news bulletin

Åbo Akademi University
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The need to combine aesthetic, humanist and science subjects is growing, partly because in the long run it seems limited and narrow-minded to have completely different cultures.

The art and science of seeing

WARRING IS NOT HUMAN | RADIOACTIVE ACTIVITIES | FINLAND IN THE WAKE OF NOKIA | SUBLIME CURVES
LIGHT AT THE END OF THE TUNNEL | EXPEDITION GREENLAND | THE HISTORY OF BIOVISUALIZATION

A WOMEN'S STRUGGLE ON WHEELS

A strategic, full-contact sport on roller blades. Roller derby is a sport where women take centre stage.

ROLLER DERBY has its origin in the USA of the 1930s. In the fifties and sixties, the sport became more of an entertainment sport, like wrestling. After failed attempts to get the sport onto television, little was heard of roller derby for some decades before it appeared in its present form in Austin, Texas, in 2001.

Roller derby is said to be the fastest growing women's sport in the world today. For instance, when the Turku team, the Dirty River Roller Grrrls played their first match, or 'bout', at home in the autumn of 2013, the 270 seats spectator stand was sold out.

It was **Laura Savolainen** who brought roller derby to Turku, having been an exchange student in Lund, Sweden. Savolainen received her Master's degree in women's studies from Åbo Akademi University with a thesis called 'Gender and Sexuality in Sports – a Study of the Queer Potential of Roller Derby' ("Kön och sexualitet inom idrott – en studie i roller derbyns queera potential"). She was herself a member of the Finnish national team in the World Championships in Toronto, Canada, in 2011.

"I was living in Malmö in Sweden and my best friend set up a roller derby team there. I joined it and when I moved back to Turku I wanted to continue playing," says Savolainen.

"There were three of us who got the whole thing going in Turku, rolling around on an asphalt court in the park. We received a lot of support from the sports instructor at Åbo Akademi University at the beginning, so that was an advantage."

According to **Salla Peltonen**, researcher in women's studies at Åbo Akademi University and a roller derby enthusiast, the sport has a liberating function, having encouraged many women to actually start practising a sport. All the leader positions are held by women and it is possible to connect the aesthetics of the sport with the riot grrrl phenomenon, which has its roots in the punk and anarchofeminist movements.

"As a sport roller derby is like any other. Watching a bout is a bit like watching a handball match. Things are happening all the time and the scores roll in," says Peltonen.

"The sport has a visibly feminist aspect, even if it is not possible to unambiguously define it as such. Roller derby is not actually explicitly feminist even if many women claim that the sport has changed their lives. There is something liberating about women tackling each other on roller blades."

"Roller derby is also practised by men, but they do not have such a prominent role within the sport. The sport is the only one which has a policy of including transgendered people; people whose gender identity deviates from the gender norms.

"Despite this, roller derby is not a problem-free area for transgendered people. Sexual conservatism can be found also here." ◆

NICKLAS HÄGEN

The "jammer" of the team from Turku, distinguished by the star on her helmet, has just managed to pass the opponents blockers and gathers speed in order to score points.

Roller derby is played by teams of five on an oval court. A match is divided into two halves of thirty minutes each. In a simplified version, the rules of the game are that one player on both teams – the so-called 'jammer' – should pass by the players in the competing team. When this happens, the team scores. The other players are called blockers and they try to stop the jammer from overtaking them.

© PHOTO: SAM SIHVONEN

intro

Starting one's own business is an increasingly popular trend among young people in Finland. Why is it that entrepreneurship is suddenly an attractive option for the young? The success of several Finnish companies within the global gaming industry is definitely one reason for the growing interest in free enterprise. In other words, the image of running a company has changed. While owning a company was previously regarded as involving hard work and several risks, many now find that in starting your own enterprise, you can realise your dreams, create new forms of work and be free to make your own decisions.

It is not only the video game industry which interests young entrepreneurs; the field of IT also offers many business opportunities. The company Walkbase and its unique concept, developed by then students at Åbo Akademi University, is presented in this issue of the News Bulletin.

FREEDOM AND CREATIVITY are two of the more attractive features associated with free enterprise. In fact, these are the same values that characterise the world of science and which are prerequisites for successful research. Solving tomorrow's problems, developing new solutions and making new discoveries are the driving forces for many researchers.

Åbo Akademi University houses several examples of successful research environments which combine innovative thinking with basic research. A research discovery does not necessarily end up as a commercial product, but it may very well do so. Universities are the best possible laboratories for future business concepts and for innovative activities which are relevant for society. In this issue of the News Bulletin, we offer a selection of research news from our university and its relation to current trends in society. Research is done in continuous dialogue with the surrounding world.

WISHING YOU ALL interesting reading!

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news bulletin

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in brief...

PROJECT COURSE DEVELOPED INTO A THREE MILLION EURO BUSINESS

THE INVESTMENT company SBT Venture Capital and **Olli-Pekka Kallasvuo**, former CEO at Nokia, will invest three million euros in the Walkbase IT enterprise in Åbo. The company was originally born during the course of a project which was arranged at the Department for Information Technologies at Åbo Akademi University.

Walkbase has developed a smartphone application which analyses the buying behaviour of customers based on their geographical position. The application can, for example, send direct information on special offers to the customers' phones when they enter a shop or a restaurant.

"At the moment, this is 'anyone's game'. Nobody is established enough to have a dominant position on the market. In the USA, there are some companies on the West Coast and some on the East Coast. Thanks to the capital investment, we now have a good position in Europe. But the American companies aren't giants, either", says **Björn Sjölund**, one of the founders of Walkbase.

According to him, our shopping habits will change radically within the next ten years.

Walkbase means business. Björn Sjölund, Mathias Fredriksson, Niclas Jern, Tobias Zetter and Olle Svanfeldt-Winter.

"It's not a question of online shops replacing physical ones, but rather of a hybrid model combining web retail with the traditional high street shops. However, the physical premises will be more of a showroom for the products: a place where customers can see and test a product, and then order it to be delivered to their home. Walkbase is an example of a company working at developing the links between physical reality and the internet", says Sjölund.

"Other possible applications include sending an advert to your smartphone when you are close to a specific shelf, or the menu appearing on the screen of your mobile phone as you enter a restaurant." ◆

CERTIFIED USABILITY ANALYSTS AT MEDIACITY

MEDIACITY, an independent institution at Åbo Akademi University, has for the last ten years focused on research into usability and user experiences. The efforts of MediaCity have resulted in the formulation of new methods for testing and understanding user needs and fulfilling these in the design of various technical and media applications.

With its biosensors, eye tracking cameras and brainwave measurement equipment, the Content Testing Lab has been in frequent use in both research and commercial projects.

"Usability and user experiences are increasingly critical factors in our everyday lives. Identifying the aims and needs of the users is crucial for designing successful and usable products. Creating positive user experiences is also important in order to make us willing to accept and adapt to new technology", says **Sören Andersson** at MediaCity.

Three of the MediaCity user experience researchers are certified usability analysts, a qualification issued by Human Factors International (HFI). The certified usability analysts collect various forms of user data, analyse how users react to and experience – for example – a game or an application, and then present suggestions as to how usability can be improved.

"The fact that we are able to validate our knowledge through the leading company in the field globally is very positive. It's important for our daily work at MediaCity, but it is also demonstrates the quality of our work to external partners", says **Joachim Högväg**, one of the certified usability analysts at MediaCity.

There are around 4,200 certified usability analysts in the entire world. Only five of these are found in Finland and out of these three are employed at MediaCity in Vasa, Finland. ◆

Certified usability analysts. Joachim Majors (left) demonstrates EEG scanning of the brain on Joachim Högväg.

Warring is not human

Humans are not necessarily violent by nature. New research shows that it was a rare occurrence for our nomadic ancestors to make war.

ARI NYKVIST

We are aggressive and bellicose by nature. Have always been and will always be. Wars are as old as humankind itself and fundamental to it, and warring and mass killing were already common thousands of years ago. Warring, consequently, has deep roots in the history of humankind.

These widespread (mis)understandings are now being questioned by the anthropologist **Douglas Fry** and the doctoral student **Patrik Söderberg** at the Department of Developmental Psychology at Åbo Akademi University. In their article on the origins and causes of war, which has been published in the prestigious scientific journal *Science*, they show that wars are actually a relatively recent phenomenon in the long history of humankind.

In their article, Fry and Söderberg show that among societies lacking agriculture and animal farming, where people still live as nomads and wander around to find food and protection, wars and mass killings are uncommon. The material for the study was taken from the international database SCCS, the *Standard Cross Cultural Sample*, and in order to avoid bias, criteria for inclusion that had been set by other researchers were used. This resulted in the selection of 21 contemporary nomadic hunter-gatherer cultures around the world and a total of 148 cases of deadly violence.

"When we studied the reasons for deadly violence among these peoples in detail, it turned out that it is actually unusual for people to die as a result of war. In more than half of those cases, there was a victim and a perpetrator and those involved almost always belonged to the same society," says Fry.

"There were often personal motives, not collective ones, for the murders. Men fighting over the same woman, over infidelity, and theft or revenge of different kinds. More rarely they fought over access to food or drink," says Söderberg.

War is a relatively recent phenomenon

Out of the 21 different peoples that were studied, twenty were anything but war-mad. However, one group of nomads, the Tiwi people of northern Australia, alone represented nearly half of all deaths and more than three quarters of the deaths between groups. Apart from that, only 15 per cent of the deaths were the result of violence between two different groups. Thus, according to Fry and Söderberg, the Tiwi people is rather the exception that confirms the rule. Are humans, then, peaceful beings and has war, in reality, played a less prominent role in the evolution of humankind than we have so far believed?

"Yes, but we have become somewhat more bellicose over the past 5,000-6,000 years. As settled societies arose which were characterised by agriculture, a variety of resources, large tribes with strong leaders and subsequently different forms of government, war became more common. The more socially complex a society becomes, the more often it seems to make war against other societies," says Fry.

Consequently, neither Fry nor Söderberg find a direct connection between aggressiveness and war. Aggressive individual behaviour is a different phenomenon compared to war. War is often a strategy, a game and an image of threat that politicians and economic leaders practice in places where war as a phenomenon is often dehumanised. An example of this is is the United States' use of remote-controlled droners in Afghanistan.

As individuals we are, on the contrary, very flexible; we may live together in many different ways and those who are not aggressive and do not wish to keep clashing horns with others all the time are rewarded. Killing other people is still an exceptional event in human societies, which, for instance, is reflected in the fact that in Finland only four to five murders are committed annually per 100,000 inhabitants. According to Douglas Fry, there is thus a great potential for peace, cooperation and consensus.

"Before, there was both the time and space to simply avoid opponents and enemies. Today more complex and active solutions are needed to avoid war, which has often both political and economic causes. Such solutions may include peacemaking, war courts, and international negotiations," Söderberg adds.

The present widely-held idea that war is close to unavoidable and a part of our nature, has been strongly affected by what is happening in our own society. Peace being often cynically signified today as a brief period between different wars is, according to Fry, a negative definition of the word peace, which is typical of our times. Peace is about so much more, and it is about a long list of things that are positive and natural and desirable for us humans.

"Social equality, access to food and a roof over one's head, democracy, human rights, a clean environment, security and safety. The list can be endless when peace is defined in a positive manner. We wish to feel safe and secure. Peace is the starting-point, the obvious one, war is not. We did not find one single case where a group of nomads would have attacked another group just for the sake of war itself or for the fun of it. War is not a part of the personal character of human beings and it is possible to avoid it," says Fry. ◆

Expedition: Greenland

A voyage on a research vessel to one of the most unaffected sea environments in the world: the expedition TUNU-V investigated how biological diversity in the fjords of north-eastern Greenland is affected by climate change.

NICKLAS HÄGEN
PHOTO: ERIK BONSDORFF

North-eastern Greenland. On the tundra musk oxen wander around and among the ice bergs sharks of up to 450 years old are swimming. This land is virtually untouched by human beings. The sole sign of human activity is a solitary hut that fur hunters left behind in the first half of the twentieth century.

This wide expanse is the biggest national park in the world and about three times the size of all of Finland. The mountains are several kilometres high and treeless. Only the odd flower grows along the coast.

Erik Bonsdorff, Professor of Marine Biology at Åbo Akademi University, claims not to be a spiritual person, but he understands those who seek out areas like these in pursuit of spiritual experiences.

"One loses one's sense of proportion. Everything is big and the sky is so crystal clear that a view of fifty kilometres is nothing. I asked the captain if we could not to take a little detour into a fjord, but the distance that I estimated to be two nautical miles turned out to be fourteen," says Bonsdorff.

"When one is far away and there are no people around, one becomes very conscious of one's vulnerability as an individual. If, for instance, you break a leg here you know that it will be a long time before you reach a hospital."

Bonsdorff took part in the fifth TUNU expedition to the fjord landscape of the north-eastern coast of Greenland last August. The expedition was organised by **Jørgen S. Christiansen**, a professor at Tromsö University in Norway and visiting professor of marine biology at Åbo Akademi University for the academic year 2013–2014. The voyage was made by trawler, the FF *Helmer Hanssen*, from Tromsø via Jan Mayen and Greenland, up to Svalbard. The more than twenty researchers on the expedition represented half a dozen countries.

There is an ongoing conflict of economic and ecological values on the northern seas. As the climate warms the ice is shrinking, opening the area up to oil extraction and fishing – which themselves have further consequences for the environment.

Bonsdorff says that the Barents Sea between northern Norway, Svalbard and Novaja Zemlja is rapidly changing. So far the environments around Greenland's north-eastern coast are among the most unaffected areas on the planet.

"But the area risks being damaged if the exploitation of resources continues to be uncontrolled. Areas such as this, are worth their weight in gold for the opportunities they provide for research and a thorough, fundamental knowledge of the arctic environment."

The impact of climate change is already clear to see.

"Insight into what is at stake in climate change becomes crystal clear on an expedition like this. When you use your eyes you notice that the changes are happening fast and an entire ecosystem is at stake."

The goal of the expedition was to find out how the species inhabiting the sea, with a focus on arctic fish, adapt to a changeable climate. The research is wide-ranging and varied. The existing species are described and environmental toxins, genetic factors, and physiology at a molecular level are investigated, as well as Bonsdorff's own speciality, food webs. Geologists also took part in the expedition. They investigated the palaeo-climate, which pertained before there was any access to meteorological instruments, and charted the spread of inland ice during the most recent ice age.

In the Antarctic waters, the cold water around the pole forms a barrier between such organisms that are solely adapted to the cold water and the ones that live in somewhat warmer waters. The waters of eastern Greenland, however, offer considerably greater variation.

At the bottom, temperatures may even go down to levels of below zero degrees, whereas up at the surface the water the temperature may rise up to ten degrees in places.

Moreover, when more water comes from the accelerating melting of the glaciers, above all in summer, the surface water is sweet. These variations require special adaptations in the organisms which inhabit these waters.

Because of the unique environment, the authorities take a negative attitude to humans landing. Only once did the expedition touch solid ground. The stay at the Danish research station, Zackenberg, in Greenland, was brief, as one of the Zodiacs suffered sea damage and with both polar bears and musk oxen having been previously sighted in the area the group was not able to stay on the beach without backup.

"This entire area is a national park and you have to be extremely careful not to harm the environment. For instance, we were not allowed to take samples without the authorities' permission, and the leader of the expedition stayed in daily contact with them. Trawling was permitted for fifteen minutes at a time," says Bonsdorff.

"When a similar expedition was mounted in the year 2003, trawling was carried out in one of the fjords we visited on this trip. With a very sensitive sonar we found tracks from the trawler on the bottom of the fjord. Changes happen that slowly in these environments."

Among the most exotic things they got in their nets were Greenland sharks, a slow and rather indolent species which may live for as long as 450 years.

"They eat just about anything and in one stomach we found, for instance, the remains of a seal cub. The individuals we caught were between two and four metres tall and between 75 and 350 years old. Some of them were here as far back as as the pre-industrial era, but will suffer from the consequences of the industrial age."

Two weeks on board a sea trawler along the coast of Greenland involves shared cabins, constant daylight, and occasionally rough seas. Before the expedition reached Jan Mayen the waves were between six and eight metres high.

The journey was exhausting but well worthwhile.

"Research should not always be done for reasons of utility, in real time. The principle of curiosity is also important. The single greatest experience I have had of the nature here was probably coming to Jan Mayen in the middle of the night and noticing the perfectly-shaped cone of this vulcano sticking up out of nothing, in light conditions in which it was just about possible to take pictures," says Bonsdorff.

– Everybody was incredibly tired when we landed on Svalbard. This was partly to do with the sea; the waves are exhausting. Partly it was because one gets too little sleep when every opportunity is seized for taking samples, and you want to experience all the natural features you can. This makes all the researchers stand on deck, for example, to see if one catches sight of any sharks. This is good for unity on board and it increases the levels of understanding across the disciplines within an international research team. ◆

> When one is far away and there are no people around, one becomes very conscious of one's vulnerability as an individual. If, for instance, you break a leg here you know that it will be a long time before you reach a hospital.

Pictures

Above right: A Petrel in bad weather. **Right:** The tip of an iceberg. **Down right:** The trawler FF *Helmer Hanssen*. **Below, far right:** Doctoral student **Julius Nielsen** (to the left, from Denmark) and Professor **Peter G. Bushnell** (USA) with a Greenland shark (*Somniosus microcephalus*).

Finland in the wake of Nokia

Nokia mobile phones have been a source of national pride for the Finns ever since the beginning of the era of the mobile phone in the middle of the 1990s. Times are changing and the company sold its production of mobile phones to Microsoft in early September 2013.

NICKLAS HÄGEN

CEO **Stephen Elop** came to Nokia from the software giant Microsoft in September 2010 and fully three years later he completed his return journey – nearly 19 million euros richer. This caused a stir in Finland. Many Finns considered that the affair was a sign of Elop having failed to achieve his remit as CEO; that of getting Nokia's mobile phone production on its feet again – a failure which should not have been rewarded.

The professor of international marketing at Åbo Akademi University, **Malin Brännback**, has difficulty understanding the concern.

"For me it was already something of a knee-jerk response when Elop came to think that he was there to sell the company. Rather than speculating on 'whether' the production of mobile phones would be sold on, it was more a question of 'when'. For half a year people had already been pondering when [previous CEO **Olli-Pekka**] **Kallasvuo** would leave."

For a professor and researcher of international marketing it is important to notice one's own reactions, in order to be able to see if they are shared by others. That way trends can be studied. Brännback goes over the signs of Nokia's fall; a process she has been observing over the years. They range from the moment she bought the more user-friendly Ericsson mobile in 2004; on to the white iPod-headphones she saw everyone was wearing in the London underground; then to being startled at noticing that everybody was using iPhones in the US in 2007.

"For a long time Nokia was an example of how you can easily move from one model to another. They should have stuck to developing that aspect. Instead they went in for getting Excel into the phone. The manual was already thicker than the phone at the turn of the millennium. At that point, somewhere an alarm bell should have been ringing."

The market for mobile phones, like the rest of the electronics market, is the source of some of our biggest environmental problems and Nokia was for a long time taking advantage of people regularly changing their phones as soon the batteries failed. This had an enormous environmental impact, but it was good for business.

Malin Brännback has been an iPhone user since 2007.

When the smartphone train then left the station the company could not follow. Brännback suspects that what happened was that Nokia started defending the position they had. This is one of the most dangerous things that can befall a company.

"The 'dinosaurs' challenge is about renewal. It is as if a spell had been cast over the whole thing. At the point where people start saying that 'we don't do that' it is time to run, if one wants to take part in the development of something," says Brännback.

"During **Jack Welch's** time as CEO for General Electric the value of the company increased by 4,000 per cent, but he annoyed his people to the point of madness by constantly remarking that a company has to challenge its success. It may be very stressful to question what one is doing, but that is what's required for success. The Finnish paper industry was saying over and over again for a long time that there were no limits to the forests; but now people's use of paper has changed – few had thought about whether the consumers would change their behaviour."

Nokia represented a big share of Finland's BNP at the beginning of the 2000s. The company then steadily lost its position and the sale of the company was as such no disaster for the country's economy any longer.

The problem is that much of the Finnish economy has been built around Nokia and the longer term consequences are therefore difficult to assess. Success in the 1990s was a major reason why Tekes, the Finnish authority which by means of loans and funding to companies and research supports the development of new innovations, became the source of innovation that it is today. The connection between the two was strengthened when **Yrjö Neuvo** went from Tekes to Nokia; a move which boosted the company's formulation of its applications.

"Criticism has been directed at Tekes, saying that they have done more harm than good as it was difficult for a long time to get funding from them if you didn't belong to Nokia's network of subcontractors. This allowed only certan kinds of thinking and genuine innovativeness was disqualified," says Brännback.

"There is similar criticism of Sweden's equivalent authority, Vinnova, and the source of that might simply be people who have become bitter because their ideas haven't received any funding. I'm not sure whether any systematic study of Tekes has been done, but all the information is public and this would definitely be a topic for a doctoral dissertation."

Where the next pillar of support for the Finnish economy is to be found is unclear.

"The service sector is strongly rising, but the margins are not of the class that the mobile phone industry and the forest industry were. All credit to Rovio, but there is a gap in the Finnish economy that companies of that category don't manage to cover." ◆

Jan Svanberg put his trust in South Korean technology rather than Finnish, when buying his Samsung.

A self-image made out of high technology

In Finland, there has been an engagement around Nokia that has occasionally been similar to the way people follow sports. The company has been a kind of national team of the business world, into which many Finns have made investments; not only economically but also emotionally, in the form of pride and interest.

Jan Svanberg, university lecturer in comparative religion at Åbo Akademi University, says that the loss of Nokia's mobile phone arm to a foreign company like Microsoft leaves behind a powerful vacuum in the construction of what it means to be a Finn.

"You want to pin down the idea of what being Finnish means to certain symbols. Nokia has managed to make a name for itself in the world and has been part of that image of Finland which conforms to how we want it to look," says Svanberg.

Svanberg has studied in which way the images of Finland and the Finns have been constructed in a future report, which was submitted to the then foreign minister **Alexander Stubb** in 2010. The commission's task was about creating a vision of how a brand could be constructed around Finland. The previous CEO of Nokia, **Jorma Ollila**, acted as chairman.

When constructing the image of Finland in the report, closeness to nature is combined with the feature of high technology. It is said that the Finns are creative thanks to the contact we maintain with the savage in us. We get power from nature and pre-Christian traditions and thus we are able to think in an unconventional way.

"Through the sale of Nokia the self-construct which is built on high technology is weakened. At the same time it is interesting that we are not capable of letting go of the image of the Finn who digs deep into the bog. It has to be included. This has probably to do with our not being fully urban yet; it is from a Finland of the lakes that the Finns get their strength," says Svanberg.

The Finnish background of the mobile phones makes the sale particularly sensitive, as the Finns do not have that many success stories in their business world to build a positive national self-image around.

The country has had big industries before, indeed, but much of what has built up the Finnish economy has been developed by foreign business men. The big textile industry which boomed in Tampere in the nineteenth century, for instance, had Scottish roots.

"It's the same in Sweden, which was built by the Walloons to a great extent. That happened so far back in history, however, that there are no fresh historical memories of it," says Svanberg.

"We are a relatively young nation that does not have a broad industrial base. When my generation grew up we talked about the forest as the green gold of Finland. Then came Nokia and occasionally the shipbuilding industry was also woven into the picture. We are a small country, however, and there are few innovations in circulation."

RADIOACTIVE ACTIVITIES

MARCUS PREST

Positron emission tomograhy (PET) is a technique for visualisation which requires a vast infrastructure. In Turku, Åbo Akademi University, Turku University and Turku University Hospital are cooperating in PET activities and the development of a national PET Centre.

The heart of the PET Centre, the particle accelerator – the cyclotron, is situated down in the basement of a stone building situated behind the university hospital main building, and it is hidden behind a seven tonne, radiation-safe steel door. The space is barred while the production of isotopes is going on. Production is kept up for five days a week and the isotopes are highly radioactive. They are used for research and in the field of medical research for, for instance, diagnosing cancer. This research is carried out on the floors above the accelerator laboratory.

The cyclotron is operated from a control panel which is being supervised by the laboratory engineer **Stefan Johansson** (Åbo Akademi University) and researcher **Johan Rajander** (Åbo Akademi University). The three isotopes produced are carbon-11, fluorine-18, and copper-64, in the main. The accelerator laboratory at Åbo Akademi University is responsible for the production of radioactive isotopes, whereas radiochemistry, which is the joining of the isotopes to molecules that take the isotopes to the correct receptors in the human body, is the responsibility of Turku University. The diagnoses are made by Turku University Hospital.

The cyclotron is a kind of particle accelerator, which with the help of magnetic fields and a high-frequency alternating current, creates highly energetic particles out of ions that are passed out of the magnetic field in a controlled way, building a beam of ions. The cyclotron and its system for the transportation of beams has been constructed by the Efremov Institute in St Peterburg, whereas the rest of the production system and the transportation lines have been made by the experts at the PET Centre.

"We develop and produce the target systems or the target chambers ourselves," says Stefan Johansson.

The target chambers are massive cubicles made out of aluminium, with precisely measured aisles for the ion beam and space for the actual radiation targets. Åbo Akademi University has its own metal workshop where people work with the aluminium parts.

"The two products that we produce most are carbon-11 and fluorine-18. Carbon and fluorine require different kinds of radiation targets," says Johan Rajander.

The process – a simplified version

The production and application of the isotope carbon-11 can be explained as follows: The cyclotron shoots out an ion beam, in this particular case consisting of protons, with an energy of 18 MeV (million electron volts) which is guided and focused onto a target where the beam hits a gas at high pressure; it is a mixed gas consisting of nitrogen and one per cent oxygen at a pressure of circa 40 atmospheres. The pressure is adapted to the length of the target – different pressures give different densities – which affects the range of the proton beam in the gas. As the protons hit the nitrogen, the beam diffuses, which explains the conic shape of the target chambers. Simultaneously a radioactive reaction is taking place: one proton enters the nucleus, one alpha particle leaves it. Carbon-11 is a radioactive isotope with a half-life of 20.4 minutes. The radiation done, the irradiated gas is sent up to the lead-lined cabinets in the clean space of the radiochemistry laboratory on the second floor, and the isotope is connected with the right kind of molecule and is 'refined' into a preparation that can be injected; a radiopharmaceutical. The radiopharmaceutical is given as an injection to a waiting patient, who is then sent on to a PET examination where the physician reads off the radiation originating from the tailored molecule with the PET scanner. Carbon-11 and fluorine-18 decompose through the positron emission; this process is a particular kind of so-called 'radioactive beta decay'.

"When the positrons, which originate from the radioactive decay, hit electrons, an annihilation occurs and two gamma quanta photons move in the opposite direction, which is an event that may be detected by means of a PET scanner. It's a clear radioactive signal. You consequently get a good image," says doctor **Sarita Forsback** from Turku University.

The radioactive preparations are short-lived pharmaceuticals. New ones have to be produced each day and in order for the right kind of product to be made at the right point in time, a great deal of Forsback's time goes into ensuring that all the timetables cohere with the coordination of the accelerator's operation and the work done in the lead-lined cabinets, and into making sure that the right patient is waiting when the preparation and the relevant staff are ready at the PET scanner.

"One can feel a strong sense of responsibility for the whole thing at this point," says Forsback.

These preparations are not anything like Burana painkillers. The isotopes are radioactive and all of the work that is done with them must be done in lead-lined cabinets, and the quality of each round must be defined and tailored for the patient in question.

"Every new kind of radiopharmaceutical we have developed and every part of the system of the production process, must go through a meticulous process of checking before they are taken into use. FIMEA, which is the Finnish Medicines Agency, keeps us under constant scrutiny."

The radioactive preparations are called pharmaceuticals despite the fact that they do not have any remedying effect. It is actually very important that they do not have an effect at all. The great advantage of radiochemistry is that it makes it possible to examine patients and decide the position of tumours, as well as whether the tumours are hypoxic (i.e., use oxygen, in which case radiation treatment is less effective), in organs which are difficult to reach, without having to use surgery. Deciding what kind of tumour is dealt with is also possible, to a certain extent, with the help of scanning, which means that it becomes possible to make more exact programmes for treatment.

"The molecules are tailored in such a way as to have a high affinity with a specific process in the human being. They gather in the receptors that we examine without affecting the function of the receptors. A large part of the development work we do within radiochemistry is about finding a way to make radioactive isotopes connect with the right kind of molecule."

The radiopharmaceutical which is used the most in examinations using PET is FDG, fluorodeoxyglucose, which is produced by attaching the isotope fluorine-18 to a glucose molecule. FDG can be accessed commercially, but the preparation is produced by the PET centre in Turku itself.

"FDG works on most tumours, since tumours tend to use very fast energy – sugar, that is. This makes FDG, which is consequently a glucose analogue – a sugar with a radioactive isotope – go looking for the tumour which burns sugar more intensely than other tissues. As the concentration of FDG then will be larger in the tumour tissue, we will also notice more gamma radiation from the annihilation of positrons from the FDG, hitting the electrons in the tumour's mass."

"For radiochemical marking, we use a method that has been developed in Turku and which is unique in the world. It is based on an electric discharge which dissolves all the connections in the molecule. Instead of always getting a loaded fluorine-18 ion, we can also create positively-loaded fluorine-18 ions, which provide us with more opportunities for combination. In addition, the process is both fast, automated, and it often produces radiopharmaceuticals which have highly advantageous features for imaging."

In the work on her doctoral thesis, Sarita Forsback has herself developed two new types of molecules that are connected with dopamine receptors. It is possible to use the molecules in, for instance, research into Parkinson's disease. ◆

Sarita Forsback at her daily task of producing FDG. The isotopes are delivered from the accelerator bunker up to a hot cell (a lead-lined cabinet) on the second floor, to be manipulated so that they can be used for radiomedical purposes.

Photo: **Roni Lehti**

The Turku PET Centre

The Turku PET Centre was established in the 1970s. The centre acquired the status of a national research institute in 1996. It produces and carries out research into short-lived isotopes that emit radiation. These activities are authorised for medical research into diagnosing patients by means of radiochemistry.

The core activities of the PET Centre are based on an agreement between Åbo Akademi University, Turku University and Turku University Hospital. All of the activities are located at the university campus and the hospital area. The centre consists of an accelerator laboratory, a chemistry laboratory for radiopharmacology, a preclinical examination laboratory, and the PET laboratory. The staff at the Centre numbers more than 110 people at the moment, including staff and researchers representing various research fields. The PET Centre has three cyclotrons, 19 hot cells (for the production of tracers), and six PET or PET/CT scanners and digital ultrasound systems.

The centre has two main tasks: the production of high quality research and the provision of diagnostic services for the entire country. Research at the PET Centre is concentrated in four main fields: the energy metabolism of the cell, neurotransmission, preclinical visualisation, and radiochemical research. There is active cooperation between the universities and the medical industry.

The cyclotron, or the particle accelerator. The cyclotron sends out a particle beam that is directed at the targets.

The transportation line. Fluorine-18 is fed through the tubes up to the lead-lined cabinets on the second floor.

Radiation targets.

Magnetic quadrupole lenses for focusing the beam.

Radiation targets.

Targets. The end point of the particle beam. The beam hits the targets and through nuclear reactions the desired radioactive isotope, such as carbon-11, fluorine-18, or copper-64, is formed.

Photo: Roni Lehti

The history of biovisualization

Generally speaking, the aim of visualization is to produce pictures that present information as clearly as possible. Learning to create these types of images requires training, particularly if they are to support a scientific text.

THERE IS A vast number of scientific images in circulation, mainly created by natural scientists who have not sufficiently taken into account how people see images and how people deduce information from pictures", says art historian **Fred Andersson**, who teaches visual studies at Åbo Akademi University.

The first example of biovisualization in a modern sense is **Andreas Vesalius's** collection of illustrated textbooks, *De humani corporis fabrica*, published in 1543. It represents what Andersson calls top-level research in the field of anatomy during the Renaissance. Vesalius' pictures demonstrate that at that period in time, no distinction was made between art and science.

"To simplify, it could be said that in the 16th century, there was neither art nor science in a modern sense. These were entities that were intertwined. The terms used were medical art, the art of war and so on. And it was a given that an anatomist was a master drawer as well as a medical expert."

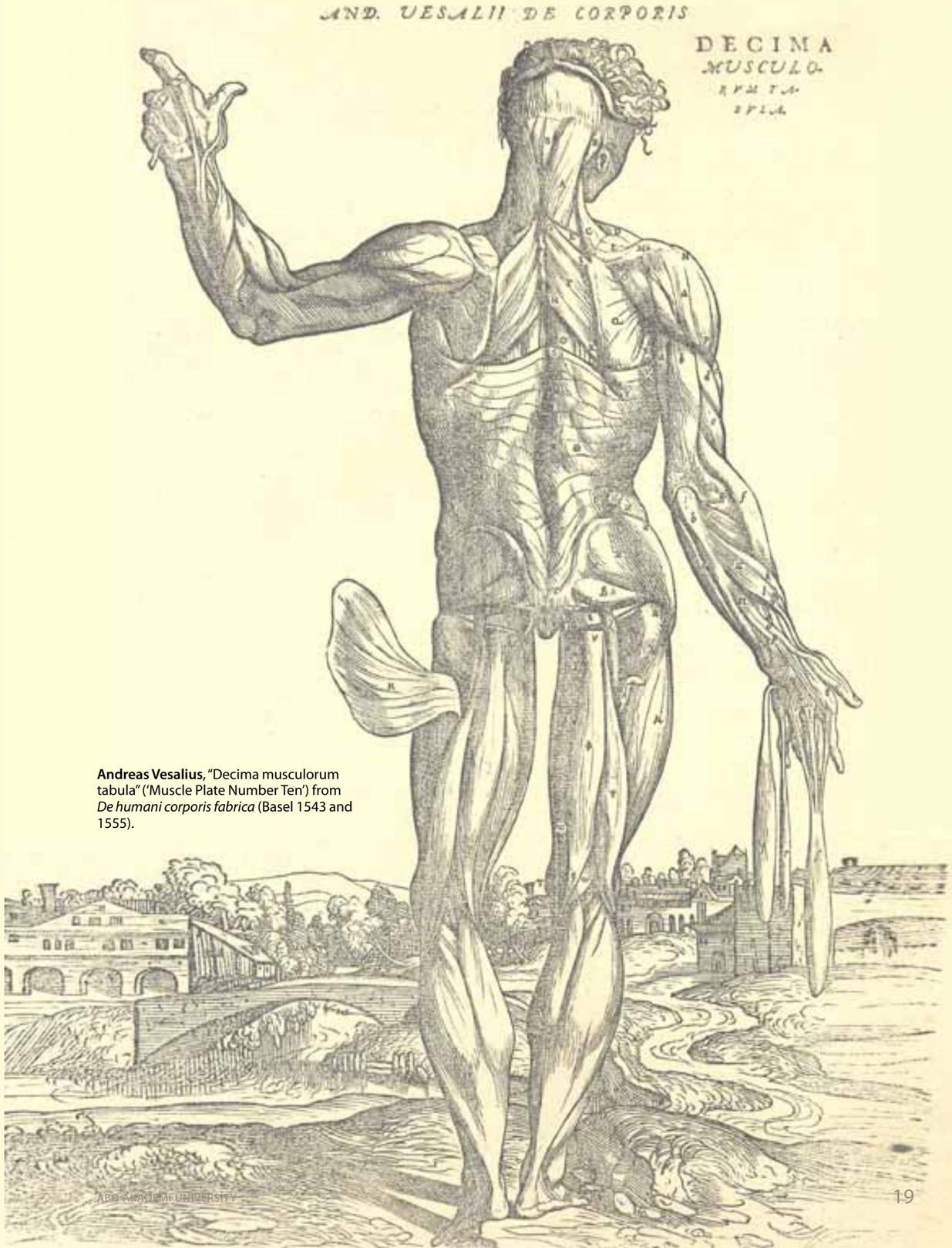
Vesalius' pictures combine the unknown with the well-known in a way which still characterises biovisualization today. The subjects are presented in classical poses, as in figure-paintings. This was achieved by hanging human corpses in the position needed for the particular illustration using ropes attached to the studio walls and ceiling. Neither the hanging device, nor the studio environment is depicted in the actual image. Often a classic landscape is seen in the background. So what we see is both a very realistic image and a picture with strong fictional features, as in any created image. There was no concept of a separate form of expression for scientific pictures; anatomical illustrations were like any other pictures.

"Looking at Muslim pictures from the same period, we see an obvious and important difference: reduction. The Arabs and Persians, who at that point in time had the most advanced medical culture, created illustrations much more similar to our present-day visualizations than the naturalistic Renaissance pictures. In their reductions, the Arabs demonstrated what they already knew about the body. The Western-European style during the Renaissance was explained by the fact that the naturalistic picture had been rediscovered."

This had an impact not only within medicine, but also for the visual arts, since an ideal which depicted nature in exact detail had developed, and this was taught at the fine art academies which were established in the 17th century. The institution of the art academies meant that the state directly influenced art and medicine, since governments supported the academies financially. Earlier, artists were trained as apprentices with a master painter. But in the 17th century a kind of 'university education' was introduced for artists. (The actual universities at that time only taught philosophy, medicine, law and theology.)

"Our current art education at universities encompasses subjects within the humanities and philosophy. During the Renaissance, the

Photo: Marcus Prest



Andreas Vesalius, "Decima musculorum tabula" ('Muscle Plate Number Ten') from *De humani corporis fabrica* (Basel 1543 and 1555).

training of artists was medically and technically focussed. The link between art and science has more or less disappeared today.

"In order to do what we're doing now, that is, creating an exchange of knowledge between aesthetic subjects and natural sciences, artificial arrangements are needed – such as courses in biovisualization. It is artificial since there are no natural platforms for cooperation between natural scientists and humanists. Our educational backgrounds are totally different and we don't speak the same language."

The need to combine aesthetic, humanist and science subjects is growing, partly because in the long run it seems limited and narrow-minded to have completely different cultures.

"I think we who teach the humanities have a need to see a clearer application for what we do, while natural scientists need to learn to communicate their results."

When it comes to natural scientists whose work has had a great impact, visual elements have often been essential for illustrating and spreading their ideas. **Einstein's** theory of relativity is one such example: "$E = mc^2$" is a clear image; although it is a formula consisting of letters and a number, it forms a visual picture that most people in our culture immediately recognise. The image as such does not say anything on the theory of relativity, but it functions as a trigger for the memory. According to Andersson, the same can be said about **Ernst Mach's** demonstrations of the dynamics of motion in the late 19th century.

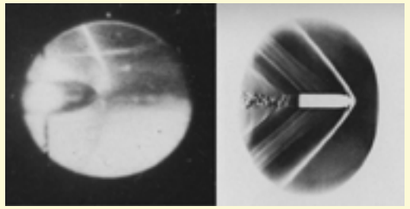
"Mach's photos of, for example, a bullet passing through air and sheets of cardboard, do not tell us anything in their raw versions. The pictures that were later presented, and which most people think are the original ones, are actually highly abstracted. The edited images nevertheless show what has later come to be called the 'Mach cone', which was used in the emerging field of ballistics in the late 19th century."

"Images can also be discussed in terms of visualization technology. At various stages, technology offers various opportunities for visualization – the object of visualization must be adapted to the image technology. Colours play an important part within biovisualization. Take for example a PET scan of an internal organ, like the heart – the data registered only shows the level of radioactive uptake, but with the use of colour coding the images might show what we are looking for."

Without expert knowledge visualization is meaningless, and the type of visualization varies greatly depending on the field of research. For example, sociological studies are not based on photographs.

"Such research can even be made seductively graphic for rhetorical purposes. And biovisualization, too, may be used rhetorically, for example to provide a scientific field with a certain image. There are various stages in the way in which images are used and separated from their original context. One example are some pictures used within modern physics. They have no direct connection to the processes that are being visualised, since these are processes that cannot be translated into sensory qualities. One such instance are the well-known Feynman diagrams created by **Richard Feynman**." ◆

MARCUS PREST



One of **Ernst Mach** and **Peter Salcher's** first ballistic photographs taken in April/May 1886 (left) in comparison to an illustration from Mach's article "Weitere Versuche über Projectile" ('Further Experiments with Projectiles') published in 1896.

From a Persian manuscript on medicine and anatomy by **Mansūr ibn Muhammad**, 1384. Yale University Library, Collection of Muslim Manuscripts.

in brief...

BRAZILIAN COOPERATION GOOD FOR THE ENVIRONMENT

IT IS A LONG WAY from Åbo Akademi University to Brazil, but they have one thing in common: extensive knowledge within the field of biofuels and renewable energy sources. This fact has resulted in active cooperation.

Pedro Fardim, professor in fibre and cellulose technology at Åbo Akademi, was part of the delegation of the Finnish Minister for Education, **Krista Kiuru**, when she visited Brazil in the autumn of 2013. The aims of the visit included furthering international cooperation in education and research, and enhancing the opportunities for the export of education.

Professor Fardim is one of the leading forces behind the Network of Excellence in Biomass and Renewable Energy (NOBRE), which is working at forming closer cooperative links between Finland and Brazil within these fields.

Visits also occur in the other direction. **Carolina Viégaz** and **Mariana Fortes** from the Federal University of Rio de Janeiro spent the spring term of 2013 at Åbo Akademi University learning about a deoxygenation process which the Labratory of Industrial Chemistry and Reaction Engineering are specialised in. This is a chemical reaction which removes carbon dioxide from a triglyceride; the fuel thus extracted is a so-called green fuel.

Viégaz and Fortes brought along pulverised microalgae and knowledge on how to extract and utilise various components from the algae. The procedure, which involves breaking the algae down into each of their components in order to utilise as many of them as possible is a new method.

"So far, we have mainly extracted lipids from the algae. Lipids are used as raw material for fuel, for example in biodiesel. But now we're breaking up the algae into all their component parts and can extract carotenoids, proteins and carbohydrates from them, in addition to lipids. In other words: we are extracting nutrients that can be used for food production", Fortes explains.

"At the moment, algae give 6–8 per cent oil per weight unit, but this can be increased to as much as 30 per cent", Viégaz points out. ◆

Carolina Viégaz, Mariana Fortes, Päivi Mäki-Arvela and Dmitry Murzin are satisfied with the cooperation between the Federal University of Rio de Janeiro and Åbo Akademi University.

"CAN EVERYBODY MANAGE IN BROKEN ENGLISH"?

"WHEN AN ITALIAN speaks a hundred words, it's just ten that he actually wants to say. When I, as a Finn, speak ten words, I mean each one of them!"

This statement was made by one of a number of employees at the Wärtsilä company in Vasa, Finland, who were interviewed for a study on language policies and language planning in industry. The project was commissioned by Åbo Akademi University's and the University of Vaasa's joint development centre for language planning and language education, LingVaCity, and used the multilingual Wärtsilä company for its case study.

"Language policy and language legislation in Finland usually only focuses on the public sector. The need for language planning for state and local authorities is increasingly being debated, but the need for a language policy within the private sector is often neglected, since enterprises are only marginally covered by the Language Act", **Kjell Herberts**, a researcher at the Department of Political Science at Åbo Akademi University, points out.

"Here at Wärtsilä, we take quite a pragmatic view on the use of languages within the company, and immediately try to solve practical problems as they arise. But it's been both useful and interesting for us to now start thinking about language policy and language planning from a broader perspective", says **Marica Lassus**, Director of Communications at Wärtsilä.

Wärtsilä has chosen English as the internal language for the company. What are the consequences of this for Finnish and Swedish, the domestic languages of Finland? And can everybody manage in 'broken English'? Should linguistic competence be supplemented by cultural competence? These were some of the questions discussed within the framework of the project. ◆

SUBLIME CURVES

Few record covers have endured as long as that of Joy Division's album *Unknown Pleasures*. There are T-shirts, posters, tattoos and art exhibitions featuring the image – the fact that even Disney produces an image of Mickey Mouse based on the cover's design is an indication of true greatness. However, the roots of the image go back to science.

When, in 1979, the four members of the post-punk band Joy Division turned to the record company's artist **Peter Saville** with an idea for the album cover, they probably based it on instinct. What exactly made the band's drummer **Stephen Morris** pick up *The Cambridge Encyclopaedia of Astronomy* is unclear, but nevertheless there he found the image for a cover that has gone on to have a life of its own for over 30 years.

It is equally unclear what made **Jocelyn Bell Burnell** respond to the radio signals picked up by the observatory's parabolic antennas in 1967. The discovery by the then post-graduate student gave her thesis supervisor the Nobel Prize in physics seven years later and it is depicted in the form of the curves on Joy Division's album *Unknown Pleasures*.

"Radiation of various kinds is our only source of information about the universe, but we cannot respond to all the signals which are picked up by our instruments. First it was assumed that the signals came from a transmitter situated on the face of the Earth. So it's important to keep one's eyes open and not dismiss potentially interesting finds such as deviations in measurement data", says **Johan Lindén**, a lecturer in physics at Åbo Akademi University.

The curves in the picture represent the signals from the first-ever discovered pulsar, which was initially nicknamed 'LGM-1' ('Little Green Men') because of its extraterrestrial origin. The first real name given to the pulsar was CP 1919, while today it is known as the PSR B1919+21. It is part of the constellation Vulpecula, commonly known as the Fox.

Tremendous pace

When a star is about to die, its pressure decreases rapidly, the star collapses under its own weight and a supernova is formed. During this process the outermost layer of material is hurled out into space, while the inner layers are compressed.

Depending on the size of the supernova, either a black hole is formed, if its mass is big enough, or a neutron star, if the mass is smaller. According to current theories, black holes are surrounded by a gravity field so strong that not even light emerges from it. The compression is weaker in neutron stars, but strong enough for electrons from the star's atoms to have been forced into the core of the atom. These neutron stars can be smaller in size than the planets in our solar system, and they rotate around their own axis in a few seconds or less.

Neutron stars generate a magnetic field, which because of their fast rotation emanates energy in the form of radio pulses. If the radio waves radiate in a certain direction, they can be registered as highly regular pulses on Earth. Such neutron stars are called pulsars.

The pulsar PSR B1919+21 sends out a signal every 1.3373 seconds. "Several pulsars have been discovered and they are all equally dull, as compared to the radio pulses sent by broadcasting radio programmes. All they do is repeat themselves", says Lindén.

"But they do have certain areas of use. Just as there are earthquakes, there are starquakes, too, and when one of these takes place, the radius of the star changes, which is reflected in the rhythm of the pulse. These can also be used for calibrating instruments, such as telemeters, and for finding out what there is in the almost total emptiness of space."

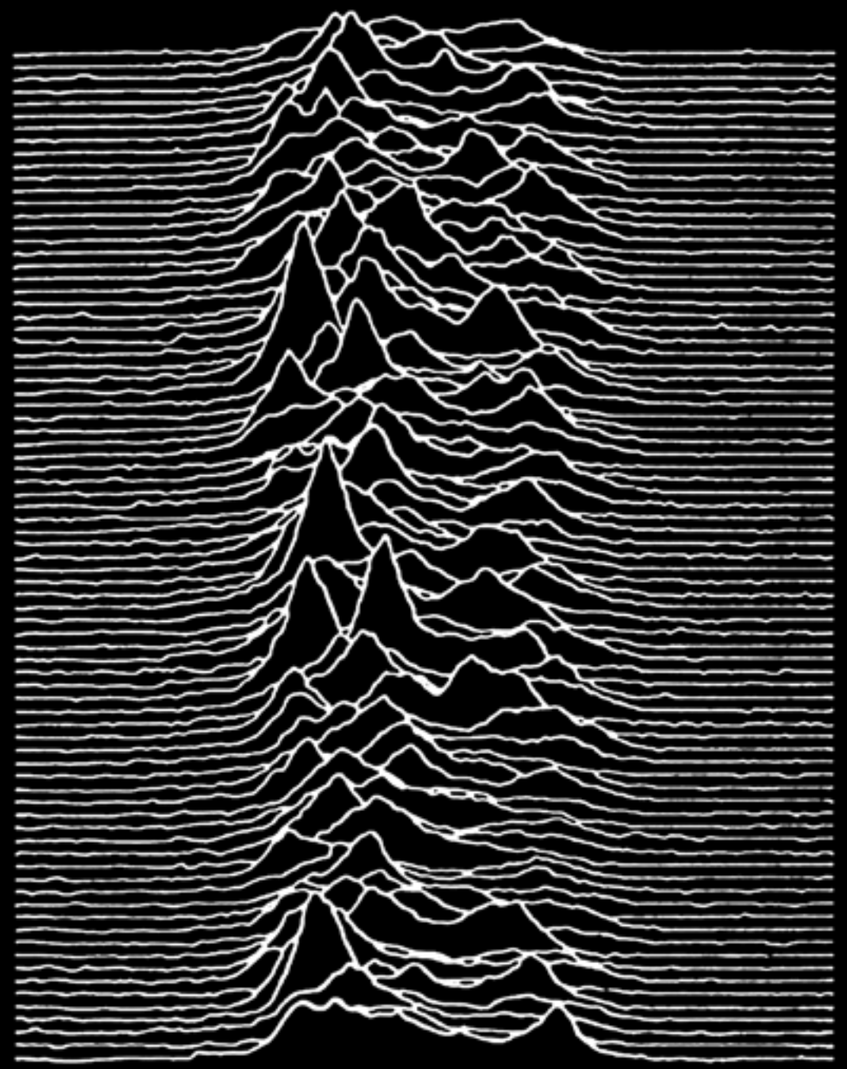
Joy Division

Joy Division was a rock band formed in 1976 in Manchester, England. The style of the band was a refined and a more artistic version of the raw energy of punk, paving the way for so-called 'post-punk'.

The career of the band was short-lived. Joy Division had themselves produced the EP *An Ideal for Living* (1978) before being discovered by the record company Factory Records, which released the album *Unknown Pleasures* in 1979.

An essential part of the myth of Joy Division is the vocalist **Ian Curtis's** constant struggle with himself and his existence. Curtis committed suicide the evening before the band was due to start its first tour of the USA in May 1980. The album *Closer* was released posthumously in July 1980.

The rest of the Joy Division members – **Bernard Sumner**, **Peter Hook** and **Stephen Morris** – continued their career as the band New Order. The band has split up twice and replaced its members even more frequently, but has been playing actively again since 2011.



Artistic impact

There is an entire field of aesthetics linked to science and the border between science and art. **Étienne-Jules Marey** and **Ernst Mach** were among the pioneers of the use of photography within science with their experiments on movement in the late 1800s.

The same period of time saw the birth of Modernism. Jenny Wiik, a doctoral student in art history at Åbo Akademi, says that the aesthetic roots of the cover of the *Unknown Pleasures* album reach back to the beginning of the 20th century.

"Abstract art developed during the second half of the 19th century, and, contrary to academic art, it did not aim at depicting a reality or an ideal. In the early 20th century **Picasso** and **Braque** developed Cubism, which was characterised by simplified surfaces and geometric forms."

The outcome of taking abstraction and cubism to their extremes is Suprematism, which is primarily represented by the Russian and Soviet artist **Kazimir Malevich**. One of his works consisted of a black square, which he hung across the corner of a room in the same way as icons are hung in Russia.

"The cover of *Unknown Pleasures* is also a black square, which gives it a minimalistic and simplified aesthetic. At the same time, there are the white lines which create a pattern, which is vaguely figurative. They remind us of a mountain or something that we have previously seen, although they are totally inexplicable", observes Wiik.

"Suprematism gave simple forms and empty surfaces a spiritual significance. In icons, the empty golden surfaces symbolise the divine. On this cover, the empty surface is black, which according to our cultural associations make us think of something depressing and frightening. It can be interpreted as an awe-inspiring experience of a great power, and thus the image becomes sublime – it is enjoyable and terrible at the same time."

Johan Lindén is not particularly impressed by the curves used on the cover of *Unknown Pleasures*; he feels that there are aesthetically more attractive curves available.

"The pulses have been arranged in a row so that they form a 3D pattern reminiscent of a landscape. They should actually be identical. The variation in them may to some extent be explained by the signals being distorted as they travel through the atmosphere. Partly, this might be caused by the instruments used", Lindén explains.

"Some measurement data do look attractive, but pulsar curves look like any other curves."

When analysing why the album cover has, after all, become as iconic as it has, we must not forget the impact rock bands have on creating identities. They become something that their fans want to identify with, and the album cover is an image that can be used for 'dressing' oneself and one's environment.

Wiik says that the theme of the cover is based on the industrial aspect of Joy Division's music, which is characterised by rather monotonous rhythm and a synthetic sound under the desperate vocal tones of **Ian Curtis**.

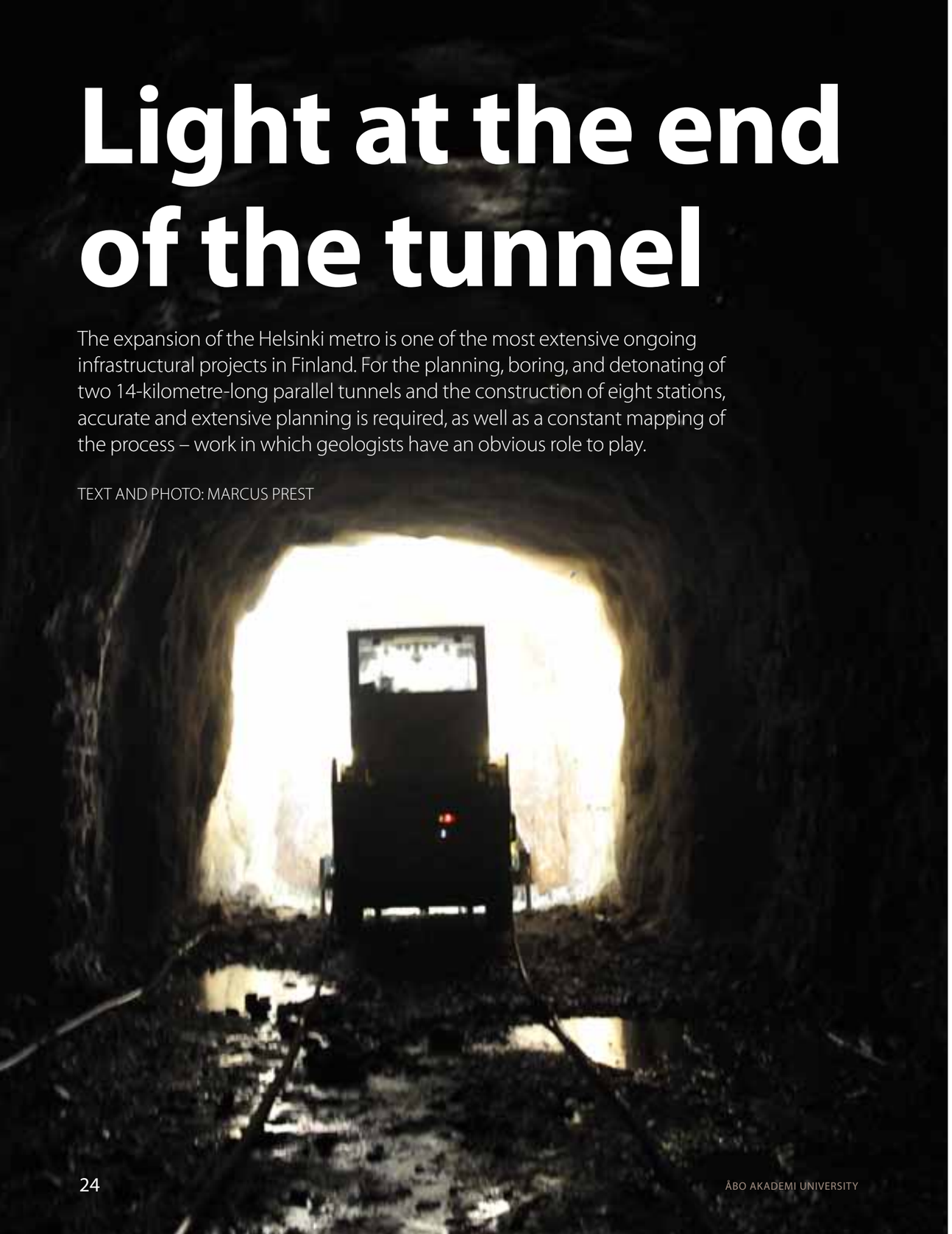
"Modernity has a dark side to it. Joy Division's aesthetic is also gothic, which leads us back to Romanticism and the melancholy mind. Romanticism also contained a lot of anxiety and focussed on emotions, not rationality." ◆

NICKLAS HÄGEN

Light at the end of the tunnel

The expansion of the Helsinki metro is one of the most extensive ongoing infrastructural projects in Finland. For the planning, boring, and detonating of two 14-kilometre-long parallel tunnels and the construction of eight stations, accurate and extensive planning is required, as well as a constant mapping of the process – work in which geologists have an obvious role to play.

TEXT AND PHOTO: MARCUS PREST



On average, the metro tunnel runs 20-30 metres below the surface. Up to 20 of these metres consist of earth and mud, and beneath the mud lies the bedrock. The engineers have planned the tunnel in such a way as to ensure that there is a consistent layer of some ten metres of rock above the tunnel's vault.

The geologist **Simon Granbacka** works for the Finnish engineering company Pöyry. In the recently detonated section of the tunnel that Granbacka is inspecting, there have been reports of 'spallings' – blocks of rock falling from the ceiling and sticking out of the walls, ricocheting around in the tunnel, as the pressure is equalling out. In addition, in this particular section of the tunnel there is a large mass of rock that rises 20 metres above the ground, and which causes the pressure levels in the walls of the tunnel to be particularly high. Towards the afternoon the pressure has stabilised and it is safe to move in the tunnels.

It is absolutely pitch dark in the tunnel; there are no sources of light at all except the artificial ones we carry with us. Granbacka has provided us with strong LED-lamps as a complement to the Davy lamps, but if the beam is pointed in the direction of the tunnel the light disappears without lighting up anything at all, except a white rock dust which looks like fine snow or flour, and which makes it necessary to protect the camera lens. It would probably also be a good idea to protect one's lungs if more time was to be spent down here.

Granbacka leads us down under the earth through the north tunnel in the direction of the working station far to the west. Having walked around for a while, it would be easy for a beginner to get lost, simply not finding the tunnel that leads up to the surface. As I have said, it is absolutely dark and there are no particular indications as to where we are or where to go; the darkness also gives a sense of endlessness, which is not an entirely incorrect notion, considering the extent of the tunnels.

The bed is muddy: it consists of gravel and mud from the crushed rock and is constantly wet due to water, coming either from the boring process, or running down from cracks in the rock. A power cable thickly insulated with rubber also runs through the tunnel – the cable extends from a so-called 'Jumbo' boring machine. As we approach, the sound from the drills increases. The boring machine stands on its own at the end of the tunnel, lighting up the rock wall, and the light spreads around the machine forming a cathedral in the dark.

"The reason that the mapping is sometimes so time-consuming is partly the darkness. It takes time to light up the vault metre by metre," says Granbacka.

Drilling through the bedrock is slow work. Compared to Switzerland or other parts of central Europe, for instance, where the rock is not as compact and you can drill straight through with the help of gigantic boring machines – so called TBMs, Tunnel Boring Machines – the work in Finland is extremely intensive: a number of cavities of a length of six metres each have to be drilled at a time. The cavities are then filled with explosives, the tunnel is evacuated, the explosives are detonated, and the mass of rockfill is transported away. Since work began in 2010, the metro tunnel has advanced 14 kilometres; six metres at a time, and three million cubic metres of rockfill have been transported away.

The detonations done, it is Granbacka's job to enter the tunnels and map ruptures and the quality of the rock. Occasionally, when the tunnel is 'unstable', the job might be a bit dangerous because of the risk of falling rock. Moreover, if the quality of the rock in the newly-cleared space is poor, time is scarce. This is because concrete is sprayed onto vaults and walls to minimise the risk of slides and falling rock, which is a problem, as the concrete conceals the rock and the ruptures that need to be mapped.

On the passage that Granbacka is now inspecting some of the ruptures and crushed zones have already been covered by concrete. The mapping is done manually on a paper sketch pad; sometimes the work is very demanding. Granbacka determines the frequency and character of the ruptures with the help of various parameters; he also checks the direction of the ruptures and their gradients with the help of a compass. The number of ruptures and their character in turn determine the degree to which a given passage must be strengthened by rock bolts and a degree of thickness in the strenghtening concrete. As a rule the Finnish bedrock is very hard and there is thus less need to strengthen it here than in other parts of the world.

> My education in geology at Åbo Akademi University has provided me with a fundamental understanding of how the rock behaves, what it consists of, and what one can expect to find in the terrain.

"My education in geology at Åbo Akademi University has provided me with a fundamental understanding of how the rock behaves, what it consists of, and what one can expect to find in the terrain. The actual planning of the test drilling and the engineering geology I have learnt on the job," says Granbacka. He received his Master's degree in geology at Åbo Akademi University in 2007.

The western metroline is a gigantic project; just the planning of the tunnels has been divided into ten segments, for which various engineering companies, such as Pöyry, have tendered. In addition, there are the rails, drainage, ventilation, electricity supply, and all the details of the stations, and so on. Pöyry is responsible for the planning of two segments and two stations, Otnäs and Ängskulla. The entire planning process is governed by Västmetro Ab (Westmetro Ltd.), which in its turn is owned by the City of Helsinki, the City of Vantaa, and the State of Finland.

As the work has been divided into so many sections and is done by so many different firms, it is difficult for the various parties to have an overview of the entire process. A great deal of time goes into meetings where people try to coordinate all those activities that a number of companies share with each other, all with different and simultaneous ongoing sub-projects.

Even the test drilling itself is a very extensive job. Before the drawing up of the tunnel is finished, the rock through which it will run must be carefully probed. Granbacka plans the test drilling, which involves not only drilling straight down through the ground where the tunnel has been projected to open out – this being a probe drilling to find out at what depth the surface of the bedrock is situated. The work also consists of making systematic, diagonal, long slices through the area; so-called core drilling, to get a picture of what is to be found on both sides of the planned walls of the tunnel, and what there is above and beneath them. The probe drilling also requires very precise preparations, as one must take care not to drill into electric cables, water pipes, insulated pipes, mountain heat pipes, and all the other infrastructure that might be buried in the ground of a built-up area. Sometimes it becomes particularly awkward doing test drillings which need to be done through basements; awkward both in relation to the owner of the basement and practically, when the machine, which is the size of a tractor, is to be fitted into an enclosed space.

There are plans for an extension of the western metroline. The issue of funding has not been decided yet, but the fundamental planning, which takes at least a year, has been finished. Granbacka has been out in the terrain marking places for test drilling and working with the route.

"What I'm primarily looking at is the quality of the rock, the character of the rock, and the direction of the ruptures, suitable places for test drilling, and the general morphology of the area, such as the shapes of the landscape, and so on."

"The test drillings then indicate how the tunnels should be drawn. Simply adjusting the height or the geometry of the tunnel by a couple of metres will have an impact on the whole project over almost the whole route, as the metro is a rather rigid, inflexible vehicle. One must not make the curves too deep."

The plan is that the new metroline should be taken into use in 2015. At the moment of writing, 96 per cent of the rock work has been finished – the basic work of fitting out the tunnels has begun. Electricity and ventilation plans are being drawn up, and the basics of fitting out more stations has also begun. The rail is waiting its turn. ◆

in brief...

STUDY OF KERATIN IN THE INTESTINES

THE OUTERMOST layer of cells in the large intestine, or colon, has a double function: it absorbs nutrition and liquids, and it also prevents unwanted bacteria and substances entering the blood system.

In the colon, this epithelial layer is only one cell thick, so its function is of utmost importance. A cell biology research group headed by **Diana Toivola** studies the function of the protein 'keratin 8' in the epithelial cells, and by extension the effects of the protein on the health of the intestine.

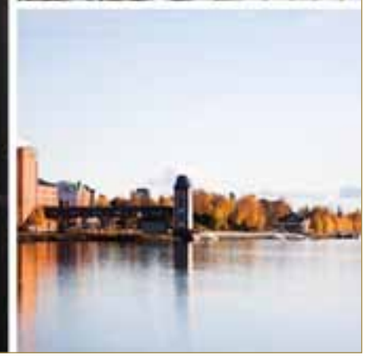
"Keratin is part of the skeleton of the cell, the 'framework' which upholds and supports it – the protein could be compared to the poles of a tent. For many years, it was believed that these 'poles' only have a mechanical function, but lately they have been discovered to do much more", Toivola says.

This study is carried out as a four-year project within the Centre of Excellence: Cell Stress and Molecular Aging at Åbo Akademi University. Toivola is also the coordinator of intestine research at the Turku Centre for Disease Modelling at the University of Turku.

"We have a good context for research here, with several people studying the role of keratins and other related proteins in protecting the cells from stress. There aren't that many researchers working on these issues in the world, so we're lucky to be able to get support from and cooperate with our colleagues", Toivola says.

"Intestine expertise comparable to the one we're building using animal disease models cannot be found anywhere else in Finland." ◆

Åbo Akademi University



Åbo Akademi University (ÅAU) is a multidisciplinary and an internationally acknowledged research university in Finland. Åbo Akademi University, with two main campuses in Turku/Åbo and Vaasa/Vasa, offers high quality education in Swedish and English for approximately 7 000 students and has a very low student teacher ratio – class size is often small and teachers have time to assist students individually. Around 1 000 international students study and conduct research at ÅAU.

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