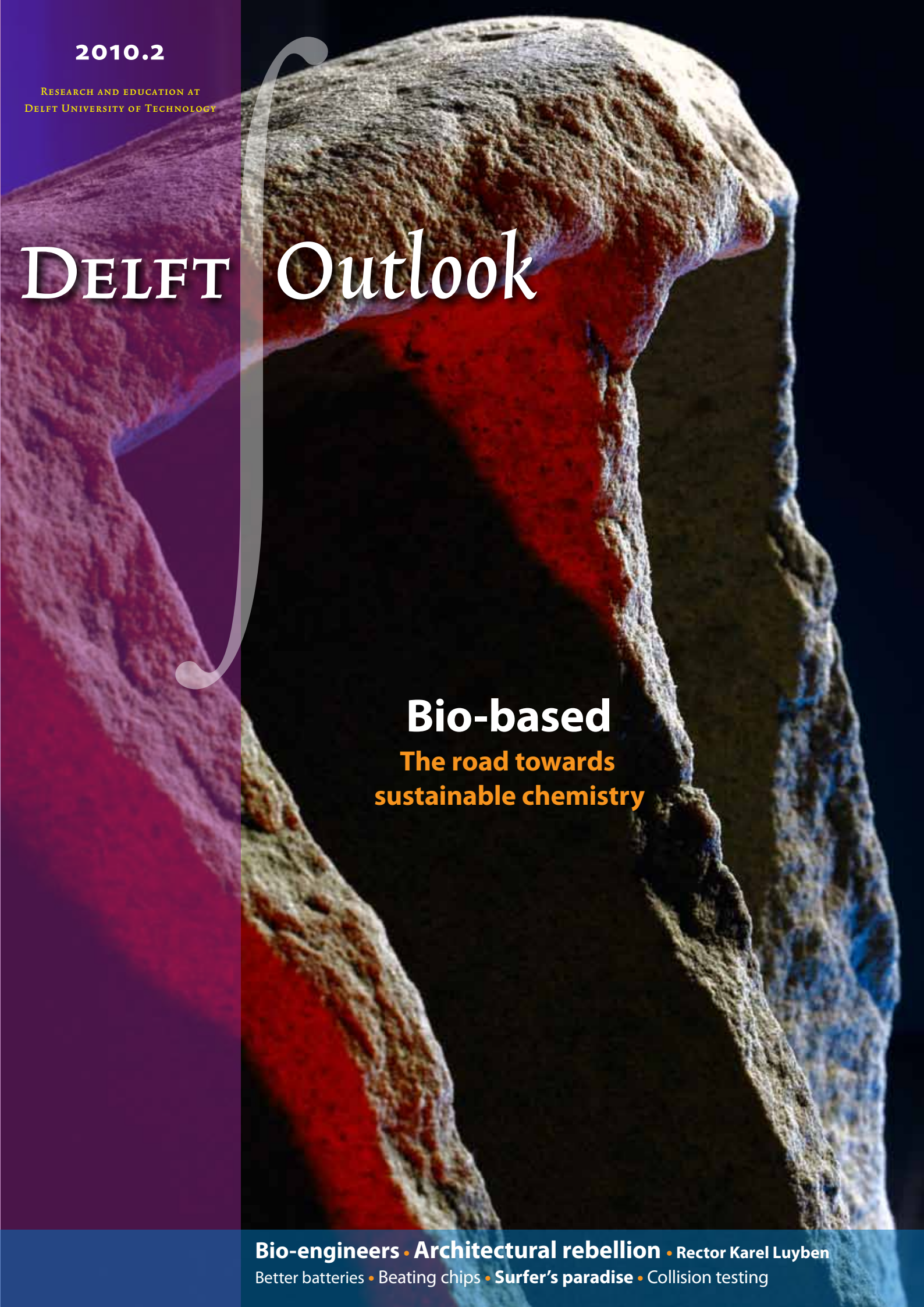
2010.2

Research and education at
Delft University of Technology

Delft Outlook



Bio-based

The road towards sustainable chemistry

Bio-engineers • **Architectural rebellion** • **Rector Karel Luyben**
Better batteries • Beating chips • **Surfer's paradise** • Collision testing

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2010.2

In this edition of DO

Delft Outlook

[Edit] DI

TU Delft 'reassesses'. What budgets can be cut, and where exactly should new investments be made? A task that Rector Karel Luyben seemingly knows how to handle: "I'm good at being selective, and that is a plus point if your aim is to optimise the university." There is certainly no lack of ambition, and that applies to TU Delft's researchers as well. Over the next five years, Professor Luuk van der Wielen will have 120 million euro to spend on the BE-Basic research program. He will use these funds to ensure that 30 percent of the chemical industry's production comes from renewable, biological raw materials. Professor Cees Dekker's ambitions are not visible to the naked eye, since they lie on the nanoscale. As the head of the university's new bionanoscience department, he is striving "to attain a leading position at the convergence of nanophysics and molecular biology". The cell is his laboratory. Architects and civil engineers meanwhile have a much larger laboratory: Delft's railway zone. The elevated tracks will be replaced by a railway tunnel. Delft is changing, and the university leads, with ambition as a compass.

Frank Nuijens
Editor-in-chief, Delft Outlook

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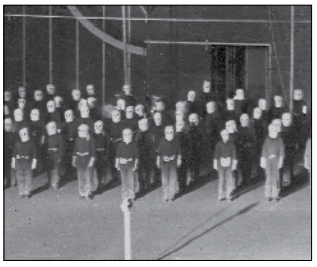

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COLOPHON

cover photo
Sam Rentmeester/FMAX

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Better batteries

Lithium-ion batteries are set to improve. Dr Wouter Borghols, recently awarded his PhD in Applied Sciences, has developed batteries that deliver greater capacity, are capable of storing more energy for the same weight, and charge more quickly. These kinds of batteries are needed for electric cars and scooters. Borghols succeeded in doubling the storage and increasing the speed of charging and discharging by 50 to 100 times, which is necessary for serious acceleration.
He switched from micro to nano particles in the batteries, a move which led to unexpected side-effects. There is still insufficient understanding of the processes in the battery on the crystal surfaces between titanium, lithium and oxygen. However, what did emerge is that amorphous nanostructures of titanium dioxide far outperform other crystal forms in terms of storage capacity and charging and discharging speeds. This is good news, because these materials are cheap and can be manufactured quickly.

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Photo: Sam Rentmeester/FMAX

Surfer's paradise


Photo: internet

The annual depositing of sand on the Dutch coast around the town of Scheveningen, intended to combat dune erosion, created excellent conditions for surfing this spring. Hydraulic engineer and TU Delft alumnus Erik van Ettinger, who now works for the company SurfReefs, and PhD students Sierd de Vries, Matthieu de Schipper and Martijn Henriques (Civil Engineering and Geosciences), were commissioned by the local municipality to calculate where sand should be deposited in order to create an artificial reef. "It works incredibly well," says De Vries, himself a keen surfer. "Normally, you're lucky to stay standing on the board for ten seconds. Now we can surf for 24 seconds at a time." The bad news is that the reef is only temporary, as the sand will gradually be washed away.

More information:
www.surfreefs.nl

Dry run with Waterspot

Delft PhD students have spent ten years working on a simulator programme (Waterspot) for water purification companies which has now been adopted by a consortium of water purification companies. The name Waterspot stands for 'simulator for proactive operation and training'. It is used in two different ways: to provide better and quicker training for operators and to optimise the purification process. Working with the simulator also helps people develop a better feel for the purification plant, according to Professor Luuk Rietveld (Civil Engineering and Geosciences). A water purification plant generates drinking water by applying processes such as aeration, filtration, coagulation (flocculation), the ozone process (for disinfection), water softening and passage through active carbon filters. The simulation programme involves the mathematical modelling of these processes.

More information:
www.waterspot.nl

Dim the lights

According to Chinan Shah (TPM), saving energy need not be too great a challenge. His plan for intelligent street-lighting won his team first prize (2500) in the Energy Challenge, a design and ideas competition for students and PhD candidates.
Together with Haibo Zhou (TPM) and Vijay Rajaraman, Shah developed an intelligent dimmer system for public lighting. The prototype, which is twice the size of a mobile phone and can be mounted in any fitting, is almost complete. Shah and his team are launching a pilot on dimmable outdoor lighting on campus.

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Photo: Sam Rentmeester/fmax

Sharper

Using new free software, partly developed by TU Delft, and a rapid graphic chart, medical researchers can display images of cell structures that are up to ten times sharper.
The software was developed by Dr Bernd Rieger (Applied Sciences) in collaboration with colleagues from the University of New Mexico. The procedure, described in the April edition of Nature Methods, improves the resolution of optical fluorescence microscopy possible in practice from between 200 and 300 nm to 20 to 30 nm. However, there is one limitation: the cell needs to be frozen or chemically fixed for the image to be generated. Because of the time it takes to create the image, the technique is not suitable for use on living materials.

Bumping

How do people react when they almost bump into each other? Dirk Versluis investigated this for his graduation research in the transport and planning department of the faculty of Civil Engineering and Geosciences. He positioned a series of test subjects, put the lights on green and filmed what happened. From his 1500 observations, it emerged that men are more likely to move out of the way than women, people prefer to stay to the right and people in a hurry move out of the way more often than normal pedestrians. These kinds of microscopic interactions could prove important for the design of busy pedestrian areas.

Photo: Sam Rentmeester/fmax


Photo: Bert Vermeersen

On Darwin's trail

This spring saw geophysicist and planet scientist Dr Bert Vermeersen (Aerospace Engineering) sailing in the clipper Stad Amsterdam for a TV programme recreating Darwin's voyage in the Beagle. Between Perth (Australia) and Mauritius he used GPS equipment to study the absolute position of the ocean surface, the equipotential surface.
"The surface of the ocean is not a perfect ellipsoid," Vermeersen explains. "The sea has mountains and valleys caused by local differences in gravity. In the Indian Ocean, these differences in height can reach as much as a hundred metres." Before setting out, Vermeersen had high expectations in terms of science. "We aim to measure the differences in height with an accuracy of 10 cm," he told Delta. This proved unsuccessful as a result of the impact of waves and ocean currents and because the ship simply moved too much. "But if we position GPS equipment on more stable vessels, we will probably be able to gather some very interesting data."

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Jokulhlaup

The eruption of the Icelandic volcano Eyjafjallajökull could continue for quite some time, says Dr Andy Hooper of the earth observation department (Aerospace Engineering). Since 2006, Hooper has been using space-based radar to study earth deformations in the area surrounding the volcano. Since the eruption, the surface of the volcano has hardly sunk at all. According to Hooper, this suggests that magma is being carried upwards from great depths, rather than from a magma chamber, a relatively shallow reservoir in which magma has accumulated. Hooper warns of even more dramatic consequences if Eyjafjallajökull sets off a further eruption of the nearby Katla volcano. This would not only cause problems for aviation. The inhabitants of the island could then face a 'jokulhlaup', floods caused by meltwater from the glacier on the volcano.

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Safer swashbuckling

Safe sword fighting is possible, according to Maarten Kamphuis, who recently graduated as an industrial designer and has set up his own sword manufacturing company: Mblades. The swordfighter created a sword that causes significantly fewer broken bones. "You are almost always struck by the outermost 40 cm of the sword. One way of ensuring the design is safe is to make the end of the sword out of rubber. I also decided to enable the blade to retract 10 cm into the handle during a strike. This prevents whiplash if you're struck on the head."

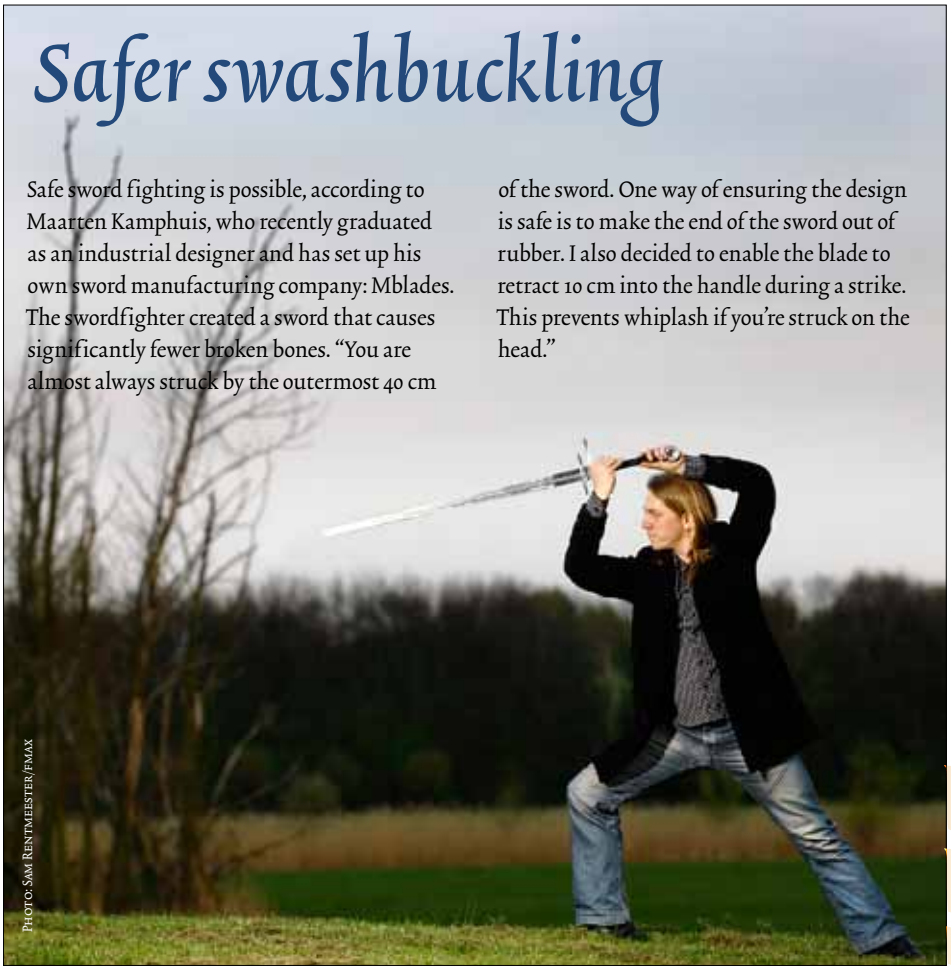

Photo: Sam Rentmeester/FMax

Twitter your dream house

Photo: Isabel Driessen

For their graduation project, eleven Bachelor's students spent eavesdropping on other people's lives. They monitored eleven Twitter fanatics, analysed their lifestyle based on their tweets and designed customised homes for them. The project has culminated in a book, Twitterhouse. One house is for actress Victoria Koblenko. "Based on her tweets about her job and her eating and sleeping patterns, I guessed it was important to her to keep her public and private life separate," explains student Isabel Driessen. "That's why I opted for a house that's like a kind of snail shell. The further you venture into the house, the more you enter the private domain." The students received support from the architects' firm XML studio, set up by TU Delft architecture graduates Max Cohen de Lara and David Mulder. They have discovered that technological developments like Twitter can have an impact on life and public space and therefore also on architecture.

More information:
www.x-m-l.org

Anammox

In a recent paper published in *Science*, researchers from TU Delft and Radboud University Nijmegen demonstrate how sewage water purification can generate energy through the use of anammox bacteria. According to biotechnologist, Professor Mark van Loosdrecht (Applied Sciences), with this new technology, they can produce energy instead of using it. Nationally, that would make a difference of around 50 MW in power generated, or just under 10% of that generated by the average coal-fired power plant.
In May, the Dokhaven sewage water purification plant in Rotterdam launched a pilot programme with anammox technology.

Beating chips

The bizarre combination of silicon chips and the beating cells of the heart promises to be a highly useful application for testing the side-effects of medicines. This chip is being developed at Dimes by technological start-up company Pluriomics, an initiative of the LUMC with Professor Ronald Dekker (Electrical Engineering, Mathematics and Computer Science), who is responsible for the design. "It works in principle," Dekker says, "but the selection and cultivation of the right heart cells is crucially important." This is the responsibility of Braam of LUMC. The next type of chip will need to have a flexible basis, enabling it to be moved by air pressure, so that the chip can beat at the same time as the heart cells.

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A better world: action not words!

Chemicals, materials and fuels made from biological raw materials.

It is time to stop just thinking about the ideal world. We must take action to make it a reality,

believes Professor Luuk van der Wielen.

MAAIKE MULLER

"This pen is made from maize sugar." Luuk van der Wielen, professor of bioseparation technology at the faculty of Applied Sciences, holds up a green ballpoint pen. It seems a perfectly ordinary pen. It bears the legend 'B-Basic', the name of the research programme of which Van der Wielen is director and TU Delft coordinator. "This one is made from the edible part of the maize plant," the professor explains. "Hopefully the next version will be made from the non-edible part."

That next pen will bear an extra 'e'. In late May, the conclusion of the B-Basic (Bio-Based Sustainable Industrial Chemistry) research programme was marked by the publication of a coffee table book and a symposium. The consortium of universities and private sector companies which is working to make the chemicals industry more sustainable will now continue as 'BE-Basic'. The 'e' refers to the ecogenomics consortium that has joined the programme and will contribute knowledge about DNA technologies that can be used to analyse the environment. (See the insert 'Lighting up contaminants'.)

The overall aim of the programme remains unchanged: the chemicals industry, which is heavily reliant on oil and other rapidly dwindling resources, must increase production from renewable, biological raw materials. "To avoid a serious problem, thirty per cent of chemicals production must be 'bio-based' within the next twenty years," Van der Wielen estimates. Academic knowledge must therefore be well matched to the demand of the companies themselves. "Over half of the partners involved in BE-Basic are from industry," says Van der Wielen. "We must all understand what is important and what isn't."

That the approach works is demonstrated by the successes of the programme's forerunner, B-Basic, launched in 2004. DSM has been able to switch from chemical to biological processes in manufacturing certain antibiotics.

PHOTO: SAM RENTMEESTER/FMAX

Luuk van der Wielen: "Much innovation relies on new starter companies"

The bacteria can make the soil as hard as concrete within days

Purac now makes plastics from sugar and starch. Deltares, the independent research institute for water, soil and subsurface issues, will soon be using the very first 'bio-sandstone' (see insert: 'Bacteria with a healthy appetite'). No matter how important these companies are, innovation calls for the input of new companies, Van der Wielen believes: "Existing organisations devote only a small proportion of their financial resources to high-risk innovation projects. Much innovation relies on new starter companies." He sees encouraging the creation of such ▸▸

Wouter van der Star (Deltares) samples bio-sandstone.

Bacteria with a healthy appetite

Sand, bacteria and a fluid rich in calcium: these are the ingredients of the bio-sandstone that Dr Wouter van der Star, researcher with Deltares, shows us. The material will soon be used for the first time to reinforce subsoil, allowing tunnels to be bored more easily or to strengthen railway foundations and dikes. If necessary, Van der Star's bacteria can make the soil as hard as concrete within days. The strain of bacteria in his mix is *Sporosarcina pasteurii*. This strain occurs naturally in soil, but high concentrations are needed for any significant hardening. Van der Star continuously rinses the bacteria with a calcium-rich solution for several days. The bacteria then produce calcite, which 'glues' the grains of sand together.

"The hard part is to ensure that the sandstone is of an even strength throughout," says Van der Star. "And to dose that strength." Contractors are now able to use the substance in practice. Van der Star is already developing a new type of bio-sandstone, since although the first version is extremely strong it does have certain drawbacks. One such drawback is an unwanted by-product of the production process: ammonium chloride, which encourages algae growth. Van der Star is now working in the laboratory on a new method which solves this problem.

"Another advantage of the new method is that the bacteria will multiply by themselves, since we will have introduced nutrients into the soil," he says. This means we don't have to culture them first, which will save money." The sandstone formed by this process is not as strong, but is quite strong enough for some applications, he believes. Dr Van der Star is now conducting experiments designed to ensure that the material is of constant strength throughout. To do so, he has built a larger set-up which uses 120 kilos of sand. He was able to fund the new equipment with the 100,000 euros he received as part of the Leo Petrus Award, of which he was joint winner in 2008. The other winner of this incentive prize offered by B-Basic was fellow TU Delft researcher Leon van Paassen, who is researching whether waste products from the food and fertiliser industries can be used as nutrients for the bacteria.

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www.smartsoils.nl

companies as one of his most important tasks, but also one of the most difficult. "Our young researchers must be made aware of the commercial value of their knowledge," he says. "We have the annual Leo Petrus Award, whereby the person with the best business plan is given 100,000 euros to put it into practice."

Over the next five years, Van der Wielen has a budget of 120 million euros at his disposal. "That is a lot of money," he says, "but nevertheless we have far more ideas than we can actually afford to fund." One of the main points for attention is the transition to bio-based production using plant waste. Van der Wielen: "It's important to establish a link between industry and food production. If we can later make plastic from the non-edible parts of maize and other food crops, that will be a very good thing. Waste will then have its own value, which is good for the grower. And if we can also use the edible parts in times of surplus, that will be even better."

Within the B-Basic programme, researchers produced biomaterials from plant waste in the laboratory. In BE-Basic, the experiments are to be upscaled. The researchers and partner companies intend to use the test facility which DSM built to develop the processes used in the production of penicillin. The plan is that the plant should be transformed into a 'bioprocess pilot facility' for all BE-Basic partners. "A factory producing plastic can easily cost a quarter of a billion euros to build," explains Van der Wielen. "The pilot facility will enable us to test the processes on a larger scale than we have been able to so far. That is important if we are to identify any problems which were not apparent in the lab."

Van der Wielen believes the close cooperation between private sector companies and research institutes, the encouragement of start-up companies, and experiments at the pilot facility will help the bio-based industry to make rapid progress. And he says the companies themselves are eager to do so: "Not just to improve the world, but also to ensure an adequate supply of production resources in future."

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www.be-basic.org, www.b-basic.nl, www.lpit.nl

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Lighting up contaminants

To ensure that the materials, chemicals or fuels produced from natural resources are of constant quality requires ongoing vigilance. "The green raw materials that go into a reactor are always of varying composition," explains Professor Bram Brouwer. His company, BioDetection Systems, has developed luminescent (light-emitting) cells which allow the process in the reactor to be closely monitored. The cells can also detect contaminants which may stop the active bacteria in the reactor working as they should.

In the laboratory, Prof. Brouwer's colleague, Dr Harrie Besselink, shows us the cells under the microscope. At first sight, they seem to be perfectly ordinary cells on a Petri dish. But as soon as they detect a certain substance, they light up. "We've added a segment of DNA taken from the firefly," Besselink explains. "The cell then emits luciferase." Each cell also has a genetic 'switch' that turns on the light as soon as the cell comes into contact with dioxin, or with any of 15 other contaminants for which BioDetection Systems has developed specific detector cells.

"The nice thing is that the intensity of light is proportional to the quantity of dioxin present," says Prof. Brouwer. Once the test sample – which can be anything from a piece of pork to animal feed, a soil sample or matter from a reactor – has been prepared, it is introduced in solution to Brouwer's cells within a closed metal container. There, a special camera measures the light signals emitted and the data is transferred to a computer. Prof. Brouwer: "We then know the exact quantity of dioxin present. At first, we had to monitor for each substance separately but it is better to do so as an entire series," the professor continues. Dioxin, for example, is actually a generic term for hundreds of different chemical compounds. The cells can monitor for all types in one pass. "If you want to test for some materials, you must first take them out of a 'matrix'," Prof. Brouwer explains. "Heavy metals in the soil, for example. That takes a lot of time." The luminescent cells enable this step to be completed far more quickly. The cells can also be very useful after the production process to detect the presence of certain substances in the environment. "Even companies which produce biomaterials produce waste. It's nice if that waste can be used as the raw material for something else, although that isn't always possible," Prof. Brouwer adds. He believes that the transition from fossil fuels to a bio-based chemicals industry is good for the environment: "But you have to be able to prove it."

The luminescent cell is a genomics-based technology which, according to the professor, can be very useful to the BE-Basic programme. The director of the ecogenomics consortium which recently joined BE-Basic predicts that other partners will soon approach Prof. Brouwer in search of similar technologies. They may want to find precisely the right bacteria for their process, for example, or a method of countering the pollution they cause. "Industry creates pollution, the ecologist complains about it," Prof. Brouwer remarks. "That was always the status quo in the past. But it seems that we can also help each other."

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The luminescent cells can be useful in the BE-Basic-programme.

PHOTO: BIODETECTION SYSTEMS

Work on the railway

The railway zone is a marvellous 'test lab' for Delft researchers.

We look at the work underground and some of the projects,

from distinctive station designs to a study of the way the city 'breathes'.

Tomas van Dijk

The Markt, with the Stadhuis and the Nieuwe Kerk, is not the true heart of Delft, says Willemijn Wilms Floet, of the faculty of Architecture's building typology research group. "Geographically, the railway zone is the city centre. Once the railway line has been moved underground, this will be an extremely interesting district," she contends, "but only if it can be structured as a dynamic hub that increases the vitality of the city."

Wilms Floet has been studying the railway zone for eight years and supervises relevant Bachelor's and Master's projects. She has written several books about the district and knows its history inside out.

"For years, Delft has been pressing for the above-ground railway line, laid in 1968, to be relocated," she states. "It is a bottleneck which blocks the addition of a fourth overtaking track. The intercity trains cannot get up enough speed because of the bend or 'dogleg' in the route. Moreover, an above-ground railway line running through the city creates unacceptable noise and an unattractive area. A railway tunnel will solve all these problems."

Greater cohesion

The tunnel will also create greater spatial cohesion between the historic city centre and the more recent expansion areas. Westlandseweg, for example, the road which connects the city centre with Delft-Zuid (a district which most people currently regard as a suburb, says Wilms Floet) will be transformed into a tree-lined city boulevard. Phoenixstraat will also become a boulevard, with the Nieuwe Singelgracht canal, filled in since the late 1960s, largely restored.

Above the 2-kilometre railway tunnel will be a long, narrow park. There will also be space for 1,500 homes and 50,000 square metres of offices and shops. There will be very little construction immediately above the tunnel itself, however, because it would be too expensive to insure against collapse should there be a disaster.

Alongside the existing station is to be an imposing futuristic building, designed by Mecanoo architects, combining the new station and the local council offices. The area development plan has been produced by the Spanish urban planning specialist, Joan Busquets. "In terms of construction, the development plan remains quite flexible," says Wilms Floet, "although rules have been devised for the various blocks. There must be plenty of variety, just as in the existing city centre. And the blocks must all have semi-public courtyard gardens."

In the graduation phase of the Master's programme in hybrid building, students use Busquets' design as their starting point. It forms a framework against which they can assess their own design solutions. Recent graduate, Luuk Stoltenborg, thought that the area around the new station had been given too modest a role within Busquets' plan. "An almost invisible transport interchange," was his verdict. He therefore designed two separate buildings, one on each side of the existing station, with one entirely dedicated to the council offices. The open area between the three buildings would extend under part of the station itself. This is possible because his design for the new station is 'stacked' on several levels, with the platforms underground, below the station forecourt. Luuk has incorporated three further levels above that, with hotels, restaurants and conference facilities. Huge light-wells ensure that the lower levels enjoy adequate daylight.

The railway zone is currently a sort of no-go area

Stoltenborg's design won the 2007 Zuid-Holland Design Award, the incentive prize which acknowledges the best designs by students in the province of Zuid-Holland. In 2008, the competition focused on ideas for Delft's railway zone. The winner of the public award was Carien Akkermans, who treated the new station as a means of restoring an important historic element of the city. She suggested that the station exit should run through a sort of transparent plinth to emerge at the Bolwerk, which until the mid-nineteenth century was the site of Delft's main city gate. So there is no shortage of good ideas. "It's just a pity that the city authority doesn't always listen to us carefully enough," says Wilms Floet with a smile.

Dr Stefan van der Spek of the faculty of Architecture is also using the railway development zone as a gigantic laboratory. He wishes to study, "how the city centre ▸▸

Photo: Sam Rentmeester/fmax

Willemijn Wilms Floet: "It's just a pity that the city authority doesn't always listen to us."

FOCUS

functions today, and how it functions once the entire programme is complete." He sees pedestrians as the lifeblood of the city. By equipping dozens of volunteers with GPS receivers, he will map the routes they use most frequently. Van der Spek's experiment began in April. He intends repeating his observations every season during the construction process, continuing after its completion. "At present, the railway zone is a sort of no-go area," he says. I want to see how that changes."

Subsidence

If any of the houses in and around the railway zone begin to show small cracks in ten or twenty years' time, remote sensing expert, Professor Ramon Hanssen, of the faculty of Aerospace Engineering, will be able to determine whether this is due to the tunnelling work. Ever since 1992, his research group has been monitoring ground movements in Delft using data from radar satellites. "We analyse the land and the buildings on it from two positions in space," he explains. "For the past year, we have done so using data from the TerraSar-X satellite. We receive the data every four or five days: one measurement when the satellite travels from the South Pole to the North Pole, and hence over Delft, and one when it goes from the North Pole to the South Pole. [Due to the Earth's rotation, the satellite once again passes above Delft – ed.]. Until 2009, we relied on a satellite which passed over the city only once every 35 days." Each satellite photo covers an area of 30 kilometres by 60 and has 200 million pixels. A small group of students and PhD students analyse each and every pixel – using software, of course. They are looking for any deviations over and above the 'natural breathing of the city'.

Since as long ago as 1992 Hanssen has been monitoring earth movements in Delft using radar satellites

"In the summer, the land dries out, whereupon the soil settles and the city subsides very slightly," Hanssen explains. "In the winter, the level is restored. Buildings, on the other hand, expand in the heat of the summer, sometimes by as much as several centimetres, depending on the height of the building. We term these movements the 'breathing of the city'. Any deviation over and above this natural process can cause excess tension within the structure of buildings. Although minor, this tension could lead to cracking at a later date, even after the construction work has finished. If you want to establish a causal link, it is important that you know all the ground movements that have taken place over a long timeframe."

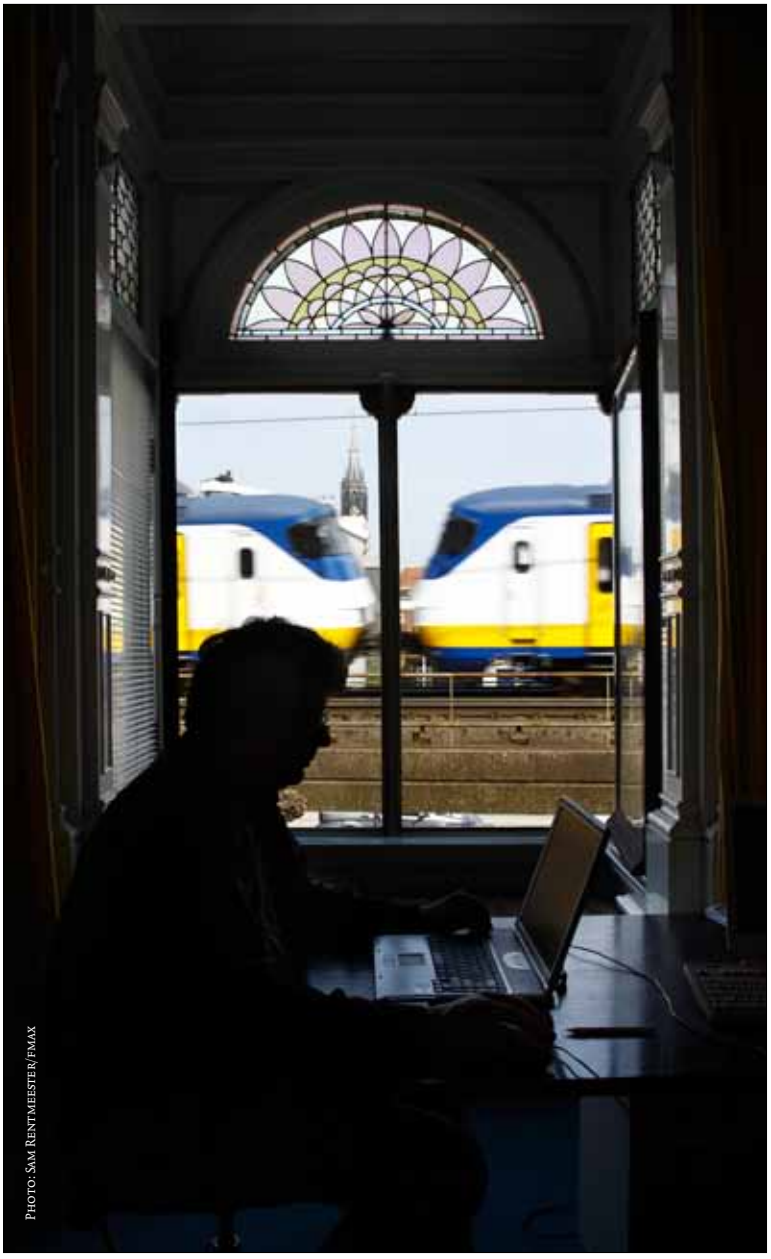


Photo: Sam Rentmeester/fmax

From 2012, working close to the railway will be in the past.

Risks

It is almost impossible to preclude slight subsidence due to the construction work on the tunnel. But what about major landslips, such as that seen in 2009 near the new Vijzelgracht metro station in Amsterdam? The construction of the double-bore underground railway tunnel in Delft is certainly no simple task. Peter Gossink, director of the consortium Crommelijn, is clear about that. The City of Delft and Prorail, the company responsible for the Netherlands' rail infrastructure, have commissioned Crommelijn to build the tunnel, which will take several years to complete.

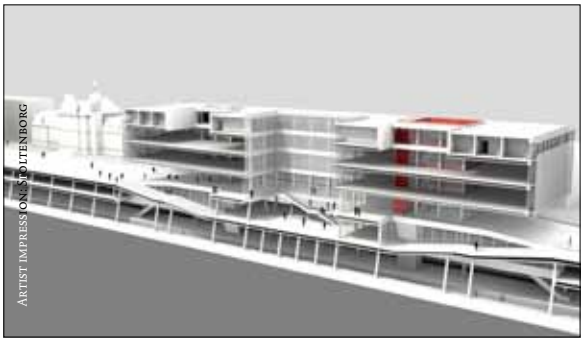
"This tunnel project is by far the most ambitious that I have been involved in to date," Gossink said earlier this year during the 'Delft – build on your future' symposium. But Gossink sees the main challenge as a logistical one. Over a 10-year period, various sections of the railway zone will be dug up in succession, but during this time trains, buses, trams, cars, cyclists, pedestrians and tour boats must be able to pass along this major city artery as smoothly as possible. Gossink is not afraid of major subsidence, such as that seen

in Amsterdam. "There, they are digging to a depth of 32 metres. We are only going down 12 metres. That makes it very much less hazardous. Moreover, the subsoil here is very different."
But JanGeert van der Post, TU Delft alumnus and one of the project managers for the City of Delft, reminds us that it is not as simple as it sounds. "One of the tunnels will be just three metres away from the houses on Phoenixstraat. That is very close. To excavate the tunnel directly from the surface here would be too risky, so we shall use the 'diaphragm wall' method instead."
This means that contractors will dig narrow trenches to a depth of 24 metres, which is where the first sand layer is found. While they are digging, they will keep the trench filled with bentonite, a sort of clay suspended in water, which prevents the trench collapsing in on itself. Once the trench is to the required depth, steel reinforcement meshes are installed and concrete is poured in. The concrete takes the place of the bentonite and the diaphragm wall takes shape.
"During this work, the houses are likely to shift by a couple of millimetres," reports Van der Post, "but this movement will be very gradual." To keep subsidence to an absolute minimum, the sections of diaphragm wall, each of which is several metres in length, must not be built directly adjacent to each other but with spaces in between. Once a series of the walls has been completed and the soil has completely stabilised, further walls are then installed to fill the gaps. Once all the tunnel walls are in place, a concrete roof is added. Contractors can then proceed to excavate the earth from within. The first tunnel is due to be completed in 2013. All trains will then pass through this tunnel and the above-ground railway can be removed to allow contractors to start on the second tunnel, which will be completed in 2016. After that, work on the parks and buildings will begin.

Leaks

There are various mishaps that can occur on a project like this. The joints between the diaphragm walls are sealed with a sort of rubber flap. But what if there is nevertheless a leak? This problem was also seen at the Vijzelgracht station project in Amsterdam. Water flooded into the excavation site, bringing with it sand from the sand layer on which the foundations of several adjacent houses were standing.

Luuk Stoltenberg's design consists of different layers.



Artist impression Luuk Stoltenborg

Photo: Sam Rentmeester / fmax

Construction builders dig trenches for the diaphragm walls.

Digging the tunnel directly from the surface here is too risky, so we shall use the diaphragm wall method

"In Delft, there can be no erosion of the sand layer like this," states Van der Post. "Above the sand layer on which the diaphragm wall rests, and on which the houses' foundations also stand, is nothing but clay and peat. They will not wash away."
Even so, Van der Post regards the *Het Bolwerk* section as a challenge. At this point, contractors will not use the diaphragm wall method but the more traditional 'box culvert' on pilings. "What makes this location so difficult is that there was once a small river, the Gaag, running through it," Van der Post explains. "The subsoil is therefore very different. The sand layer is much nearer the surface and any leakage would create a far more hazardous situation. Another factor is that there is a slight bend in the railway line at this point. The pilings supporting the railway are not vertical, but have been driven at an angle to counteract the sideways force exerted by the trains as they negotiate the bend. This makes the work more difficult, since the slanting piles leave less room to manoeuvre."

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Railway tunnel for Delft
Delft's railway viaduct carries 350 trains a day and is one of the busiest train routes in the Netherlands. A new 2300-metre railway tunnel is to replace this two-track viaduct, which dates from 1965

Diaphragm wall method
The diaphragm wall method will be used for large parts of the tunnel. The advantages of this technique are that relatively little space is required and surface works are kept to a minimum. Other locations will use sheet piling and traditional open excavation.

DIAPHRAGM-WALL CONSTRUCTION

A Guide walls are placed

The guide walls ensure that the excavator bucket falls in a perfectly vertical line. Even a small deviation by the excavator can cause a serious slant in the diaphragm wall.

B The trench is excavated

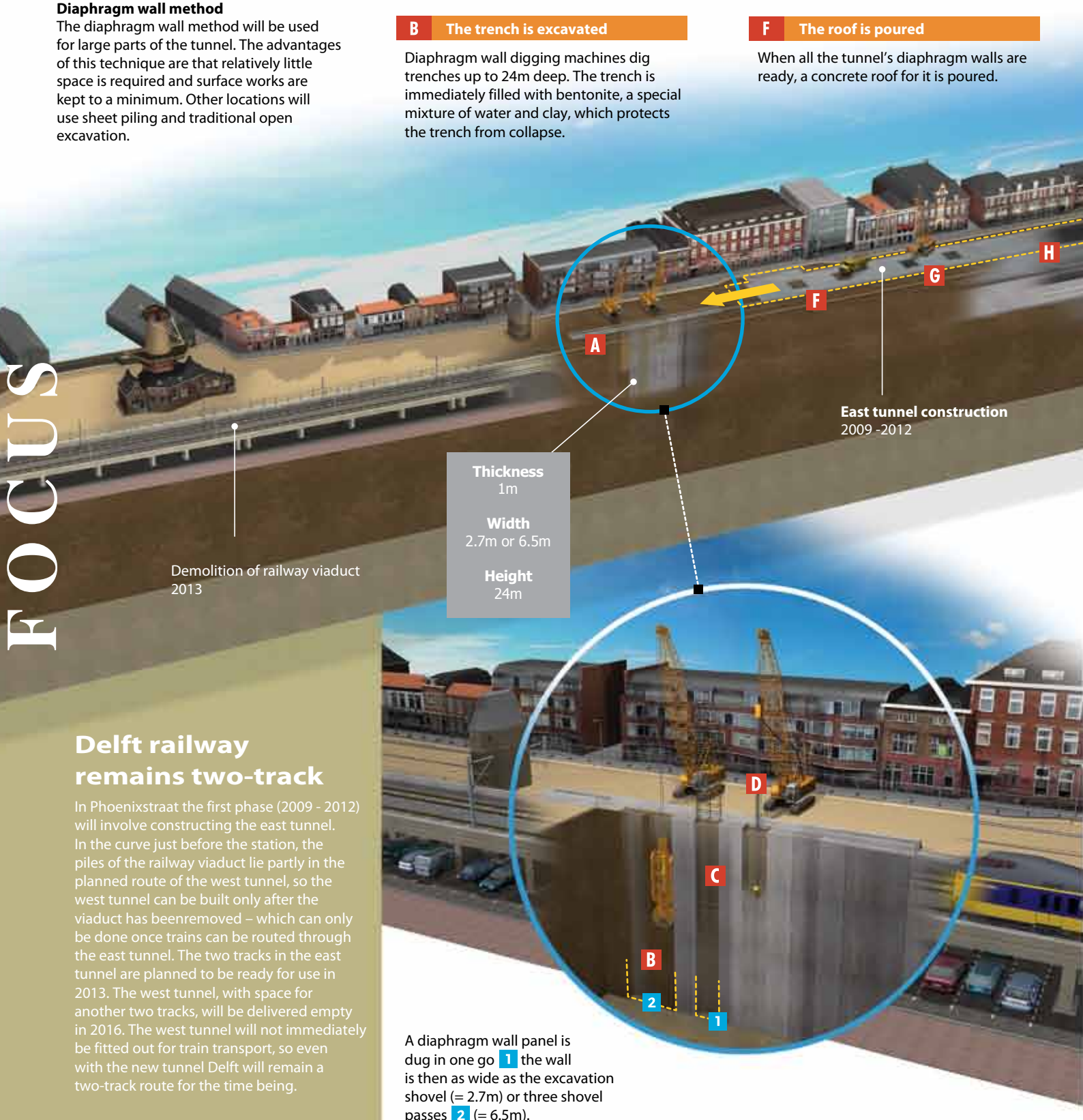
Diaphragm wall digging machines dig trenches up to 24m deep. The trench is immediately filled with bentonite, a special mixture of water and clay, which protects the trench from collapse.

E The next panel is excavated

The diaphragm wall panels are constructed consecutively. Once a panel has dried and set, the adjoining section is excavated, with the existing concrete panel serving as a guide for the bucket. In Phoenixstraat, two diaphragm wall construction units are in use.

F The roof is poured

When all the tunnel's diaphragm walls are ready, a concrete roof for it is poured.



Delft railway remains two-track

In Phoenixstraat the first phase (2009 - 2012) will involve constructing the east tunnel. In the curve just before the station, the piles of the railway viaduct lie partly in the planned route of the west tunnel, so the west tunnel can be built only after the viaduct has beenremoved – which can only be done once trains can be routed through the east tunnel. The two tracks in the east tunnel are planned to be ready for use in 2013. The west tunnel, with space for another two tracks, will be delivered empty in 2016. The west tunnel will not immediately be fitted out for train transport, so even with the new tunnel Delft will remain a two-track route for the time being.

A diaphragm wall panel is dug in one go 1 the wall is then as wide as the excavation shovel (= 2.7m) or three shovel passes 2 (= 6.5m).

C Rebar is positioned

A crane lowers the steel rebar construction into the trench.

D Concrete is poured

Concrete is piped into the bottom of the trench. The displaced bentonite is pumped off for reuse.

G Excavating the tunnel under the roof

The tunnel is then excavated through openings in the roof, and the material transported away by lorry.

H The floor poured and walls constructed

After the tunnel is excavated, the floor and interior walls are constructed. The central wall divides the tunnel into two fireproof halves.

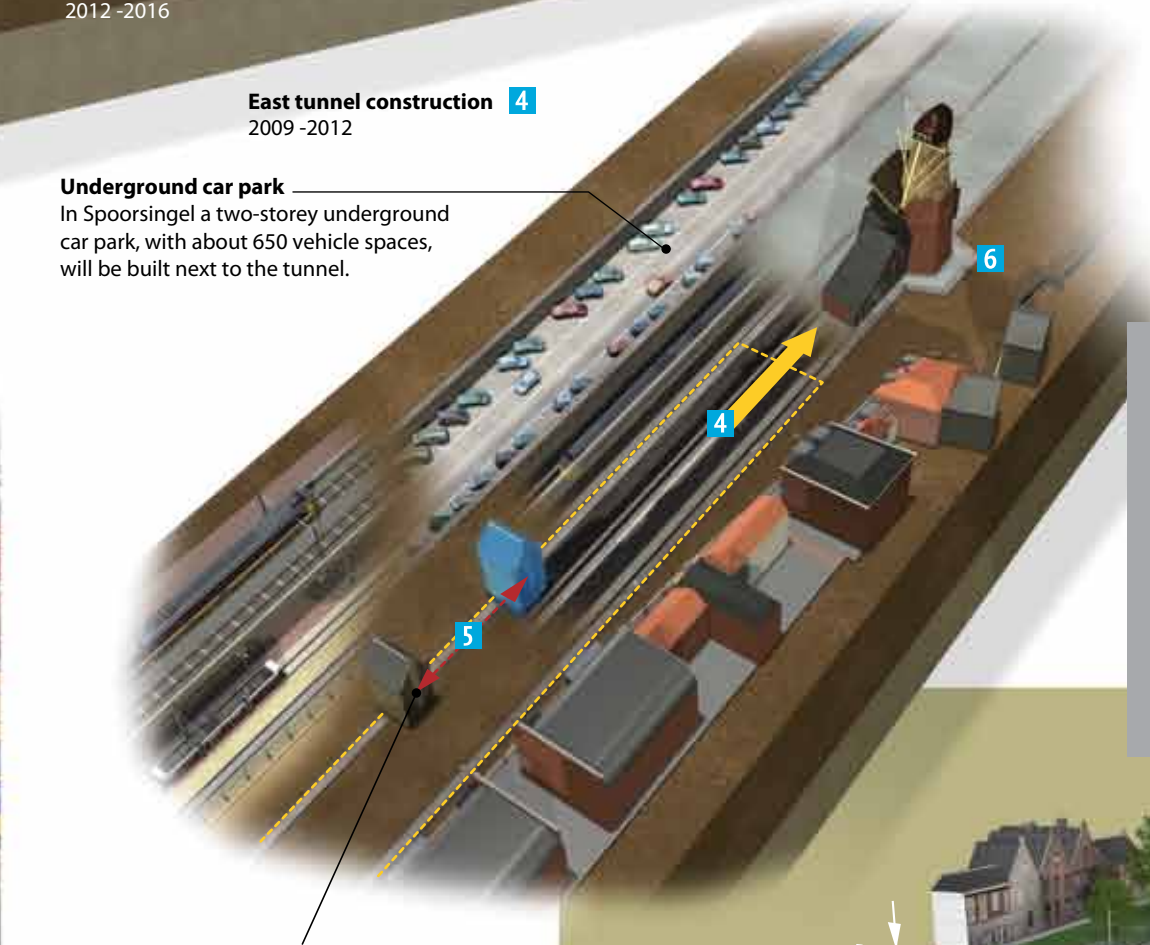
Narrow diaphragm walls
A number of nearby buildings - the Hoogheemraadschap (water board), the Nusantara Museum and the Delft Studenten Corps (student society) 3 - do not have pile foundations, and run the greatest risk of subsidence as a result of tunnel construction. The building closest to the tunnel wall is that of the Corps, with a distance of just three metres.

Moving stock
The diaphragm wall method involves a succession of building activities. Works will begin at the Binnenwatersloot crossing and will gradually move towards the Roos windmill.

Deep sand layer
Broadly speaking, the ground under Delft is made up of three layers. The topmost is a thin layer of sand and rubble. The second is a thick layer of compressed peat and clay. The third and lowest (at 24m) is a sandy layer that is capable of bearing weight. The diaphragm walls and foundation piles of the tunnel have to stand on this deep sand layer.

East tunnel construction 4
2009 -2012

Underground car park
In Spoorsingel a two-storey underground car park, with about 650 vehicle spaces, will be built next to the tunnel.



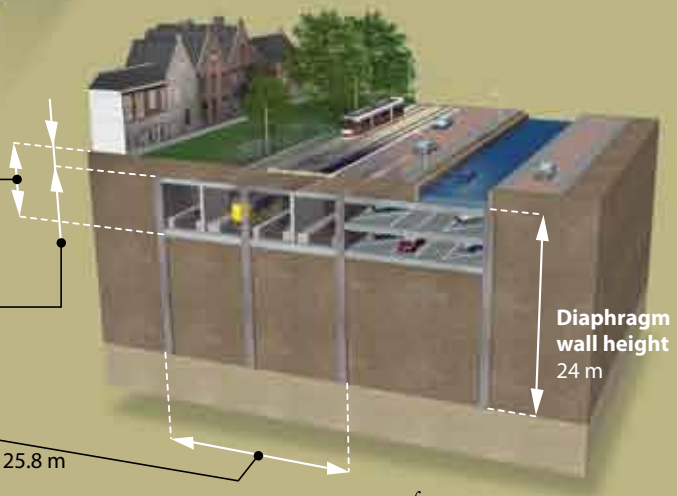
Tunnel length
2300m (including approaches)

Total investment
500 million euros
(100 million euros inclusive real estate)

Client
NS ProRail

Works contractor
Combinatie CrommeLijn

Historic monuments above the tunnel
The Molen de Roos windmill and the Bagijnetoren fortified tower, both national historic monuments, lie above the tunnel route. Both monuments will be given new foundation piles resting on the tunnel roof. Because the fortified tower stands directly above the planned route of a tunnel wall, the tower will be temporarily moved 20 m. 5. The east tunnel wall will be constructed in a bend 6 around the windmill.

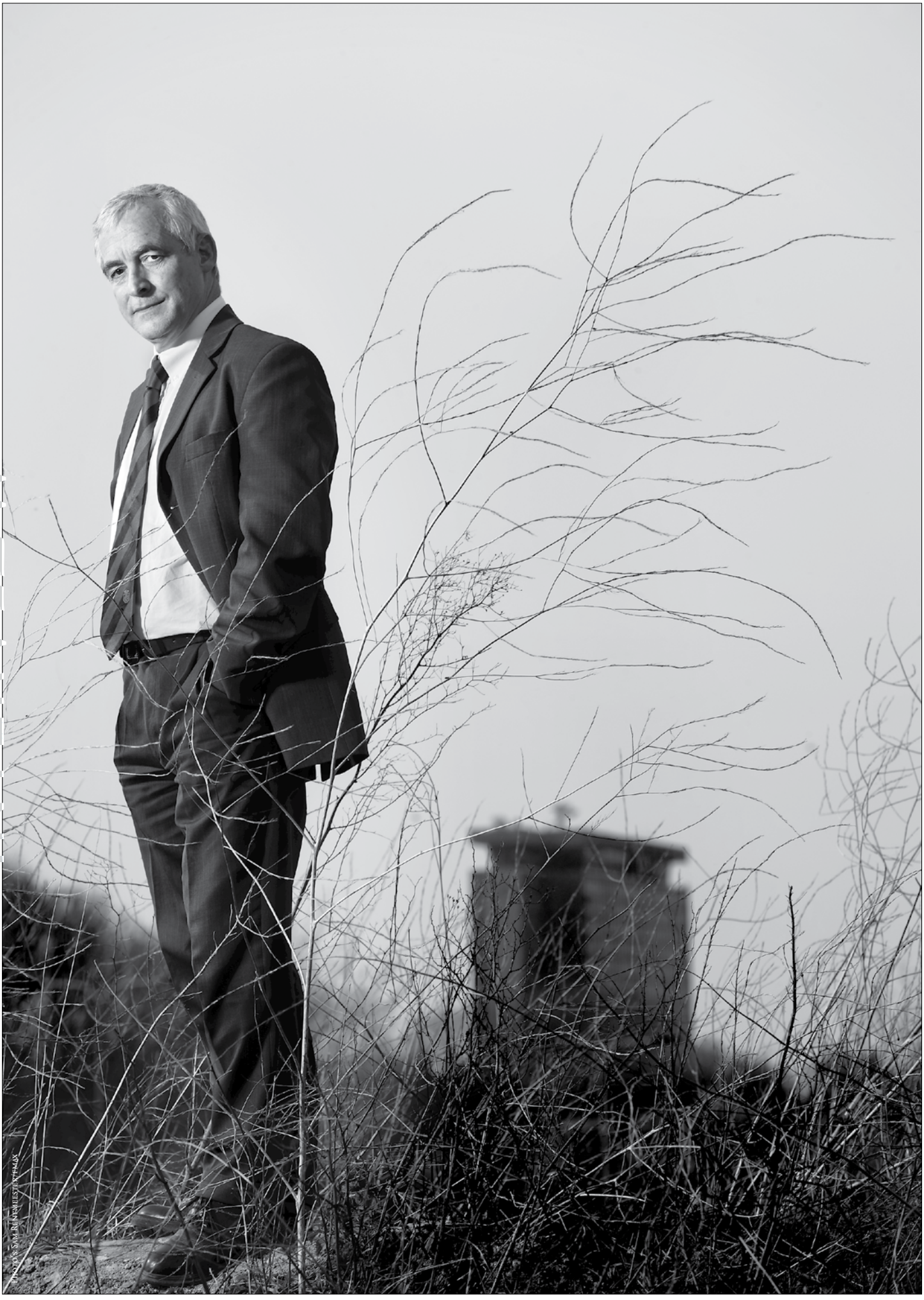


Depth of tunnel floor below surface
-8.9 m NAP

Sand cover above tunnel
About 90 cm

Tunnel width
External dimensions 25.8 m

Diaphragm wall height
24 m



Foto's: Sam Rentmeester fotografie

High intensity

As the new rector of TU Delft, Karel Luyben leaves no doubt: the level of research and education must be raised.

Joost Panhuysen

How are you finding being rector?
"I feel very much at home. The position, the responsibilities, the tasks: everything is as I had expected. And the two other members of the Executive Board – Paul Rullmann and the president Dirk Jan van den Berg – allow me the latitude to fill the role as I would wish. Of course, it is a new situation. The three members of the Executive Board must act as one. I still regularly remind myself, 'wait – I first have to consult my colleagues before I offer my opinion'. And you must never take important decisions on your own. I am therefore quite cautious. I suspect they actually find me too cautious! But I've been pleasantly surprised by how well we are able to work together already."

Who is Karel Luyben?
Karel Luyben was born in Tilburg in 1951. He studied Chemicals Technology at Eindhoven University of Technology and by the age of 28 was already a senior researcher at Wageningen University. Following a brief period in private sector research (with the Dutch agricultural cooperative Cehave and the German chemicals company Bayer), in 1983 he was appointed Professor of Biokinetics at TU Delft. Five years later he became Professor of Bio-process Technology. In the 1990s, Karel Luyben was Scientific Director of the Leiden-Delft Research School for Biotechnological Sciences. However, he is probably best known as the man who made such a mark on the faculty of Applied Sciences as its dean from 1998 to 2009. Despite the excellent reputation he helped the faculty to acquire, in 2009 he decided that it was time to step down – even if he were not appointed rector. In the event, he succeeded Jabob Fokkema as Rector Magnificus of TU Delft in January 2010. Karel Luyben is married and has one son.

Are the board members very different people?
"Yes. We complement each other very well – also in terms of experience and expertise. Since 2002, Paul Rullmann has gained enormous experience on the Executive Board in matters relating to education. The support available to education has greatly improved under his leadership. During the months ahead, Paul will be taking a very close look at the finances of the faculties. I shall be working with him a lot on the education side. Compared to me, Paul is more a 'feelings' person. Not that I'm entirely without feelings, you understand. But Paul really enjoys music. For many years he played guitar in the folk group *Crackerhash*. And he likes to visit me to celebrate the annual Carnival."

What sort of president is Dirk Jan van den Berg?
"Forceful. He knows his mind and is not afraid to pursue his ideals. But if you have any critical comments and know what you're talking about, he will listen and is willing to adjust course where necessary. As an expert in econometrics, Dirk Jan has been able to bring the financial discussion with the other universities onto a higher plane. That has made millions of euros' difference to us. Of course, not everyone is quite so grateful. Dirk Jan is also a true diplomat. If a conflict seems likely, he will come up with some creative compromise which makes all parties feel that they have won something. No one suffers any loss of face."

How do you complement the other board members?
"I have a lot of experience in finding the best people and assembling the best possible team. I am good at selection, and that is an advantage if you want to optimise a university. And yes, I know TU Delft very well. I know what the researchers are doing, I'm familiar with what their various disciplines entail. And, not unimportantly, I know the little tricks that a faculty or dean might pull in an attempt to hoodwink the Executive Board!"

Can you give an example?
"Suppose the Executive Board has set aside university funds to cover redundancy payments following a reorganisation. A faculty might be tempted to 'disguise' the departure of someone they actually wanted to get rid of for some time as a reorganisation-related redundancy. In that case, it would be the Executive Board and not the faculty which would bear the costs."

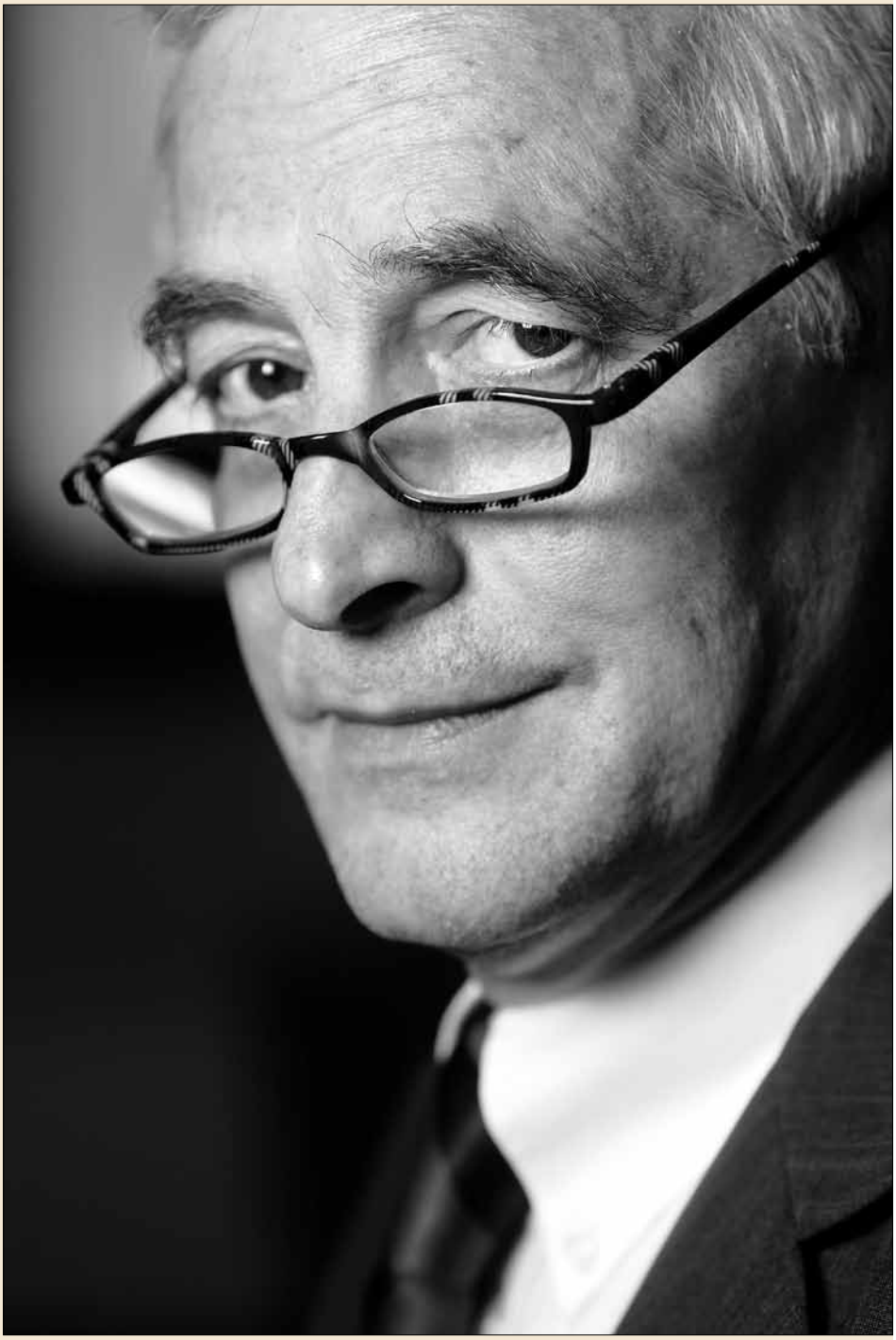
What sort of devious mind could come up with something like that?
"You will never hear me admit to such dirty dealings when I was dean *[he says with a smile]*. But such things are possible. Fortunately, as Executive Board you can reduce the temptation by requiring the faculty itself to contribute towards every redundancy scheme."

Is your main aim as rector to improve the quality of the university?
"Yes. I see it as my task to maintain the academic level of our university, and to raise it where necessary."

And where is that necessary?
"A good question. That's what I would like to know too!" *[he says with a smile]*

I assume that the problem does not lie with the faculty of Applied Sciences, the 'showhorse' of TU Delft?
"That is too simple a statement. The problem could just as easily lie with Applied Sciences as anywhere else. Half of its groups are performing under the faculty average. As dean, I helped to raise that average."

INTERVIEW



‘You must always try to become that little bit better’

If you focus on becoming the best possible university with the best possible people, won’t that make some staff – assistant professors for example – feel like ‘second rate’ academic staff. They might think that they are obviously no longer good enough for TU Delft.

“That risk does exist. And that means that we must treat every member of staff with respect. The people who were taken on when our wishes and quality standards were different are still very much part of the team. They must be taken just as seriously as the newcomers. But that’s not to say that a university can never change and that you mustn’t develop a new strategy for the future. When I say that we intend to ‘raise the bar’, am I excluding all the academic staff who are already working at TU Delft? Perhaps some people will see it that way, but the world changes constantly. Fact. If you can’t cope with change, you shouldn’t be working in a dynamic organisation such as a university.”

Doesn’t every organisation, even a university, need different levels? In addition to the excellent staff, shouldn’t there also be those who are, well, just average?

“The average won’t disappear. If you manage to raise the level of the academic staff, there will be a new average.”

But can you carry on raising quality indefinitely?

“You can always strive to achieve a higher level. The world is changing, requirements are changing. What was possible or the only alternative twenty years ago is no longer the norm today. But raising the level is a gradual process. You must not think that a large proportion of staff will suddenly fall below the required standard just because the overall level has risen slightly. It’s very easy to explain. Most people know enough about statistics to understand that if I appoint people who are below average quality, the average will fall.”

You once said that a rector should be more of a leader than a manager. Does that leadership also involve motivating people?

"Yes. It's really nice to speak to a room full of PhD students and postdocs about the opportunities they must seize, and to see them infected by my own enthusiasm. But motivation can also happen at a more modest level: people who leave this room thinking, my batteries have been recharged."

How do you do that? It isn't a pep talk.

"That's difficult to say. It's all to do with enthusiasm, a passion for my profession."

Where does that enthusiasm come from?

"It's just the way I am. When I do something, I do it with 'high intensity'. When I cycle, I cycle fast. If I'm investigating something, I want to know every last detail. And if I'm repairing something, I don't give up until it is working as good as new. In fact whatever I do, I do it with such intensity that some people get a little irritated."

Such as?

"My wife, for one! Let's say the coffee machine has broken down because a coil in the switch is broken. I then spend an entire Saturday afternoon winding 0.7 millimetre copper wire to make a new coil. 'Are you barking mad?' she'll say. 'You can buy a new coffee machine for less than 20 euros.' But that's not the point, I tell her. I want to fix it myself. It may also be due to my concern for sustainability. I don't like just throwing things away. My bike is now 35 years old. I recently replaced the pedal crank arm, the chain and the gear cogs.

"I've always been very interested in overseas development and devote five percent of my time to various projects. A few years ago, I initiated the Africa project here at TU Delft, and I have taught in developing countries such as Vietnam and the Philippines."

You've been known to repair things here in your office too: from loose cupboard doors to tape recorders.

"I like to *do* things. As a boy I'd help out in my father's painting and decorating business, and I still do all the decorating at home. In the past, if you had asked me if I was more of a do-er than a thinker, I would have said yes – that my outlook was indeed more practical than theoretical. Even just after graduation. But apparently my theoretical side was strong enough to earn me a professorship in time. I've always believed that a manager should have done every job on the workfloor himself, within reason. Then at least you know what is reasonable to ask of people."

People often regard managers as distant figures, far from the workfloor.

"Really?"

Perhaps it is a cliché, but the impression does exist.

"It certainly exists here at the university. Manager is a dirty word. That's why as dean I would never refer to the Head of Finance as the 'Finance Manager'. I even suggested that the entire university should revert to using the title 'head of...' whatever, since it seems to command more respect among academics. It's a trivial detail, but that's the way things are."

You're known as someone who will point out shortcomings and reprimand the people concerned.

"That's my style. I don't beat about the bush. Of course, I try to remain polite and diplomatic, but if I don't agree with something I have to speak out."

Do people accept that?

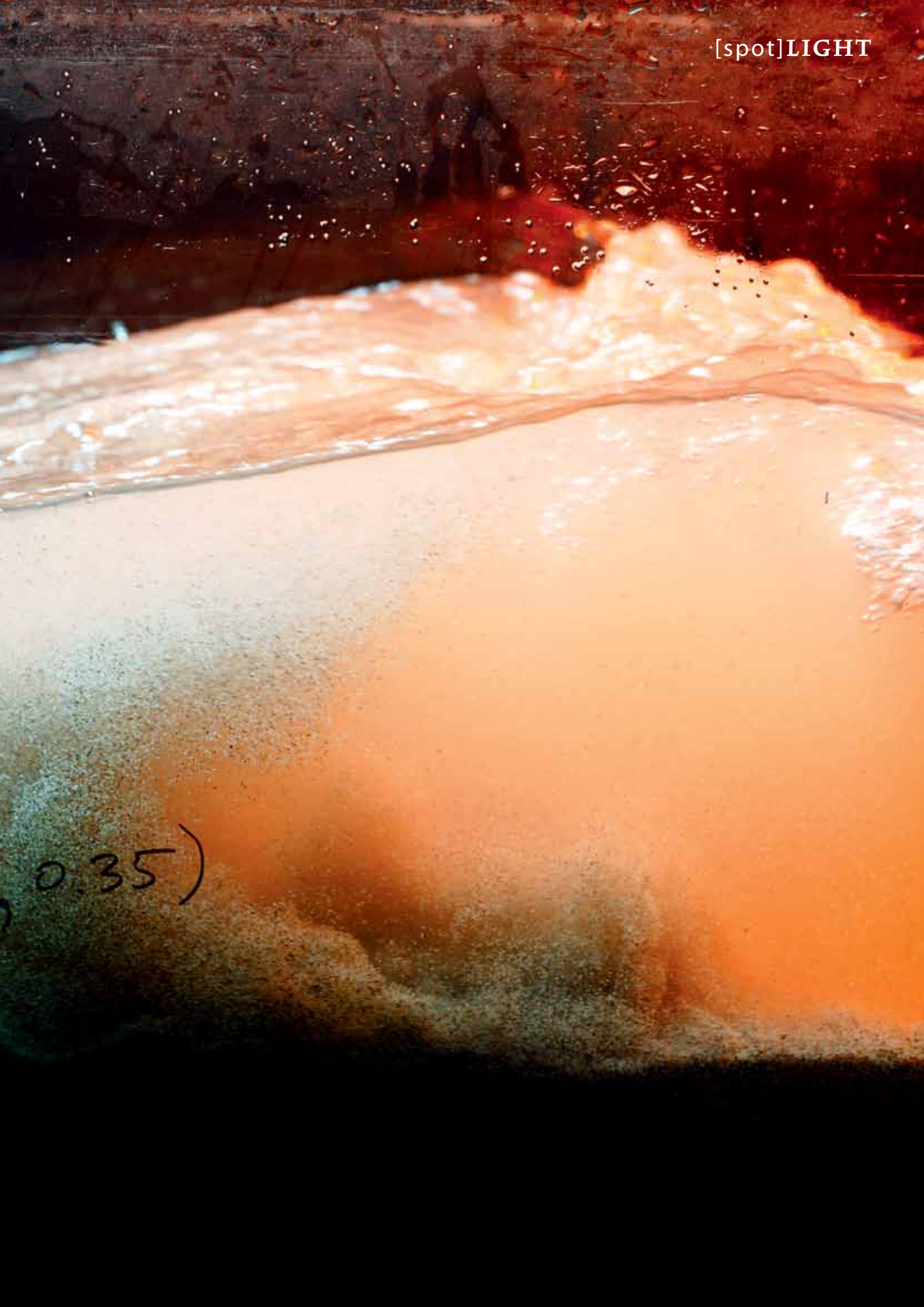
"Usually, yes. Perhaps there have been a few times they have not...but I didn't notice."

You don't think you have made any enemies?

"There will undoubtedly be a few, but again I have not noticed. If by 'enemies' you mean people who are suspicious and mistrustful, people who do not believe in my good intentions, then I think that I ended my time as dean with fewer enemies than I began. In the early days, people would often accuse me of having a hidden agenda. They assumed that a dean must always be playing little political games. I told them, 'listen – if you find my hidden agenda, tell me what it is. It's my ambition to go through life with no political games whatsoever and to run this faculty accordingly'. Some people found this very hard to believe. But I think that by the time I left, far more of the staff knew that I really meant it."

Exactly how does a sandbank form? This is the question being investigated by PhD student Martijn Henriquez in the Water Lab of the faculty of Civil Engineering and Geosciences. In the lab's long tank, he has observed how a thin layer of sediment moves back and forth over the seabed on the seaward side. On the landward side, sediment swirls up before settling. In the dynamic equilibrium between these processes, the sandbank takes shape. Henriquez is now working on a physical description of how sandbanks are shifted towards the coastline when the waves are diminishing in size.

Photo: Sam Rentmeester/fmax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Engineers in biology

In recent months, the new Bionanoscience department (part of the faculty of Applied Sciences) led by Professor Cees Dekker has gone against the prevailing trend by recruiting top researchers to take part in a broad research programme examining how living cells actually work.

Jos Wassink

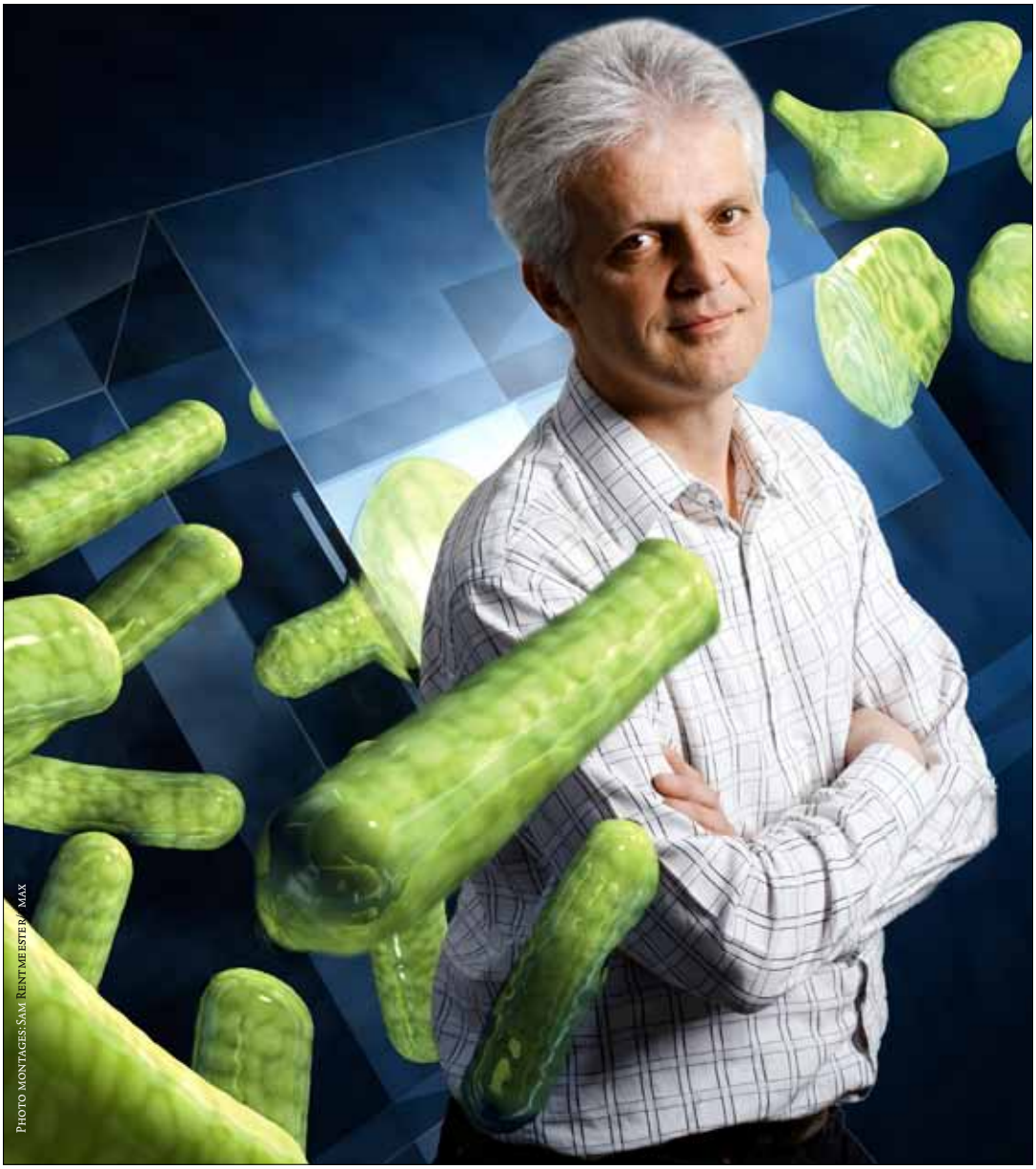


Photo montages: Sam Rentmeester MAX

Cees Dekker: "Biology is now offering many more opportunities for engineering."

Is bionanoscience a new science?

"The most exciting developments are often to be seen at the convergence of two scientific disciplines. In this case, we are looking at the convergence of nanotechnology, which has given us the tools to measure and control things at the molecular scale, and biology, which gives us the components of the living cells we study."

Where does the idea for bionanoscience come from?

"In the late 1990s, my group and I were working on the molecular physics of inanimate objects such as carbon nanotubes. We realised that the techniques we developed could be used for far more, such as studying biology. At the same time, biology has become more of an exact science in recent decades. After centuries in which the main activity was observation, biology is now offering many more opportunities for engineering.
Two and a half years ago, long before the economic crisis, my colleague, Professor Nynke Dekker, and I approached the university's Executive Board to suggest that greater attention should be devoted to biology. I considered this to be of crucial strategic importance to TU Delft. Thanks to the board's positive response and the support of the Kavli Institute, the bionanoscience department was established. It builds upon the biophysics group which was set up ten years ago."

What sort of research can we expect?

"We shall apply our nanotechnology, our single-molecule instruments for example, to biological molecules. We can 'grab' proteins and DNA strings, stretch them, measure their tensile strength, and so forth. Much of this work is now being done on isolated molecules *in vitro* [outside the cell itself – ed.]. This gives us an idea of how the molecules function. But the next step will be measurements of the molecules in their natural environment, the living cell. We wish to cover the entire spectrum, from nanotechnology to cell biology."

What is the difference between bionanoscience and biotechnology?

"A biotechnologist works downwards from the complex system that is a yeast cell or a bacterium. Bottom-up engineers design a system with which they can, for example, incorporate a small genetic network of just two genes into a cell. You can then study the cohesion this creates and devise new functions. An engineer's approach is different to that of the biologist, who thinks in terms of cellular control techniques. The nanotechnology and biophysics backgrounds also entail a different approach to that usually applied by biotechnologists."

What does your research field include?

"It is very broad and ranges from research on individual molecules to cellular biology and applications such as biosensors and lab-on-a-chip analysis. We are looking for cell biologists who wish to work alongside nanophysicists, and biophysicists who wish to talk to biologists. It's all about the synergy within the department. We want to create something new for the twenty-first century. At the European level, we shall strive to attain a leading position at the convergence of nanophysics and molecular biology. This calls for a team of some 15 to 25 scientific staff, so a department is just the right size."

The examples you give are all fundamental scientific research. Doesn't this have to be valorised?

"We have the freedom of pure research here. That is what a university is for. For me, fundamental research is the most appealing kind. Applied research will also have a place in our activities, of course. In the first instance, most research will be fundamental in nature but it will eventually and inevitably lead to new applications in, say, healthcare. One example is Nynke Dekker's research into the mechanism of the drug topotecan, which is already used in chemotherapy for cancer patients although no one knows how it actually works. Nynke has demonstrated how a molecule of topotecan worms its way into the protein topoisomerase, thus preventing the protein from removing the twists in the DNA and altering its function. She has provided the fundamental input by showing how topotecan blocks the protein."

What is the most fundamental question being addressed by your research?

"What is life, in biological terms? How does a living cell work? Despite all the progress in biology, there are still many gaps in our knowledge. You can set five researchers to work examining each one of those gaps." ▸▸

More information:
ceesdekkerlab.tudelft.nl

The origin of life

Within five years, Danelon hopes to present his first artificial cell.

His room in the Applied Sciences faculty building is freshly painted and virtually empty. He formulates his words carefully in English with a slight French accent. Following previous appointments at the universities of Toulouse and Lausanne, Dr Christophe Danelon (33) has now arrived in Delft. He considers it exciting to be part of a new department at a university with such a high reputation in physics and biological molecules, and which also has considerable expertise in microscopy and spectroscopy. He sees Delft as the ideal setting for his next great project: unravelling the origin of life itself.

Most of Danelon's publications in recent years have been about ion channels. "They are pore-forming proteins on the membranes of living cells," he explains. "They are of major importance in regulating the ion flows, in admitting nutrients and getting rid of waste products." With his arrival in Delft, Danelon's research will take 'a slight change of direction'. Here, he will go in search of the origin of life itself. "It's good to set the ambitions high and ask the big questions," he says. "Even minor progress in this area will be a major achievement," he adds modestly.

Within five years, Danelon hopes to present his first artificial cell, one which uses nutrients to meet its energy demand, can recreate and is able to evolve. The most important question for Danelon is how a set of complex biochemical molecules can remain close enough to each other to replicate. When surrounded by water, the molecules quickly drift apart. Perhaps certain minerals play a part in connecting them, or perhaps a second membrane to hold the cells together is required. Hopefully, five years of research will increase his knowledge in this regard. The underlying question, the molecular origin of life itself, is big enough to keep him busy for the rest of his life, Danelon believes.

'It's good to ask the big questions'

Alongside this fundamental research, Danelon is also working on the use of liposomes (lipid vesicles) in medication. Drugs which have a coating of liposomes can move unnoticed through the body. By introducing an antibody, it would be possible to have these medicine pellets attach themselves to specific tissue. There would then have to be some mechanism to release the contents of the pellet. This offers a promising way of getting drugs into the brain via the bloodstream.

More information:
http://christophedanelonlab.tudelft.nl

The nucleus in view

If you ask Dr David Grünwald what his specialism is, he will answer, "Visualising molecules within the nucleus of a living cell." It takes a few moments for the significance of this simple statement to sink in. You can't see molecules with an optical microscope, can you? Surely they're far too small? Seeing molecules within a living cell would enable you to watch various processes of life as they happen. Apparently, it is indeed possible. Through observation, Grünwald has established that it takes 200 milliseconds for an RNA molecule to permeate the cell wall on its way out, while the average protein finds its way in within 5 to 10 milliseconds. "The best part was seeing how an RNA molecule would try various nuclear pores one after the other. It waits for a second or so at one, then moves on until it finds a pore that will actually let it in."

Grünwald (34) can tell fascinating stories about the world which only a very few people, himself included, can make visible: the living complex that is a cell. Having studied law in Frankfurt for one year ("I wanted to do something good for mankind, but studying law is not easy when you're dyslexic"), he went on to study physics and was then introduced to biophysics. "How does life work? Not just as a description, but in the quantitative sense. How does a cell function and what principles keep life going? That question grabbed me and has never let me go." Since then, his glittering scientific career has seen him working at institutes of biophysics, biochemistry, molecular biology and medicine. After four years as a postdoctoral researcher at the Albert Einstein College of Medicine in New York, Grünwald decided it was time to return to physics.

With the help of technicians and PhD students, he is now building his own microscope, which

'How does life work?'

is specially designed to follow individual molecules. The crucial factor is ensuring the maximum possible light. The microscope, which is actually an open arrangement with lasers, a large-aperture lens, a colour-separation mirror and two ultra-sensitive cameras, will enable him to observe the interaction between various molecules with a precision of up to 30 nanometres. Fluorescence labelling can then be used to determine whether a virus is able to penetrate a nuclear pore, or the point at which a particular drug binds itself to the cell and how this affects the functioning of that cell.

"All this happens within milliseconds," Grünwald says. "These processes are taking place in all our cells. We can see them happening. Not just on the outside of the cell – its 'envelope' – but in the nucleus itself."

More information:
http://davidgrunwaldlab.tudelft.nl

David Grünwald makes biological processes visible.

Layers of complexity

Professor Sander Tans had his 'eureka moment' soon after gaining his doctorate in 1998. At the time, he and his supervisor, Professor Cees Dekker, were writing articles for leading journals such as *Science* and *Nature* about the electric charge of carbon nanotubes. "We were able to measure the electricity in individual molecules. That was fantastic! But the nanotools we developed could also be used for other things. They gave us a glimpse into the world of biological processes, all of which are very much more complex than anything we had studied so far. Motor proteins which repair DNA, for example, or which can move in and out of a cell along a special route. They are just as complex as any manmade motor, but at the nanometre scale. When you see this for the first time you think, 'Wow! How is that possible?'" This prompted Tans to opt for a career in biophysics, a discipline which he now practises as group leader of the biophysics laboratory at the Foundation for Fundamental Research on Matter's Amolf (Atomic and Molecular Physics) laboratory in Amsterdam, and since 1 January as part-time professor in the new bionanoscience department at TU Delft. Tans' specialism is applying the physicist's perspective to biological topics. His research field extends from the individual molecule to the level of cells and their evolution. Tans' ambition is to help develop a more quantitative biology, a science based on testable hypotheses, experiments and predictable results. As an example, he cites his recent research into the mechanisms of evolution, in which a population of bacteria was 'taught' a new way of reacting to bacteria through an evolutionary process over some 100 generations. The researchers demonstrated that the bacteria adapted to a variable environment (in which antibiotics were sometimes present and sometimes not) through a combination of random mutations and Darwinian selection. "This was the first time that a new reaction was instilled by the process of evolution," Tans reports. "We were also able to show what determines the success of this process. The research demonstrates that you can only really understand a process if you can reproduce it."

'How does complexity evolve?'

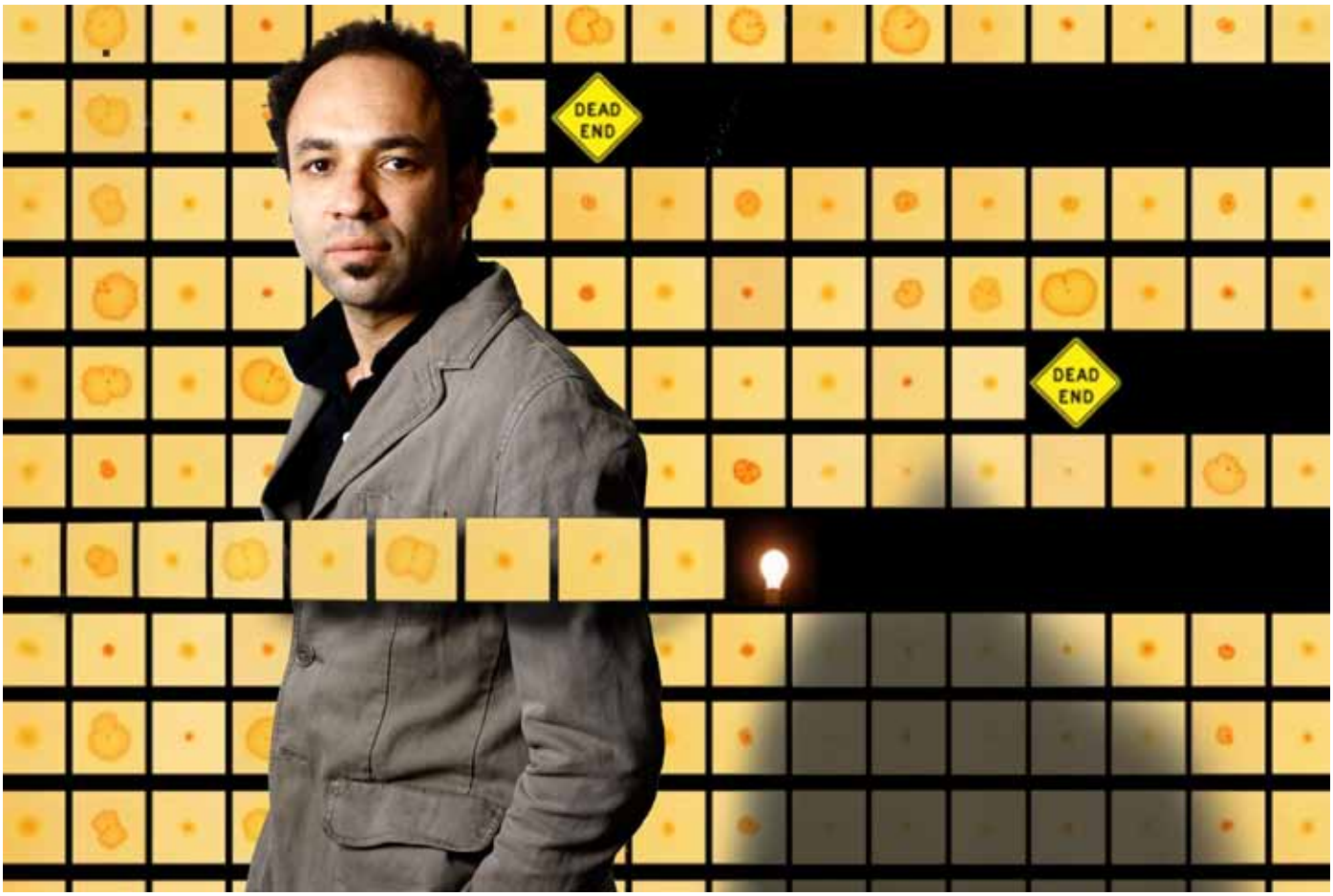
Tans' follow-up research is concerned with the evolution of complex characteristics. Most biological processes involve several different proteins. How do they change under the pressure of evolution? Or as Tans puts it, "How does complexity evolve? Can we distil some simple basic principles?" It has long been the physicist's dream that enough study and research will reveal the logic which underpins our chaotic and complex reality. That dream has not yet been entirely realised in the field of physics itself.

More information:
tansgroup.amolf.nl

Credits: Sander Tans & Graham Johnson 2007

Sander Tans has a physicist's perspective on biological processes.

Experiments with evolution



Bertus Beaumont: "Only very rarely a random chance is an improvement. That's evolution."

"Suppose you come face to face with a distant ancestor and must fight to find out who is stronger." This proposition is raised by evolutionary biologist Dr Bertus Beaumont, who conducts experiments with bacteria. "Bacteria enable you to compare two very distant generations. I keep a suspension of bacteria in the freezer and let the rest of the colony evolve. It's sometimes possible to move on eight generations in a single day. After a few hundred generations, I can compare the bacteria with their distant ancestors."

Bertus Beaumont (36) received his doctorate in molecular biology from VU University Amsterdam in 2004. He went on to work as a postdoc researcher at the University of Auckland and, with a NWO Veni research grant, under Professor Paul Brakefield at Leiden University.

"Everything we know about evolution we know through comparative research," Beaumont states. Comparisons between fossils, comparisons between fossils and current life forms, and between existing species: the entire theory of evolution was developed on the basis of comparative observations. But scientists also like to conduct experiments to test their hypotheses. Current technology makes that possible, although patience and dedication remain essential given the number of successive generations required. Beaumont's longest experiment involved studying 500 generations. In human terms, that would take 15,000 years, taking us back to the middle of the last Ice Age.

'Eight generations in a single day'

"I'm not concerned with showing that bacteria adapt to changing conditions," Beaumont says. "We know that already. Rather, I am interested in how a complex mechanism such as a bacterium can adapt through random changes to its DNA. That is the real question." The DNA of the bacteria used in his research has 6 million genetic letters. On each division, the DNA is copied, whereupon there is a 1 in 10,000 chance of a random mutation. Most mutations have no effect whatsoever. Some make the bacteria grow less quickly, whereupon the mutation itself eventually becomes extinct. Very occasionally, a bacterium will start to grow more quickly, whereupon the entire population eventually has the same characteristic. "In that case, they have evolved one step," Beaumont summarises.

In Delft, Dr Beaumont is to research the evolution of flagella. A flagellum is a sort of tail-like projection which certain bacteria have, and which they use to move around. It is rather like a tiny outboard motor. By studying only the mutations which affect the flagellum, Beaumont hopes to gain a greater understanding of the evolution of such biological nanomachines. He will also use that knowledge to make certain planned modifications. Evolution designs blind: a scientist likes to know what he is doing. ◂◂

Photo's: Sam Rentmeester/FMAX

Prof.dr. Petra Badke-Schaub

"Jaap can take the broad view"

Empirical

Professor Petra Badke-Schaub was born in Hünfeld, Germany, in 1960. Her first professional training was in commerce, specialising in optical instruments and cameras. She later studied psychology in Bamberg, with sociology and music as minors. Badke-Schaub began her academic career in psychology in 1986, which was also the year in which her daughter was born. She went on to study cognitive anthropology at the Max Planck Institute in Berlin, gaining a doctorate from Bamberg for her dissertation on complex problem-solving by groups. She then researched design processes for the Darmstadt and Munich universities of technology. Since October 2004, she has lectured on design methodology at TU Delft.

Saskia Bonger /
Connie van Uffelen

In the **Masterpiece** series, a professor and a student or PhD student (present or past) answer the same questions, creating a double portrait in the process.

How would you characterise each other?

Badke-Schaub: "Jaap is very interested in design methods as a topic. He is extremely enthusiastic. He has a good relationship with the students and is able to ask them relevant questions. If I need someone to stand in for me, I know I can rely on him."

Daalhuizen: "Petra is friendly. She's open to new ideas and developing those ideas in one's own way. And she has a good sense of humour in the typical German style. If you have a difficult problem, she will make a little joke to help you put it into perspective and see that it's not the end of the world. Perhaps she could also be described as a little disorganised on occasion."

What is distinctive about the other person?

Badke-Schaub: "On the one hand, Jaap is very philosophical. I'm more empirical in outlook. I ask many stupid questions until eventually he runs out of answers. He is very persistent."

Daalhuizen: "She lets me follow my own path. It's sometimes difficult to cope with freedom, but if you can and you enjoy this approach, it can lead to very strong results. Personally, I'm not so good at working within a rigid organisation."

What have you learned from each other?

Badke-Schaub: "Jaap teaches me to look at aspects other than those I would usually focus on. For example, I might try to make an outline plan, but he will be more concerned with the details."

Daalhuizen: "I trained as a designer and am inclined to think laterally, drawing associations with other research fields. But I often do so on too superficial a level. Petra has taught me to work at a deeper and more concrete level."

What are the key aspects of a good teacher-student relationship?

Badke-Schaub: "My aim is to ensure that every PhD student learns to deal with every topic successfully in four years. They must be able to analyse the topic, even if they have no prior experience of it. They must be able to develop procedures which can be used in any context. Dealing with topics in different ways: that is the most important thing. It may not always be fun, but eventually you will be able to derive a lot of pleasure and satisfaction from your work. And the student must be able to come to me with any question."

Daalhuizen: "On the one hand, you must keep a certain distance from each other in order to be able to think critically. On the other, there must be a relationship of trust, which requires a more personal relationship. Sometimes I need to be told that things are going well, and sometimes I need to be told what is bad. That is balance. Even so, our relationship is primarily that of teacher and student: professional."

What triumphs or setbacks remain in your mind?

Badke-Schaub: "We gave a joint presentation at

Ir. Jaap Daalhuizen

"Petra is open to new ideas"

Philosophical

Jaap Daalhuizen (29) graduated from the faculty of Industrial Design in late 2007 with a project on community-based design support. He had taken the idea for his graduation project to Petra Badke-Schaub, partly out of frustration at the current design methodology. During the project, the two realised that the concept had greater potential. In March 2008, Daalhuizen therefore began his doctoral research into the application of the methodology in practice. He realises that change will be difficult to achieve: "Working in an exclusively systematic way is not possible, but neither is working with no method at all."

a conference in Turkey. That was fun. Jaap also gave a very good presentation at Stanford in the USA. I found that very encouraging. You want your students to perform well in the international setting. And I want to be a good supervisor. That to me is the most important aspect of my work. I prioritise the PhD students. They must achieve their full potential."

Daalhuizen: "I knew that it would happen, but even so. As a researcher, I reached a point at which I was doing things with which Petra is not familiar. In the early stages, our knowledge about the research topic was on a level footing. Since then, I've developed certain ideas about my findings and conclusions. I'm going even deeper into the subject matter, leaving Petra behind. That is difficult. Professionally, you believe that this is how things should be. Personally, you are more inclined to think that she should keep pace."

What is the other person's best trait?

Badke-Schaub: "Difficult. The 'best' is always a combination. Persistence, patience and friendliness. Even when I'm being critical, Jaap never shows that he is thinking, 'Oh no, not again'! He's resilient. I can push him a little further each time. We both have a sense of humour. Sometimes he'll come to my door and say, 'I have just one quick question'. 'OK', I reply, 'but it could have a very long answer.' Jaap also gets on very well with the other PhD students."

Daalhuizen: "I often go to Petra for advice and she always takes the time to help. She's always very encouraging and never gives me the feeling that I face an impossible task."

And what is the other person's worse trait?

Badke-Schaub: "At first, Jaap would ask a lot of questions. I find it important that people are able to ask, but in most cases he already knew the answers. He just wanted confirmation."

Daalhuizen: "I'm not sure whether it's a bad thing. Petra has a very firm vision about the direction of our research but does not communicate it very often."

What is the other person's contribution to your field of research?

Badke-Schaub: "For our section, Jaap's main contribution has been his knowledge of design methodology. His overall view is very important. Designers are often inclined to focus solely on their own work. Jaap can take the broader view."

Daalhuizen: "Petra has contributed much to the human aspect of design. Traditionally, design processes were studied by engineers and then translated into methods. The processes were rational, although it's a person who actually designs. What are his limitations? What support does he need, and how can it be provided? And when should he avoid using any method at all?" ▸▸

The term design thinking has now taken on an entirely different meaning."

Married/cohabiting
Badke -Schaub: married, with two daughters
Daalhuizen: live-in partner, no children

Hobbies
Badke-Schaub: swimming, travel, music
Daalhuizen: the bonobo, biology, listening to music, DJ-ing at parties, cookery

Favourite newspaper and magazine
Badke-Schaub: *The Times Online, Süddeutsche Zeitung, Der Spiegel*
Daalhuizen: *NRC*

Discoveries you would like to have made
Badke-Schaub: the dishwasher, the principle of biomimetics – technology used by nature itself
Daalhuizen: the computer, "but not in its current form, which is usually poorly suited to people's needs"

Favourite book/author
Badke-Schaub: *Hotel New Hampshire* by John Irving
Daalhuizen: Chaim Potok and Roald Dahl

What would prompt you to resign?

BADKE-SCHAUB: "If I was forced to stop my research or if I was forced to conduct research that I did not enjoy. Something involving dangerous products, for example, or unethical implications. Commercial research is in itself not a bad thing."
DAALHUIZEN: "If I was pigeonholed and not given enough freedom. In that sense, the university is a good work setting for me, even though I would like to work in the private sector. My knowledge is geared to actual practice. I would like to offer it to companies as a consultant, for example."

What professional developments have taken you by surprise?

BADKE-SCHAUB: "The term *design thinking* has now taken on an entirely different meaning. It used to refer to the thinking process within design; now it is a process whereby an organisation is pushed in a certain direction."
DAALHUIZEN: "I have been closely involved in teaching, and I never expected to find it so enjoyable. I really have the feeling that I'm helping others. I coach design students in dealing with uncertainty, for example. Design is indeed an uncertain profession. When you begin a design, you never really know how it will turn out. But you have to make choices at various stages of the process. That is difficult and people often put off making those choices. I can help them to move forward."

Who do you admire?

BADKE-SCHAUB: "People who dedicate themselves completely to something, working in developing countries for example or devoting their lives to helping others in some other way."
DAALHUIZEN: "In the field of science, I admire Frans de Waal. He's a biologist who is studying the bonobo. He remains modest and honest about what is possible to say about his findings and what is not. It's good to know your own limitations. The bonobo is also a special interest of mine. You generally only hear about their sex lives, but bonobo society is very interesting. It is based on entirely equal relationships. These apes are very social with a high degree of empathy."

Rebels with a modernist cause

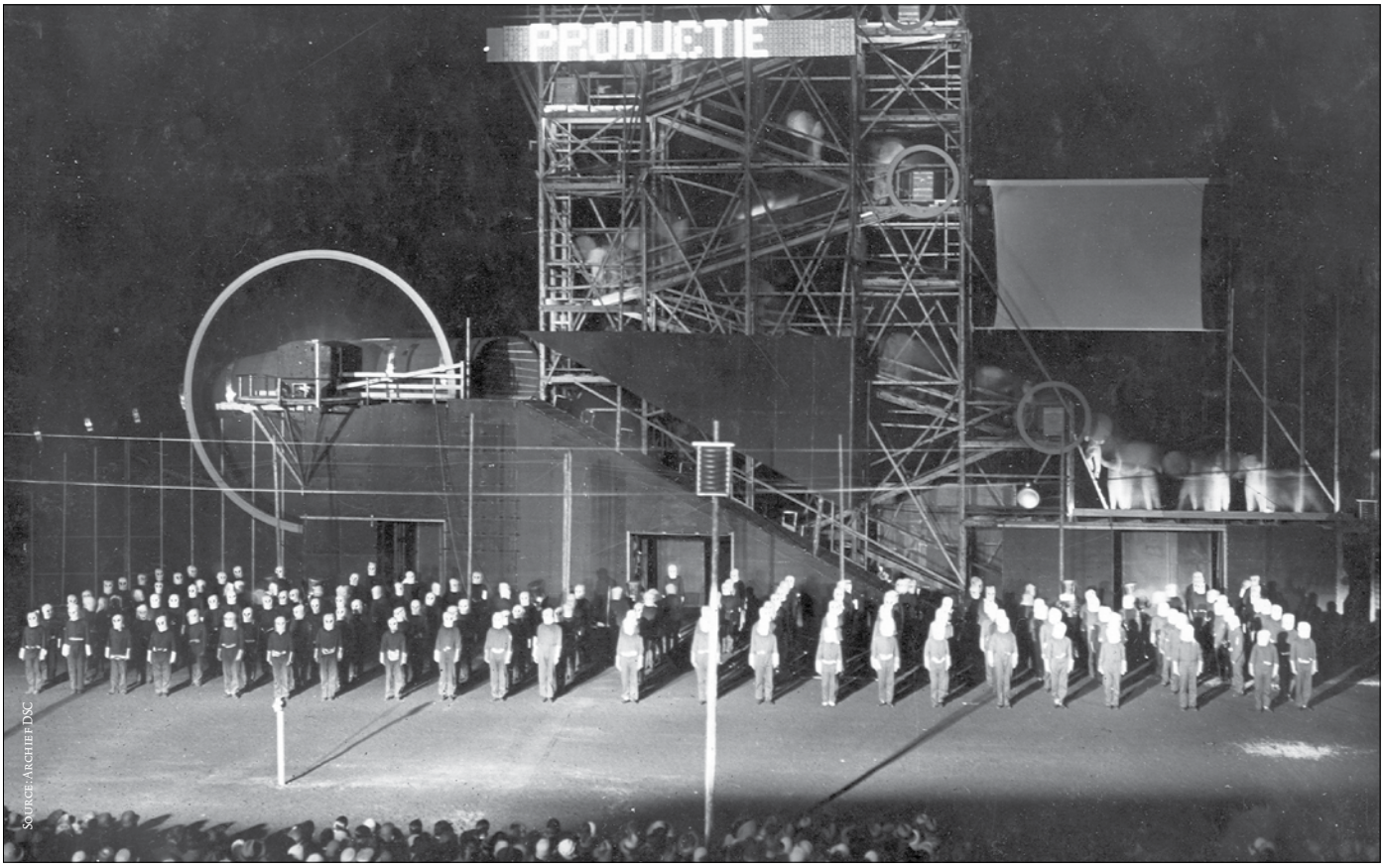
In the 1930s, a group of left-wing students rebelled against the traditionalists of the Delft School. Feelings ran high within the department of architecture.

Frans Godfroy

The clash of ideologies which so typified the period between the two world wars did not spare *Technische Hogeschool Delft* (TH Delft – the forerunner of today's TU Delft). The central figure was Professor Marinus Jan (Rien) Granpré Molière, the 'godfather' of the Delft School, which regarded Traditionalism as superior to all other architectural styles. Soon after his appointment as professor in 1924, he converted to Catholicism. Granpré Molière preached a 'true art' which must bear witness to God's plan. He dismissed modern art forms as 'passing heresy'. He pointed to mediaeval society, which he held up as the ideal Christian community. In his view, the degeneration of the arts had begun with the Renaissance, when attention turned to people and humanism. His condemnation applied not only to contemporary movements such as the *Neue Sachlichkeit* ('New Objectivity') in architecture, which he saw as only concerned with physical materials, but even to the Gothic style. Architecture, Granpré Molière contended, must return to the mediaeval harmony between God and the pious community which formed the basis of Romanesque architecture.

Following

Granpré Molière was a persuasive speaker. He also demonstrated a personal interest in his students, something which could not be taken for granted in his day. As a result, he enjoyed considerable popularity. The General Catholic Artists Society ▸▸



SOURCE: ARCHIEF TU DSC

The show Man and Machine of the Delfts Studenten Corps in 1928.

Jan Horatius Albarda

(AKKV), within which he systematically propounded his views, referred to him as 'the Leader'. He quickly gained an enormous following among Catholic architects. But there was also opposition. A group of dissidents led by Delft graduate Frits Peutz defended the standpoint that Christian principles should not dictate or exclude any style of art.

That Granpré Molière should attract support in the Catholic south was only to be expected. Far more remarkable was his influence on the national *Technische Hogeschool* in Delft. For many years, his ideas dominated the educational programmes of the department of architecture. According to Professor Jan Molema and Suzy Leemans, who have comprehensively researched this exceptional episode in our institution's history, the situation was exacerbated by the general atmosphere of conservatism which pervaded TH Delft at the time. A key role was played by the *Bouwkundige Studiekring* (Architectural Study Society; BSK), an elite club to which only religious believers – of various denominations – were admitted. It was symbolic that the society limited itself to twelve members, the number of Christ's apostles. Granpré Molière was its president.

The new Catholic fundamentalism within the department of architecture attracted opposition

But the new Catholic fundamentalism within the department of architecture also attracted opposition. A group of students with socialist leanings began to make their views heard. The *Delfts Studenten Corps* (DSC) was now in its second 'leftist' period. The first wave of socialist sympathies had been seen around the turn of the century, when members of the national SDAP (*Sociaal Democratische Arbeiders Partij*, or in English: Social Democratic Workers' Party) had visited the society and one Professor. Peekelharing had introduced students to the principles of Marxism. In the late 1920s, a second wave of social engagement took hold.

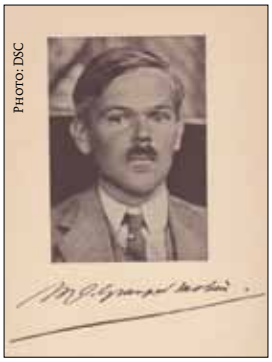
For its eightieth anniversary in 1928, the DSC organised a spectacular theatrical performance in Delft's city centre. Trees were removed to allow the colossal moving scenery, centring on a 9-metre wooden wheel, to be erected. The show was entitled *Mensch en Machine* (Man and Machine), written by the avant garde film director Mannus Franken. It had a cast of hundreds of Delft students. Various prominent figures in the arts, including cinematographer Joris Ivens, composer Leo Smit and actor Albert van Dalsum, also contributed.

Technology as a cultural problem was a particularly topical issue at the time, feeding both pessimistic and idealistic visions. The 1926 book *Mensch und Machine* by the Swiss socialist Eduard Weckerlé presented the socialist perspective as the solution. Franken's stage spectacular was directly inspired by that book, Molema and Leemans contend. They point to the opening chapter of the book, which recounts the story of how Prometheus audaciously stole fire from the gods and was chained to the rocks as punishment. They remind us that, at the time, Prometheus was one of the symbols associated with TH Delft.

Censorship

One of the youngest participants was student-to-be Jan Horatius Albarda, the son of Johan Albarda, then an SDAP alderman in The Hague and later Minister of Public Works. Albarda senior had played a prominent part in the DSC's first 'leftist' period. From a very early age, Albarda junior wanted to become an architect. He had inherited his mother's talent for drawing and as a child had met many architects who visited the home of Alderman Albarda. They included Hendrik Berlage, who had been commissioned to design the Haags Gemeentemuseum. But it was Bernard Bijvoet and Jan Duiker who had the greatest influence on the young Jan. Their offices were next door but one to the Albarda home and it was here that they worked on their designs for the Academy of Arts in Amsterdam and the Karenhuizen in Alkmaar.

It was perhaps inevitable that Jan Albarda would become a member of the DSC, which by this time was almost as left-wing as Albarda senior. Indeed, Jan was an active member from the outset and during



Marinus Jan Granpré Molière


Henk Jan Brusse


Joost Boks

his time at Delft probably devoted more time to the society's activities than to the formal curriculum. It took him nine years to graduate! He was a particularly active member of the debating society *Vrije Studie*. This group would preface its meetings with screenings of films which had been refused general release. The screenings in the Highways and Waterways building were organised by the *Filmliga* (Film Society), of which the writer and cultural critic Menno ter Braak was an active member.
In 1929, there was a major political row when Professor Steger, a Catholic member of the Dutch upper house of parliament, attempted to ban the use of a government-owned building to show films which allegedly undermined the government. This was pure censorship, claimed *Vrije Studie* and its supporters. The situation led to running battles with the police on the streets of Delft, the expulsion of a DSC member from the university, and the film society being banned from all TH Delft buildings. The conflict typified the ideological battle between the political and religious factions of the day.

Boycott

In 1930, Jan Albarda and several friends from another study society, the *Gezelschap Practische Studie*, launched yet another controversial activity: the 'international study programme in new architecture'. The co-initiators included Henk Jan Brusse, son of the progressive Rotterdam publisher Wim Brusse, and Joost Boks, who would go on to design several prominent buildings, such as the *Bouwcentrum*

In 1929 there was a major political row

in Rotterdam. With their programme, Albarda and his friends wanted to confront the official line of the architecture programme at TH Delft with the new movements in architecture. In December 1930, they organised a three-day meeting in the Highways and Waterways building to which they invited the leading names in modern architecture: Adolf Behne, Marcel Breuer, Walter Gropius, Gerrit Rietveld, Willem van Tijen, Jan Buijs, Cor van Eesteren, Han van Loghem and André Lurçat, all leading lights of the recent third *Congrès International d'Architecture Moderne* (CIAM) in Brussels. They proved more than willing to share their ideas with TH Delft's students.
However, official representatives of the architecture department were conspicuous by their absence. On

The book of Jan Molema and Suzy Leemans was presented in Delft on June 7, the centenary of Jan Albarda.

He had nothing good to say about the official programme

the instructions of Granpré Molière, the department boycotted the international programme altogether, although a number of professors did attend in a private capacity. No reports of the meeting exist, and neither is there any group photo of the participants. However, an article by CIAM member Piet Zwart which was prompted by the meeting and which appeared in *Het Vaderland* on 7 December 1930 does give an impression of the prevailing atmosphere. Zwart fulminates about the 'one-sided' nature of the Delft curriculum and stresses that the meeting should be seen as a demonstration against "the nature of the lectures and the leadership provided by the professors."
Nevertheless, the powers-that-be within the department saw no reason to deviate from their God-given course. Before long, the students once again voiced their protests. Just over a year after the international meeting, on 3 April 1932, Henk Jan Brusse gave a lecture to the *Gezelschap Practische Studie* on behalf of 'The Group'. According to Molema and Leemans, who have researched the episode in great depth, 'The Group' revolved around the three initiators of the international meeting and had approximately ten other members.
The text of Brusse's lecture, entitled 'What we want', has been preserved. It is in the nature of a forceful manifesto which defends the right to modernity. ▸▸

Brusse once again examined the topic of 'man and machine', and in the tradition of the social democrats called for a middle road between the 'machine worshippers' and the 'machine haters'. He concluded that contemporary architecture should reflect the resulting new social relationships. His closing remarks were, "The young do not hate the old but the false pathos. They have inherited a world which has claimed, cherished and lauded all sorts of ideals, wisdom and aesthetics... and which has left them chaos."

War

It is these final, rather prophetic words which form the legacy of the DSC rebels. Soon, the dark clouds of national socialism would form over Europe. The Second World War turned the lives of the Group's founders in entirely different directions. Henk Brusse joined the resistance, was captured and perished in Groß-Rosen concentration camp on 29 November 1944. After the war, the priority was reconstruction. The stark contrasts between the modernist and traditionalist ideals threatened to stand in the way of this essential process. Conciliatory conferences were held, which were successful in as much as a workable division of assignments between the 'modern' and 'traditional' architects was agreed. Jan Albarda was still trying to find his niche. There was no shortage of work, but he did not feel comfortable with what he was being asked to do. In 1951, he and his family emigrated to Canada, where he established himself as an independent architect and harpsichord builder. Joost Boks enjoyed some success as a modernist Dutch architect.

SOURCE: ARCHIVES ALBARDA FAMILY

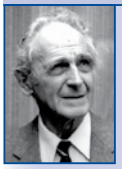
A design of Jan Albarda for a boardroom of a factory.

More information:

Jan Molema and Suzy Leemans, *Moderniteit in een behoudende omgeving. Jan Albarda en de Groep van Delft*, [Modernism in a conservative environment: Jan Albarda and the Delft Group]. Heijningen 2010.

Jos Pouls, *De kunstenaarsdagen van de Algemene Katholieke Kunstenaarsvereniging in Huijbergen* (1932-1940). Bakermat van de Delftse School', [The artists' days of the Catholic Artists Society in Huijbergen, 1932 – 1940: birthplace of the Delft School], in: *Trajecta, Vol. 2001 nos. 1 and 2*, Leuven 2001.

An overview of the most important awards, appointments and other remarkable personal milestones at TU Delft



The founder of the student rowing club Proteus, **Gerrit Athmer**, died on 29 March, aged 88. His idea of a club that combined competitive rowing with rowing for fun led to the establishment of the *Virgilius Roei Vereniging Proteus* rowing club on 7 July 1947. In 1970, Proteus merged with the open student rowing club Eretes.

After 22 years, **Professor Jan Vambersky** has retired from his position as professor of structural engineering in the faculty of Civil Engineering and Geosciences. In his farewell speech on 14 April, he highlighted what he called 'a ticking time bomb in construction'. "Our increasing demand for high-tech gadgets in our homes and offices has led to a growth in the number of specialisms. Some architects are keen to defy the laws of nature. These developments also mean that builders need to pay more careful attention to the structure of buildings."

On Thursday 29 April, two TU Delft staff members were awarded honours by the Mayor of Delft. Professor **Kemal Hanjalic** was named 'Officer of the Order of Oranje-Naussau'. **Yoka Boshoff** became 'Member of the Order of Oranje-Nassau'. Hanjalic, a former Mayor of Sarajevo and Minister of Science in Bosnia-Herzegovina, received the distinction in part for his work as professor and head of the thermo-fluids section at the faculty of Applied Sciences. Yoka Boshoff of the Botanical Gardens was honoured for establishing the Museum Shop and for her work over many years organising international trade fairs and technology days.

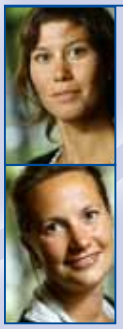
In April, TU Delft PhD student **Stephanie ter Borg** (1983) took her seat as a VVD (Liberal) member of the municipal executive in the municipality of Barendrecht. Her portfolio will include the controversial issue of CO_2 storage in empty gas fields in Barendrecht. The municipal authority, including the local VVD, opposes the move. Ter Borg studied constitutional and administrative law at Erasmus University Rotterdam and is conducting PhD research at the faculty of Technology, Policy and Management into the legal aspects of decision-making procedures relating to infrastructural projects.

In early May, **Professor Ben Immers** was appointed scientific director of the Trail Research School and professor of transport, infrastructure and logistics at the faculty of Civil Engineering and Geosciences. He is also professor of traffic engineering and infrastructure at the Catholic University of Leuven, works at the Traffic Management Expertise Centre and is an independent consultant.

This spring saw the appointment of **Professor Joris Dik** and **Professor Kristina Lauche** as Antoni van Leeuwenhoek professors. Dik's research at the faculty of Mechanical, Maritime and Materials Engineering focuses on layering in paintings. In the summer of 2008, he made world news after revealing a portrait of a woman hidden under Vincent van Gogh's painting 'Grasgrond' ('Patch of Grass'). Lauche works on innovation management at the faculty of Industrial Design Engineering. Her research includes work on the implementation of new ICT in mixed teams in the oil industry.

Dr Rami Barends (AS) and **Dr Roland Tóth** of the Delft Center for Systems and Control will both receive a Rubicon grant this year (a total of 33 grants have been awarded). This grant, awarded by the Netherlands Organisation for Scientific Research (NWO), offers young researchers the opportunity to gain research experience at leading universities abroad.

With effect from 1 June 2010, **Professor Raoul Bino** is standing down as Dean of Applied Sciences. He held the position for nine months. According to the Executive Board, Bino made the decision because his 'heart still lies in Wageningen'. The Executive Board has expressed its regrets but respects the Dean's decision. In view of the financial problems faced by the faculty, the Executive Board is keen to appoint a successor as soon as possible. In the meantime, **Professor Tim van der Hagen** will take on the position of Acting Dean.



On 15 April, TU Delft's 'Daisy team', comprising Elsbeth Geukers and civil engineering student Nicole Bakker (both 3mE), won the Philips Innovation Award (€15,000). The team developed the Delft Assessment Instrument for Strabismus in Young Children (Daisy) to measure the level of squinting in children. The procedure currently in use leads to numerous repeat operations (20 to 50%). Daisy is a faster and more accurate measurement technique.

[HORA·EST]

Propositions

Travelling should become a mandatory part of spatial planning education.
Tomas Daamen
CIVIL ENGINEER

Bright insights are best obtained when distracted from work.
Mick van der Wegen
HYDRAULIC ENGINEER

Taking economic affluence as the sole measure of human development is a serious – but common and persisting – blunder in rich countries.
Eduardo Margallo Balbás
ELECTRICAL ENGINEER

Not publishing negative results is an economic crime.
Martin van Vliet
BIOINFORMATIC ENGINEER

The term 'financial engineer' makes as little sense as 'financial carpenter'.
Ruud Binnekamp
CIVIL ENGINEER

The most important is honesty, knowledge comes subsequently.
Alina L.Barbu
MATHEMATICIAN

Women are more competitive amongst women than men are amongst men.
Mónica A. Altamirano
PUBLIC ADMINISTRATION ENGINEER

Long term policies are only possible when there is no fear of survival.
Mazhar Iqbal
AEROSPACE ENGINEER

[Sound]BITES

"The Army Corps of Engineers believes it is solely responsible for safety and not for overall management or for urban water management – that is something the local municipality must take care of and pay for. We should consider ourselves lucky that the Directorate-General for Public Works and Water Management (*Rijkswaterstaat*) is not a military organisation."
Professor of Urban Design, Han Meyer, in NRC Handelsblad

"A certain type of person works on the platforms. Strapping lads, sturdy fellows."
Professor of Offshore Engineering, Kees Willemse, in Trouw

"We give people a solid roof over their heads and this helps them to progress. It may be just a drop in the proverbial ocean, but it's a damn good drop."
Architect and TU Delft alumnus, Jip Nelissen, working in Haiti, in Algemeen Dagblad

"Half of the people who use the toilet in the train don't wash their hands. […] Even now, when they know they are being caught on camera, they still fail to do so."
Industrial designer, Marian Loth, in Algemeen Dagblad

"Will there ever be an alternative form of pricing for road transport? Perhaps not; it is apparently extremely difficult to keep politicians pointing in the same direction over several terms of office."
Professor in Transport Policy, Bert van Wee, in Trouw


PHOTO: SAM RENTMEESTER/FMAX

PROPOSITION
The most beautiful goal for scientists, specialised in waves, turbulence and numerical techniques, is the simulation of the flow of air through an organ pipe.

DEFENCE
"I'm passionate about playing the organ and have been since the age of 10. I mainly play French Romantic music. This proposition bridges the gap between my scientific work and my hobby.
"As I play, I like to imagine what is happening in an organ pipe. I have never simulated the air currents, but the work I do is definitely related: I conduct research into currents, waves and turbulence in river bends. I love the idea of doing a 3-D simulation of currents in organ pipes, but it's a challenging job and not something that you can do in a spare afternoon. After receiving my PhD, someone gave me a book about it as a gift. The people who do that kind of work really are diehard scientists."

Wim van Balen, RESEARCHER INTO CURRENTS

A TU Delft alumnus first writes a personal column, then passes the baton to another alumnus of their own choosing.

When I was a boy of just seven years old, I used to build entire churches from Lego. By the time I was ten, I had a folder full of building plans I had drawn myself. There seemed little doubt that I was destined to become an architect!
But things took an unexpected turn. My father, who had studied mechanical engineering at TU Delft, came home one evening with brochure about the industrial design programme. I was immediately sold. And I won a lottery enrolment place as well. That was in 1988. Well over seven years later (there was more to do in Delft than just study!) I was a fully-fledged industrial designer. Many of my contemporaries went into practice for themselves. That did not appeal to me: it seemed to me that the business side would leave very little time for actual hands-on design. Others went into consultancy, in innovation or IT for example. That was also not the direction I wanted to go. I really couldn't imagine doing anything other than designing good, attractive products. I graduated cum laude and the very same evening was offered my dream job by the design bureau with which I had done my graduation project.
But things took an unexpected turn. Four years later, I had the opportunity to start a design bureau together with a close friend. Suddenly, the entrepreneur's blood that I didn't even know I had started to surge through my veins. We managed to find clients, we designed good and attractive products, business was booming. I saw a future for myself as the head of a major industrial design office.
But things took an unexpected turn. I started to become more and more interested in why our clients wanted the products they did. I could design a good product for them, but what was the role of that product in their business strategy? How did the product fit in with the company's brand and portfolio, and what was their long term vision with regard to innovation? To find answers to these questions, I decided to return to university, enrolling in a two-year course in design management. I graduated in 2005 (again cum laude), bade my business partner a fond farewell (we're still very close friends) and started all over again. This time, I launched a consultancy specialising in what I term 'brand driven innovation'. I help companies to innovate in a way that is customer-focused and really matches their corporate culture and objectives. The approach is based on their brand vision and results in useful new products or services.
Today, five years later, business is once again booming. I have written a book about what I do for a Swiss/English publisher and it will be released in August. And I lecture part-time at TU Delft. I'm doing precisely what I could not imagine myself doing 15 years ago. And I sincerely hope that 15 years from now I shall be doing yet more new things which I cannot imagine today.
Oh, and I have never had a moment's regret that I didn't become an architect. I married one and that's even better!

Eric Roskam Abbing studied Industrial Design Engineering at TU Delft from 1988 to 1995. He is the founder of the consultancy Zilver brand driven innovation. Roskam Abbing now passes the baton to Rik Wuts, marketing director of Intivation in Nairobi.

The Dutchess of Delft

Photo: Sam Rentmeester/fmax

Robert Visscher

The 'granny bike', also known as the 'sit-up-and-beg bike', is a true Dutch icon. Throughout the Netherlands we hear the sound of loose mudguards flapping as cyclists negotiate the cobbled streets. Side by side they stand in the cycle racks, their handlebars tangled together. Industrial designer Wytze van Mansum decided that, after so many years of faithful service, the granny bike was due a worthy successor. As his graduation project, he designed the 'Dutchess'.
The result is spectacular. The characteristic curved crossbar of its predecessor remains, but the rest of the bike has a high-tech, elegant appearance. Van Mansum designed the Dutchess for the American manufacturer Cannondale. "They were looking for a city bike designed specifically for women. There are not many women's models on the market because only a quarter of American women actually cycle. Most Americans buy sports models. I retained the curved crossbar because it gives the impression of sturdiness and demonstrates that you're supposed to sit upright rather than leaning forwards as on a sports bike. This hidden message makes clear the difference between everyday city bikes and the sports models."
In Van Mansum's streamlined design, flapping mudguards are a thing of the past. "Another feature is that the handlebars are retractable, which solves the problem of them becoming entangled," he explains. "I spent seven years working part-time in a bicycle repair shop, so I know all the things that irritate cyclists most, like, for example, brake cables that break when they catch on the handlebars. I've moved the cables inside the frame, although this was also partly because I wanted to create a minimalist design."
The likelihood of broken lamps has also been reduced, since these too form an integral part of the frame. Van Mansum decided to do away with the traditional chain in favour of a drivebelt, and this too is hidden inside the frame: "For many people, it's a mystery how the bicycle is actually propelled!"
It remains unclear whether Cannondale will market the improved 'granny bike' in America. "But if they do, it will be sold in fashion stores," Van Mansum says. The Dutchess has already been hailed as a design classic. A prototype was featured in an exhibition at Rotterdam's De Kunsthal.

More information:
www.vanmansum.nl

WHO & WHERE

Delft University of Technology has eight faculties, each of which is engaged in education and research in one or more disciplines. The University was founded in 1842 by King William II. With 13,000 students, 2,800 scientific staff members and 2,000 technical and administrative employees, it is the largest university of technology in The Netherlands.

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Central Library

Delft University of Technology Library (dutl) supplies information and provides services, particularly in the area of the technical sciences. It comprises a central library and twelve sub-faculty libraries housed at the respective sub-faculties and institutes. The dutl is intended for students and staff at the Delft University of Technology. However, as the task of the library is to provide scientific and technical information at a national level, its facilities are also available to the general public. As well as all areas of technology and natural sciences, the library also contains a general collection in the social sciences, economics etc. This relates not only to books or periodicals, but also to standards, reports, reference works and congress proceedings. Literature not in the collection or not on hand can be obtained through Delft University's Central Library from other libraries in the Netherlands or abroad.

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General information on university education in the Netherlands:
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