Is bullying via the Internet really a problem?

Online target?

Stories about MySpace suicides and slut lists have created panic. Bullies seem to lurk everywhere on the Internet. Making the lives of young Internet users a misery. Yet is this a true picture?

TEXT: MELANIE METZ

About 20 minutes after Megan had sent her last message to 'Josh' she was found dead.

For some time the 13-year-old American girl Megan Meier had exchanged messages with 'Josh' aged 16 via the social network site MySpace. She had never met him, but was head over heels in love. That appeared to be mutual. After a month, Josh's posts became less friendly and Megan grew more miserable. The last message from her cyber sweetheart was: 'The world would be a better place without you.' Megan was found later: she had hung herself. 'Josh', it transpired later, did not exist. He was the fabrication of a neighbouring woman. Her daughter and Megan had fallen out and in revenge the woman had made a false account under the name of Josh Evans. She placed a photo of a good looking young man on the account and could now torment Megan undisturbed. She was sentenced to three years in prison.

In 2006 the world was shocked by the Megan Meier case. That was no less so in the Netherlands. The discussions flared up: how harmful is the Internet for vulnerable young people? An increasing number of grim messages followed about 'slut lists' (girls made out to be sluts) and 'slut shaming' (photos plucked from Hyves, a Dutch social network site, and decorated with abuse). It appeared that on the Internet only young people got into trouble.

Figures surprise

The commotion following the Megan Meier case called for down to earth research. Simone van der Hof, Professor of Law and the Information Society at Leiden University started this research. She was assisted by Sindy Sumter, developmental psychologist at the Center of Research on Children, Adolescents and the Media at the University of Amsterdam to get hold of hard figures. How many young people in the Netherlands are bullied over the Internet? Holding interviews about such a sensitive subject could be difficult. They therefore asked 400 young people aged 12 to 17 years to fill in questionnaires. From this small-scale study, the team discovered that strikingly few children experience problems with cyberbullying. Van der Hof and Sumter compared their results with those of a larger study from the European Commission into cyberbullying among 9 to 16-year-olds. It also revealed a strikingly low percentage. Four percent of Dutch young people are bullied via Internet. 'We were surprised by this,' says Van der Hof. 'The media panic was so large after episodes like the Meier case. The prevailing image was that the Internet was full of misery. Yet the facts were found to be more nuanced.'

Bully is not creative

The researchers made another more or less reassuring discovery. Sindy Sumter: 'The children who are bullied online are often tormented off-line'. In other words: at school or on the street. This also awful, but it also means the cyberbully is usually a person the victim knows. An annoying classmate, for instance, or a child from the neighbourhood. Not a complete stranger or a trusted adult, as in the Megan Meier case. That makes many cases of cyberbullying easier to tackle. Parents and teachers can speak to a bully in the class about his or her behaviour. In the case of an anonymous bully that would be more difficult.

What exactly do the bullies do? Surely from behind a safe computer screen it is easy to go a step further and to make extreme threats? Or they go on to stalk ▶

Childline 2.0?

How do you help children if they are bullied online? Janneke van der Zwaan from Delft University of Technology is experimenting with a 'cyberbuddy', a virtual character children can chat to if they are experiencing problems. The character is called Robin, and he looks somewhere between a teddy bear and a Teletubby. Study subjects aged between 14 and 16 years could present problems (not real ones, but from a script) to Robin. Didn't the teenagers find it weird asking a Teletubby for advice? 'Not at all,' says Van der Zwaan. 'Various studies have shown that young people prefer not to talk to adults about cyberbullying. A virtual agent offers more distance and that feels safer.' During the experiment a psychology student sat behind the scenes to type in Robin's answers. Could Robin, once he can answer independently, become a new sort of Childline? Robin probably cannot hold deep conversations. But young people would be able to talk about their problems. He could then encourage them to talk with parents, a teacher, or help services. 'At least that deals with the initial threshold,' says Van der Zwaan.

Children who are tormented online are often bullied off-line too

somebody? 'In theory, that step is smaller as you do not see the victim from behind a computer,' says Sumter. In practice, death threats are extremely rare. Neither did she come across complaints about sexually tinted information, such as names on slut lists. How come? Because Internet bullying scarcely differs from tormenting on the school playground: gossip along the lines of 'X wants to go out with Y'. Exclusion, ignoring somebody in chat conversations for example, is also a frequently stated form of bullying. Not pleasant, but also not very extreme, says Sumter. 'Cyberbullies are not that creative.'

Does bullying frighten?

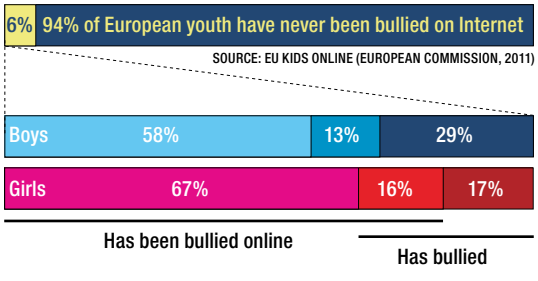
Extreme cyberbullying appears to be rare. Can the effects of 'innocent' pestering have a significant impact on a teenager? Development psychologist Sumter is now investigating the consequences of cyberbullying. She and her colleagues are following a group of 1200 young people from different primary and secondary schools over a period of several years. She will enquire about experiences of cyberbullying as well as psychological complaints such as depression or anxiety. Even though the final results of the study are not yet available, Sumter can already see a pattern: 'It would seem that children who are bullied on the Internet frequently suffer from gloominess or anxiety.' But are they more depressed and anxious because they are tormented? Or are such children more likely to be bullied because they are already anxious or miserable? That is not clear yet. 'Bullying on the Internet might exacerbate the nasty effects of 'normal' bullying,' says Sumter. Whether that is the case must still be confirmed and even then the research is not yet finished. 'In a few years time we will examine the same children again to see what has changed and how (online) bullying experiences affect children's well-being.'

Toddlers may not hit

For the time being it seems that cyberbullying is not a big problem in the Netherlands. However, the four percent of Dutch children who are bullied represent several thousand children. How do you protect them? 'You should not just focus on bullying via the Internet,' says Sumter. As cyberbullying is often associated with 'offline' bullying, you must look at all a child's problems. Why is he or she being bullied? 'Children first of all need to develop self-confidence.' Bullying in general needs to be tackled properly. Schools already have teaching programmes and 'bullying protocols' that explain how pupils should behave. What if cyberbullying persists? Harsh punishments have little point says Internet law expert Simone van der Hof. That is because young people are impulsive. As an annoying or harmful photo can be placed online

Bullies are bullied

Research from the European Commission into online bullying behaviour among 9 to 16-year-olds revealed that serious cyberbullying behaviour occurs relatively little in the Netherlands: just 4 percent. Throughout Europe, 6 percent of young people were found to experience problems from cyberbullying. Children were also asked if they bully. A number of bullies were also bullied or bullied back. The statistics are given below.



It is all too easy to take a nasty photo from Facebook and sling it into the world

in seconds, things can all too easily go wrong. 'Then something appears online without the young person realising what they have done.' What should happen then? Teachers and parents should teach young people to think twice about what they put online. It is not an excuse for parents and guardians not knowing the difference between Tumblr, MySpace, Hyves or Facebook. Van der Hof: 'Even if you know nothing about Internet, you can still tell a child not to abuse people online as you do not do that in real life either.' Keeping young people off the Internet is not an option, according to the researchers, as it has become too important for their social lives. 'They are in contact with each other 24 hours per day through computers at school and at home. From the first class of secondary school they have Blackberries and other smartphones,' explains Sumter. 'New social rules are part of this development,' adds Van der Hof: 'When they are toddlers, children learn they are not allowed to hit and kick. As teenagers they must learn to behave decently online.' ■

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Online misery

In the Netherlands, various things have gone wrong on the Internet with young people in recent years. A few well-known cases:

Facebook murder

What happened? In 2012, Joyce 'Winsie' Hau (15) from Arnhem wrote something unpleasant on Facebook about a friend. That person was so angry about it that she engaged another friend (also a teenager) to take revenge. On her instructions he stabbed Winsie who died as a result.
The outcome? The young murderer was given a year youth custody and an indefinite detention order. Although his deed had little to do with the social medium is still went into history as the 'Facebook murder.

Twitter suicide

What happened? The 13-year-old Livia from Pijnacker is said to have committed suicide in May 2012 because she was placed on a slut list (a list of girls happy to have sex). She continued to twitter until her death. **Consequence?** The term 'slut list' became well known due to this case, although in the end Livia's death was found to have nothing to do with such a list.

YouTube slanging match

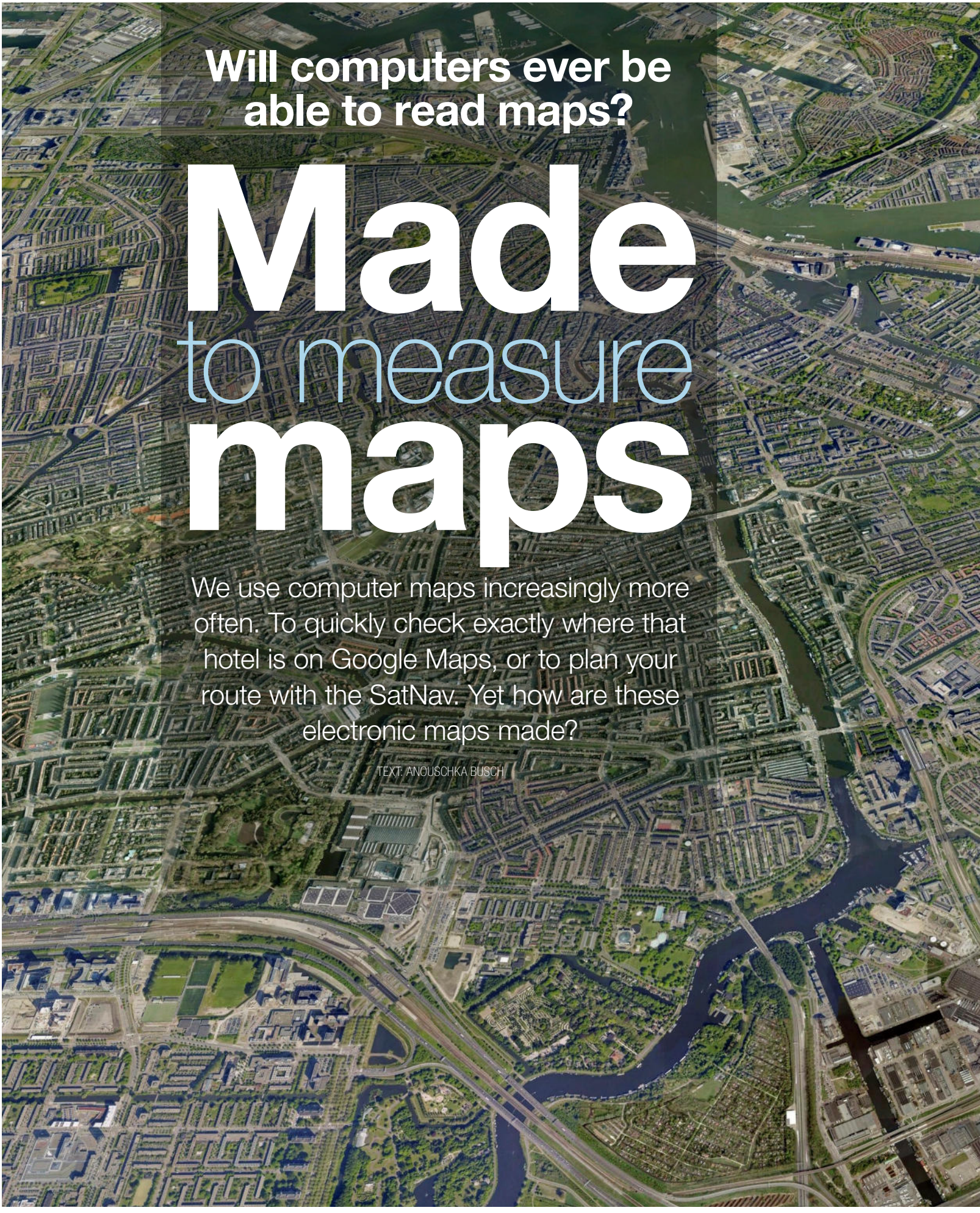
What happened? In 2010, raunchy films were made of two teachers and two pupils from Bonaventura College in Leiden using photos from Hyves and Facebook. The jokers stuck text on these such as 'look at that dirty broom' (Broom is urban slang for 'idiot' or 'tart').
Consequence? The police arrested one perpetrator. YouTube took no measures against the 'broom films'. Dozens are still in circulation.

Victim number 1

The first victim of cyber bullying was a 14-year-old Star Wars fan. The Canadian Ghyslain Raza filmed himself imitating Darth Maul, using a golf ball retriever as a light sabre. His classmates got hold of the videotape of the teenager jumping wildly around and placed it online. Although he mainly got a lot of compliments, Raza was not amused. His father took the classmates to court and this ultimately led to damages being awarded. The film spread over the entire Internet and jokers added lighting and sound effects. Countless versions can still be found on the web.

! FURTHER INFORMATION

www.ccam-ascor.nl: more research into young people and media.
tinyurl.com/cyberpesterij: Sindy Sumter's article which reveals that children bullied online are often bullied 'offline'.
www.nwo.nl/mvi: webpage of the Responsible Innovation programme

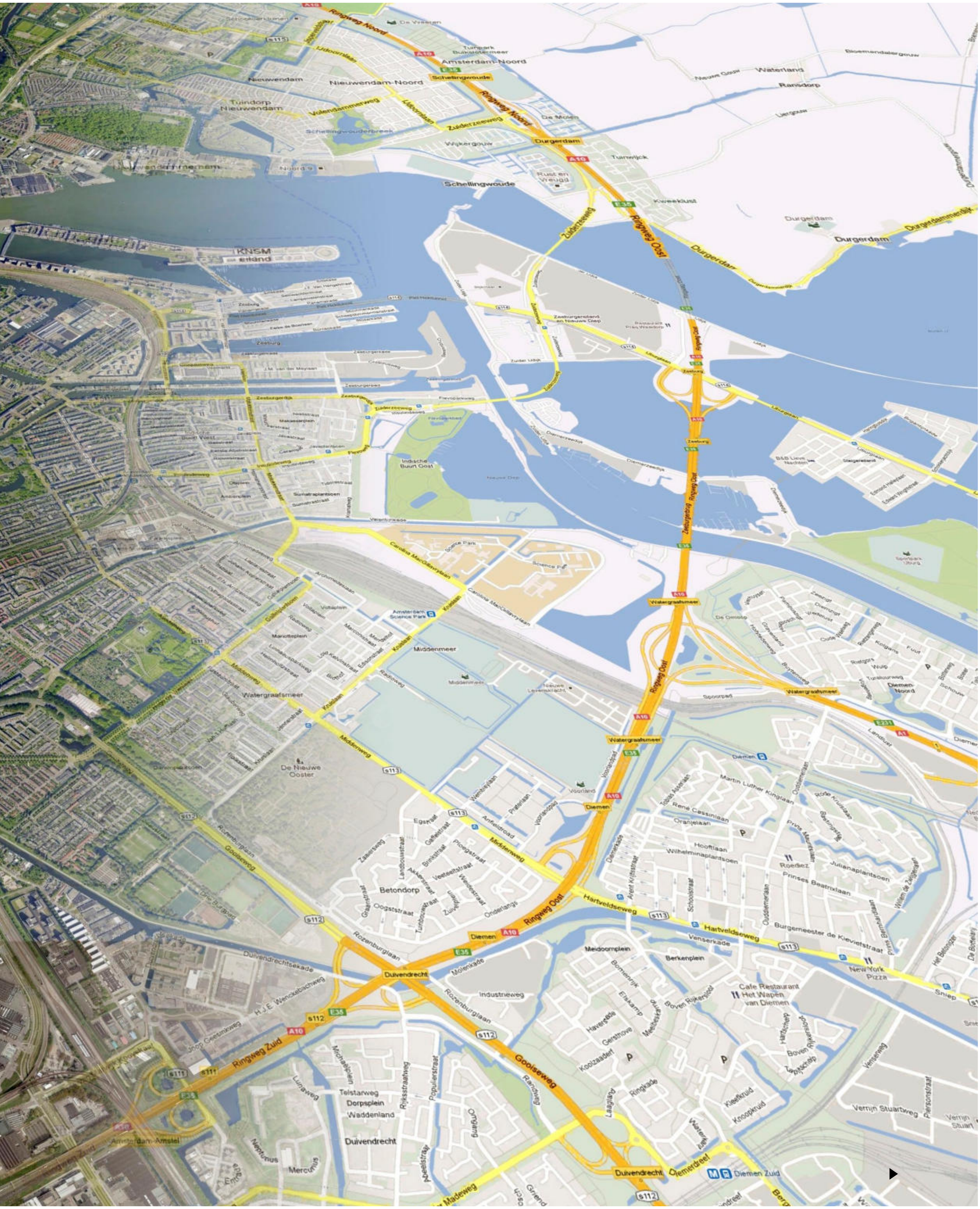


Will computers ever be able to read maps?

Made to measure maps

We use computer maps increasingly more often. To quickly check exactly where that hotel is on Google Maps, or to plan your route with the SatNav. Yet how are these electronic maps made?

TEXT: ANOUSCHKA BUSCH

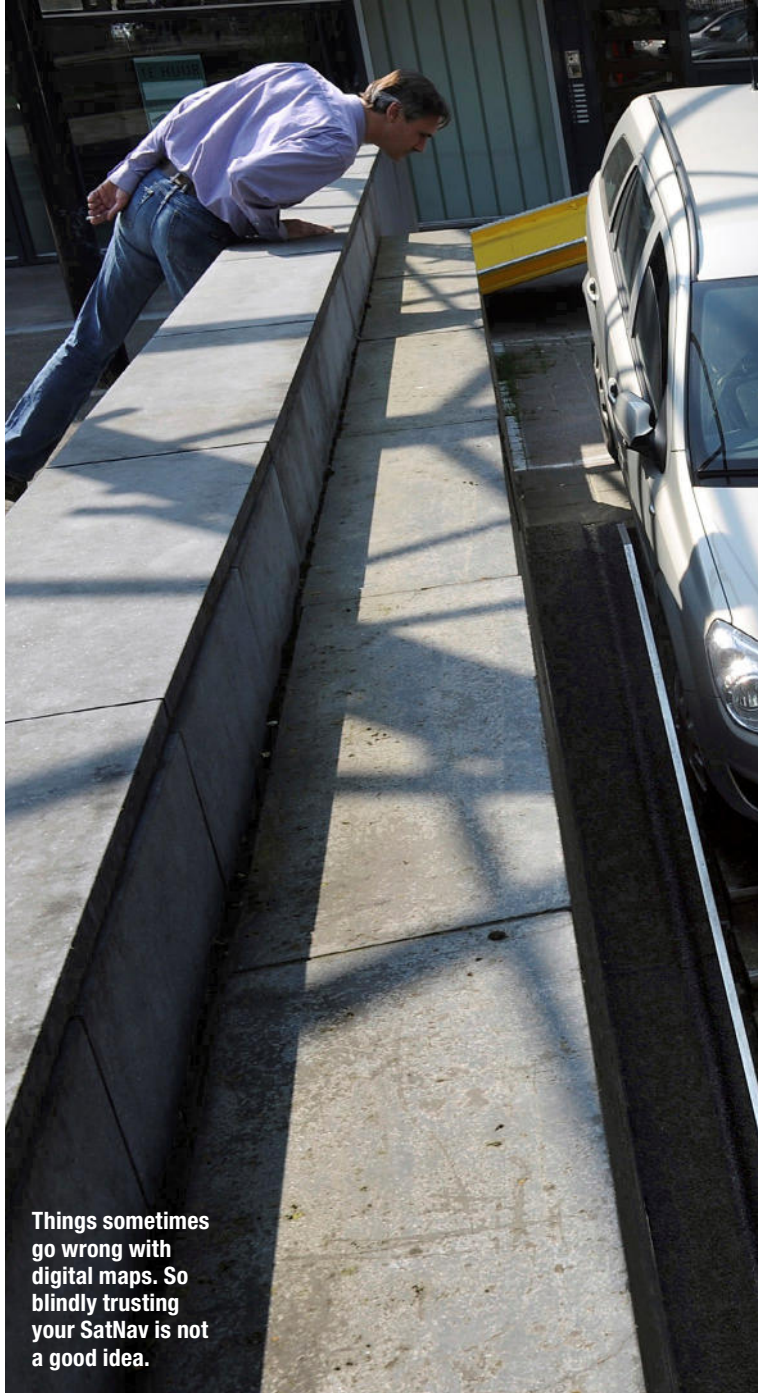

Ringweg Noord
Amsterdam-Noord
Nieuwendam
Nieuwendam-Noord
Schellingwoude
Tuindorp Nieuwendam
Volendammerweg
Zuiderzeeweg
Durgerdam
Waterland
Ransdorp
Kweeklust
KNSM eiland
Ringweg Oost
Zeeburg
Indische Buurt Oost
Carolina MacGillavrylaan
Amsterdam Science Park
Middenmeer
Watergraafsmeer
Middenweg
De Nieuwe Ooster
Diemen
Voorland
Martin Luther Kinglaan
Rene Cassinlaan
Oranjelaan
Hooftlaan
Wilhelminaplantsoen
Julianaplantsoen
Prinses Beatrixlaan
Burgemeester de Kievietstraat
Hartveldseweg
Betondorp
Oogststraat
Rozenburglaan
Duivendrecht
Duivendrechtsekade
H.J.E. Wenckebachweg
Ringweg Zuid
Gooiseweg
Industrieweg
Meidoornplein
Berkenplein
Cafe Restaurant Het Wapen van Diemen
New York Pizza
Telstarweg
Dorpsplein
Waddenland
Duivendrecht
Amsterdam-Amstel
Diemen Zuid
Verrijn Stuartweg
Diemen-Noord
Spoorpad
Landlust

The computer has to learn what to leave out and when

In the past, most mapmakers had to go on a journey themselves when they produced maps of the world. Nowadays, most of the data a cartographer could wish for is readily available: aerial photos, satellite images, altitude measurements, etc. These are all being continually updated. This data have been collected electronically in databases called geographical information systems. Yet electronic maps still need to be partly processed by hand. Bettina Speckmann, Professor of Computational Geometry at Eindhoven University of Technology is investigating methods to automate the production of maps.

Data are a mess

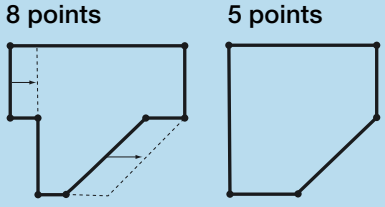
If you have access to a geographical information system then, in principle, all the information you need to produce a map is present. Realising a real map, however, is still a considerable process. The geographical data come in a wide range of forms: from scanned-in maps and aerial photos to altitude measurements and postcode files. All of these must be converted into the same format before a map can be produced from them. Subsequently, the data have to be cleaned up as well. The data are a mess. Why? Because they originate from different sources and years. Measurements may not be accurate. Different data collections sometimes describe the same area, so that some data occur twice. Speckmann gives an example: 'Google Maps generally has very good data, but not about every location in the world. For the 'less important' areas they have never checked their data. When we were in Madeira last April we discovered that many streets there are on the map twice. They had merged two data collections and nobody had ever cleaned up those data.' And cleaning up such data is an enormous job. An entire team at Google Maps has been busy for several years doing nothing but adjusting maps.



Things sometimes go wrong with digital maps. So blindly trusting your SatNav is not a good idea.

Shifting and measuring

You zoom into a building (figure left) on a map, simplifying into the figure on the right. It is the same building if you zoom out. However, two lines shift the right and three corners disappear. Because the lines remain oblique (i.e. have the same angle), the overall impression and total surface remain the same. Increasing recognition.



Yes, this 'map' changes, but when zooming out you scarcely notice that.

Details make a map unreadable

Once your data are correct then you face the next problem: not all data are equally relevant. You want to take the abundance of information and limit this to keep the map usable. Speckmann: 'If you try to put all of the details from the geographic information system on a map, it will be unreadable. In some countries, we now have all of the geographic data. We can tell you exactly where each streetlamp is located.' You do not want to see all that information on a map. You would not see the wood for the trees. Too many details make a map unreadable. Such an enormous quantity of data places a considerable burden on your computer's memory and data processing capacity.

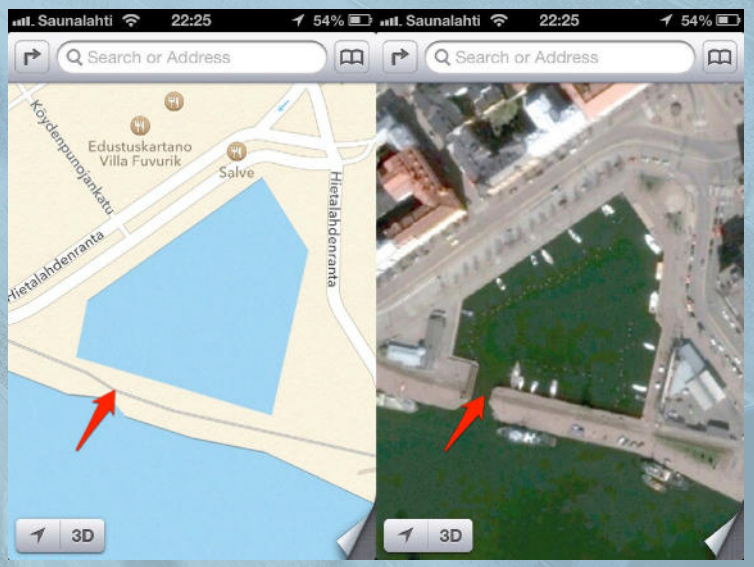
Map must become simpler

Which data want to be represented on a map will partly depend on your objective. A walker is interested in different information than a car driver. You probably want to know where a river flows, but possibly not the differences in depth and flow rate. Unless your job is disaster management, and you want to know where the poison that has leaked at a certain point in a river could end up. Then all of a sudden such information is vitally important.

The scale of the map is also important. If you zoom in considerably, seeing all of the data is fine: all of the little bending paths and individual houses may be visible. But if you zoom further out then all of those details make the map messy. In other words: the map must be simplified or, as the experts say, generalised. At present, cartographers

Pier becomes road

To simplify a building, road or other elements of a map, it is sometimes useful to merge these. For example, a building can be merged with the shed next to it. But you have to do it right. Because if you merge a pier with the other side of the harbour, as has happened on this map from Apple Maps, then it suddenly looks like there is a path to the other side when, in fact, you actually need to walk around.



still do some of the work by hand. A cartographer does an awful lot of work to ensure a map remains clearly legible on a small scale. Elements that are too small to be clearly visible or disrupt the map are removed by the cartographer or merged. Individual houses, for instance, are then converted into a block of houses. A park with paths and buildings? That becomes a green surface. Unimportant details of buildings and small bends in roads and rivers are removed by the cartographer during zooming out. Important elements are enlarged a bit, however, so that the characteristic curves of the building, for example, are still clearly recognisable. As you zoom out, roads are shown as wider than they really are so that they can still be easily followed and sometimes the cartographer moves elements to create space for something else. If you make a road wider then the houses alongside it need to be moved a little as well.

Map is calculated

Speckmann and her colleagues are trying to automate the generalisations of cartographers. At least some of these: Speckmann is working on simplification, merging and so-called 'squaring', making lines nice and straight. How does she do that? In the case of simplification, this is done by removing details. For example, by removing small corners and crevices from an old building. In concrete terms that means reducing the number of vertices that describes the object. A computer can only perform calculations on maps if these are stored in a form that the computer can use: vertices and edges between vertices. The greater the number of vertices, the more complex the object. If you remove vertices, then you are left with a simpler shape. If you do that randomly, there is a chance that the outcome will scarcely look like the original. You need to come up with a smart approach. Speckmann's solution: shift lines in such a way that the vertices coincide.

Computer lacks insight

The simplification of elements on a map does not sound like a particularly complex problem. Yet the calculations required for this are far more difficult than you might think. 'Computers do not have the slightest bit of spatial awareness,' explains Speckmann. 'They cannot spatially relate ▶

The computer does not read a map it only sees numbers

things to each other.' People on the other hand have an enormous visual perception. If you change a line slightly then we automatically see that the object is simpler. But for a computer those changes are no more than numbers that receive a different value.

For Speckmann, coming up with computer programs is only part of the work. Equally important is to demonstrate that the programs work properly. In other words, the calculations are fast enough and generate no wrong results. For example, during the merging of elements you do not want a small building to suddenly end up in a large building next to it. Or that bridges are suddenly added or disappear (see the box 'Pier becomes road'). If you remove vertices, then you also want to prevent Escher-like impossible figures from arising (see the box 'Impossible figures'). For a navigation system, it makes little difference if a road is not always entirely on the right spot. If you use maps for disaster management, then you certainly do not want anything to go wrong because the information has not been represented properly. So you must be able to prove that everything is still correct after the calculations.

Why automate?

Automating generalisations saves a considerable amount of work. There is another major advantage: tailored maps can then be generated on demand. If you want a map at the right scale on your computer or mobile phone then you will no longer need to download it. The computer calculates at that moment what the map should look like. For mobile phones, where downloading costs a lot of time and only a limited quantity of data are permitted, it offers an ideal solution. Such maps are not yet available on your phone, but you will certainly see the fruits of Speckmann's research in the future. A research group in Bremen that is developing an alternative to Google Maps has already expressed an interest. ■

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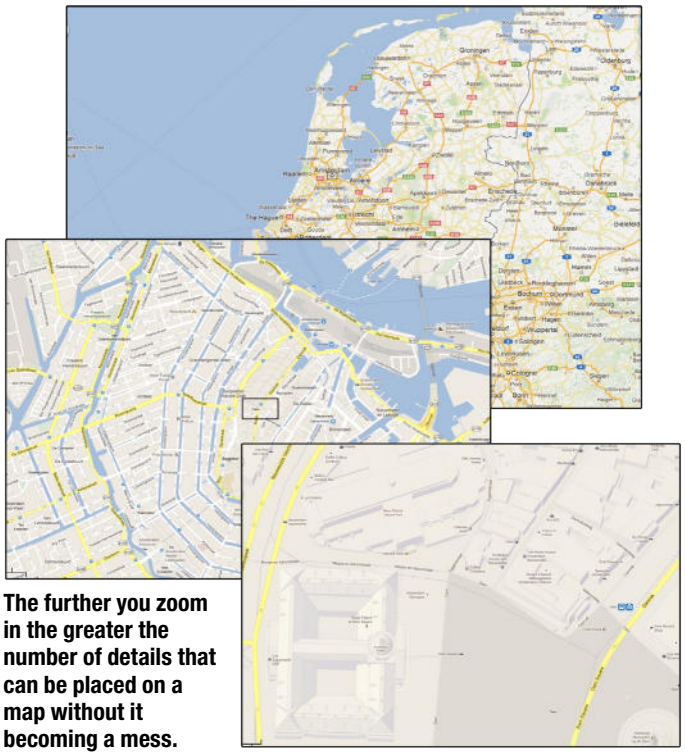
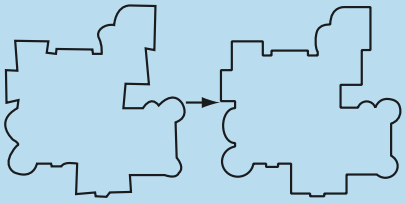


The further you zoom in the greater the number of details that can be placed on a map without it becoming a mess.

What is straight?

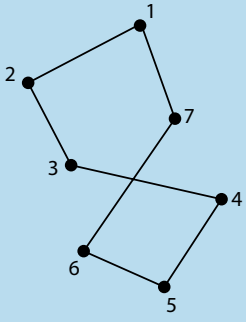
Buildings usually have straight corners. But on a map that is sometimes not the case. If the coordinates in your database are not entirely correct then sometimes the walls will suddenly become higgledy-piggledy. Bettina Speckmann's computer program can rectify this. This is referred to as 'squaring'. The program takes into account the fact that some components of a building are not that straight at all, for example the curves of an old church.



If everything is pulled straight for this 'church' then not a lot will be left of the building.

Impossible figures

If you make a drawing by linking vertices, then you might accidentally make an 'impossible figure'. At first glance, nothing appears to be wrong with the illustration below. If you try to process the image or use it for analyses or calculations, however, you will encounter problems. Why? Because the building crosses itself. Imagine, for example, that you want to fill up the inside of this figure with a colour. Then you must tell the computer what is inside. Curently it is hard to know which side of the line is the inside and which the outside. That cannot be determined with the help of a formula. If you start at Point 6 on the walk around your building, then halfway along the line you will suddenly end up on the inside. Such nonsensical representation can lead to awkward situations: What if the fire service had to analyse where the escape routes from the building based on such a map?



In this case a computer cannot immediately tell what the inside is.

ELKE GERAERTS (30), psychologist at Erasmus University Rotterdam, received a Veni grant in 2007.

False memory

Talented scientists with an innovative research plan can obtain funding from NWO. For researchers who have recently gained their PhD, there is the Veni grant worth a maximum of 250,000 euros. For more experienced scientists, there is the Vidi grant worth 800,000 euros. The Vici, worth 1.5 million euros, is for senior scientists.

Why exactly were you chosen?

'Thanks to a Rubicon grant from NWO in 2006 I had already worked at Harvard for a year. My Veni proposal was a follow-up to this. It was a clear research line focused on recovered memories of child abuse. So it had a clear social relevance as well. Of course, there has been more interest in this subject in recent years. I received my grant in 2007, before the Netherlands was shocked by Robert M. and the sexual abuse in the church.'

What are you using the money for?

'I have investigated the memories of adults who were abused in childhood. The question was whether they could forget the experience, but remember it again at a later age. That could indeed be the case. People often say that the memory is shut out whereas it has often been stored under a different 'label'. A child does not yet refer to an unpleasant experience as abuse. Only later can adults realise that this was indeed the case.'

'This memory can be recovered in two different ways. The first is in a spontaneous memory triggered by a situation. For example, somebody reading about abuse in the newspaper or somebody who has children thinking about their own childhood. Or even earlier still during the first biology lesson about sex. The second way is if a therapist treats somebody with a suggestive technique, such as hypnosis or dream interpretation. Therapists regularly suspect that a depression has arisen from sexual abuse during childhood. Some psychotherapists then go and search for this. They say, for example: 'Think back to when your father touched you indecently.' My research shows that this is a very unreliable technique. Those memories could be false.'

How did you end up in this line of work?

'When I studied psychology I was always interested in memory. My grandmother suffered from Alzheimer's disease and she was only a shadow of her former self. I was fascinated by how influential certain memories can be for who you are. I was offered a PhD position that focused on suppressed memories. Then you very soon end up investigating child abuse.'

What would you still like to investigate?

'Initially my research was mainly theoretical. Now I increasingly focus on the treatment of abuse victims. We are developing a new therapy that uses virtual reality to process memories. People often think it is a good idea to hide away anxieties. That works in the short term, but later it results in even more anxiety. We therefore simulate the memory.'

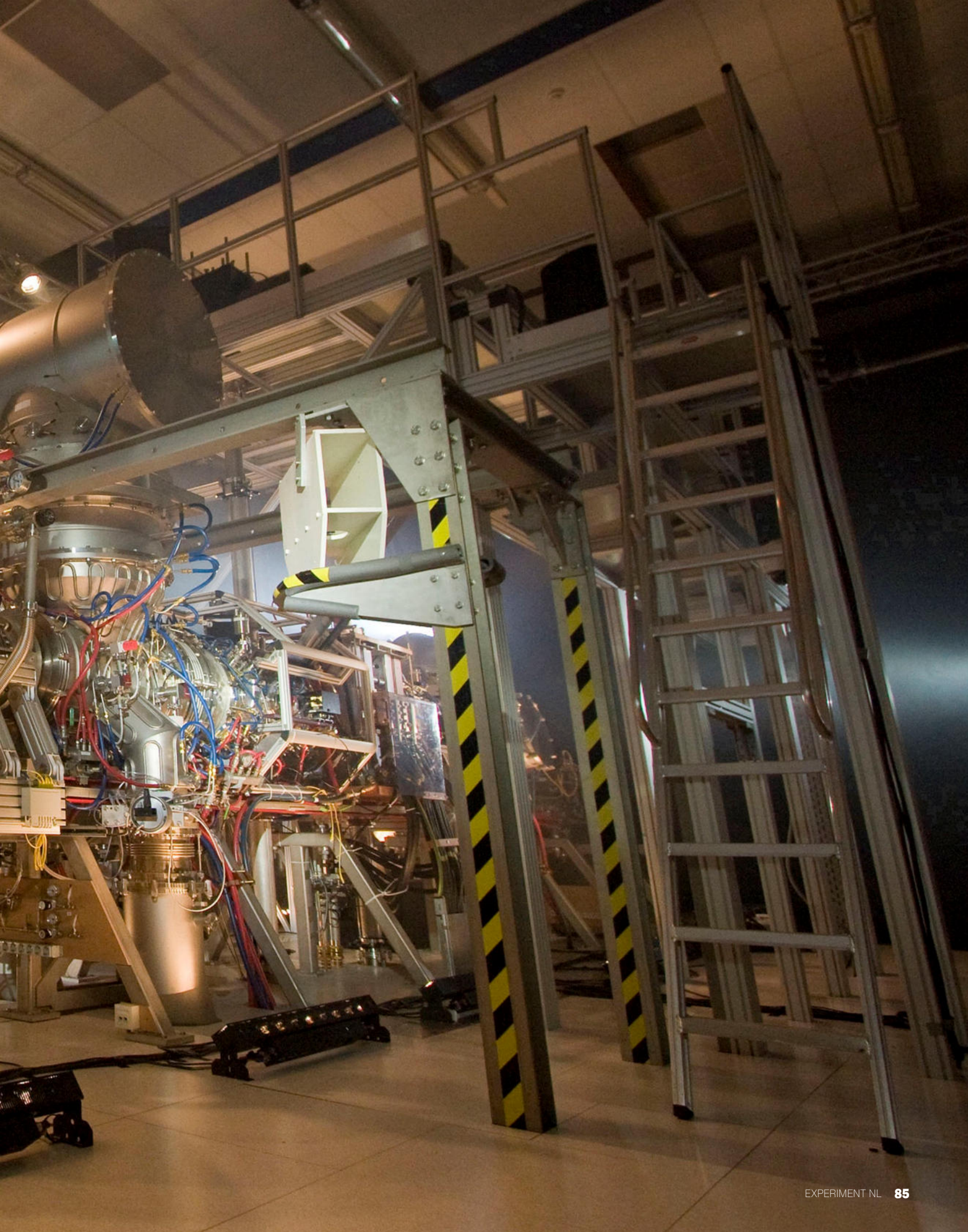
'I am also investigating depression and anxiety disorders. People with depression tend to devote a lot of attention to the negative aspects in their environment, and that is related to memories. I am now working on a training in which patients shift their working memory, their attention, to the positive.' ■

Nuclear fusion will provide more energy than it costs

Hot exhaust

In France, a nuclear fusion reactor is under construction. Various hurdles still need to be overcome, such as how you make an exhaust pipe resilient to temperatures of more than 10,000 degrees Celsius. Solutions to this problem are being sought in the Netherlands.

Magnum-PSI is a unique piece of equipment. It is the only installation in the world that can already generate the white-hot conditions materials will be subjected to in the future ITER reactor.



‘We are working at the limits of our capabilities’

‘This is it,’ says Pedro Zeijlmans van Emmichoven from DIFFER, the institute for fundamental energy research in Nieuwegein. He proudly points to Magnum-PSI. We are standing in front of a shining giant structure of stainless steel pipes, cooling devices, buzzing pumps, green and red cables, yellow gas tubes, bits of drainpipe, observation windows and magnetic coils. As we walk around the 15 m long, 4 m high and 6 m wide device, an electronics engineer drills a hole in the control cabinet. ‘Paul, can you stop for a moment, please?’

Basis is already laid

Magnum-PSI is officially the acronym for ‘magnetized plasma generator and numerical modelling for plasma surface interactions’. The name is a tongue-in cheek reference to Magnum P.I., the American TV series of the 1980s in which private detective Thomas Magnum, wearing a tropical shirt and swinging a revolver, solves one case after the other. That is also what Magnum-PSI must do: solve one case after another by shooting. Only the Magnum-PSI canon is not aimed at people, but at slices of carbon and tungsten. The case to be solved is what the exhaust pipe of the future experimental nuclear fusion reactor ITER must look like. ‘Now we are really working at the limits of our capabilities,’ says Zeijlmans van Emmichoven. ‘We are the only group in the world that can already generate the future conditions in ITER.’ And the importance of this should not be underestimated: nuclear fusion ultimately has the potential to replace the exhausted supplies of fossil fuels.

Fusion yields energy

First, the basis. ITER emerged from an initiative of Michail Gorbatsjov and Ronald Reagan, leaders of the Soviet Union and the United States in the mid-1980s. The two superpowers joined forces to search for a long-term solution for energy problems. Even back then, it was apparent that natural gas and crude oil would run out one day. There are alternatives such as wind parks in the sea and solar panels on roofs. Parks and panels occupy a lot of space, however, which is scarce in towns and industrial areas. Nuclear power stations also provide usable alternative energy, but regrettably leave us with waste that is radioactive for a long time to come. We need to find an alternative that can satisfy our growing demand for energy: nuclear fusion, for example.

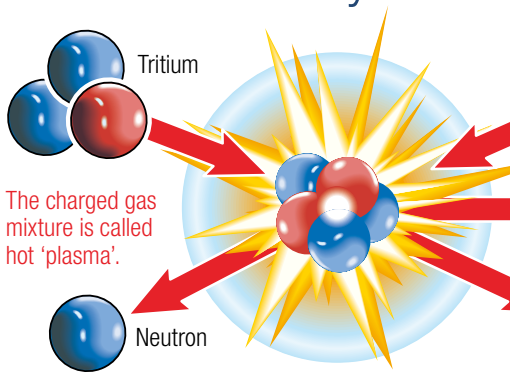
Although the terms seem similar, nuclear fusion is not the same as nuclear energy. Nuclear energy is obtained from splitting a large atom, such as uranium, into two smaller atoms. With nuclear fusion you do the opposite: you fuse two smaller atoms. That releases far more energy than nuclear energy, and the smaller amount of waste produced is less radioactive.

The atoms to be fused are tritium and deuterium. Both are variants of hydrogen, the smallest atom on earth. Tritium can be made with the help of the fusion reactor and deuterium is found in seawater. Unfortunately, tritium and deuterium do not spontaneously fuse. You first have to create the right conditions. First of all, tritium and deuterium gas are shot into the fusion reactor where the mixture is charged by a large electromagnet. This strips the atoms of their electrons creating a charged gas mixture called a plasma. Next the researchers fire radio waves and microwaves at the plasma causing its temperature to rise up to 100 to 200 million degrees Celsius. This ensures that the two substances eventually fuse.

Doughnut becomes hot

At least that will happen if the reactor survives: nothing on earth can withstand such high temperatures. The toughest material already starts to melt at 3500 degrees. Russian scientists came up with a solution at the end of the 1950s: a doughnut-shaped reactor surrounded by very strong magnets. The magnetic field contains

Nuclear energy for the 21st century



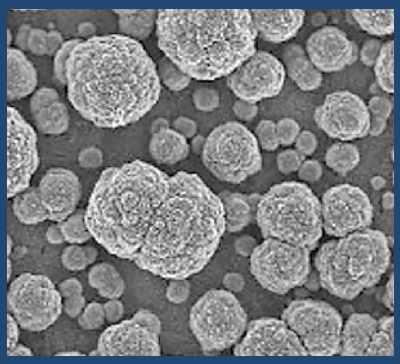
Only at a temperature of 100 million degrees Celsius can tritium and deuterium fuse.

Cauliflower carbon

On paper, carbon seems to be a good material to incorporate into the exhaust pipe of a nuclear fusion reactor. Unlike metals, it cannot melt. It can, however, become damaged or deformed. To investigate that, PhD student Kirill Bystrov bombarded plates of carbon with a jet of hot plasma. When he looked at the plates under the microscope he discovered, to his surprise, that the surface was littered with miniscule carbon cauliflowers. The longer the bombardment, the larger the cauliflowers. Bystrov worked together with the Forschungszentrum Julich in Germany and the University of Basel in Switzerland. The cauliflowers are bad news for ITER, as these can dislodge from the wall and contaminate the reactor.

Bystrov: ‘You could make thick walls, but dust would still come into the machine and that is absolutely impossible to remove.’ ITER has now changed course and is investigating a wall of tungsten.

The discovery has provided an unexpected lead for another group of scientists: the nanotechnologists. The bombarding technique of Bystrov and his colleagues might make it possible to produce not just nano-cauliflowers, but also nanotubes and nanowires. Thousands of times faster than the current techniques.



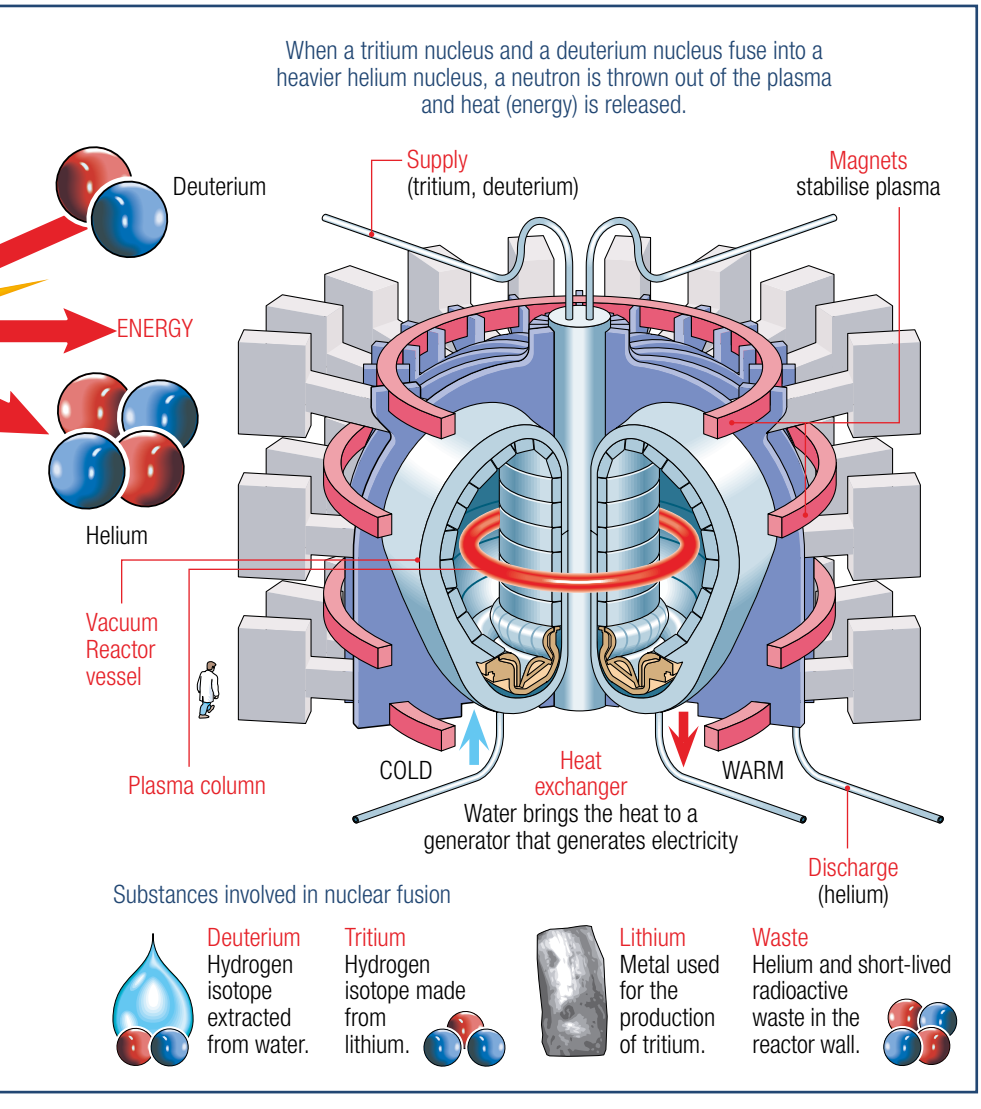
The discovery of miniscule cauliflowers reached the cover of the *Journal of Nuclear Materials* in 2011.

De funderingen van de toekomstige fusiereactor ITER zijn zo ontworpen dat ze bestand zijn tegen aardbevingen.

Towards ITER

'Iter' is the Latin word for 'path'. The aim of ITER is to demonstrate the technical feasibility of fusion as a source of energy. Several impressive figures:

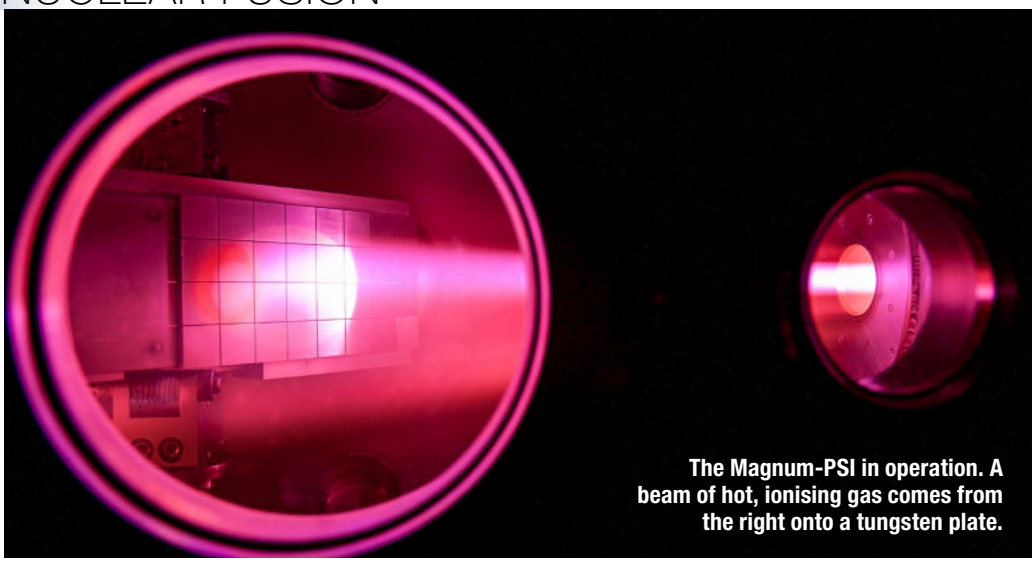
80,000 kilometres of wire is needed to make the magnetic coils. The coils are not made of copper but from superconducting niobium-tin.
5000 builders will swarm across the construction site each day during the peak of the construction in 2014.
13 billion euros is the estimated construction costs. Making an exact calculation is hard as the participating countries are delivering a lot of materials in kind.
73 metres will be the height of the building that houses the fusion reactor. This is about the height of a 25-story block of flats.
150 million degrees will be the temperature inside the fusion reactor, which is 10 times hotter than the sun's core.
6 bar is the pressure inside the reactor. This is 2 to 3 times higher than in a car tyre and considerably lower than the pressure inside the sun.
100 kilometres is the length of the ITER Itinerary, the special road for heavy transport running from the harbour at Marseille to the construction site.



the white-hot plasma so it cannot touch the wall. They started with a small doughnut, with quite low plasma temperatures and small magnets. Other countries joined in and so increasingly larger doughnuts were developed with stronger magnets and higher temperatures. All of that knowledge should come together in ITER. The reactor's 'doughnut' will have a diameter of 30 metres, and this will be surrounded by tonnes of heavy, superconducting magnets. Additionally, according to the calculations, it will contain a temperature of 200 million degrees Celsius. There was much debate about the reactor's location. The two main contenders where France or Japan. Then there was the matter of who would pay the projected costs (thirteen billion euros). That matter has now been decided. Together with the location, which is in Cadarache in the south of France. Europe is funding half of the costs. India, Japan, South Korea, China, Russia and the United States are funding one-twelfth each. Only ten percent of the budget is cash contributions. The rest is being supplied as materials and services.

Exhaust pipe melts

Magnum-PSI is part of that, says Zeijlmans van Emmichoven. 'Here we make plasma hotter than 10,000 degrees Celsius collide with pieces of wall material.' Although the scorching plasma of 150 million degrees will not touch the reactor wall, it will become ▶



The Magnum-PSI in operation. A beam of hot, ionising gas comes from the right onto a tungsten plate.

The ‘exhaust pipe’ has to convey the hot helium outside

hot due to the waste created in the fusion: neutrons and helium atoms. The neutrons unavoidably collide against the wall and heat it up. The Dutch researchers are mainly interested in the material of the so-called ‘diverter’, the reactor’s ‘exhaust pipe’. This has to transfer the hot helium to the outside, as otherwise this will disrupt the fusion reaction. The exhaust can be cooled, but that will not prevent the exhaust pipe from being worn out. So methods are being sought to minimise the wear, or at least keep it within reasonable limits. Magnum-PSI shoots hot plasma onto pieces of carbon and tungsten, two candidates for inclusion in the wall of the reactor’s exhaust pipe. ‘We study the wall and try to understand the complex processes taking place there. We are also testing a range of materials for their resilience to the extreme conditions,’ says Zeijlmans van Emmichoven.

Industry is also taking part

DIFFER is not the only party to benefit from ITER. ‘Industry is benefiting as well. On behalf of ITER, a Dutch company tested how to shape and strengthen 5 cm thick steel using explosions. I do not know whether this steel will be used for ITER, but as a result of that work the company now has orders from the aircraft industry.’ As work on the reactor generates many new possibilities, Dutch science and industry have united in the umbrella organisation ITER-NL. Eindhoven University of Technology, TNO, the Nuclear Research & consultancy Group (NRG) and the Foundation for Fundamental Research on Matter (FOM) work together in this with Dutch companies. The Dutch are designing and constructing measurement equipment and control systems. Zeijlmans van Emmichoven: ‘In the Netherlands, we are developing robot arms and other equipment that can replace the exhaust pipe components without human hands needing to touch these.’

ITER should be ready in a few years time, and the reactor will start supplying energy in 2020. Eventually the reactor should deliver ten times more energy than it consumes. It is mainly a pilot project to demonstrate that clean energy can be generated on a large scale using fusion.

After that the plan is to build DEMO, an even bigger reactor that will continuously provide just as much electricity as a conventional power station. If everything works out as planned, then DEMO will become operational in about 2050. By that time natural gas will have become scarce, crude oil supplies will have been exhausted and we will need even more energy. ‘That seems a long time away,’ says Zeijlmans van Emmichoven, ‘but we will only be able to use fusion by then if we invest a lot of time and energy in it now.’ ■

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FURTHER INFORMATION

www.differ.nl: Netherlands institute for fundamental energy research.
tinyurl.com/Magnetisedplasma: plasma in the Magnum-PSI.

Cycle or fuse?

200.000 Dutch people use about 1000 MW of energy, which can be generated by a single coal-fired power station. What alternatives can provide 200,000 Dutch people with energy?

Coal-fired power station
3 billion kilos coal per year (emission 10 billion kilos CO_2 per year)

Oil-fired power station
2 billion litres of oil per year (emission 8 billion kilos CO_2 per year)

Gas-fired power station
3 billion cubic metres of natural gas per year (emission of 6 billion kilos CO_2 per year)

Nuclear power station (fission)
100 million kilos of uranium ore per year (producing 1000 kilos of radioactive waste each year and 200 kilos of carcinogenic and highly toxic plutonium)

Nuclear power station (fusion)
100 kilos deuterium and 150 kilos tritium per year

Wind turbines (at sea)
1300 wind turbines spread over 600 square kilometres (about 25 by 25 kilometres, roughly half the Province of Utrecht)

Solar panels
(based on current panels, which convert 15% of the light into electricity)
60 square kilometres (8 by 7.5 kilometres, an area the size of Maastricht)

Biofuel (rapeseed, plants, trees, one percent efficient)
3000 square kilometres of land (55 by 55 kilometres, roughly the Province of South Holland)

People on home trainers
10 million (if you could keep it up for 24 hours per day)
30 million (if you cycle in shifts)

SOURCE: ENERGY SURVIVAL GUIDE, JO HERMANS, 2011

Penalties research

A Rubicon grant gives young scientists the possibility to gain research experience at an excellent foreign institute soon after acquiring their PhD.

MATT DICKS (30),
movement scientist VU University Amsterdam, received a Rubicon in 2011. He came from New Zealand to the Netherlands.

Why exactly were you chosen?

'Luckily my research in New Zealand tied in well with the research in human movement sciences in Amsterdam. I study the interaction between player and keeper when a penalty kick is taken. In the past, this research topic – which includes the measurement of eye movements - was typically investigated during a simulation in which the keeper watched a video of the penalty taker. In New Zealand, I worked with new technology that allowed the measurement of eye movements *in situ* and so instead of a screen you can study the situation in real-time. I enjoy watching and investigating penalties, but I am more interested in the underlying theoretical question: 'How do people use body language to anticipate each other's actions?'

What are you using the money for?

'Over the past few months we have done many tests. The study of real-time behaviour is more time consuming and challenging than video simulation experiments, but this also yields more interesting data. In situ measurements seem to reveal something the video tests do not. For example, some keepers predict where the ball will go and so they respond before the player shoots. Other keepers watch what the player does and only respond at the moment of or after foot-ball contact in the kick. This skill is also related to keeper's agility. In 80 percent of cases, the player's standing leg points to the corner he/she will shoot to, but it is not to a slow keeper's advantage to wait for that. Can he/she already read something from the player's earlier movements? Such questions are still on-going.'

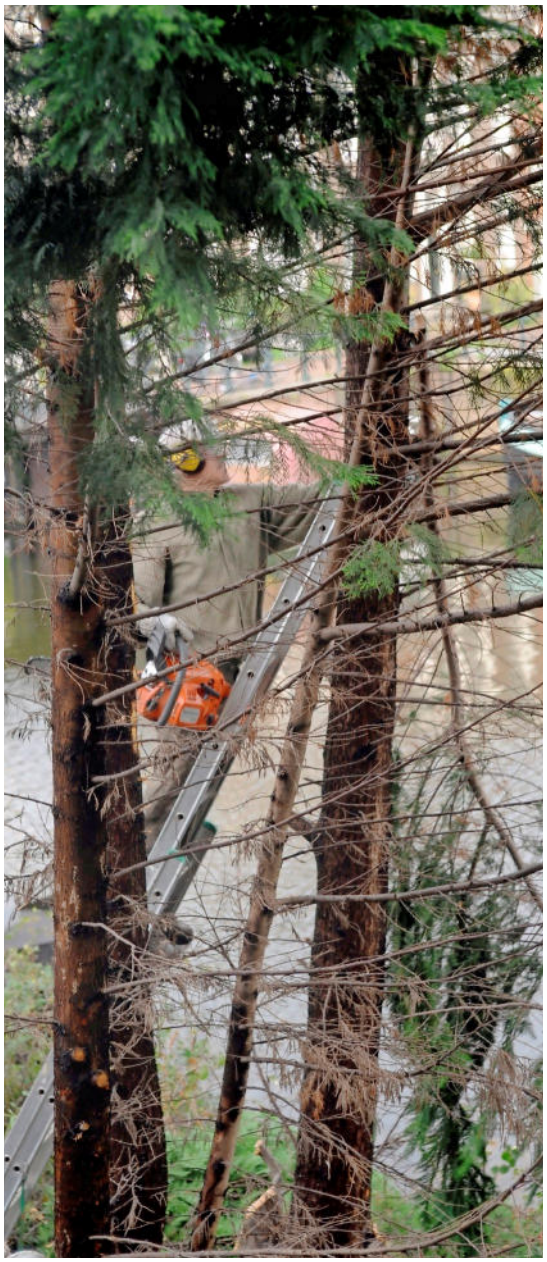
'Some coaches in the Netherlands are interested in the results, but they are not exactly queuing up for them. We are still building up those relationships. It was the same in New Zealand, although that was partly because football is not the most important sport there. However, there was interest from other sports such as rugby.'

How did you end up in this line of work?

'When I studied in the United Kingdom I also coached youth football. I think that whenever I read studies in my discipline I always subconsciously asked myself what the results meant for footballers. When I had the chance to go to New Zealand, my previous coaching experience led me in the direction of this research. My present interests are more aligned with the theoretical aspects of the research.'

What would you still like to investigate?

'I am increasingly looking at interactions, other than penalty kicks, to study how people interact with each other on a daily basis. For example, have you experienced walking opposite somebody on the street and misestimate the direction that person is going? And then you briefly adjust your movement to avoid a collision? We clearly misread each other's body language on occasions. Similarly, a magician tries to do the same thing, deliberately. And during the penalty, the player and keeper try to mislead each other by accentuating the wrong body language. I want to broaden this research topic. I still find it interesting to answer the theoretical question through situations that speak to many different people, like penalties and navigating in a busy street.' ■



Plastic from plants

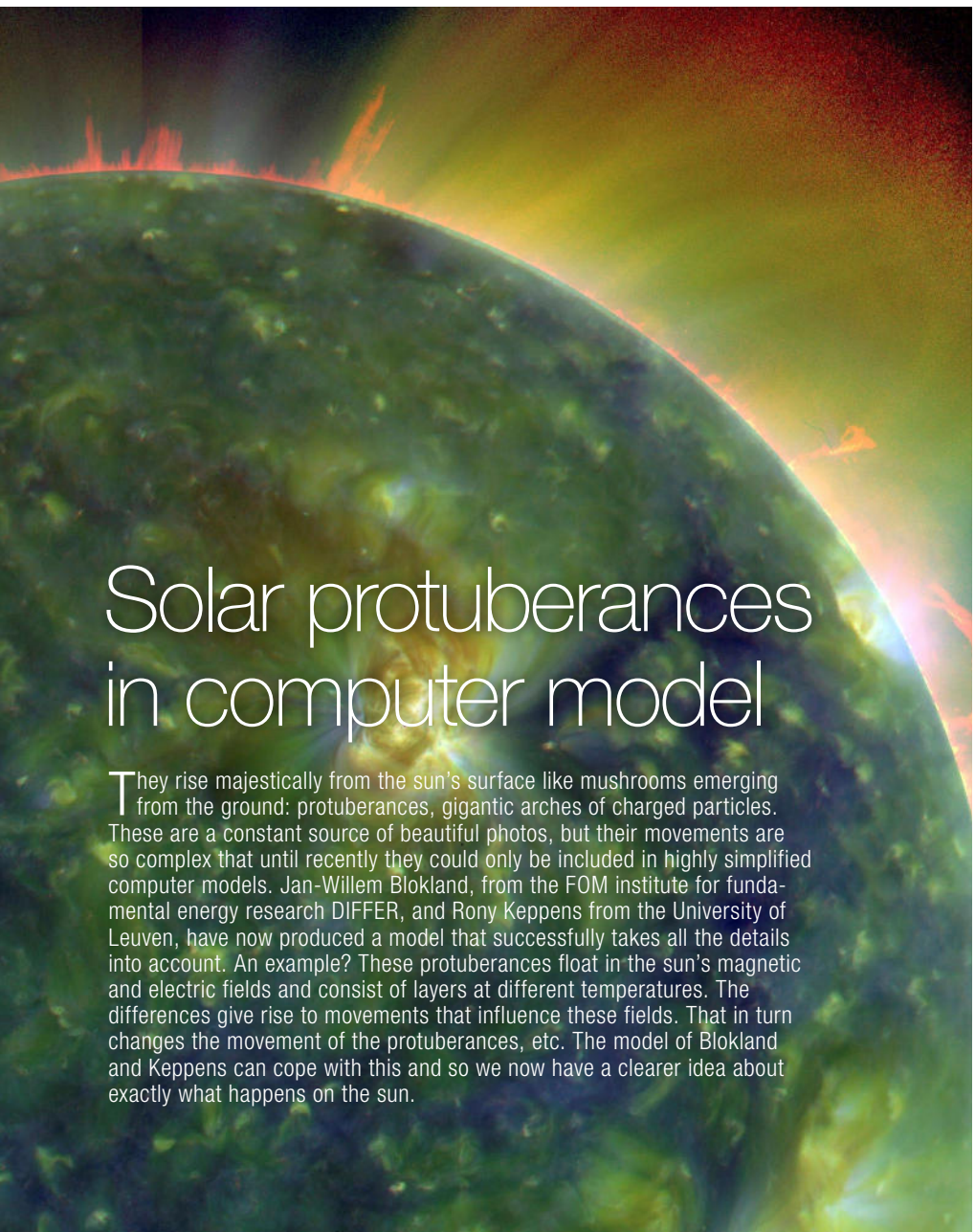
Barbie dolls and sandwich bags made from branches and plant stems could soon be a reality. Scientists from Utrecht University have found a catalyst (a substance that gets a chemical reaction going) that makes it easier to produce plastic from plant cuttings. That is good news because we normally make plastic from crude oil, and that is running out. The technology to produce plastic from wood already existed, but was complex and expensive. With the new catalyst, the process goes faster. How? First of all the woody plant remains are heated with air to convert these into biogas. The catalyst can then directly convert this gas into the building blocks of different types of plastic, such as propene. Consequently, the 'green plastic' can be produced in the same way as ordinary plastic. This makes it far more attractive for manufacturers to produce environmentally friendly plastic.

Sustainable coffee not that sustainable

We like to drink our favourite cup with a clear conscience. We are told sustainably grown coffee beans are good for the environment and the coffee producer. Not necessarily, says sustainability researcher Verena Bitzer from Wageningen University. In her PhD thesis published in 2011 she says that small producers, in particular, hardly benefit from the partnerships for a sustainable coffee trade. Why not? Producers must satisfy expensive certification standards and the collaborating partners do not pay for those. The producers pay. Technical help is sometimes offered to improve the production methods. Yet it is questionable whether a producer can actually reap the benefits. The business targets of companies that market sustainable coffee are not aimed at strengthening the producers' position in the global coffee chain, which casts doubt on the sustainability of such coffee.

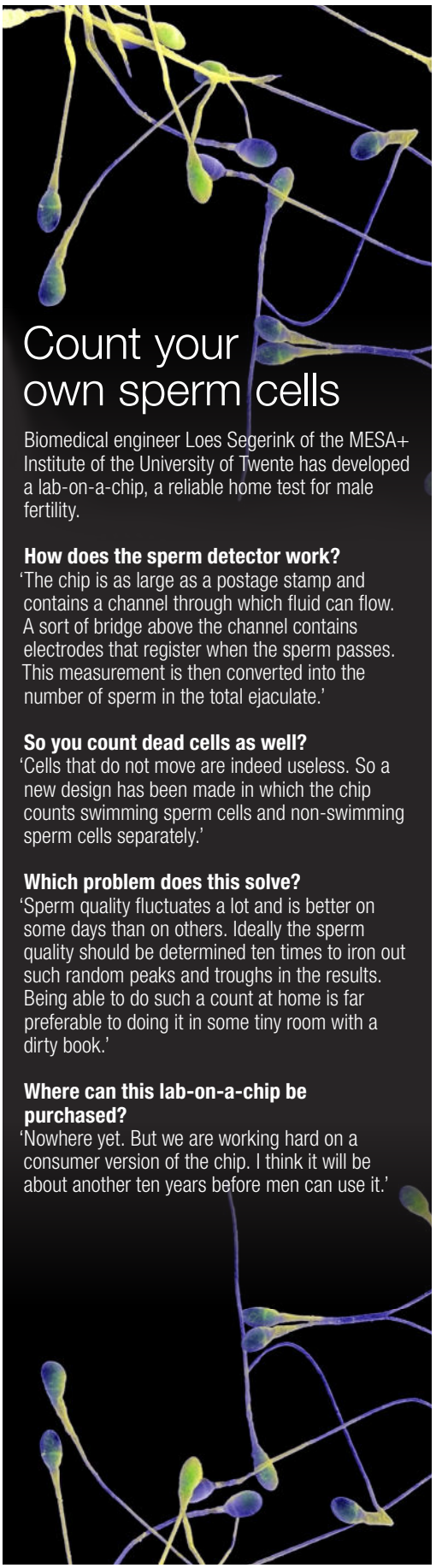
UV image of the sun with a protuberance made in 2010 by NASA's Solar Dynamics Observatory.

Women in Tanzania remove the skins from between the coffee beans.



Solar protuberances in computer model

They rise majestically from the sun's surface like mushrooms emerging from the ground: protuberances, gigantic arches of charged particles. These are a constant source of beautiful photos, but their movements are so complex that until recently they could only be included in highly simplified computer models. Jan-Willem Blokland, from the FOM institute for fundamental energy research DIFFER, and Rony Keppens from the University of Leuven, have now produced a model that successfully takes all the details into account. An example? These protuberances float in the sun's magnetic and electric fields and consist of layers at different temperatures. The differences give rise to movements that influence these fields. That in turn changes the movement of the protuberances, etc. The model of Blokland and Keppens can cope with this and so we now have a clearer idea about exactly what happens on the sun.



Count your own sperm cells

Biomedical engineer Loes Segerink of the MESA+ Institute of the University of Twente has developed a lab-on-a-chip, a reliable home test for male fertility.

How does the sperm detector work?
'The chip is as large as a postage stamp and contains a channel through which fluid can flow. A sort of bridge above the channel contains electrodes that register when the sperm passes. This measurement is then converted into the number of sperm in the total ejaculate.'

So you count dead cells as well?
'Cells that do not move are indeed useless. So a new design has been made in which the chip counts swimming sperm cells and non-swimming sperm cells separately.'

Which problem does this solve?
'Sperm quality fluctuates a lot and is better on some days than on others. Ideally the sperm quality should be determined ten times to iron out such random peaks and troughs in the results. Being able to do such a count at home is far preferable to doing it in some tiny room with a dirty book.'

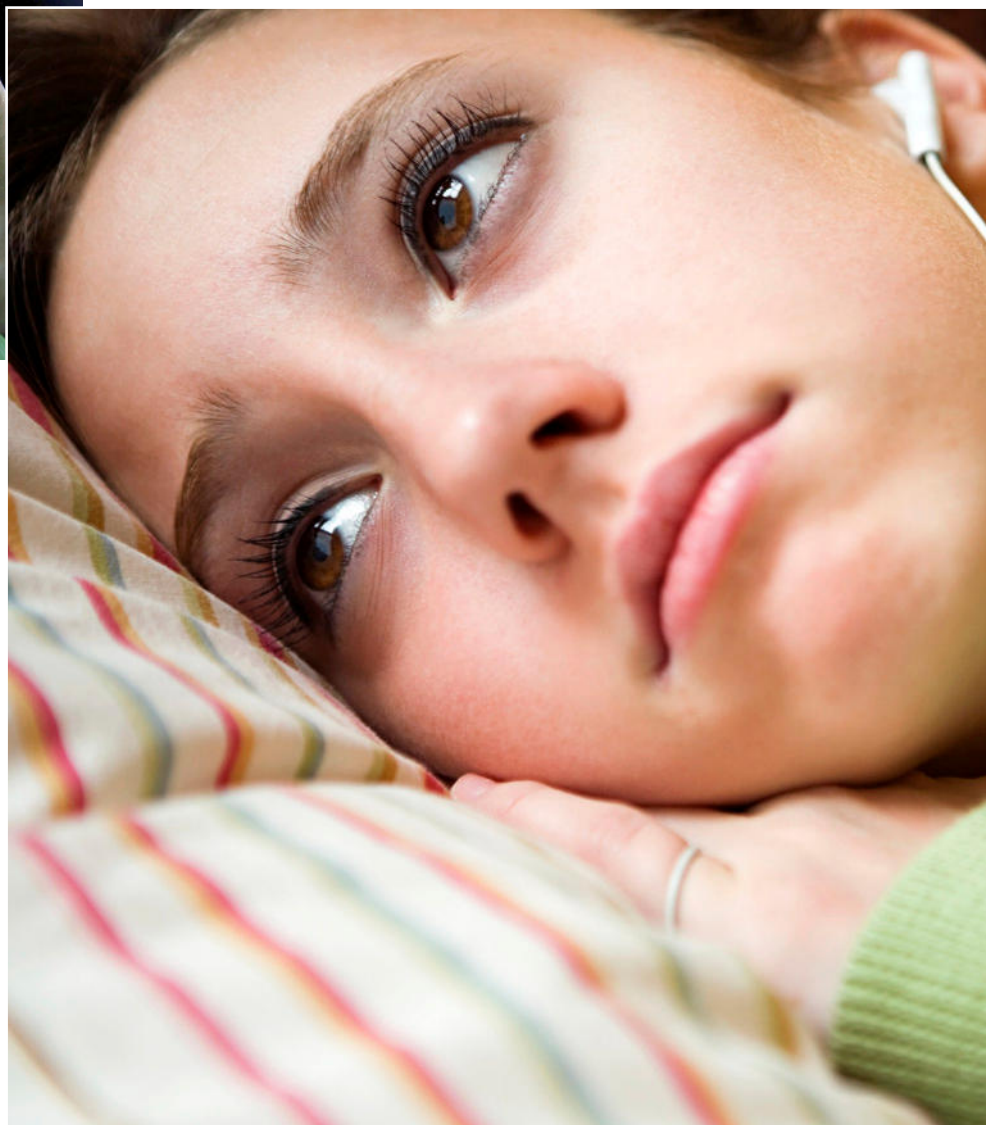
Where can this lab-on-a-chip be purchased?
'Nowhere yet. But we are working hard on a consumer version of the chip. I think it will be about another ten years before men can use it.'

Weakened parasite helps immune system

A malaria vaccine produced from weakened malaria parasites. That is what Chris Janse from Leiden University Medical Center is working towards. Janse weakens the parasite by removing several genes from it. Result: after vaccination it can no longer cause the disease symptoms:to make us sick the parasite must reach our red blood cells via the circulatory system and liver. Janse's modified parasites do not get beyond the liver. So not far enough to do any harm, but far enough to be detected by the body and to elicit an immune response. There is just one problem: an awful lot of weakened parasites are needed to elicit a good immune response. 'So we are now looking for ways to make the parasite more immunogenic: making the parasite easier for the body to detect and killed earlier.' The vaccine has been tested successfully on rodents, but not on people.

Cultivated tomato loses immunity

The immune system of the cultivated tomato is in a miserable state. Researcher Kirsten Leiss from Leiden University and two of her PhD students wondered why. So they carried out the first 'metobolomic' study into insect resistance. The scientists compared the metabolic products in cultivated tomatoes with those in wild tomatoes and discovered that cultivated tomatoes contain no acyl sugars. In wild tomatoes, hairs on the leaves secrete these sticky substances trapping their arch enemy, the thrips. Cultivated tomatoes once had a sticky line of defence, too, because they originate from wild tomatoes. Due to breeding, cultivated plants have lost this immune system. Leiss received a grant from Technology Foundation STW to develop a metobolomic resistance test. Plant breeders can use this to predict how resistant a new plant cultivar is against pathogens and voracious insects.



Seeing eating, elicits eating

A pig farmer wants his piglets to quickly become independent of their mother. Then the sow can immediately produce new offspring and that yields more piglets per year. Young piglets are removed from their mother after four weeks, but this can only be done if they can already eat solid food. This can be a struggle. Some piglets eat nothing for days before they dare to eat solid food. The problem? In most pig sheds the sow's pen is arranged such that the piglets cannot see or smell how and what their mother eats. When it comes to eating, piglets prefer to copy their mother, discovered researcher Marije Oostindjer at Wageningen University. They want to eat the same food as their mother eats. A piglet that has never seen its mother eat adjusts to solid feed less quickly. The smell of the feed also gives a feeling of familiarity. Feed that smells the same as the food their mother ate is eaten better by the piglets. The solution: a special feeding trough from which the mother eats at the same time as the piglets and filled with feed that has the same smell as the piglets' feed.

A sad person is faster

Leave your ski hut CDs at home. On the motorway to the Tyrol you are better off listening to the funeral top 20. Cognitive neuroscientist Henk van Steenbergen from Leiden University brought research participants into a joyful or sad mood using happy or sad music. They then had to do an easy and difficult test and during these the researcher measured the reaction rate and made brain scans. The happy study subjects scored worse in the difficult test. Why? On the images from the fMRI scanner Van Steenbergen saw less activity in the prefrontal medial cortex. That part of our brain gives us warning signals in stress situations. A positive mood therefore dampens signals from our alarm centre. The scientist concludes that sombre people possibly respond quicker in dangerous situations than happy people.

Finger on the emotional pulse

If a woman is administered the male hormone testosterone, then just like men she becomes less good at feeling other people's emotions. At least if she has an index finger that is longer than her ring finger. This connection between finger length and empathy was discovered by Jack van Honk, psychologist at Utrecht University and the University of Cape Town. He administered women testosterone or a fake substance (placebo), then the women had to discern complex emotions from faces. Women with a relatively long index finger started to perform less well, while women with a long ring finger were not affected by the testosterone. The relationship between finger length and hormones develops in the womb: a lot of testosterone ensures the baby's ring finger becomes longer. Finger length is therefore an indirect measure for prenatal exposure to the sex hormone. This is the first time it has been demonstrated in people that prenatal hormonal exposure affects social behaviour later in life.

CSI of the universe

The NWO Spinoza Prize is the highest award in Dutch science. The winners receive 2.5 million euros that they can use for research of their choice. Xander Tielens, professor of astronomy at Leiden University, is one of the four winners from 2012.

TEXT: ANTJE VELD

What did you want to be when you were younger?

'I am a moonchild. I was growing up when Kennedy said: 'We are going to the moon.' And that made me realise that I wanted to do something with astronomy. When I was not at school I played football in the park. But in those days there was no Johan Cruijff to emulate. So we played purely for fun.'

And what exactly do you do now?

'I study the molecular universe. Molecules can be found everywhere in the Universe. In fact, there is a great variety of molecules in space. These molecules play an important role in the evolution of galaxies and the formation of stars. They might even have played a role in the prebiotic evolution of life. I study to what extent that is possible.'

That sounds complicated. What exactly do you mean?

'When you realise there are 100 billion stars in the Milky Way and 100 billion galaxies in the universe then there are 100 billion times 100 billion stars. We think each star has its own solar system. Of all those planets, can we be the only one inhabited by life? That would be quite unique. So I am interested in whether life could exist on other planets and how that could evolve. I am tackling the astronomical side of that problem. Therefore if we look into the universe what sort of molecules can we see in areas where stars and planets are forming? And can you also form life from these?'

How do we see molecules?

'You see the molecules spectroscopically. This means that molecules only absorb light of a certain colour. So based on the colours you see you can determine which type of molecules you are looking at. It is a sort of fingerprint. I am, as it were, the CSI of the universe. The downside is that you must go to a considerable altitude to see the molecules. We mainly do that using satellites. You give these a certain job each day. For example: 'Look at that location in space at that colour light.' At the end of the day the satellite sends all the data to a computer on earth. The following day you can issue a new job. That all happens remotely, so it is quite expensive. Such a satellite costs about one billion dollars to develop.'

And what have you discovered?

'We already knew that there are a lot of small molecules. These are gathered together in molecular clouds where dust particles protect them from harmful radiation emitted by stars, for example. However, these small molecules can only be found in these clouds. I have discovered that larger molecules also exist in space. For comparison: a small molecule consists of a few atoms, whereas the large molecules we are studying contain about 50 carbon atoms. This makes them a bit more resilient and so they can 'survive' in space more easily. We therefore find them at different locations than small molecules.'

Where do those large molecules come from?

'When stars become old they extinguish just like a bedside candle. Such a star throws out the rest of its material into space and soot particles form. That material can float around for 1 billion years due to the resilience I have just described. Ultimately the surviving large molecules are in a region in which new stars and planets will form.'

How?

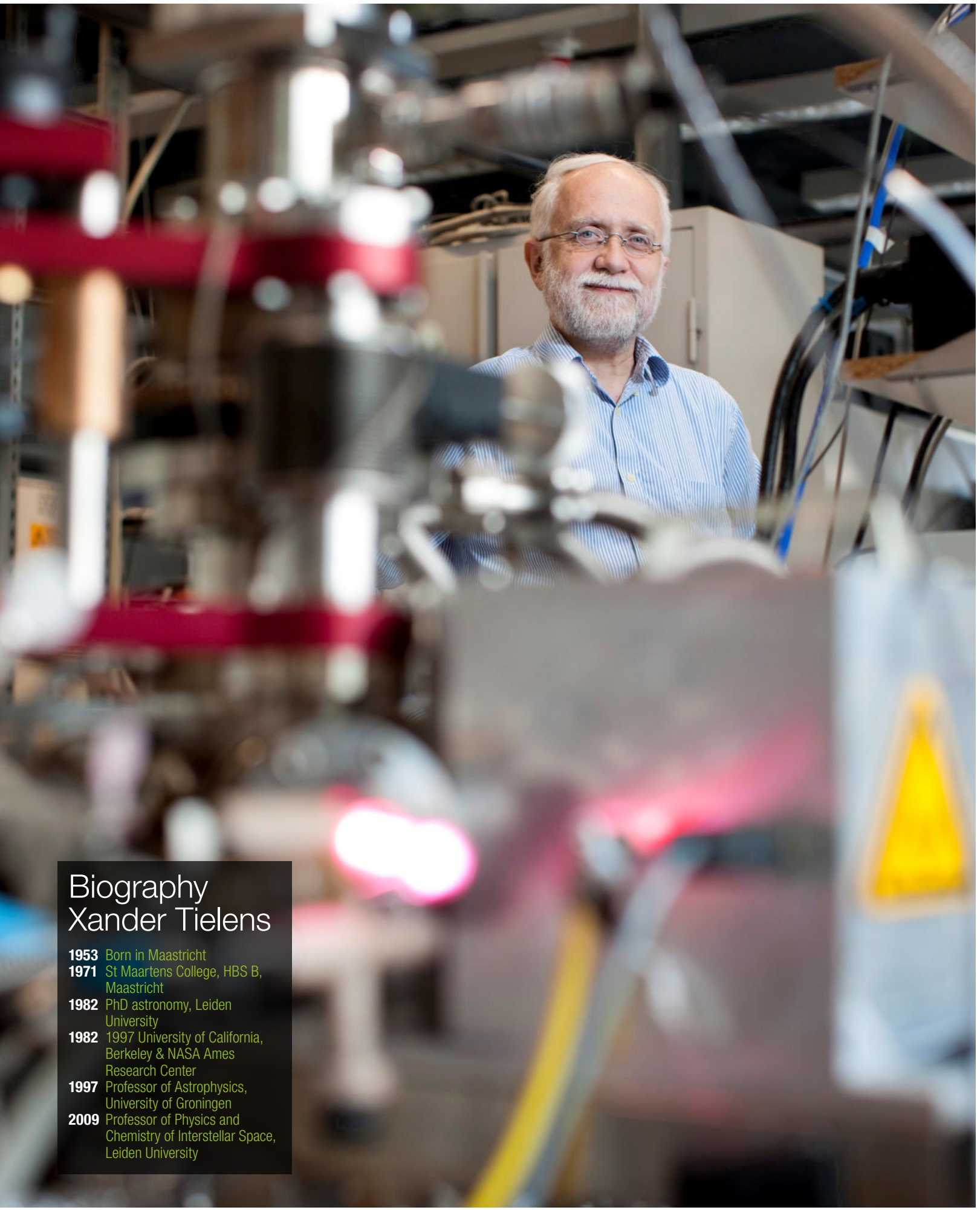
'We do not know the exact details yet, but at least we have demonstrated their existence. In Leiden, we have just set up a laboratory study to investigate how easy it is to destroy these molecules. We can produce the same types of molecules here. They are in effect soot particles. We capture these in the laboratory and hold them together in a magnetic field. We then fire a UV laser at them to investigate when they break up.'

Were you surprised about the Spinoza Prize?

'Yes, you do not think about this in advance. When they called me, I was sitting in the train in a silence compartment. So at first I did not take the call. Fortunately they called back later. They said: 'Congratulations, you are a Spinoza Prize laureate and will receive 2.5 million euros.' I said 'thank you', but I did not really know what it entailed. The importance of the prize only dawned on me when I told my daughters. They looked it up on the Internet and said "Dad, that is fantastic". You are only as big as your children see you.'

What will you use the money for?

'The work I do is highly interdisciplinary. I collaborate with the best international physicists, chemists and astronomers. Until now, my contribution to the quest for possible life on other planets has always stopped at the moment we hand over the research results to biologists and biochemists. Something like: 'Here you are, have some fun.' Only they still usually start with small molecules and slowly build up something big. I would like to reverse that. We will begin with something big, like the molecules we have discovered, and break those into small pieces. Maybe these can also be used to build up completely new or different life. I intend to do that in collaboration with good biochemists.' ■



Biography Xander Tielens

1953 Born in Maastricht
1971 St Maartens College, HBS B, Maastricht
1982 PhD astronomy, Leiden University
1982 1997 University of California, Berkeley & NASA Ames Research Center
1997 Professor of Astrophysics, University of Groningen
2009 Professor of Physics and Chemistry of Interstellar Space, Leiden University

A lorry only becomes energy efficient if the driver cooperates

Art of con

vincing

Technology helps make cars more energy efficient and safe. Such energy-efficient gadgets can only make a difference if drivers want to use them. How do you motivate people to use new technologies?

TEXT: GUIDO HOGENBIRK

A hypermodern lorry is parked at DAF Trucks in Eindhoven. It has been built according to DAF's 'Advanced Transport Efficiency Philosophy' (ATe). To the average person it looks like a fairly normal lorry. Various technical adaptations, however, ensure the vehicle uses fuel very efficiently. After five minutes of idling, for example, the engine automatically switches off. It also has an automatic gearbox that changes gear as efficiently as possible. The speed limiter, often present in lorries, has been brought back from 89 to 85 kilometres per hour. Such adjustments make the lorry more environmentally friendly and ensure its fuel costs are 5 to 10 percent lower than in many other lorries. So surely a transport company would want to get all of its drivers using such a lorry as quickly as possible? It is not quite that simple. To achieve that saving you need more than just an energy efficient fleet of lorries. The technologies must be comfortable and easy for drivers to use and they must enjoy using them. How do you ensure that? To find out, DAF is working intensively in a large-scale study at Eindhoven University of Technology. Scientists from the departments of psychology, philosophy and mechanical engineering have joined forces to investigate persuasive technology. In other words, how do ▶

DAF drivers see a summary on their dashboard after each journey. How far did they travel and at what speed? This makes them aware of their driving behaviour.

Hidden distracter

A robot on your dashboard that cheerfully says things if you drive in an energy efficient manner. Nice or not? And according to the researchers from Eindhoven it works as well. But convincing people can also be less obvious. In 1957 the American advertiser James Vicary caused a commotion. He claimed to succeed in persuading people to buy a bottle of Coca-Cola using hidden advertisements. During cinema films a bottle was briefly shown. So briefly, that the cinema visitors could not consciously observe it. However sales of the black drink during the interval rose significantly. The term 'subliminal advertising' was born. But also anxiety. Because if you could persuade people unawares to desire a Coca-Cola will you might also be able to use hidden advertising to influence them politically. It turned out that Vicary had invented the entire thing to get more clients for his advertising agency. Many scientists believe that subliminal advertising does have a clear effect. However, none of the many studies into this have convincingly demonstrated that the technique works.

- you persuade people to use technology that benefits both them and society?

Let go of the wheel

Sometimes driving in a more energy efficient and safe manner means leaving part of the steering to the vehicle. One example is an energy-saving braking system fitted to some new lorries. The energy normally lost during braking is stored via a dynamo in a battery for later use. Research leader Anthonie Meijers, Professor of Philosophy and Ethics in Technology: 'You could say to a driver: "Brake making optimal use of the system," as then you can realise a considerable saving on fuel costs.' For lorries this means making the braking distance as long as possible, as then you break more on the engine and less with the brake pedal. Meijers: 'But braking perfectly is still very difficult, so the automatic braking system is very handy. That requires the driver to let go, which is easier said than done. The vehicle in front of you looms unpleasantly close, then you really do need to be convinced that you will stop on time.'

Win trust!

How does a technical gadget win a driver's trust? To answer that question you first of all need to know what trust is based on. According to associate professor of psychology and technology Jaap Ham there are two influential factors. 'Trust is often based on experience. Yesterday the system worked fine and so it will do the same again today.' Trust also has a social aspect. If somebody you respect says the system can be trusted then you also trust it. It could be a friend or an expert, but equally a brand. Ham: 'It is an Audi, therefore I dare to get into it, that idea.' To win trust you must capitalise on feelings.

Remotely setting the temperature at home. Does that lead to more energy efficient behaviour?

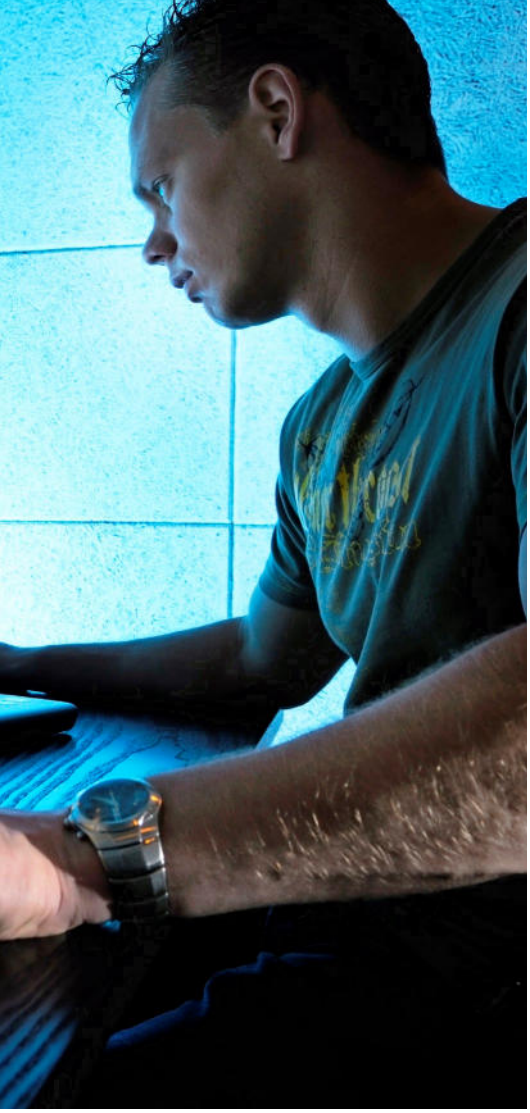
How do people behave if a robot gives feedback? That is investigated using an 'iCat'. This robot shows 13 different facial expressions by moving its head, mouth, eyebrows and eyelids.

Compliments help

There are many ways to influence people. Ham: 'Most people like to be rewarded if they do something well. How? We are investigating that now.' In one of the studies, volunteers are being asked to adjust the thermostat programme at home according to different scenarios. For example: grandma comes to stay. She feels the cold easily and so she would like to have the guest room at 25 °C. 'Next we gave the users feedback during the programming about how much energy they would use with the settings they had chosen,' says Ham. For some users we did that with a lamp. In the case of a more energy efficient setting, for example, ignoring grandma's wishes, the lamp was green. If a lot of energy was consumed, the lamp gave a red light. Other users were given feedback by showing them the number of cubic meters of gas they would use.' The research revealed that people who were given feedback with the lamp programmed the thermostat in a energy efficient manner. So should we standardly fit dashboards in cars with energy efficiency lights? Ham: 'Yes, it helps to give feedback during the action. There are other approaches that work better than a coloured light. Another study revealed that people are most sensitive to feedback with a certain social character. If the volunteers received positive comments from a robot they were far more inclined to do things as well as possible. Ham: 'This is probably because people feel they are being watched. Even if that is by a very lifeless robot.'

Feedback is fun

A little robot on your dashboard that continuously praises you for good driving behaviour. Some drivers would throw such a lifeless thing out of the window in no time. Ham: 'We are trying to find out more about persuasive profiling. Can we categorise groups of people? Because not everybody is sensitive to the same things.' Different



‘Count on it: everybody can be influenced’

car experiments give positive feedback when you drive energy efficiently. For example, drivers of the electric Opel Ampera can continuously examine stacks of data about their energy consumption. If you drive a hybrid Hyundai, however, the feedback is more playful: Energy efficient driving causes flowers and plants to grow on the dashboard screen. Which system works better, Opel or Hyundai, and for who? The scientists do not know yet. Ham: ‘We are looking for the most effective ways to influence people’s behaviour. Count on it: everybody can be influenced.’

Where does the boundary lie?

With technology experts (mechanical engineers) and human behaviour experts (psychologists), collaborating closely in this project is logical. Yet why is the Department of Philosophy involved? Andreas Spahn, assistant professor of philosophy and ethics, explains: ‘When is influencing still ethically acceptable? On one hand, certain approaches are highly effective, but transgress the generally applicable standards and values. Our task is to investigate where the boundaries lie.’ For example: along a stretch of road the government would like people to drive at 30 kilometres per hour. What options can be used to realise that? Placing a sign on the side of the road with the maximum speed is ethically very acceptable, but not particularly effective. One popular method now is a sign that states your speed followed by a smiley figure if you are not driving too fast. Psychologist Ham: ‘Rewarding works and people feel they are being watched. Why not project people who drive too fast onto a large screen?’ Philosopher Spahn: ‘Then I think you are crossing an ethical boundary. Is somebody who drives too fast harming themselves or others? That is important. For example, far more is permitted when you are trying to prevent drink driving than in a seatbelt campaign.’

Influencing better

Once all of the studies and descriptions have been completed, the team will publish a list of application-oriented recommendations. Parties such as the government can use that to make, for example, road safety campaigns more effective. The team, however, is not limiting itself to the behaviour of drivers. Meijers: ‘The most important outcome of the project is the widely applicable principles. How do you ensure that ill people, for example, take their medicines when needed? Or that people are more aware of the energy they waste at home? During this project we want to gather fundamental knowledge.’ So a better environment starts with you, once you have been influenced by Eindhoven University of Technology. ■

The more energy efficiently you drive the faster the plants grow on the dashboard screen of the hybrid Hyundai Sonata.

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! MEER INFORMATIE

www.nwo.nl/mvi: more about research into the ethical issues of technical innovations.

I have a relapse

Imagine you buy a car that is 50% more energy efficient than your last one. Then your fuel costs are also 50% less, or not? Unfortunately people tend to ride less energy efficiently with a more energy efficient car. For example, they use the car for short journeys instead of cycling like before. This ‘rebound effect’ means that energy-saving technology never gives the maximum saving possible. The English Energy Research Centre discovered, for example, that families with energy-saving lamps leave these on more than people with less energy efficient traditional light bulbs. Why people do that is not clear yet. It could be compensation behaviour. By doing something ‘good’ we may compensate for that elsewhere. For example: a family saves a lot on its energy bill by using energy more efficiently and so they have enough money to fly to a faraway holiday destination. However, such a long distance flight can completely undo their entire year of environmental friendliness.

How does artificial light confuse nature?

Green light

How does artificial light affect plants and animals? To find out researchers have placed streetlamps in nature reserves. These colour the flora and fauna between sunset and sunrise.

TEXT: RIK KUIPER / PHOTOS: MARCEL VAN DEN BERGH

Bird-friendly drilling platform

When flying over the sea, migratory birds orientate using the sun and moon. That can be difficult when it is cloudy, for example. Light from drilling and production platforms can also cause the birds to stray. Each year, this affects several million of the 50 million or so migratory birds that cross the North Sea. During bad weather, thousands of birds can circle around such an artificial island, increasing the chance of collisions. On the beach of Ameland the owner of the platforms, the Nederlandse Aardolie Maatschappij (NAM), investigated whether the light colour makes a difference. It did. With green light, birds flying overhead strayed less off course than was the case for red or white light. So the NAM decided to make one of the production platforms more bird friendly. The lights on platform L15, about 20 kilometres north-west of Vlieland, were made green in 2007. Another platform followed later. Now the experiment has been called off, says George Wintermans of NAM. 'Because after 15 years of international consultations it was decided that helicopter decks must be lit in green. So the deck on our green platforms was no longer clearly visible. When pilots refused to land on the green islands, NAM decided to revert to the old light colour. People's safety takes precedence.' What about the birds? 'Now we are looking to minimise the lighting on platforms at night, especially on the unmanned platforms. That is difficult, however, as many platforms do not have a light switch. A light switch gives off sparks and that is far from handy with so much gas nearby.'

The streetlamps were placed in the winter when the ground was frozen. 'So the lorries caused little damage to the natural habitat,' says researcher Kamiel Spoelstra.

It is almost dusk as Kamiel Spoelstra drives his car over a bumpy sand track. He avoids potholes and puddles, passes a remote farm and points to two red deer that swiftly disappear between the trees. Soon afterwards he parks on the verge, gets out and pulls on his boots. Here, at a secret location in the middle of the Veluwe, the biologist has placed four dead straight rows of five streetlamps. Just after 8.30 in the evening the lights switch on. A green glow falls over the grass, shrubs and bushes. Street lights without a street casts a surreal image.

One row is dark

The streetlamps are part of 'Light on Nature', a scientific research programme from Technology Foundation STW. It is a unique project, says Spoelstra, with some pride. Nowhere else in the world are researchers carrying out such a large experiment into the effect of artificial light on nature. Rather than one or two lamps, the scientists from the Netherlands Institute of Ecology and Wageningen University control several rows of streetlamps at eight different nature reserves in the Netherlands. All locations fully satisfy three requirements: many different plants and animals are found there, hardly any other artificial light is present and there is electricity nearby. 'At first we wanted to generate the energy using solar panels, but that proved to be unfeasible.'

At each location Spoelstra and his colleague Roy van Grunsven received permission to set up a row of green, a row of white and a row of red lights perpendicular to the edge of the wood. There are always two streetlamps in the wood, one on the edge of the wood and two in the field, at a distance of 25 m from each other. To complete the scientific set-up, there is always a row of streetlamps without light. Spoelstra: 'Imagine that owls like to sit on the top of these looking for mice. Then there will be fewer mice around the streetlamps. That has nothing to do

For three years each blade of grass is monitored

'When the lights were switched on for the first time I took photos throughout the night,' says Kamiel Spoelstra.

with the light, however, and we need to take such things into account.'

For three years, biologists will monitor how the flora and fauna respond to the light at all eight locations. That is a considerable task. For example, plant researchers from the Floron foundation mapped the vegetation for several square metres around the streetlamps before the experiment started. They noted how many bilberry bushes there were, as well as how many blades of each grass species. At the end of the experiment, they will do that again to see what has changed under the influence of light. Then they can compare, for example, if grasses grow better under red light than under white, and whether that is also the case at the other research locations.

Camera counts mice

For the animals, Spoelstra and his colleagues have taken different measures. The biologist points to a fir tree in between the green streetlamps. Hanging on the trunk, several metres above the ground, are three wooden bat boxes. Once in a while somebody from the Dutch mammal society comes to see if they are occupied, says Spoelstra. In between the boxes is a listening box that registers the ultrasonic sounds of passing bats. This allows the scientists to count how many bats fly over. In many cases they can also work out which species are present, as each species makes a different sound. The Dutch mammal society will also monitor other mammals in the lit areas. For example, a volunteer will place a camera trap several times a year next to each row of streetlamps. This is a photo camera focused on a paving stone that has been placed in the woods for the experiment. For several days a movement detector will register when a mouse, badger or a marten stands on the paving stone, after which the camera will take a photo. It gives an indication of how many small mammals are in the area. Ten times per year butterfly traps will be placed. A beetle researcher will occasionally place traps and bird researchers will monitor the bird boxes. The locations are heavily visited says Spoelstra. 'On average somebody visits a location about once every two weeks.'

What does colour do?

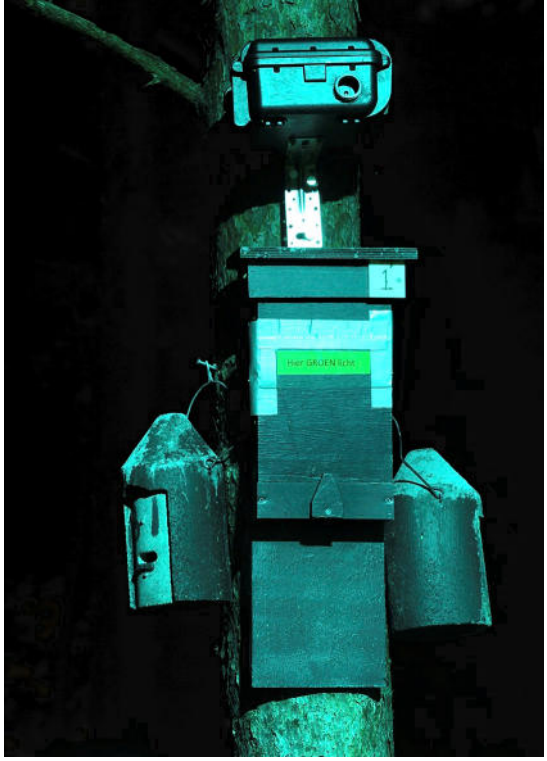
Nobody doubts that light influences nature. Examples are the cockerel that immediately starts to crow after sunrise, the bee that navigates using the sun and the hedgehog that concludes from the shortening days that it is time to hibernate. Artificial light can confuse such natural behaviour, even if the reason for this is not always clear. In many cases we do not know whether the light colour has an influence. Do birds lay more eggs under a red light? Do more moths disappear under white light? Do mice behave differently under a green light?

We walk further along the edge of the wood through the high grass that according to Spoelstra is teeming with ticks. We pass the second row of streetlamps, which spread white light and walk further to the row with red light. Several bats are circling there. They are not circling here by chance, suspects Spoelstra, and scarcely in the vicinity of the green or white light. 'Bats like the dark,' he says. 'And because they can observe red light less well they prefer to fly here rather than at the other streetlamps.'

Yet the question remains whether this effect will be demonstrated by the measurement data later on, says the researcher. Because how artificial light confuses nature, is quite unpredictable. If one part of the food chain is disrupted, a new equilibrium must be found. For example, if a certain plant cannot tolerate red light then the flies that like to eat the plant must also relocate sooner or later. And the bird that likes those flies will also have to search his meal elsewhere. 'Perhaps these bats will soon search further up,'

Colourful cubes

Eighty colourful light cubes are neatly arranged on a field in Wageningen. This looks like a work of art, but in fact it is science. The experiment, which runs until 2014, is part of the project Light on Nature. The cubes are made of netting and are lit with white, green or red lamps. A few cubes have no light. The cubes contain caterpillars, from which moths emerge. They feed on grasses and herbs that grow in the cubes. Ecologist Koert van Geffen from Wageningen University wants to find how the artificial light influences the animals' eating and mating behaviour. Once each year he counts the number of moths per cage. He also mows and weighs the crops in the cages to assess whether these grow better if the number of caterpillars and moths decreases.



says Spoelstra. ‘The moths they like to eat prefer green light.’ Our conclusion might be that the bats live near the red light, but mainly hunt near the green streetlamps.’

Light goes out

After three years of research, the streetlamps will disappear from the nature reserves at the end of 2014. By then Spoelstra hopes to have enough data to conclude what red, green and white light do to nature. Besides fundamental knowledge, the enormous experiment will also yield practical knowledge. The researchers hope they can limit, for example, the harmful effects of artificial light at night.

‘Imagine that a cycle path through the woods needs to be lit to make it safe for cyclists,’ says Spoelstra. ‘First we will analyse which species live near the cycle path. If a rare or important species is found that cannot tolerate green light well, then we will place streetlamps with red light.’ But we are not so far yet. We first of all need to complete the measurements at these locations.

Towards eleven o’clock Spoelstra takes his keys. He checks his boots for ticks and brushes off his trousers. While the bats go in search of moths, he returns to his car. The headlamps briefly light up the bumpy sand road. ■

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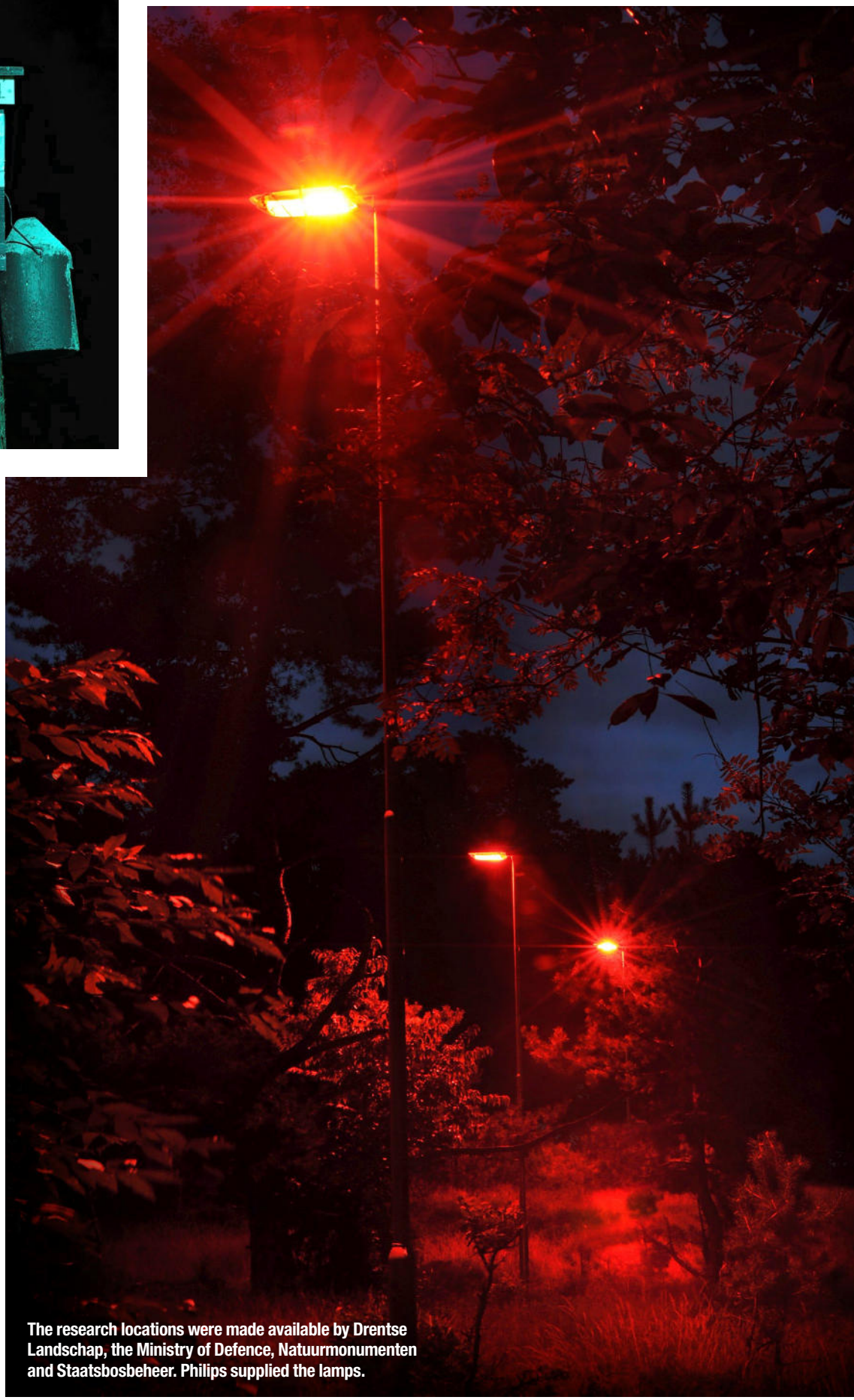
! FURTHER INFORMATION

www.lichtopnatuur.org: website of the ‘Light on Nature’ project.
www.nioo.knaw.nl: website of the Netherlands Institute of Ecology, where Kamiel Spoelstra works.



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Experiment NL, September 2013

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ANDRÉ MISCHKE (40), Physicist at Utrecht University received a Vidi in 2008.

Small Big Bang

Talented scientists with an innovative research plan can obtain funding from NWO. For researchers who have recently gained their PhD there is the Veni grant worth a maximum of 250,000 euros and for more experienced scientists there is the Vidi grant worth 800,000 euros. The Vici, worth 1.5 million euros, is for senior scientists.

Why exactly were you chosen?

'I do research at CERN's particle accelerator in Switzerland. I have been involved with that since the start of my career. Doing research with particles at such high energies is fantastic. At CERN we can temporarily make heavy quarks. These particles do not exist on earth, but are assumed to have existed for just a few milliseconds after the Big Bang. We have models about the Big Bang, and the early evolution of the universe that must be tested, so I am doing research into the characteristics of heavy quarks.'

What are you using the money for?

'Now the particle accelerator has been up and running for three years, we know more about the quark soup after the Big Bang. Our research has revealed that it must have been very dense matter in the form of a friction-less liquid, a so-called perfect liquid. These are important data for cosmol-ogists, as they can use it to adapt their model of the Big Bang so that we understand more about the universe.'

'This is of course fundamental research for which no immediate application is apparent. New technologies are also developed at CERN. For example, new techniques and better computers are needed to search the enormous quantity of data we have. The accelerator has a diameter of 27 km and operates at -271 degrees Celsius. This makes it the largest refrigerator on earth, and this is interesting technology for industry.'

How did you end up in this line of work?

'I started in 1997 during my Masters degree at the predecessor of the current particle accelerator at CERN. Since then I have always been involved with the newest accelerator, which is a real thrill. I still remember having to wait for six months after we had all of the data before we could obtain the results. Now the technology is so advanced that we have the results within a few hours. Computers have become far faster and that is largely thanks to the work we do. It is exciting that we partly determine the quality and possibilities of equipment, as physicists continually want equipment that does not exist. Of course, there are occasions when technologists say 'We cannot deliver what you want.' Then we have to search for a different solution.'

What would you still like to investigate?

'We can now simulate the conditions of the quark soup. We make a little bang that, just like in the real primordial soup, requires a temperature more than 100,000 times that of the sun's core. It is fascinating that the universe contains stars, so-called neutron stars, which possibly have a core in which this quark soup is present. It ought to be possible to do measurements on that. I have no idea about how that could be done, but I would like to come up with an interesting solution to this. It sounds a bit like Star Wars, but 20 years ago we could not have imagined that we would have such a powerful particle accelerator as now.' ■

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There are coloured streetlamps at secret locations.

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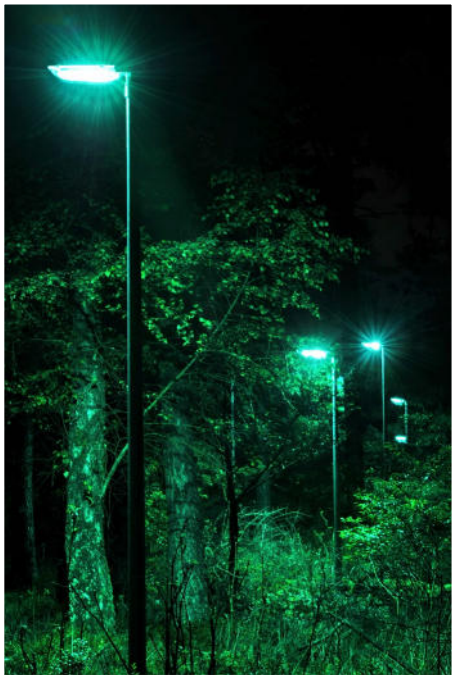

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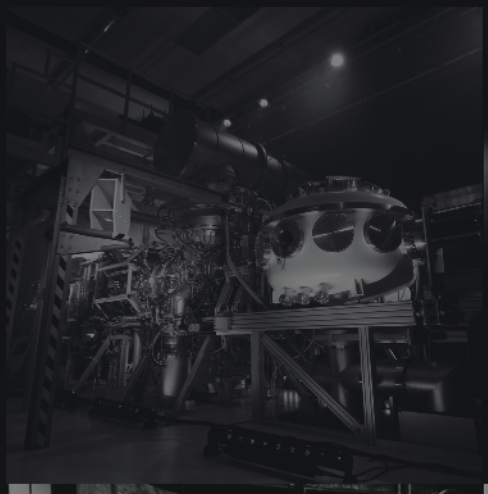

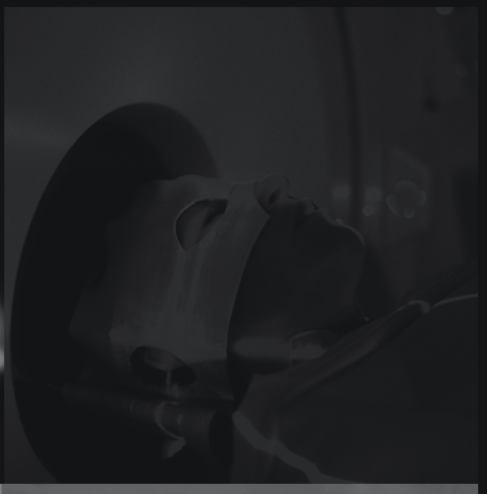

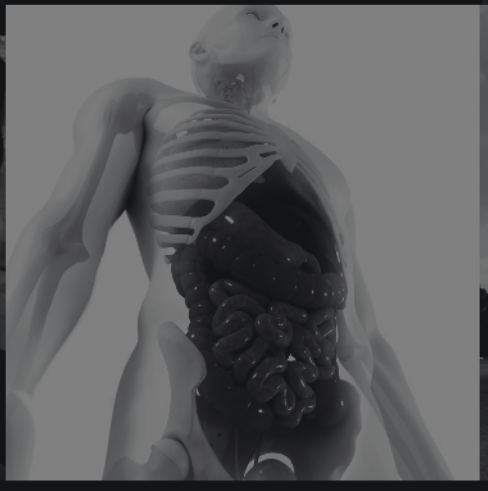

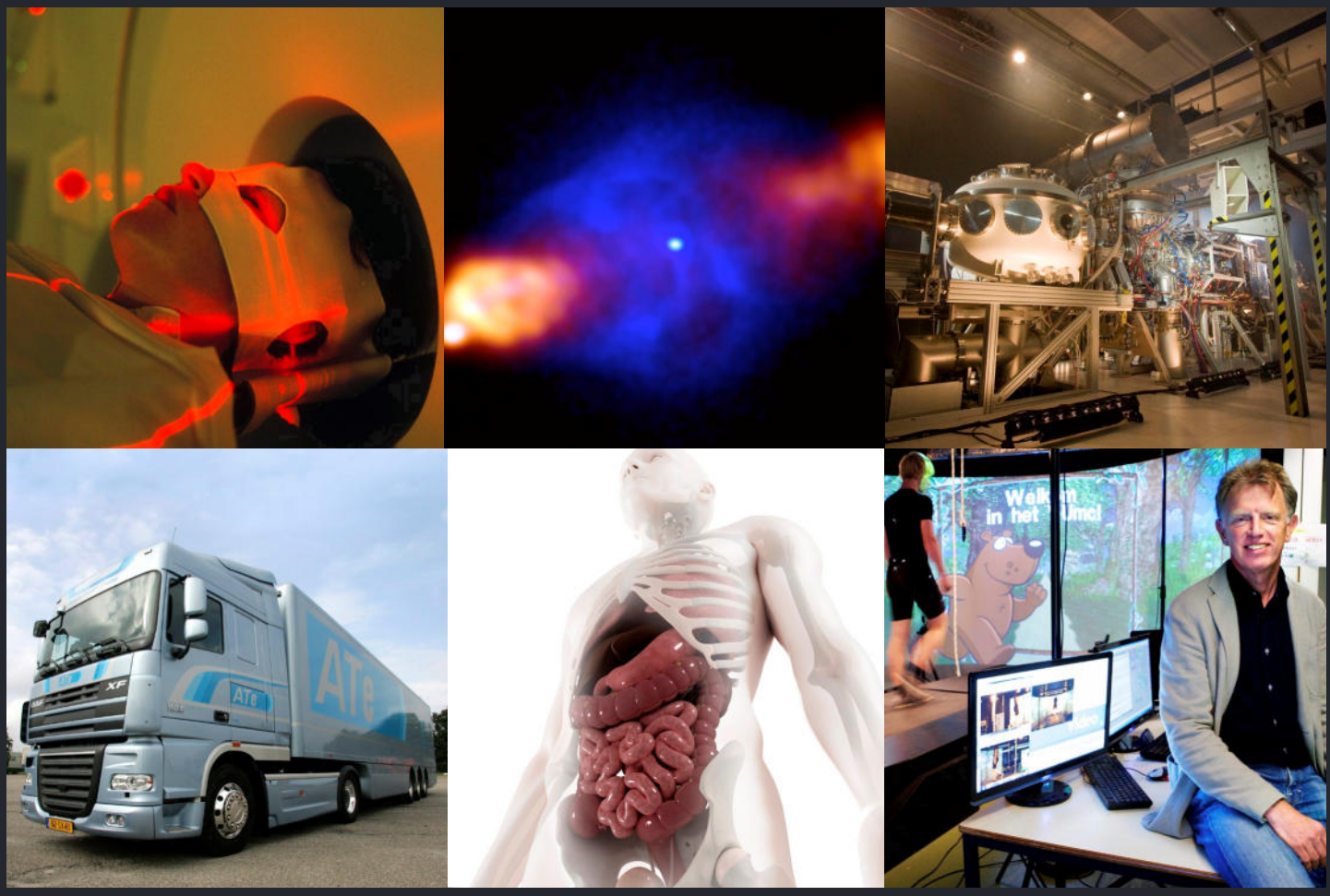

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