people waiting straightaway demonstrated less stress behaviour than is usual in a waiting room. They felt more at ease and were even happier with the services provided. This was proven by observing 1,950 people using the waiting rooms and by a survey of 482 people. In the case of 157 people, the researchers also measured their physical reactions by means of a smartphone app. Klingemann observes that service providers' conventional waiting management mostly aims to shorten waiting times. But that can miss its target because time that is measured objectively often does not correspond to subjective time. "If I'm waiting anxiously to see the doctor about the results of a test, five minutes can be an eternity". But a pleasant spatial experience on the other hand can serve to relax people. This is not just a service to the people who are waiting, but also to the service providers. *Susanne Wenger*

From Gotthelf to Godard

The 1960s and '70s marked a transitional phase in Swiss cinema. This was a time when Switzerland moved from the homely world of dialect films to the experimental films of the *auteurs* emerging in the wake of the 1968 revolts – though the latter group proved unable to achieve any lasting breakthrough. The old guard was represented by Franz Schnyder, whose films were based on the novels of Jeremias Gotthelf, while the new was represented by Jean-Luc Godard, the iconic figure of nonconformist film.

Thomas Schärer, a lecturer at the Zurich University of the Arts and at the University of Basel, has placed these two names – Gotthelf and Godard – in the title of an extraordinary book offering a history of that turbulent period from multiple perspectives. First, the reader is given the viewpoint of the film-makers themselves – Schärer has conducted conversations with forty directors, cameramen, actors, cutters and so on, and quotes them liberally. Secondly, his book offers many images, with particularly spectacular behind-the-scenes pictures. Last, there are passages printed in italics offering a kind of lexicographical view of the topic. This book – some seven hundred pages long – is held together by Schärer's discussions of important films. He deals not just with their artistic value, but also the conditions under which they were made and the beginnings of official Swiss cinema policy.

This chapter of Swiss cinema history has surely never yet been told in so comprehensive, compact and yet exciting a manner. All it perhaps lacks is some kind of summing up; the author seems at times to disappear behind his mass of material. Even as late as the 1950s, the medium of film was regarded as trash by the cultural elite. Today it is so accepted as a genre that reading Schärer's account at times produces a melancholy hankering for the epoch when rebellion was in the air. *uha*

Thomas Schärer: Zwischen Gotthelf und Godard. Erinnerte Schweizer Filmgeschichte 1958–1979. Zurich: Limmat Verlag, 2014. 701 pp.

Media Information Centre ZHdK

Into the new: Swiss film students learning their skills in Antwerp, ca 1968.

The invisible achievers

Postdocs on temporary contracts are responsible for a large proportion of research in Switzerland. But only ten percent of them manage to get a permanent job at a university. A career in academia has to become more attractive. *By Valentin Amrhein*

Valérie Chételat

We're in a room at the Zoological Institute of the University of Basel. Daniel Berner is feeding long rows of numbers into a computer. He is investigating the genetic diversity of sticklebacks – small fish native to Switzerland that extend their sharp dorsal barbs when they land in the mouth of a larger fish. After his doctorate, Berner went to a Canadian university for two years, and since then has been conducting research in Basel. When his contract runs out in four years, he will have worked as a full-time biologist at different universities for a total of twelve years.

Next to Daniel Berner sits Tobias Roth, whose computer is right now calculating the effect of global warming on the speed at which Swiss plants, birds and butterflies extend their habitat up into the mountains. Roth is working in an ecological consulting office and is researching as a sideline at the University of Basel. These two biologists probably have no chance of a professional career at a Swiss university. Or at least no chance of a future in which they would be paid a wage commensurate with the highly qualified work they do.

They are both 'postdocs' – people who do research at universities after completing their doctorate, but who are not professors and only have limited contracts. These research staff and assistants supervise undergraduates and doctoral candidates, and they deliver a major share of Switzerland's scientific research. They either earn a regular salary like Berner, or are absent from university wage lists because, like Roth, they do their research essentially as a hobby, earning their living by working for other employers or financing their research with scholarships or grants from foundations.

All the same, no one can actually say just how big a contribution postdocs make to Swiss research. Because – as astonishing as it may seem – no one knows just how many postdocs there are. The universities usually don't know because the category of 'postdoc' is vague; postdocs work in fields and under circumstances that mean they overlap in part with other professional groups at universities. And different universities and faculties also have different names for their different areas of activity.

Getting a bad deal

At the request of parliament, the Federal Council presented a report last May in which it was assumed that there are currently between 5,000 and 8,000 postdocs. "That's undoubtedly too small a number", says the bioinformatician João Martins, who surveyed some 400 Swiss research groups for the SNSF. He reckons that the number of postdocs lies between 12,000 and 14,000. In that case, there would be at least three postdocs for every one of the roughly 4,000 professors in Switzerland. "Sadly, we don't have any exact data about the motivation and ambitions of postdocs" says Martins. It is assumed that postdocs want to qualify themselves for higher academic positions. But they have a poor chance of that, for only about ten percent of them reach the level of professor.

Critics of this system fear that an academic career is unattractive, especially for young, home-grown talent. There are too few permanent professorships for too many postdocs. For this reason, a group of young researchers got together in 2012 to present a position paper entitled 'Vision 2020', one of the proposals of which was for the creation of a thousand new assistant professorships with the option of a permanent appointment. It is clear that this would only improve the job prospects of postdocs on a temporary basis, namely during the period in which the new positions were created. But this initiative from the young researchers led to a discussion in parliament which itself led the Federal Council to reply. Its recommendation is that "creating more differentiated posts that offer earlier independence and responsibility might promote a greater degree of flexibility in a career structure currently centred on professorial chairs; this could make a contribution to improving the prospects for an academic career".

The idea is to offer up-and-coming academics more career paths that could lead to a permanent position if they achieve an excellent track record. At the same time, however, the question arises as to whether Swiss universities are in fact producing too many postdocs. One reason for this is surely the fact that the number of doctoral students is increasing every year. In the USA, too, according to a paper published in April in the journal *PNAS*, there are discussions about whether the 'hyper-competitive atmosphere' is in fact homemade, at

> "In order to reduce their number by half, we should double their salaries".
>
> Gregory Petsko, neurologist

least in biomedical research. The reasoning for this is that institutes are continually getting bigger, but without more funding becoming available. However, too much competition soaks up time and energy that would be better used for the creative thinking that is needed to explore uncharted scientific territory and to produce reliable results.

Alke Fink, a professor at the University of Fribourg and co-author of 'Vision 2020', also recommends reducing the number of postdocs. "The selective process has to take place as early as possible. Otherwise, when postdocs leave the university environment, they are too old for the private sector. We have to give them an honest assessment early on as to whether we can recommend an academic career to them". But honesty surely also means admitting that universities and professors today profit from the large numbers of postdocs.

High output, low maintenance

Academia profits from postdocs because they have completed a long period of training, they can work on their own, they're often productive and they require little support. The intense competition among them for the few permanent positions means they are mostly highly motivated. And they're cheap too. According to the report by the Federal Council, postdocs earn on average fifteen to twenty percent less than people with a doctorate who are working in industry or in the civil service. It is possible that the intense competition among young Swiss researchers acts as a deterrent, but then the numbers are made up by the many foreign postdocs in the country.

But do we really still want a mid-level tier of academic staff who remain into middle age on a one-way career track that in 90 percent of cases is actually a dead-end? And if not, what should we change? In an online lecture that is well worth watching, the neurology professor Gregory Petsko analyses the situation of postdocs in the USA, which is clearly similar to the state of things in Switzerland. "Postdocs are the invisible people. We asked institutes how many postdocs they had, and in many cases they couldn't even give us a rough idea".

Raising salaries

Petsko makes three recommendations. First, every research institution should have an administrative post that knows how many postdocs there are, how they are paid, and what their career ambitions are. Secondly, the universities should be compelled to prepare their postdocs for alternative fields of work, because the usual career trajectory for postdocs takes them outside tertiary education. And thirdly, Petsko has a simple suggestion to reduce the number of postdocs: "In order to reduce their number by half, we should double their salaries. Then I would have to make clear, economic decisions about who I want to keep and who I think has a real future in academia".

In Switzerland, too, a moderate increase in postdoc salaries could lead to a situation in which it is no longer cheaper in every case to appoint a postdoc instead of a permanent member of staff. Furthermore, we could initiate a discussion about reducing the financial support and professional security that is enjoyed by Swiss professors, which is uniquely high in international terms. The money involved could then be reallocated to mid-level academic posts. It is interesting that the Federal Council writes the following about the US university system, which is often praised as being exemplary: "Depending on their respective field and university, it is usual for chairs to have far less facilities and adjunct staff compared to Switzerland (or even none at all). Nor are professors always appointed to a 100% post, but often have to find part of their income from third-party funds. This gives US universities more flexibility, and at the same time it means that professors are subjected to a far greater degree of competitive pressure".

But who in Switzerland would dare "to reduce the overly cumbersome, weighty professorial chairs", as the group of young researchers of 'Vision 2020' recommends? It might well be that the Swiss university system just functions far too well for this to happen – with its few, highly paid permanent posts, lots of competition among younger researchers, and a big influx from abroad.

Valentin Amrhein is Head of Public Relations at the Swiss Academies of Arts and Sciences.

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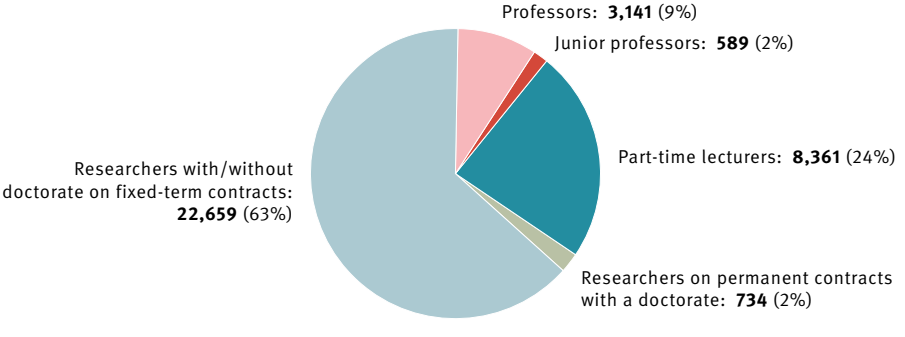
B. Alberts *et al.* (2014): Rescuing US biomedical research from its systemic flaws. PNAS online.

G. Petsko (2013): The postdoctoral situation. www.ibiology.org

Mostly fixed-term contracts

In 2011, there were 35,484 researchers employed at Swiss universities. Of these, some 80 percent had only fixed-term contracts, including most lecturers (in the category 'part-time lecturers'). The category 'Researchers with/without doctorate on fixed-term contracts' is heterogeneous because the personnel categories it encompasses are defined differently. 'Assistants' can be both doctoral students and postdocs. For this reason, the precise number of postdocs is unknown.



Source: Employee survey SBFI/CRUS

Now make it happen!

Are the Federal Council's proposals to support young academics satisfactory? Markus Zürcher, General Secretary of the Swiss Academy of Humanities and Social Sciences (SAHS) is not completely happy. *Interview by Christine D'Anna-Huber*

Valérie Chételat

"The problem with up-and-coming scholars has to be tackled by supporting them earlier on".

Markus Zürcher,
General Secretary of the Swiss Academy of Humanities and Social Sciences

Horizons: The Federal Council wants to improve conditions for young academics. Do you find their report convincing?
Markus Zürcher: It's the best, most comprehensive review we've yet seen of the situation in which young academics find themselves.

H: The report calls for more equality of opportunity and recommends supervising doctoral candidates better, and paying them better wages. But above all it wants to make careers in academia both more attractive and easier to plan. So it proposes having earlier selection processes and creating a wider job profile for academics, besides professorial posts. Do you agree with all that?
MZ: That's both right and necessary. But the Federal Council doesn't overly emphasize these proposed measures and leaves it largely open as to how they might be put into practice. Of course, that also reflects the fact that it's ultimately up to the universities to implement them. Given the problems we're facing, what I feel is lacking is the message: 'Now make it happen!'

H: In the humanities, it's all somewhat worse, isn't it?
MZ: Let's put it this way: there are discipline-specific aspects that influence today's problems for up-and-coming scholars in the humanities and social sciences. The report makes no attempt at differentiation here.

H: But the recently published SAHS baseline report on supporting the humanities does just that. It's one of a series of many reports and proposals for recruiting young academics in Switzerland. Aren't there now too many doctors trying to treat the patient?
MZ: That is precisely why the new plea by the SAHS for a national education strategy is such an important signal. We can really only solve the problems in our education system if we develop a programme for all of Switzerland, across all levels of education. We have to succeed in exploiting everyone's potential to the full, not just at tertiary level. The problem with up-and-coming scholars has to be tackled by supporting them earlier on.

Christine D'Anna-Huber is an editor at TA-SWISS.

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Is more security possible only at the cost of less privacy? Many citizens don't agree. *By Christine D'Anna-Huber*

Little joy for Big Brother

The Swiss are particularly sceptical about state intervention in their private sphere. In Switzerland, only 38% of those asked believe that surveillance technologies should be used routinely by the state. The European average, on the other hand, is 54%. This is one of the results of 'SurPRISE' ('Surveillance, Privacy and Security'), a survey organised by the European Commission across nine countries to investigate the relationship between modern security technologies and our basic rights as citizens. Some 2,500 people, chosen randomly, offered their opinions on the use of modern surveillance technologies in public spaces and the Internet. In Switzerland, the Centre for Technology Assessment TA-SWISS held a discussion forum in three different language regions in conjunction with the SurPRISE survey.

A north-south cleft

The survey shows that the value assigned to one's private sphere is very dependent on one's own sense of security. In countries where people feel safer, they're more averse to the use of modern technologies to monitor the population for security purposes. There is also something of a cleft between north and south. In Denmark (92%), Norway (90%), Switzerland (84%), Austria (81%) and Germany (73%), those approached feel particularly safe, whereas the general sense of security in Spain (49%), Italy (43%) and Hungary (31%) is far less pronounced, meaning that their citizens have fewer objections to state control.

This trend can even be seen within Switzerland itself. Here it is the German-speaking Swiss who feel the safest and are most opposed to state surveillance, followed by the French- and then the Italian-speakers. Internationally, an average of 50% feels that those with nothing to hide should also have nothing to fear from being monitored; in Switzerland, however, 64% rejected this notion.

In political debate, it's often assumed that citizens accept the equation: 'more security = less privacy'. But in fact people don't swallow that trade-off quite so easily. This doesn't surprise the project coordinator, Johann Čas. "If we take a more comprehensive view of security, then privacy is an integral component of it. After all, the concept of data protection and protection of the private sphere was introduced precisely to prevent the misuse of power and the indiscriminate exercise of state authority".

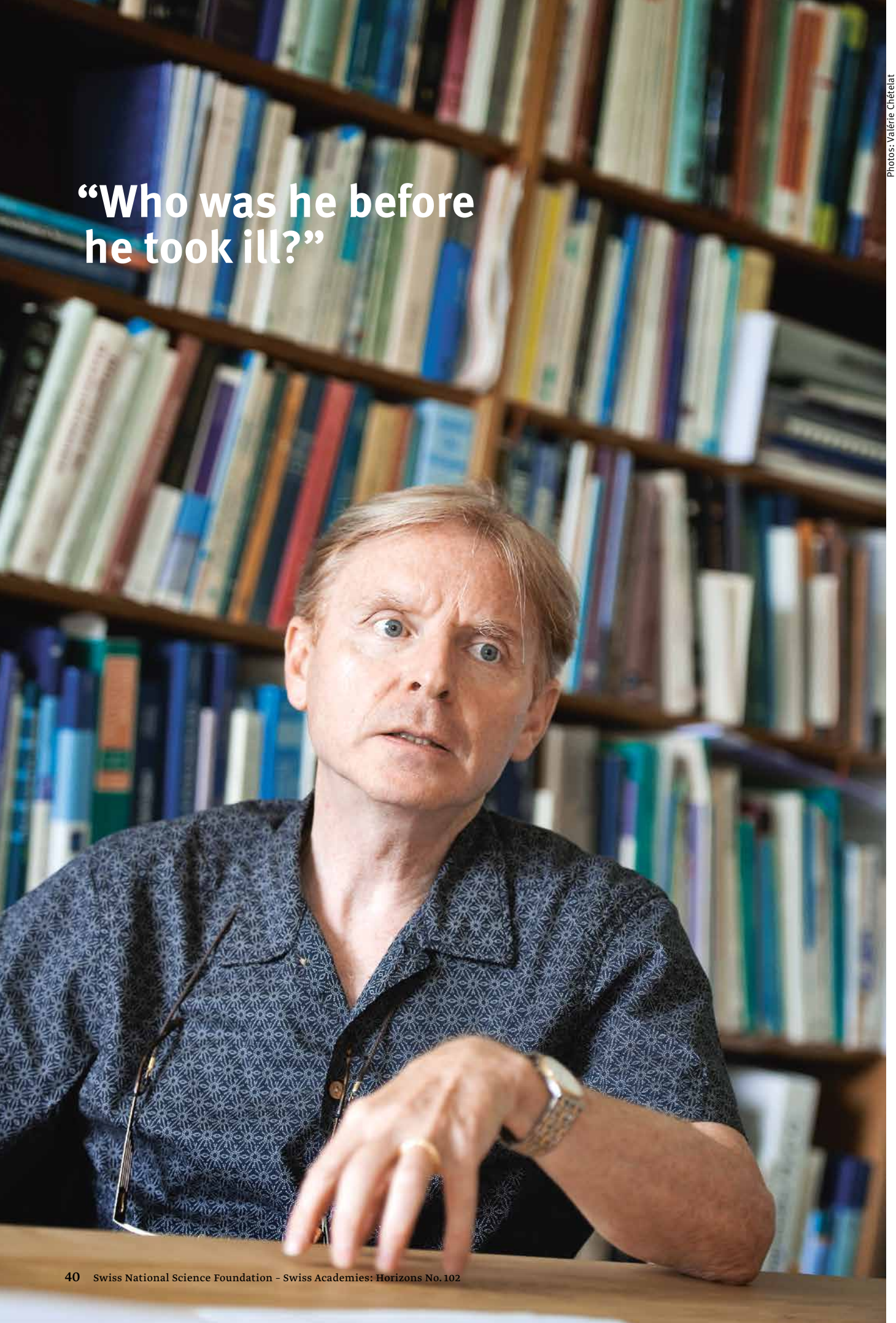
The results of the survey in these nine countries are now being analysed in detail. The Swiss report will be ready by late September and will then flow into the overall European evaluation that is to be presented in November in Vienna. "The results should offer politicians a solid foundation for drafting legislation", says Čas, "because ultimately it's the politicians who have to look at what's technologically possible, and then decide how much of it they should actually implement".

Christine D'Anna-Huber is an editor at TA-SWISS.

For more information, see: www.ta-swiss.ch and http://surprise-project.eu

Technology makes many things possible – but what should actually be implemented? Surveillance cameras in Geneva, 2007.
Photo: Keystone/Salvatore Di Nolfi

“Who was he before he took ill?”



Photos: Valérie Chételat

Senile dementia is generally incurable. In order to alleviate suffering, therapy should also take into account life stories, says the geriatric psychiatrist Armin von Gunten. *By Ori Schipper*

Horizons: Prof. von Gunten, your research into senile dementia focuses on the role played by personality traits such as anxiety. Such connections are absent from most research into Alzheimer's, which instead is concerned with revealing biological mechanisms.
Prof. Armin von Gunten: That's right. When we collect data about a patient, take blood samples or record brain activity, we get a snapshot in time: a picture of how the patient is at the time of the examination. That's all well and good. But we should also be interested in the patient over the course of time. What kind of person was the Alzheimer patient before he or she took ill? The answer to that can help us better adjust our treatment to his or her individual needs. If a dementia patient in the clinic vehemently resists showering, for example, then that might not be the result of an irrational, behavioural disturbance. Perhaps the patient had only been accustomed to bathing two or three times a week, and now finds it unreasonable to be washed every morning and evening.

H: So should doctors turn their attention more to the patient's pre-history and less to a snapshot of the present?
AG: I'm not talking about an 'either/or', but an 'as well as'. We shouldn't pay any less attention to the findings made in the clinic, but we should also take the personality of the patient into consideration. If we know the hygiene preferences of a patient, then we can better understand his or her defence reactions – the result of this is that we can try to adjust our nursing and psychosocial procedures instead of using drugs to prevent abnormal behaviour.

H: Do you feel that drugs are prescribed too often?
AG: I'm not saying that drugs are bad – on the contrary, they are often very helpful. But anxiety-reducing, tranquilising drugs, such as the neuroleptics that are often prescribed to patients with dementia, can produce side-effects that have a negative impact on the brain. As a result, neuroleptics might in fact intensify the origins of the symptoms, even if superficially they are alleviating them and are helping to calm an unsettled patient.

H: What else can we do against Alzheimer's?
AG: As a rule, senile dementia isn't curable. But we have to 'catch' the patient better. If a patient had always been interested in cars, but you now try and get his or her attention with animal films, then you're probably setting off on the wrong foot. In daily clinical practice, the personality and the habits of a patient are decisive. If a male patient was accustomed to walking about while thinking when he was healthy, then if he gets dementia he'll belong to those patients who have restless motor functions. This restlessness doesn't have to be a behavioural disorder in need of correction.

H: You propose an approach that is adjusted to the individual personality. Normally, the catchword 'personalised health' is applied to therapies that are adapted to the patient's genetic make-up.
AG: The mapping of the human genome has not yet brought any progress to geriatric psychiatry. Genetic analysis and magnetic resonance images of brain activity offer important information that can help us to answer questions such as: what is the connection between brain function and abnormal behaviour? If the brain chemistry becomes unbalanced, then we're simply dealing with a neurotransmitter problem. But the 'why' of it remains unanswered – why does a patient behave in one way, and not another? Perhaps it allows her to get around her anxiety or at least reduce it. What we describe as abnormal behaviour is a result of the adjustment mechanisms of a diseased brain. Instead of just altering the brain chemistry, we should try more often to alter the environment to which the brain – even a diseased brain – is trying to adjust.

> "Neuroleptics might intensify the origins of the symptoms, even if superficially they are alleviating them and calming an unsettled patient".

H: Your results suggest that people with incipient dementia become more anxious.
AG: Yes. It is interesting that the personality of a human being always alters in the same way. Whereas the manifestation of specific characteristics – such as having an 'agreeable' personality – stays roughly the same, incipient dementia is coupled with a reduction in openness and an increase in neuroticism – that's an anxiety that is difficult to overcome.

H: How do you explain this?
AG: Mental decay influences your personality. Both in tests and in everyday life, people generally act more circumspectly

"The World Health Organization believes that the number of people with dementia will quadruple in the next 40 years, from over 30 million to almost 120 million people".

and more distrustfully than before. Why that is, however, remains unclear. On the other hand, our brain is also marked by our personal history. It seems that severe or recurring depression increases the risk of Alzheimer's because it leaves clear traces in the brain and destroys nerve tissue. We have also found out that certain personality traits – such as increased anxiety – are probably risk factors with regard to the later onset of dementia.

H: How can your findings be put to concrete use?
AG: Personality changes can herald the onset of dementia and thus have diagnostic potential. In contrast to brain imaging, for example, they can be determined by simple means and are thus useful for family doctors. But they can also help us to improve the situation in emerging and developing countries. Over half of the world's total dementia cases are found in those countries today, but only a small minority is diagnosed and treated properly. The World Health Organization believes that the number of people with dementia will quadruple in the next 40 years, from over 30 million to almost 120 million people. The biggest rise is expected in emerging and developing countries, so there will undoubtedly be an increasing interest in simple screening and diagnostic tools.

H: How do people react to the diagnosis?
AG: In very different ways. A few commit suicide, like the celebrity Gunter Sachs. But most don't have the feeling that they are sick. After all, dementia isn't something that you can physically feel. It doesn't hurt. Many people are not at all concerned but regard a failing memory as one of the natural side effects of getting older. Often, they're quite right. Other people who lack a feeling of being ill nevertheless sense subconsciously that they don't function like others any more. They then react to stress with anxiety and inappropriate behaviour.

H: What does this mean for their relatives?
AG: Often, patients are themselves protected by the fact that they don't feel ill. But this can cause additional problems for the family members who look after them, many of whom adopt a lecturing tone with them – but this just makes things worse for the patients. It can make them even more anxious, and their behaviour even more disturbed. The result can be even more detrimental to quality of life than their actual cognitive decline. So we direct our therapy not just at the people with dementia, but also at their families. We try to help them deal with having a family member with dementia.

Ori Schipper is a science editor at the SNSF.

Armin von Gunten

Armin von Gunten grew up in eastern Switzerland and studied medicine at the universities of Fribourg and Lausanne. After various research visits including to London and New York, he returned to Lausanne where since 2011 he has headed the university service for geriatric psychiatry and run the research group 'Neuropsychiatry and premorbid determinants'.

Alzheimer's disease

Alzheimer's disease is the most frequent form of old-age dementia, accounting for roughly half of all cases. In Switzerland it affects some 60,000 people and is on the rise. Alzheimer's can't be healed, but there are different therapies that enable the patient to remain independent for longer. Statistics show that there is a slightly lower risk of Alzheimer's among those who have a higher level of schooling, a healthy lifestyle, who get about enough and have neither high blood pressure nor diabetes.

The misunderstood massacre in the stomach

Doctors have demonised a germ in our stomachs because it's carcinogenic. But it protected our forefathers from asthma and allergies. Could we still use its protection today?
By Ori Schipper

Man's most faithful servant is the dog, so they say. But our relationship to an inconspicuous microbe called *Helicobacter pylori* (*H. pylori*) goes back much further. Our forefathers carried this germ around with them 60,000 years ago when they left East Africa to explore and populate the rest of the world. This is proven by molecular-biological analyses of the genetic make-up of different strains of the microbe.

Biologists describe the microbe as a pathobiont, in other words an organism that can act as either a helpful guest in our stomachs or as a harmful pathogen. It is natural that the history of such a long relationship with so ambivalent a partner should be marked by trials and tribulations. And yet it is astonishing how vehemently medical science has changed its mind about this faithful microbe over the past thirty years.

In the late 1970s, the Australian pathologist Robin Warren was regarded as an oddball. In stomach biopsies of gastritis patients that his colleagues at the clinic sent him, he found numerous, curved germs. At that time, the stomach was thought to be an organ that harboured no living bacteria. Science assumed that even the most resistant germs would be killed off by gastric acid. So Warren's colleagues only grudgingly took note of his findings, assigning them no significance whatsoever.

The germ could be seen clearly on the photos that Warren made of his coloured specimens of stomach lining. But the gastroenterologists remained convinced that stomach upsets were connected to one's lifestyle, and a result of too much stress or too much alcohol. They preferred to talk of 'idiopathic gastritis', i.e., of a stomach inflammation of unclear origin, instead of believing that Warren's germ could have any causal relationship to inflammation in the stomachs of their patients.

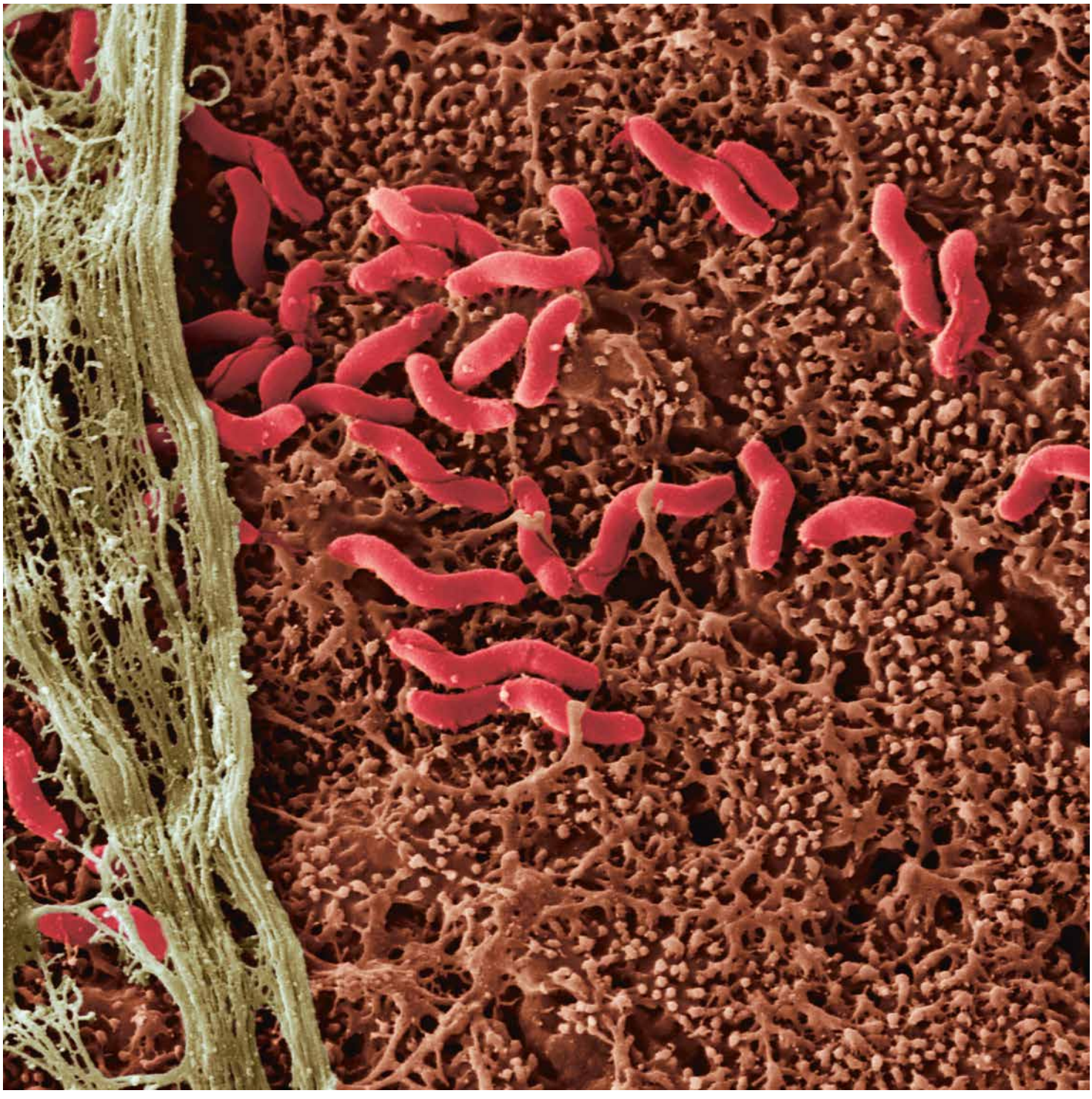
But Warren's ideas gained currency when the young, recently qualified gastroenterologist Barry Marshall joined him, having been assigned to "that pathologist who wanted to believe that gastritis was an infection", as Warren remarked in 2005 when he and Marshall were awarded the Nobel Prize for Medicine. In 1982 Marshall took a small piece of normal, non-inflamed stomach lining from 100 patients who had visited him for a gastroscopy. Warren looked at the tissue samples under the microscope – and found the curved germ in more than half of them. In some patients, the presence of *H. pylori* went hand in hand with frequent belching, bad breath and ulcers in their duodenum, the first section of the digestive tract that follows the pylorus, the muscular opening from the stomach to the intestine.

A drastic self-experiment

Marshall racked his brains as to how to kill off these germs. Would the ulcers in the stomach and intestine just return afterwards? He achieved astonishing results with antibiotics. But the medical profession still wouldn't change its mind. His sceptical colleagues lacked the final proof that the stomach germ actually caused stomach ulcers and was not just an attendant symptom of them. The germ isolated from a sick person had to be able to trigger the same illness in a healthy person who acquired it.

Because he made no progress with animal experiments, Marshall resorted to a last, drastic measure. He used himself as a guinea pig, swallowing a culture of *H. pylori* that he had grown from the stomach contents of one of his patients. After three days his breath began to smell badly. A week later he began vomiting repeatedly, and a biopsy of his stomach proved that the experiment had worked: Marshall had acquired gastritis.

In the following years it was proven that *H. pylori* covers itself in a protective coating that is able to neutralise stomach acid on the spot. And when other studies confirmed the results of Warren and Marshall, everyone gradually became convinced that this 'impossible' germ did indeed exist in the stomach. More than that: it's dangerous. It is connected not just to ulcers of the stomach and intestines but



Valuable immunomodulatory qualities: the microbe *H. pylori* lives in people's stomachs (electron microscopy).

Image: Keystone/Science Photo Library/Eye of Science

also to stomach cancer, which is why the World Health Organization declared it to be a carcinogen in 1994.

This faithful microbe was now combatted intensively as a new enemy – and with success. The frequent prescription of antibiotics, and other factors such as clean drinking water and increased hygiene, led to fewer and fewer people having the germ in their stomachs. Whereas 50 years ago a large majority of humans had the germ (as do many still in large parts of Africa and South America), it is found today only in 10% of children in the USA and Europe.

As the germ has gradually disappeared, the rate of stomach cancer has also decreased. That is grounds for satisfaction – but this joy is increasingly tinged with regret. For several years there have been hints that the lack of the microbe can also have negative consequences. "*H. pylori* has two faces", says Anne Müller of the Institute of Molecular Cancer Research at the University of Zurich. She and her team infected mice with the bacterium at two different times: just after birth for one group, and six weeks later for the other. The immune system of the mice infected early was not yet fully developed and was thus 'tolerogenic'. In other words, the immune system believed that the microbe belonged to it and so wasn't a target for attack. As a result, these mice had a hundredfold more germs in their stomach than those that were infected later. But, astonishingly, they had no stomach problems.

Power of conviction

When mice are infected at six weeks, the picture is very different. Their adult, mature immune system reacts immunogenically: it regards *H. pylori* as an intruder that has to be attacked. But the immune system cannot win the battle, so it fails to wipe out the germ and a certain number of *H. pylori* cells remain in the stomach of the mice. These then trigger chronic inflammation.

"It's not the microbe itself, but the chronic defensive reaction of our body that carries out this massacre in the stomach" says Müller. Her group has discovered that the microbe in the stomach is able to influence our immune system and reacts in an 'immunomodulatory' fashion. The microbe convinces our immune system to offer a 'youthful', tolerogenic answer. This is why the adult system cannot react so as to kill off the germ completely. It's not that the attack of the immune system stops, it is just redirected against the cells of the body's own gastric mucous membrane. This ultimately degenerates into an ulcer or even into cancer.

H. pylori has adapted to life with man over the course of thousands of years and has learnt to train our immune system not to sound the alarm against all germs in the body. For this reason, the significance of this microbe extends beyond the realm of stomach problems. Over the last 30 years, coincident with the reduction in *H. pylori*, scientists have noticed a sharp increase in allergic illnesses. Other tests carried out by Müller's group have proven that this development did not just happen by chance at the same time, but that there is a causal relationship involved. The stomach germ when given early to mice also protects them from asthma, hay fever, neurodermatitis and coeliac disease throughout their lives, for example. "This complete protection is the most drastic phenotype that I ever had the pleasure of investigating", says Müller.

Müller can achieve a lot with the "disappearing microbiota hypothesis". It posits that the loss of microbes inherited from our distant forefathers is connected to numerous diseases in modern society, such as obesity or asthma, that have beset the northern hemisphere most of all in the last thirty years. If we were to resort less often to using antibiotics – especially in children – and thereby better preserve the "microbiome of our forefathers", then we could utilise various germs that make our immune system more tolerant, according to Müller. "We should not rid ourselves of useful microbes without good reason".

But *H. pylori* is a complex case. The gastroenterologists actually have good grounds for their efforts to eradicate it. "The germ has a bad reputation, and rightly so. Cancer is worse than asthma, after all. There is no question of prescribing living microbes for therapeutic purposes", says Müller. She and her team are pursuing a more subtle approach.

Children with asthma

In *H. pylori,* they have identified two so-called persistence factors, i.e., the molecules that the germ excretes and that make the immune system tolerogenic or benevolent. Müller and her group have tested whether these two factors in isolation would suffice for protection against asthma. "It functions astonishingly well in mice", says Müller. Now, in collaboration with the pharmaceutical industry, they are developing a new inoculation strategy with which she hopes to avoid the disadvantages of the germ, without losing its advantages. She can imagine using it to treat children with a high risk of asthma. The persistence factors could help to avoid the threat of stomach cancer, yet still utilise the valuable immunomodulatory qualities that *H. pylori* has acquired in the course of its long, common history with mankind.

Ori Schipper is a science editor at the SNSF.

Understanding what our brain and muscles tell us

Silvia Arber is a neurobiologist working on a map of the nerve connections between the head and the body. Her work increases our understanding of human dexterity.
By Florian Fisch


Valérie Chételat

For Silvia Arber, the photo sessions have become tedious. Since it was announced that the neurobiologist is to be awarded the Otto Naegeli Prize, she's had to cope with a never-ending stream of journalists. Now they all want to take their own photos, despite her already having spent two hours at a professional photo shoot.

Prof. Arber would much rather spend the time working in her lab. She even has a microscope set up in her little office, sandwiched between two laboratories, at the Biozentrum of the University of Basel. Nor is her microscope just for show or to impress her visitors – she uses it almost every day. She mostly examines slices of the brain or the spinal cord. It's there that nerve cells from the brain meet motor nerve cells that transmit signals for muscles to contract. Arber is researching into how the nervous system steers our muscles. "Almost everything that the brain does has motor consequences", she says.

This focus on practical matters is typical of a pragmatic neurobiologist like Arber. She doesn't think much of simulations of consciousness or of the 'Human brain project'. They simply lack the neurobiological basics. We don't even understand how the nervous system functions in the roundworm with its mere 302 nerve cells, despite all the connections between the nerve cells having already been mapped. Controlling muscles is a complex task. To demonstrate this, Arber always likes to show a picture of Roger Federer: only the subtle interplay of innumerable nerve cells allows for the smooth movements that world-class tennis players need. Not even Arber knows the exact processes involved. But that is what appeals to her: "What drew me to neurobiology is that we still understand so little".

A helping hand from the rabies virus

Her research team is studying the mouse. They observe, for example, how it takes hold of a tasty food tablet that is difficult to reach. "What interests us is how such motion sequences are controlled". She wants to know what types of nerve cells are linked to others. Thanks to her training as a cell biologist and molecular geneticist, Arber can distinguish between the different cells, based on their genetic activity.

While working as a postdoc in New York, she studied how nerve cell extensions grow in an embryo and create connections to their neighbours. It results in accumulations of nerve cells with different functions at different points of the spinal cord and the brain. "We are constantly discovering new cell types", she says.

In order to make the connections between the nerve cells visible, Arber's experiments make use of the rabies virus – a specialist in wandering through nerve cells. Researchers have altered the virus so that it can only leap over a single contact point

"What drew me to neurobiology was that we still understand so little".

and then gets stuck in the next cell. A fluorescent protein then makes this cell glow under a special microscope. When Arber and her team inject this virus into a muscle, they can find the controlling cells that activate the motor nerve cells in the spinal cord and the brain.

With this trick, Arber's group has been able to make nerve cells visible in the brain stem. In the mouse, this part of the nervous system has more cell types to control the forelegs than the back legs, which explains their varying degrees of dexterity. And, in fact, the mice with a reduced number of muscle-controlling nerve cells were less able to grasp the food tablets than the group of unaltered mice. When Arber's team also infected these controlling cells with the altered rabies virus, this led them straight to different motor centres in the brain of the mouse.

Accompanying Dad to the lab

Arber's career planning was also done skilfully. She was appointed assistant professor at the Biozentrum of the University of Basel at the age of 31, without any detours along the way. "I was lucky to be able to research in excellent laboratories when I was a student", she says. In order to outdo the competition from Zurich, Basel at the same time offered her the chance to lead a group at the Friedrich Miescher Institute that is financed by Novartis. So she and her group now commute by bicycle over the Rhine and back.

This dual post was important to her because there were hardly any neurobiologists at the Biozentrum back then, and she wanted to work with her established colleagues at the Institute. Today, she is the connecting link between two high level centres. "Neurobiology in Basel is at a high level and has grown immensely in the last ten years". Her father, the microbiologist and Nobel Laureate Werner Arber, was also based in the Biozentrum in Basel. As the elder of two daughters she often accompanied him to his laboratory on weekends and marvelled at the bacterial cultures she saw. During her studies she even attended lectures by her father. Whether she was influenced by his career, and if so to what degree, is difficult to say. "I don't know what I'd have otherwise become", she says cautiously.

With her rabies virus method, Silvia Arber would like to penetrate even deeper into the brain. The centre of Parkinson's disease could soon be reached. The potential medical relevance of her research was one of the reasons for her being awarded the Otto Naegeli Prize. But Arber sees herself as working primarily in basic research. She wants to find new things that no one before her has seen.

Florian Fisch is a freelance science journalist.

Silvia Arber

Silvia Arber was born in Geneva in 1968 and grew up in Basel. She later studied at the University of Basel, where she also took a doctorate in cell biology and molecular genetics. After four years as a postdoc at the Howard Hughes Medical Institute at Columbia University in New York she was called back to Basel. Since 2000 she has been both a professor at the Biozentrum of the University of Basel, and head of a group at the Friedrich Miescher Institute.

Blacklisting invasive species

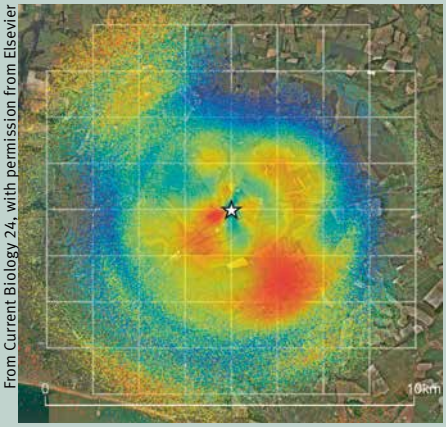
In Europe there are more than 13,000 species of flora and fauna with origins in other parts of the world. Up to a quarter of them have the potential to become invasive and damage local ecosystems. Up to now it has been unclear just how dangerous the individual species are. Today an international team of researchers has created categories for a unified rating system. This so-called black list assesses how great an influence alien species have on native species and ecosystems. It allocates them to one of five different categories ranging from 'minimally' to 'massively' detrimental. In its structure, the list is similar to the 'red list' of endangered species kept by the International Union for Conservation of Nature since 1964. Because the red list has proven to be effective in the protection of species, the researchers hope that their 'black list' will help to identify invasive species that require urgent action. This would be an initial step towards transnational measures against them.

In Europe, many alien species would belong to the highest threat category. Such as the muskrat, for example, which was introduced from North America. Its tunnels destroy the vegetation on river banks, which are then eroded and washed away by the rivers. But the process of categorisation has not yet begun properly and will undoubtedly take several years to complete. "First we are trying to get support from various environmental organisations" says Sabrina Kumschick, a biologist at Stellenbosch University in South Africa who is supported by the SNSF and is a co-author of the study. "After that, money and people have to be organised". *Atlant Bieri*

Tim M. Blackburn *et al*. (2014): A Unified Classification of Alien Species Based on the Magnitude of their Environmental Impacts. PLoS Biology 12: e1001850.

Eduard Kyslynskyy/Shutterstock

The muskrat too is an unwanted alien.



From Current Biology 24, with permission from Elsevier

Particularly large numbers of bees are found in the red areas (Castle Hill nature reserve, Sussex).

Bees – nature protection experts

Animal behaviour offers great potential in helping us to assess areas of countryside. For example, the strongest male hoopoes establish their territory on the most ecologically valuable pieces of land. A study at the University of Bern has recently proven that the 'expert knowledge' displayed by these birds could help us to mark off areas that are particularly worthy of protection.

Bees are also experts in environmental protection, as the behavioural biologist Roger Schürch has found out. In work supported by the SNSF, he and his colleagues from the University of Sussex have been observing the so-called tail-wagging dance of the honey bee. Every day, these social insects scour huge areas of up to a hundred square kilometres. Using complicated, dancelike movements they then show the other bees from their hive where valuable food can be found. Schürch's analyses show that the bees clearly prefer specific agricultural areas. They fly more often to areas where flower diversity has been actively propagated – with fallow grasslands and species-rich hedgerows, for example.

Up to now, there have been almost no reliable ways of calculating the effectiveness of ecological compensation measures. Schürch is convinced that bees could be deployed as cost-efficient helpers for such evaluations: "The honey bee is a generalist. If we protect its feeding places, we end up helping other insects at the same time". Where there is a large degree of insect diversity, this in turn has a positive impact on the biodiversity of other species of flora and fauna. *Thomas Pfluger*

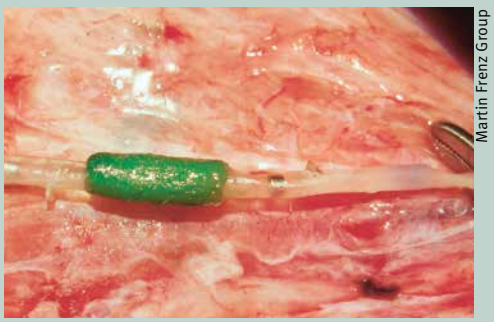
Margaret J. Couvillon, R. Schürch, F.L.W. Ratnieks (2014): Dancing Bees Communicate a Foraging Preference for Rural Lands in High-Level Agri-Environment Schemes. Current Biology 24: 1212–1215.

Soldering – a substitute for sewing

Researchers at the University of Bern and the Inselspital (as the Bern University Hospital is also known) have developed a method for reuniting divided blood vessels by means of laser beams. This technology could be employed, for example, when reattaching a severed finger. It is similar to soldering, explains Martin Frenz, Professor of Biomedical Photonics. But instead of using a metal alloy as the solder, he uses a protein.

The researchers have incorporated this protein in a wafer-thin tissue – a kind of plaster – made from a biodegradable plastic. It also includes a green dye. After the surgeons have introduced a balloon catheter into a divided vessel to stabilise the connection point, they wrap a piece of the plaster around the vessel ends to be joined. They then zap the joint with a red laser, which is channelled through a glass fibre in the catheter. The laser is absorbed by the dye, warming the plaster and altering the form of the protein, which then provides a permanent bond between the ends of the vessels.

The researchers have successfully tested their technique on isolated blood vessels and in animal experiments. They have achieved highly promising results, especially with regard to tear resistance, seal tightness and clinical applicability. But it might take several years before the method is ready for its first human tests. It is intended to develop it up to a point where it can be utilised in all situations where surgeons today have to sew wounds or use other techniques to close them. *Fabio Bergamin*



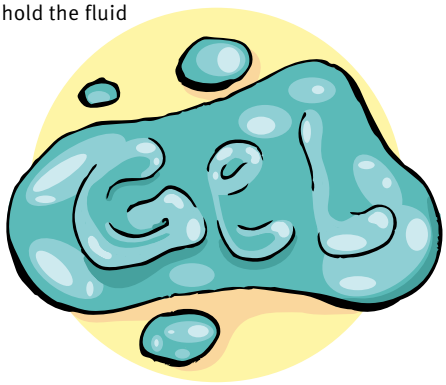
Martin Frenz Group

A pig's blood vessel, reunited successfully.

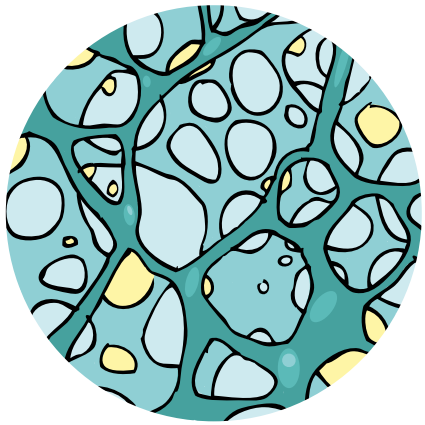
Gels: neither solid nor liquid

By Philippe Morel. Illustrations by Marcel Gross

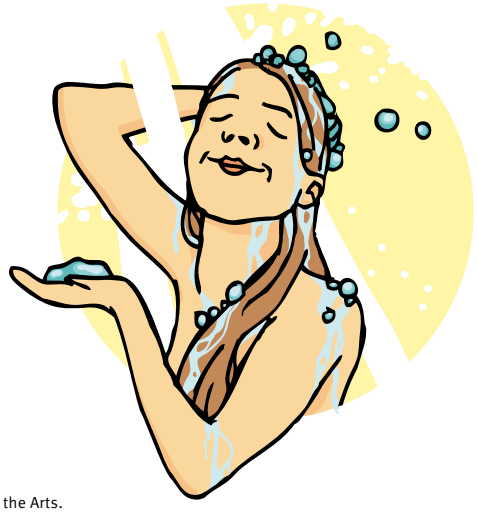
1 The bulk of a gel's mass is composed of fluid, yet in terms of its physical and mechanical properties it behaves like a solid. Whether soft and ductile or hard and brittle, a solid does not flow when it is in a stable state. The key to this feature of gels is a three-dimensional network entangled within the fluid. This is like scaffolding to hold the fluid in place.



2 This very diluted network can take different forms: a tangle of crystals, or various chemical or physical bonds. In principle, the scaffolding can maintain any type of fluid: water (hydrogel), air (aerogel) or even oil. The density of a gel is very close to that of a fluid. For example, a hydrogel can be composed of more than 99% water!



3 Gels have all kinds of applications: contact lenses, absorbent layers, even shock absorbers in sports shoes. Because of their high water content, the flexibility of hydrogels is very close to that of natural tissue. For this reason, there are numerous bio-engineering applications. They can, for example, be used for reconstituting tissue: the fluid providing for the development of implanted cells, while the scaffolding holds them in place.



4 Others are sensitive to physical chemical changes in their environment. A change in temperature or pH, for example, can break the bonds that hold the scaffolding in place and allow the fluid to escape. This makes them excellent detectors and vectors of drugs.

Philippe Morel is an editor at the SNSF; Marcel Gross studies at the Bern University of the Arts.

A hand out, not a hand up

By Martin Vetterli

"The year is 50 B.C. and all Gaul is occupied by the Romans ... All of it? No! One small village of indomitable Gauls still holds out against the invaders". The preface to the Asterix comic series sounds rather like a description of today's political relations between Switzerland and the EU. Not unlike the Gauls, the Swiss too have kept themselves out of international politics for a long time. The failed overtures to the European Economic Area, to NATO and even, of course, to the EU all come to mind.

SNF/Beat Brechbühl

Our history shows it's often been right for us to go it alone. It saved us from the ravages of the First and Second World Wars. Since 9 February, when the Swiss electorate accepted the popular initiative against mass immigration, we have again been experiencing an increasing degree of non-cooperation (including non-cooperation from the EU itself). But this time it could well prove a dead end in economic terms, especially with regard to research and technology.

Barely three weeks after the acceptance of the initiative, the EU suspended Switzerland's participation in European research programmes. Researchers in Switzerland can no longer apply for European research funds, not even to the European Research Council (ERC). The ERC has become the most prestigious source of research support in Europe – the place where the best researchers of the continent measure up against each other, rather like athletes going to the Olympics. The ERC was in fact a success story for Switzerland, because Swiss researchers were bringing back considerably more ERC funds than Switzerland was paying in.

This success story has now come to an abrupt end. In order to limit the damage as much as possible, the SNSF has launched its 'Temporary backup schemes'. This bridging system, however, is essentially a crutch, especially from a long-term perspective. You can't replace an international competition like the Olympics with a local stop-gap. There is no getting around it: Switzerland has to participate again on the European research scene. Otherwise we risk missing the boat for research in the 21st century.

It was little different for the Gauls. Holding out indomitably might have let them preserve their traditions for longer, but they couldn't match Roman achievements such as road-building, aqueducts and bridges. Sometimes it seems today as if we were back in Gaul in 50 years B.C.

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

September to December 2014

Science Cafés

"Cours en ligne: démocratisation ou grande illusion?" (17 Sept); "Famille, lieu de tous les dangers" (22 Oct); "Surpoids: le marketing dans la balance" (19 Nov)
University of Neuchâtel, Neuchâtel
From 6pm to 7.30pm
▸ www.unine.ch/cafescientifique

From September 2014

"Napoleome"

Meetings and workshops on the genome
University of Lausanne Campus, Dorigny
▸ www.napoleome.ch

Until 29 March 2015

"De A à Sexe(S)"

Exhibition on sex in the animal world
Musée de zoologie, Lausanne
▸ www.musees.vd.ch/musee-de-zoologie

17 October 2014

Annual Balzan Lecture 2014

Thinking with Literature in the Twenty-First Century
University of Bern, Bern
5.30pm to 7.30pm
▸ www.balzan.org/en

18 – 19 September 2014

ScienceComm'14

Fourth ScienceComm conference: "Relations between Science – Media – Politics"; "Science and Art"; "Science Visualization"
Beromünster, Surcee, Lucerne
▸ http://www.sciencecomm.ch

Until 14 December 2014

"Don't panic! Fear from head to toe"

Exhibition and workshops on anxiety in animals and humans
Zoological Museum, University of Zurich
▸ http://www.zm.uzh.ch/sonderausstellungen/sonderausstellungsvorschau_en.html

Until 31 October 2014

"Le jeu de la vie"

Games and toys in Antiquity
Musée romain de Nyon, Nyon
▸ www.venividiludique.ch

Medical knowledge has to be open to all

Hospitals, resident doctors and patients all need access to specialist medical literature. Regrettably, however, the cost of subscribing to most specialist journals is so high that often only university hospitals can afford it. The Swiss Academy of Medical Sciences (SAMS) is therefore urging that research results should be made public, either via open-access journals or through online public platforms that are

Valérie Chételat

freely accessible on the Internet. Researchers – both as authors and as editors – should also consider ceasing to cooperate with any publisher that doesn't make their work freely available on the Internet within at least six months of publication. The different models of open-access publication, along with other recommendations from the SAMS, will be explained in a new position paper (www.akademien-schweiz.ch/communications).

SNSF signs DORA

The SNSF has signed the San Francisco Declaration on Research Assessment (DORA). DORA encompasses a series of recommendations on improving the ways that scientific research outputs are evaluated. In particular, it recommends largely eliminating citation indicators as quality criteria. It also urges research funding agencies to assess research on its scientific merits rather than on bibliometric indicators or on the reputation of the publishing journal. Furthermore, assessments should consider the impact of all research outputs, not just publications. Although the SNSF is aware that citation metrics cannot be wholly excluded from the selection process, it is convinced that when assessing research applications it will largely be able to adhere to the principles laid down in DORA.

Compliance Committee for the SNSF

The SNSF has set up a Compliance Committee (CC). Its task is to support the SNSF in minimising risks which could prevent it from either achieving its objectives or abiding by its principles. Specifically, the CC is intended to support the SNSF in keeping its assessment procedures for research funding programmes reliable, fair, impartial and transparent. This will help the SNSF to continue to meet the high expectations placed in its selection and funding procedures. In many companies in the private sector, compliance is already an established component of risk management. But in the field of research funding, setting up the CC means the SNFS has taken on a pioneering role.

Three new publication series from the Academies

In this, the ninth year since their association was founded, the Swiss Academies of Arts and Sciences have now launched three joint series of publications. The four Academies (SCNAT, SAHS, SAMS and SATW) will publish their studies, systematic reviews and conference proceedings

in the *Swiss Academies Reports*. The *Swiss Academies Factsheets* will contain brief information on important research topics, while the *Swiss Academies Communications* will bring together position papers, written statements and recommendations. The publications can be dowloaded as free PDFs at www.akademien-schweiz.ch/publications.

SAHS Prize for Young Academics

With its 'SAHS Prize for Young Academics', the Swiss Academy of Humanities and Social Sciences is supporting young scholars in the humanities and social sciences to the tune of CHF 10,000. This award will be made to young researchers from Switzerland who have published an exceptional article in a specialist journal. The deadline for submitting articles is 1 December 2014 (www.sagw.ch/nachwuchspreis).

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

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.


"The problem with up-and-coming scholars has to be tackled by supporting them earlier on".
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"If we know the hygiene preferences of a patient, then we can better understand his or her defence reactions".
Armin von Gunten page 40
"Almost everything that the brain does has motor consequences".
Silvia Arber page 46