2008.3

Research and education at
Delft University of Technology

Delft Outlook

Blowin' in the wind

The latest research tunnel

Spy in a cigarette pack • **Sleeping Beauty awakes**

Dyeing without water • Rocket caterpillars • **The art of drinking tea**

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Delft Outlook

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Being prominent in society. In an academic setting, this sounds like some modernistic mission statement. Yet prominence has long been a distinguishing feature of TU Delft. Countless citizens of Delft, as well as visitors from faraway lands, have strolled through the Botanical Gardens over the past one-hundred years, and in so doing have learned about the wonderful scientific world of botany. For centuries a procession of TU Delft trained architects brought brilliance to the position of Government Architect, a position filled last month by TU Delft alumnus Liesbeth van der Pol.
Remaining prominent is the message. TU Delft is always constructively leading from the front. Recent examples are the micro air vehicle Delfly, the Open Jet Facility wind tunnel, TU Delft's hydrogen racing team and the magical appearance of Van Gogh's painted-over portrait of a farmer's wife.

Frans Godfroy,
Editor-in-Chief

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COLOPHON

coverphoto

Photo: Sam Rentmeester/fmax

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The sound of scrap

Photo: Tomas van Dijk

The promising separating magnet that was developed a few years ago by Dr Peter Rem will in future actually be used to grade plant seeds as well. A technique using acoustic scans will refine the process further.

Lecturer Dr Ir. Maarten Bakker, who was recently appointed to the Faculty of Civil Engineering and Geosciences, will be using sound waves to visualise the way in which particles of scrap are separated. The process takes place in an opaque liquid containing iron oxide nano particles.
A solution of iron oxide nanoparticles flows across a conveyor belt, below which a strong magnet is fitted. The nanoparticles closer to the magnet will be attracted more strongly, locally increasing the effective density of the liquid. This gives the liquid its separating capability. The higher the density of the scrap, the more it will sink into the liquid."
"Based on the reflections of the sound waves we should ultimately be able to work out what the various particles are made of."

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Dented apple

The Goce satellite, which was launched on 10 September, will be charting irregularities in the Earth's gravitational field in order to make changes in sea level easier to predict. Doctoral student Ir. Hugo Schotman has been analysing the sensitivity of the satellite.

All things considered, the Earth is more like a dented apple than a sphere. As it turns out, gravity varies quite a bit from place to place. Local gravity is expressed as the difference between the actual sea level and the sea level that would occur if the earth's distribution of mass were homogenous. If you project these differences in height in the globe, the bumps and dents of the gravitational field become apparent.
These irregularities are often the vestiges of the Earth's geological past, for example of the last ice age, which peaked around 20,000 years ago. Hugo Schotman did his doctoral research under the supervision of Professor Ir. B.A.C. Ambrosius (Aerospace Engineering). In his thesis he explains how, under the weight of several kilometres of ice, the Earth's surface flexes like a gel-filled bicycle saddle under the pressure of a thumb. Right below the pressure point the surface is pushed down but on either side the surrounding surface becomes raised. When the ice melted the opposite happened with the surrounding landscape sinking back while the former ice plain flexed upwards. The latter takes place so slowly that Scandinavia is still rising at a rate of approximately one centimetre each year.
The European Goce satellite (Gravity field and steady-state Ocean Circulation Explorer) focuses on rock flows in intermediate (less than 200 kilometres deep) strata. Schotman compares these zones with a jam sandwich. The jam is easily squeezed out by pressure, but doesn't flow back as readily. The ESA satellite with its high sensitivity is expected to provide a gravity field map of previously unheard of detail with a resolution of 100 kilometres. It will be very useful to help improve predictions about local sea level changes.

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IN•BRIEF

Underwater detection

A police dog and a formula devised by civil engineer Reinder Bil can pinpoint the position of a body underwater to within a few metres.

The usual way of finding underwater bodies in the Netherlands is to use sniffer dogs at the water's surface. The dogs are trained to bark at the merest whiff of a corpse. In practice however, the body's location on the bottom can be hundreds of metres away from where the dog starts to bark. The flow of the water and the wind spread the scent in an unpredictable way.

Photo: KLPD

Or at least, they did until recently, for a formula devised by civil engineer Reinder Bil can now be used to accurately calculate the location of a body to within a few metres. The police dog still acts as the detector. A team in a boat takes the dog on the water, travelling both upstream and downstream, each time recording as accurately as possible where the dog starts to bark. Those two points and the depth of the water are enough to calculate exactly how far upstream the body is lying on the river bed. According to Bil the main source of inaccuracy in the result is the recorded position of the dog when it responds.
Graduation supervisor Dr Ir. Wim Uijttewaal estimates the precision of the method to be about ten metres. That is quite an improvement, as without the calculation trick, estimates often turn out to be a hundred metres off, or the body remains undiscovered. It is estimated that only about one in every ten bodies underwater is ever found.
If the formula really makes drowned persons easier to find, the police intends to introduce the method with the national dredging team, according to Leendert Amersfoort of the National Police Services Corps.

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Robo-race

Flame may not be much good at soccer yet, but he can make a dash for it. This summer the robot, which was developed at TU Delft, took second place at the RoboCup Soccer 2008 event in China, in the 'fastest across a field' category. "The aim is to defeat a human soccer team with a robot team in 2050," doctoral student Ir. Tomas de Boer says. He is in charge of the scientific support for the student team, which is about thirty strong. The human robots are still too vulnerable to be any use in a real soccer match.

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Photo: Lennart Middelplaats

Measuring the repairs - DNA

For the first time, researchers at the Kavli Institute of Nanosciences have measured the DNA repair process on a single DNA molecule in real time.

The scientists of the Faculty of Applied Physics are making the leading science periodicals with their molecular research on the processes of life, together with their colleagues at the Erasmus Medical Centre and the Cancer Genomics Center. Their research paper was published in the scientific publication, Molecular Cell of 23 May 2008.
Professor Dr Cees Dekker (molecular biophysics, Applied Physics) likes to compare the curled DNA molecule with a telephone's spiral flex. For the experiments, a single DNA molecule was mounted between a sheet of glass and a magnetic bead (one thousandth of a millimetre in size) which the researchers could rotate using magnetic fields. As the spiral was unwound, so the researchers found, the DNA grew in length. The position of the bead reveals the length of the molecule.
The scientists discovered that after adding DNA with repair protein, the repair process makes the DNA molecule slightly longer (about one thousandth of a millimetre). This indicates that the protein causes the strand of DNA to be wound less tightly. They were also able to ascertain that the active part of the protein is only eight base pairs (genetic letters) long, and that the protein takes about ten minutes for the whole process, from attaching itself to the DNA to detaching again.
In another publication researchers from Delft and Leiden gave a step-by-step demonstration of how the DNA ligase protein repairs breaks in the double helix. Their research appeared in the scientific publication PNAS on 19 June 2008.
The genetic material in cells can be damaged by a variety of factors: sunlight, chemicals, infections, radiation, or simply the process of ageing. It is essential that such damage be repaired as quickly as possible. DNA normally gets repaired in a fraction of a second (about 5 milliseconds), but by cooling the whole process to a temperature of -33 degrees Celsius the researchers managed to slow down the process to the point where they could follow it step by step.

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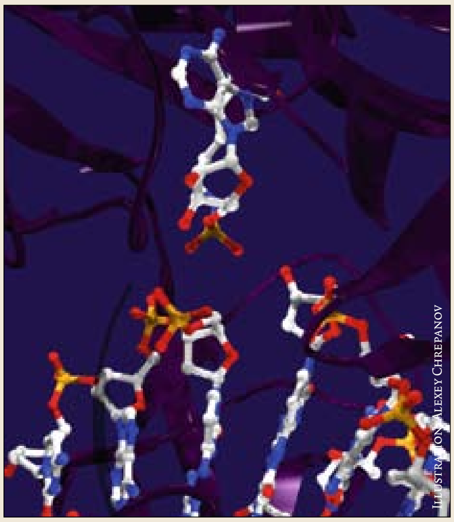

Illustration: Alexey Chrepanov

Artist's impression of a DNA strand being copied.

Photo: Anke Kempen

Custom ride

The carbon fibre wheelchair used by athlete Kenny van Weeghel to participate in the Beijing Paralympics was designed by Ir. Anke Kempen, who recently graduated from Delft University of Technology. She made the wheelchair together with the Infinious company. At the Paralympics Van Weeghel will be competing in the 100, 200, and 400 metres wheelchair sprint events. "The wheelchair was entirely made to measure; we built it around him," Kempen says.

IN•BRIEF

Own energy source

Far below Delft there are steep mountains of porous 'Delft sandstone', which are full of hot water. TU Delft intends to dig a two-kilometre deep well to extract energy from it.

The water has a temperature of seventy to eight degrees Celsius. It is located right below the university campus and forms a practically inexhaustible and environmentally friendly source of energy. Last year, as the Faculty of Mining celebrated its 115th anniversary, a group of mining students decided to investigate ways of putting this geothermal energy to good use. "We wanted to come up with a real stunt," student Douglas Gilding recalls. The stunt, which was named 'Delft Geothermal Project', could save Delft university no less than 4.9 million cubic metres of natural gas each year. "It is also a good demonstration project for sustainable energy in our own backyard," says rector Professor Dr. Ir. Jakob Fokkema, who welcomed the project. The university is currently trying to secure permission to extract the energy from the Ministry of Economic Affairs.

The project ties in with the plan launched by the town of Delft to set up a heat network. In a few years' time, new houses in Delft are to be heated using the residual heat from factories in the vicinity. This will require an extensive network of pipelines to be constructed, as well as a combined heat and power station. "The hot water that will flow through these pipes can be supplemented very nicely by the geothermally heated water," Gilding says.

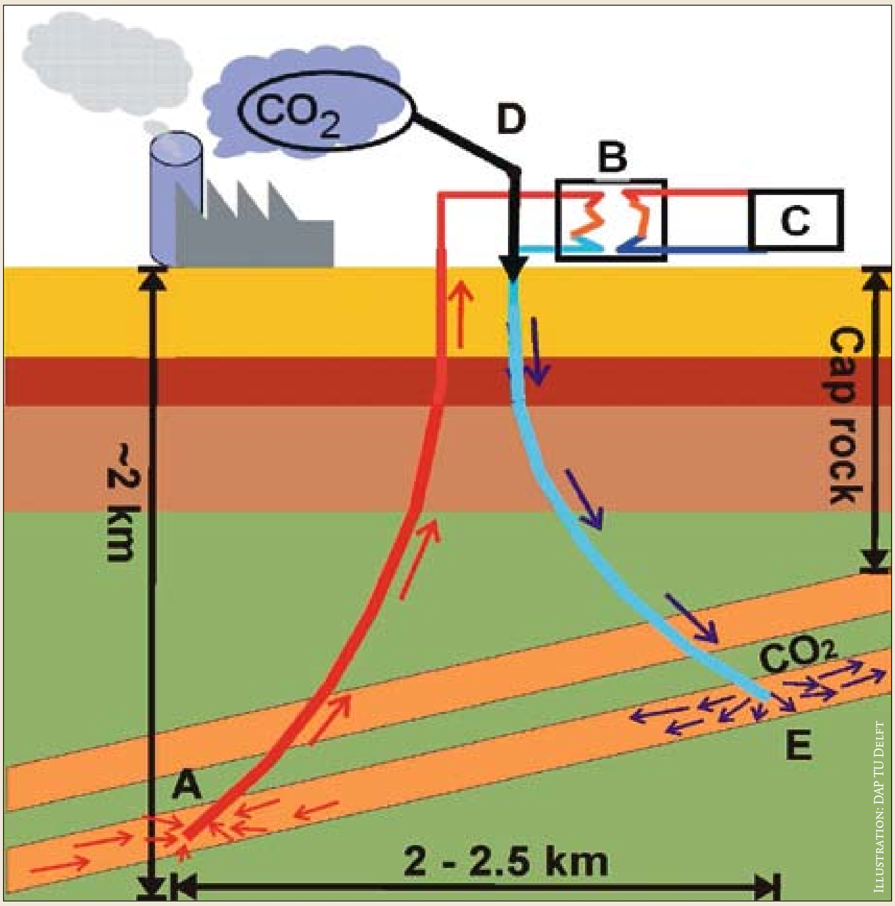

Illustration: DAP TU Delft

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Launch of the rocket caterpillar

Five rockets and a cherry picker were needed to ensure that all 46 CanSat mini satellites made their maiden flights this June. A real party for science buffs at the Dutch army range 't Harde.

No tanks or artillery, just five slender, bright red rockets, an egg yolk yellow cherry picker, and all over the place party tents with groups of school children working earnestly to complete the final checks of their project: a mini satellite packed in a soda can and about to show what it can do.
The CanSat competition was launched in November when starter kits were distributed to teams of interested secondary school children. The kits could be used by the children to build an instrument that uses a transmitter to send altitude and temperature data back to base. The challenge lay in trying to add just that little bit extra. This resulted in a caterpillar to explore the landing site, gps receivers, and fine dust measuring equipment.
At the army range, the ten best entries will be launched in a rocket, reaching an altitude of one kilometre in twelve seconds, where they will be ejected. The rockets were built by students at Dare, a TU Delft academic association. The remaining satellites will be dropped from a height of seventy metres by a cherry picker to return to earth dangling from a parachute. In those few seconds the instrument will have to prove its worth.
The team of the Randstad school in Rotterdam secured the first prize, a zero G flight with the TU Delft laboratory plane.

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A farewell kiss, and then the work of months is loaded into the rocket.

Safe radiation

Proton radiation is more effective in the fight against cancer than x-rays. Dr Enrica Seravalli reduces the risk.

Doctors who have a three-dimensional image of a tumour can use a computer programme to create a proton beam that will accurately irradiate the tumour. The computer calculates the amount of energy each of the different beams in the bundle should have.
The equipment is always tested before use, in most cases on a proton-sensitive film. A water-filled bellows is placed between the proton bundle and the film to simulate human tissue. By varying the thickness of the bellows and each time recording the pattern of light on the film, a three-dimensional image is obtained of the destruction the proton beam would cause in the actual tissue.
"The problem is that at a certain point the film becomes saturated," Seravalli says. "which causes the image to be distorted." The researcher, who recently obtained his doctorate in Applied Physics, developed a more accurate test method, which uses a light sensor and a gas that lights up when irradiated.

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Hidden face

For a few moments the art world was in turmoil. This summer, materials expert and art historian Dr Joris Dik of Delft University of Technology conjured up a woman's face, right down to the smallest details, hidden behind Vincent van Gogh's painting, 'Patch of Grass'. This is the first time a repainted piece of art has been be recreated with such accuracy.
Hidden layers of paint are normally revealed by means of conventional x-ray radiography. In collaboration with experts of Antwerp University, the German Electron Synchrotron in Hamburg, and the owner of the canvas, the Kröller-Müller Museum, Dik decided to use a different approach. He irradiated the painting with an x-ray beam produced by a synchrotron radiation source. He then measured the fluorescence of the paint layers. What makes this technique so useful is that each chemical element has its own specific fluorescence. This means that every type of pigment can be detected and its position exactly mapped. The synchrotron radiation offers the added advantage that the covering layers of paint interfere less with the measurements. In addition the measuring speed is high, enabling relatively large areas to be visualised.

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Blowin' in the wind

The new Open Jet Facility wind tunnel, which is scheduled to blow its first wind on 24 October, has been a project in the mind of designer Nando Timmer for over twenty years. "I have had moments when I thought it was never going to happen."

Jos Wassink

"Open Jet means that the airflow is unrestricted," says Professor Dr Ir. Gijs van Kuik (Aerospace Engineering), the scientific director of the DUWind wind energy research institute. "This makes the tunnel ideal for research on wind turbines. Turbines are made to stop as much air as possible, but in an enclosed tunnel this leads to all kinds of problems."
Asked about the unique properties of the tunnel, aerodynamics professor Dr Ir. Leo Veldhuis of the Faculty of Aerospace Engineering says: "It is first and foremost a research tunnel. Three-quarters of our time will be spent on exploratory research and teaching. Other tunnels are too expensive for that."
The designer of the tunnel, Ir. Nando Timmer, also of Aerospace Engineering, is relieved the project has come to fruition at last. "Fortunately I had a lot of other work to get on with," says Timmer, putting the long wait into perspective. It was anything but certain that the promised wind tunnel would be built at all.

Sawdust

Opposite the high-rise building of the Faculty of Aerospace Engineering stands the high-speed laboratory with wind tunnels for transonic and hypersonic airflows. This summer a brown extension to the low building is receiving the finishing touch. This shed accommodates the Open Jet Facility. Inside the air smells of chipboard and the floor is strewn with sawdust and power cables. Veldhuis zigzags between the tools to show the inside of the tunnel. Dark brown chipboard panels form a tapering space that gives onto an enormous fan inside a cage. It's just as well that the fan isn't turning yet. The monster

'You name it and they'll test it in a wind tunnel'

contraption will soon be powered by a 500 kW electric motor, accelerating the air to speeds of up to 35 metres per second (over 120 kilometres per hour). After the fan the air passes through two sets of angled vanes that divert the air through two successive 90 degree left angles. The blast then passes through a taut mesh the size of a theatre curtain. Its purpose is to reduce speed differences in the airflow, fast-flowing air encountering more resistance than its slower counterpart. The air then passes through a set of horizontal and vertical vanes, the flow rectifier, which evens out the airflow by preventing lateral flows. At the end of the settling chamber, in which the air is allowed to expand, a funnel-like structure directs the air into the octagonal, 2.85 metre diameter jet pipe. This sits at the top of a 6.5 metre wide hall, at the end of which, fifteen metres downstream, a giant cooling radiator spans the full height of the hall. This device, which consumes 350 kW, extracts the heat from the air before another two sets of angles vanes direct it back to the fan.
"At full power, which we seldom use, we can run the facility for about an hour," Timmer estimates. After that, in spite of the cooling system, the air gets too hot (over 40 degrees Celsius) for the comfort of experiments and researchers alike.

Professor Calculus Heath Robinson

Nando Timmer joined the wind energy group at the Aerospace Engineering faculty in 1984 under the supervision of Professor Dr Ir. Theo Holten (who has since achieved fame with his ornicopter design). For wind energy research, an old wind tunnel, known as 'the blow-pipe', had been procured in 1980 from TNO-IWECO. The device, which has a certain air of the TinTin comic strip character Professor Calculus about it, ended up in a hall of the high-speed laboratory. Perhaps the most famous experiments to be carried out in it were the tests on aerodynamic ice-skating suits and the development of the storm-resistant Senz umbrella. Wind energy research in this tunnel has resulted in a number of doctorates and improvements to design rules for wind turbines. Its diameter of 2.20 metres proved too small for more extensive research however, so a new wind tunnel for wind energy research was needed. At the time the Ministry of Education and Sciences realised the merits of wind energy research at TU Delft and in 1986 invested one million guilders in the plans for the tunnel. The money would remain sitting in the bank for the next twenty years.
The first design Nando Timmer made in 1987 was for an extension to the High-Speed Laboratory at the Kluyverweg, with a steel return section outside the building proper. The Aerospace Engineering faculty vehemently opposed the idea, and a few years later the wind energy group moved to the Civil Engineering faculty building. Initially (a early as June 1989) a new building behind the Civil Engineering building was considered, but at 3.1 million guilders this was way over budget. A year later it became known that the Stevin II hall – behind the Civil Engineering Building – would become available. Timmer adapted the plans to fit the existing hall and devised a vertical wind tunnel with a reflow section through the basement. It was a beautiful plan, but it had to be abandoned when the hall turned out to have been assigned another purpose after all. Almost immediately after that (in January 1991) the Stevin I hall became available. Again the joy turned out to be short-lived when major alterations proved necessary. In 1994 the old blow-

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Photo's: Sam Rentmeester/fmax

pipe was rehoused at the Leeghwaterstraat, near the Low-Speed Tunnel (LST, also referred to as LTT), which dates from 1953. Since 2000 Timmer had been making plans to separate the jet flow and the reflow along the walls, first by means of screen running parallel to the jet flow, then with angle vanes at the end of the hall to redirect the air back to where it came from. He then decided that it would be more practical to have the return air flow along one side, and in 2003 the design for an open jet wind tunnel was finished.

But then (2004) the position of the wind energy group again became the subject of debate. The Faculty of Civil Engineering wanted to move the group, which by now was being headed by Professor Gijs van Kuik, back to the Faculty of Aerospace Engineering. To Van Kuik the move to Aerospace Engineering felt like coming home. The faculty welcomed the idea of a new open jet wind tunnel, although it would be required to blow a bit harder (up to 35 metres per second) and would have to provide room for experiments on objects other than wind turbines alone. And so it came about. Timmer adapted his last design and fitted it into the original location. And there it now stands, the Open Jet Facility, at a cost of approximately 1.8 million euros, excluding the extension.

Flaps

"This is going to be the first subject for the new tunnel," says Gijs van Kuik, who is now scientific head of the DUWind wind research institute after Professor Dr Gerard van Bussel has succeeded him as professor of wind energy. Van Kuik means the dynamic rotor blades. Sitting around the table are three doctoral students who are all researching the same subject. Ir. Thanasis Barlas (Aerospace Engineering) is doing the aerodynamics, Ir. Jan Willem van Wingerden (Mechanical, Maritime, and Material Engineering) is doing the control system, and Ir. Teun Hulskamp (Aerospace Engineering) is doing the structural part. All three fields are required for dynamically stabilising a wind turbine blade. The purpose of this kind of stabilisation is to drastically reduce variable loads in the rotor blades (up to ninety percent in theory) and thus reduce fatigue effects in the material. "All wind turbine manufacturers have to deal with these fatigue problems," Van Kuik says. Timmer agrees: "Fatigue is one of the main design problems in wind turbines. The rotors can be up to 126 metres in diameter. They are simply the biggest fatigue-inducing machines on earth." If you can reduce the variable loads, the blade can be made lighter – or bigger, to produce more power.

Van Wingerden can demonstrate the effect of dynamic stabilisation. With two of his doctoral students he positions a section of a reduced-scale turbine blade in the LST wind tunnel.

Professor Gijs van Kuik.

The blade is then rotated around its longitudinal axis to induce variable loads. A camera is used to monitor the blade, looking from the end towards the mounting. The blade clearly vibrates heavily in the airflow, moving to and fro by several centimetres. A switch is thrown and suddenly the blade stands practically motionless in the airflow. The switch is reset and the vibration starts again, as if by magic.

Smart Structure Rotors, is what Van Kuik calls the concept, and it works by using controllable flaps at the trailing edge of the rotor blade. "They are a bit like the ailerons on an aircraft wing, with without the complex hinges, hydraulics, and what have you." Just like in an aircraft wing controllable flaps on a rotor blade can increase or reduce the wind pressure on the blade. In order to stabilise the blade, the stress inside the blade is first measured. As it increases – for example as a result of a local gust of wind – the flap corrects the excess stress. And vice versa if the stress decreases. In the wind tunnel feedback frequencies of up to twenty times per second proved to work well. The flaps are controlled electrically by means of built-in piezoelectric ▸▸

Wind Tunnels at TU Delft

tunnel	location	built	diameter	wind speed
DCT tunnel	Julianalaaan		1 × 0.6 m	7 m/s
Blow-pipe	Leeghwaterstraat	1980		2.2 m Ø 20 m/s
OJF Open Jet Facility	Kluyverweg	2008	2.85 × 2.85 m	35 m/s
Subsonic Boundary Layer Tunnel	Rotterdamseweg		1.25 × 0.25 m	50 m/s
Low Turbulence Tunnel LTT	Leeghwaterstraat	1953	1.25 × 1.80 m	120 m/s
ST-4 Supersonic Wind Tunnel	Kluyverweg	1962	40 × 40 mm	Mach 0.5 - 3.0
ST-15 Supersonic Wind Tunnel	Kluyverweg		150 × 150 mm	Mach 0.7 - 3.0
ST-3 Supersonic Wind Tunnel	Kluyverweg		30 × 30 mm	Mach 1.5 - 3.5
TST-27 Transsonic Wind Tunnel	Kluyverweg	1962	28 × 28 cm	Mach 1.1 - 4.2
HTFD Hypersonic Wind Tunnel	Kluyverweg	1995	350 mm Ø	Mach 6 - 11

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elements, which curve according to the voltage that is applied across them. They are clad with foam and film to provide the smoothest possible integration with the blade.

The DUWind team is now working on a twin-bladed type of wind turbine with smart blades to be tested in the new wind tunnel. The wind tunnel tests will have to prove that the concept of the auto-adjusting smart structures can reduce the forces acting on the rotor blade. The next step will be to fit a set of smart rotor blades to a small wind turbine at the ECN wind energy test site near Wieringen. The wind energy group recently entered into a collaboration effort with Sandia National Laboratories in America. "They know all there is to know about blades," Van Kuik says. That will be useful to TU Delft. On the other hand the Americans are very interested in the concept of intelligent blades.

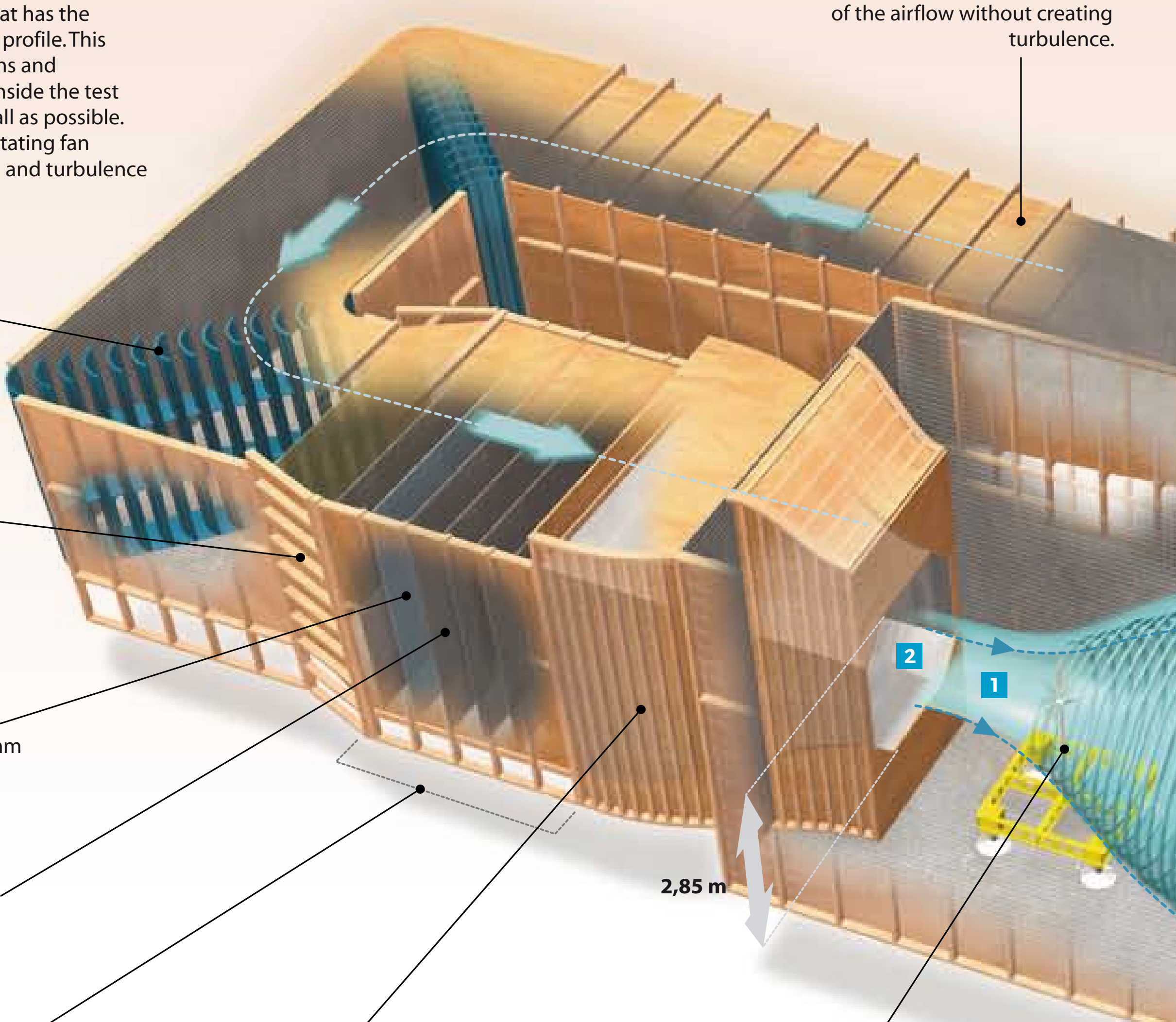
Research

"You name it, and they'll test it in a wind tunnel," Leo Veldhuis summarises the diversity of wind research. Depends on what one calls research, one supposes. After all, a television reporter standing in a wind tunnel to report on hurricane Katrina isn't exactly engaged in research journalism. It's a different matter though with models of trucks, umbrellas, badminton shuttlecocks (soon to become commercially available), a racing car spoiler, the Nuna solar car, a bobsleigh, wind between buildings, and a fireworks stand (how much wind does it take to blow over?). Veldhuis has a large portfolio of photographs that illustrate the diversity of research.

The new Open Jet Facility, OJF, will also be open for use by third parties, other faculties of TU Delft University and external customers, but its main purpose is to be used for teaching and

Smooth speed profile
The purpose of the tunnel is to subject a test object to an airflow that has the smoothest possible speed profile. This means that speed variations and turbulence in the airflow inside the test section 1 must be as small as possible. One problem is that the rotating fan introduces a lot of vortices and turbulence into the air.

Long diffuser
The diffuser increases the diameter of the airflow without creating turbulence.



Angle vanes
In each corner 17 to 18 vanes guide the airflow around the corner.

Short diffuser
Vergroot over korte afstand de doorsnede dankzij een gaas dat stromings-loslating tegen gaat.

Rectifier
A honeycomb mesh (9.5 mm hole height) smoothes the airflow by reducing transverse flows.

Anti-turbulence screens
Five square-mesh screens (mesh size 1 mm, wire thickness 0.2 mm) reduce local differences in speed.

Settling chamber
The aim of the open jet tunnel is to have a measuring section of 7 m² (2.85 x 2.85 m). Ideally the settling chamber should have a section of 84 m² (1:12 contraction). The actual section of the settling chamber is 22 m² (1:3 contraction) to keep down the size of the installation.

Primary contractor
Inside the contraction cone the air is accelerated rapidly up to a maximum speed of 35 m/s = 120 km/u. The cone's jet pipe 2 is octagonal in shape (2.85 m square). This is a compromise, since some experiments require a square section, while others need a circular section.

Closed versus open tunnel
In a closed wind tunnel a test object blocks the airflow as it passes through the tube, so the air has to be squeezed between the object and the wall of the tube. This causes the air to crash into the wall, disturbing the airflow around the object. In an open jet tunnel the test object is placed in a large space, allowing the air to move freely around it 3.

Test section
A test object of up to 2 m wide, e.g. a rotating rotor model, can be placed in the airflow to measure the forces acting on the rotor, or the vortex airspeeds in the wake 4 behind the rotor.

research. Veldhuis: "We do have some opportunities for other things between those main tasks, but I don't wish to create the impression that we need to make money out of this. We're not a commercial business."
Timmer agrees: "DNW (a wind tunnel company operating in Germany and the Netherlands, ed.) charges 4,500 euros for one hour in the Marknesse tunnel, and 50,000 for the one in Cologne. You can't do exploratory research at those prices; there simply isn't the money. At our place you can easily take a few days to tinker with your setup."
The first two European projects in which the OJF plays a part have already been awarded.

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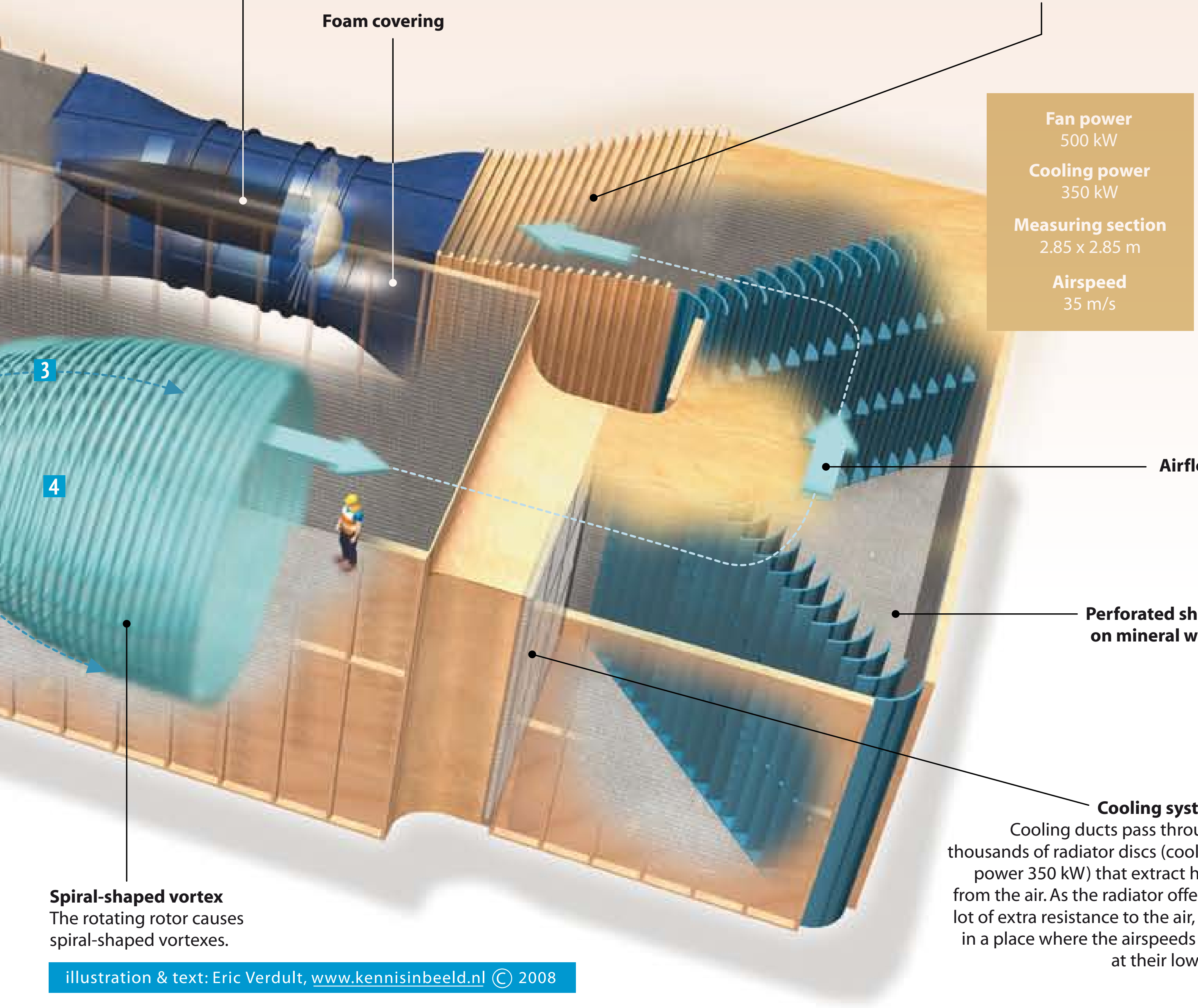
Fan
The open jet tunnel is a closed circuit through which a fan (driven by a 500 kW motor) pumps air. The fan needs to be kept turning to compensate for the losses caused by friction as the air hits the angle vanes, screens, cooling system, and tunnel walls.

Unwanted noise
The fan produces a lot of noise (100 dB) as unwanted turbulence is created in the airflow. To reduce the turbulence, the steel ventilator tube is covered with foam, and all the other walls and floors are clad with mineral wool covered by perforated sheets (to keep the wall's resistance as low as possible).

Secondary contractor
The secondary contractor accelerates the air as a step up to the acceleration in the fan. The speed profile needs to be as smooth as possible since an uneven profile will result in an even worse profile by the time the air emerges from the fan.



Fan power
500 kW
Cooling power
350 kW
Measuring section
2.85 x 2.85 m
Airspeed
35 m/s

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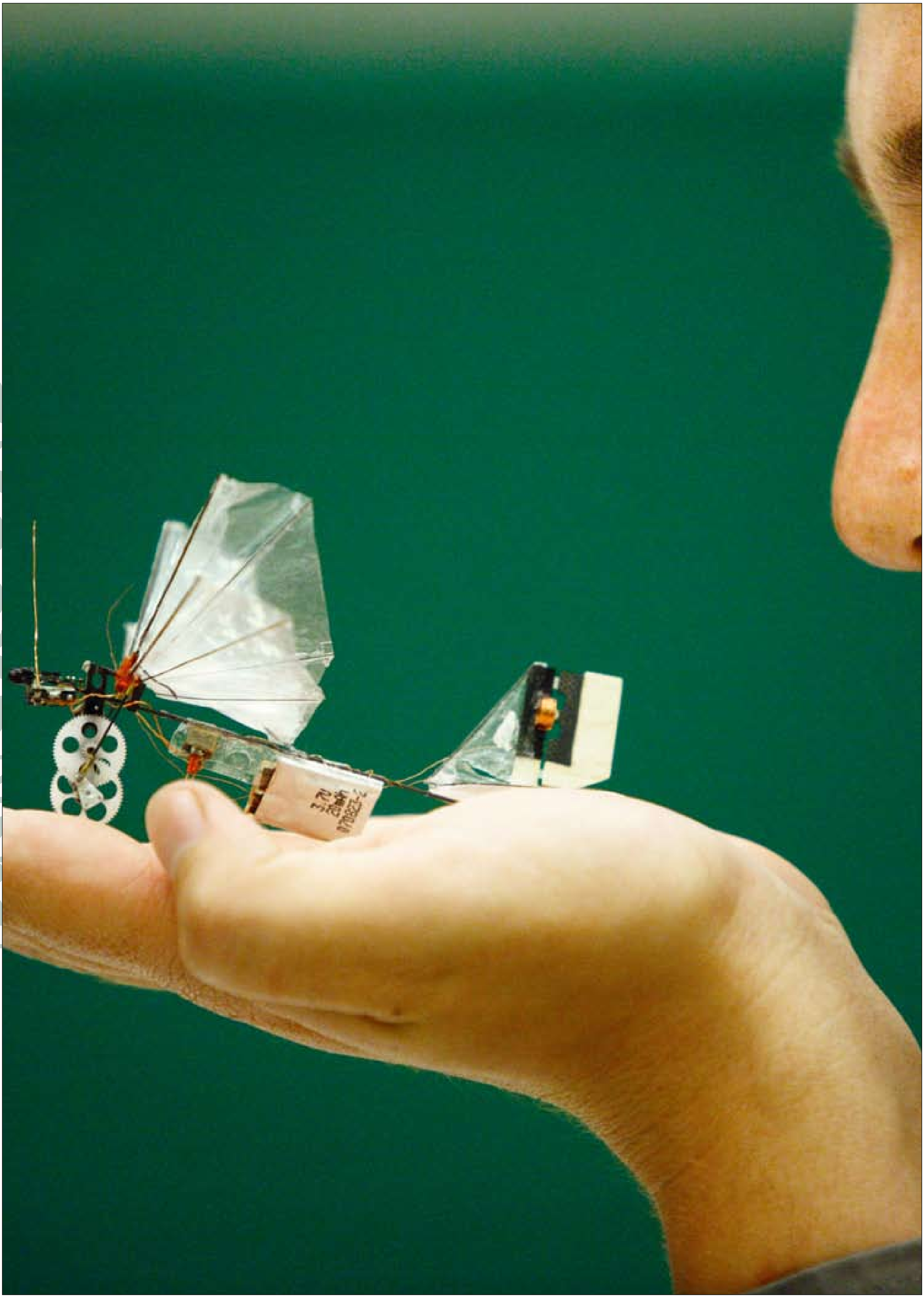
Spiral-shaped vortex
The rotating rotor causes spiral-shaped vortexes.

Cooling system
Cooling ducts pass through thousands of radiator discs (cooling power 350 kW) that extract heat from the air. As the radiator offers a lot of extra resistance to the air, it is in a place where the airspeeds are at their lowest.

[Back]GROUND



Born under a stereo microscope:

Detective dragonfly

The latest camera-toting flying spy and aid worker to come from TU Delft, the Delfly Micro, almost fits into an empty cigarette pack. This summer the micro air vehicle, which flies just like a dragonfly, flapped its wings for the first time.

Tomas van Dijk

The miniature camera, the size of a match head, was developed for use in keyhole surgery. In combination with a micro transmitter it weighs less than half a gramme. The camera is one of the 'heavy' loads the radio-controlled Delfly Micro aircraft has to lug along. With the ten-centimetre span of its two pairs of flapping wings the aircraft, which weighs only three grammes, comes close to a dragonfly in size.

When it was first aired to the press this summer at TU Delft's sports and culture centre, the minute aircraft crashed almost immediately when it flew among the reporters, obscuring the pilot's view. After straightening the PET film wings and realigning the DC brush motor, pilot Ir. Christophe de Wagter managed to keep the device airborne for a minute. With a light rattling sound like that of a large moth it flapped its laps through the sports facility.

The fragile-looking Delfly Micro is what is known as a micro air vehicle (MAV), a minute, remotely controlled aircraft. More specifically, it is a MAV ornithopter. In other words, it flaps its wings. And according to its makers, the latest research object to come out of the Micro Arial Vehicle Laboratory (MAV Lab) at the Faculty of Aerospace Engineering is the world's smallest MAV to carry a camera.

The Delfly Micro is the successor to Delfly I and Delfly II, also ornithopters, that brought the MAV Lab fame a few years ago. Today these giant mechanical insects, with wings spans of fifty and thirty centimetres respectively, look like primeval creations when compared with the Micro. "At first we used magnifying glasses, but now we need a stereo microscope to glue the parts together," says electronics expert Ir. Rick Ruijsink of the MAV Lab.

Precision

Assembling all the components including the camera and transmitter, the carbon fibre and balsa wood frame, and the PET film wings and tailplane requires extreme precision. But above all the researchers have to keep up to date with the latest technological developments of batteries, cameras, transmitters, receivers, hinges, and actuators.

"We need to keep in close touch with the manufacturers," Ruijsink says. "We depend on their goodwill. When we heard about a new, super small endoscope camera, we managed to persuade the manufacturer to make an even smaller version, especially for us, without all the plastic protective layers of the original."

With the ten-centimetre span of its two pairs of flapping wings this aircraft, which weighs only three grammes, comes close to a dragonfly in size

Building the world's smallest camera-carrying ornithopter is not something Ruijsink and his colleagues do just for fun. Because the aircraft are so tiny, they are very inconspicuous. They can also fly through small openings. The aim is to develop them to the point where they will be capable of hovering, or even flying backwards. Delfly could then be used to monitor anything, search through buildings, and land anywhere. They make ideal spies, but they can also be used to support emergency rescue operations, for example in areas struck by earthquakes.

The smaller the plane gets, the more numerous its applications become. Ten centimetres is just the first main step towards miniaturisation, Ruijsink warns. "In a few years we intend to finish Delfly Nano, weighing only one gramme, and with a wingspan of five centimetres."

Spectacular though it may be, the Micro is far from fully developed. Delfly II can perform many more tricks than Micro can. Delfly II can take off vertically, hover, and fly backwards. Image recognition software enables it to fly autonomously. It can recognise objects and is capable of avoiding them, which comes in handy during ▸▸

[Back]GROUND

observation flights over hostile or inaccessible terrain, where a pilot and his remote control cannot venture. The technology in Delfly II recently brought the researchers the first prize in a competition for autonomous MAVs, held in Germany. Micro is still unable to do all this.
The main challenge now is to get Delfly Micro to do the same flying tricks. "We are constantly putting Micros together for this purpose," MAV Lab coordinator Ir. Bart Remes explains. "As soon as one is finished, we measure all its aspects, fly it, and use it to film with, and we go on till it breaks," he laughs, opening a cardboard box containing three samples prepared earlier and written off since.

Stalks

One room further along the corridor we find student Kristien de Clercq and Ir. Christophe de Wagter, a doctoral student of visual recognition in unmanned aerial vehicles. They are measuring the force with which another Delfly's wings flap up and down. Sensors connected to the wings via stalks detect the forces. A computer then relates the information to the undulating motion of the wings. "We want to find out when the wing flaps at its strongest," De Wagter says. "We will use that information to optimise the aircraft further."
The Delfly Micro current endurance is three minutes at a speed of five metres per second. This will soon be upped to five minutes. Autonomous flight is something the minute craft is not yet capable of, because the images the camera produces are too shaky. Delfly Micro has to become more stable in flight, and the image recognition software needs to be improved.
Another major challenge is hovering in flight. "At thirty flaps per minute the plane flies forward," Remes explains. "If we increase the frequency to forty-five flaps per second, it will raise its nose and remain suspended in the air. At least, that's what we are betting on. We haven't been able to test it yet. The DC brush motor we're using isn't capable of creating those frequencies. We will be fitting the Micro with a more efficient and much smaller brushless motor."
If the Micro is to stay longer in the air too, the battery will need to be tackled as well, but not at the cost of adding much more weight. When miniaturising the device, making it light enough for its wingspan is a major challenge, and one which Remes is none too sure about. "I don't think lithium polymer batteries will be getting much lighter. The problem with batteries like these is that their technological development is driven by the demands of the mobile phone industry. In a mobile phone a few grammes more or less makes next to no difference. Volume is what counts to them."
In spite of these problems, hovering and smallness of size go together well, very well. This is demonstrated by mother nature in the form of hummingbirds, dragonflies, and fruit flies. These creatures experience the air around them in different ways than large flyers do. The air is much thicker to them, and they put this apparently higher viscosity to good use. The Delfly team can still learn a lot from them.

'The aircraft was attacked by a crow and crashed, which at least gives us mother nature's stamp of approval'

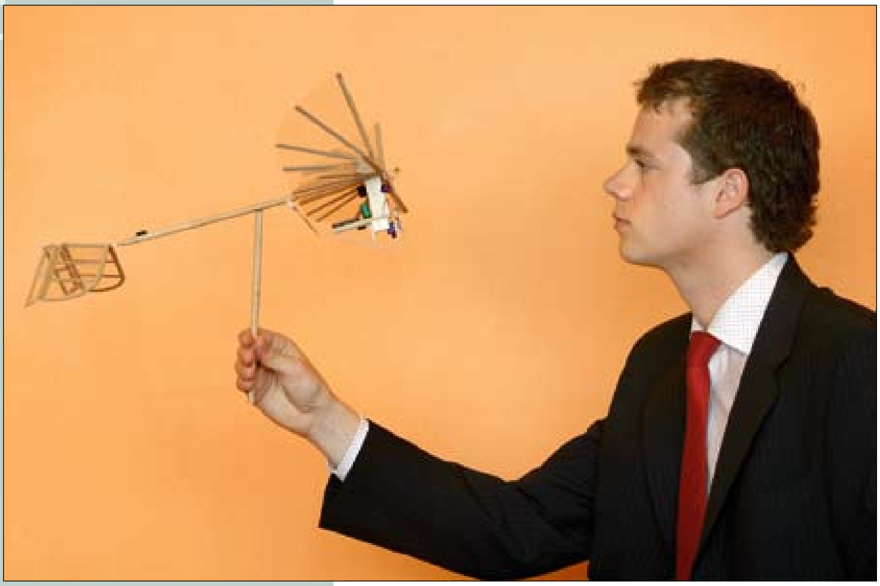
A small flyer can hang over backwards and hover in one spot in the air. By flapping its wings it creates strong air vortices. The thickness of the air at this small scale means that the air vortices stay attached to the wings for longer, and this produces additional lift.
If a fixed-wing aircraft were to hang backwards in the same fashion, it would stall and crash. It cannot handle the large angle between the incoming airflow and the leading edge of the wing. Regular aircraft use the fast air that flows over the top of the wing to create lift. If the angle between the airflow and the wing becomes too much, the air detaches from the wing in vortices.
"Vice versa small flyers cannot glide because the air is too thick for that," Remes says. "The tipping point at which it becomes more efficient to flap your wings rather than glide on a fixed wing, is at about ten centimetres," he estimates. In other words, the size of the Delfly Micro.

Flapping

Delfly Micro manages to fly quite well by flapping its two superimposed pairs of wings. The pairs of wings move up and down in antiphase, with the top pair moving up at the same time as the bottom pair moves down from the same joints. The wings then move back to meet again in the middle. "By doing so, each pair of wings creates two alternating tornados," Ruijsink explains.
Ideally the Delfly should move its wings so that the tips follow figures of eight, the way many insects and birds do, but that would require an extra motor, which would make the aircraft too heavy.
There is another trick from the animal kingdom that the Delft researchers could copy. Veins in the wings of insects form a surface texture (Continued on page 16)

Delfly I

Delfly I, Micro's eldest brother, flapped its wings for the first time in 2005. It became an instant hit. Inspired by the natural world, eleven Bachelor students at the Faculty of Aerospace Engineering had created the flapping-wing aircraft in ten weeks time as a graduation project. They were supervised by researchers of the MAV Lab and by Ir. David Lentink of Wageningen University, an expert in the field of aerodynamic and fluid-mechanical animal strategies. Delfly turned out to be more stable and less vulnerable than a helicopter. You could fly it into a wall and it would still keep on flapping merrily.



DelFly Micro

the mechanical dragonflyle

Wings and flapping frequency
The flapping wings and the tail are made of PET film stretched over a carbon fibre frame. It is still unknown how the distortion of the wings affect the airflows — and thus the lift. The wings flap approx. 30 times a second.

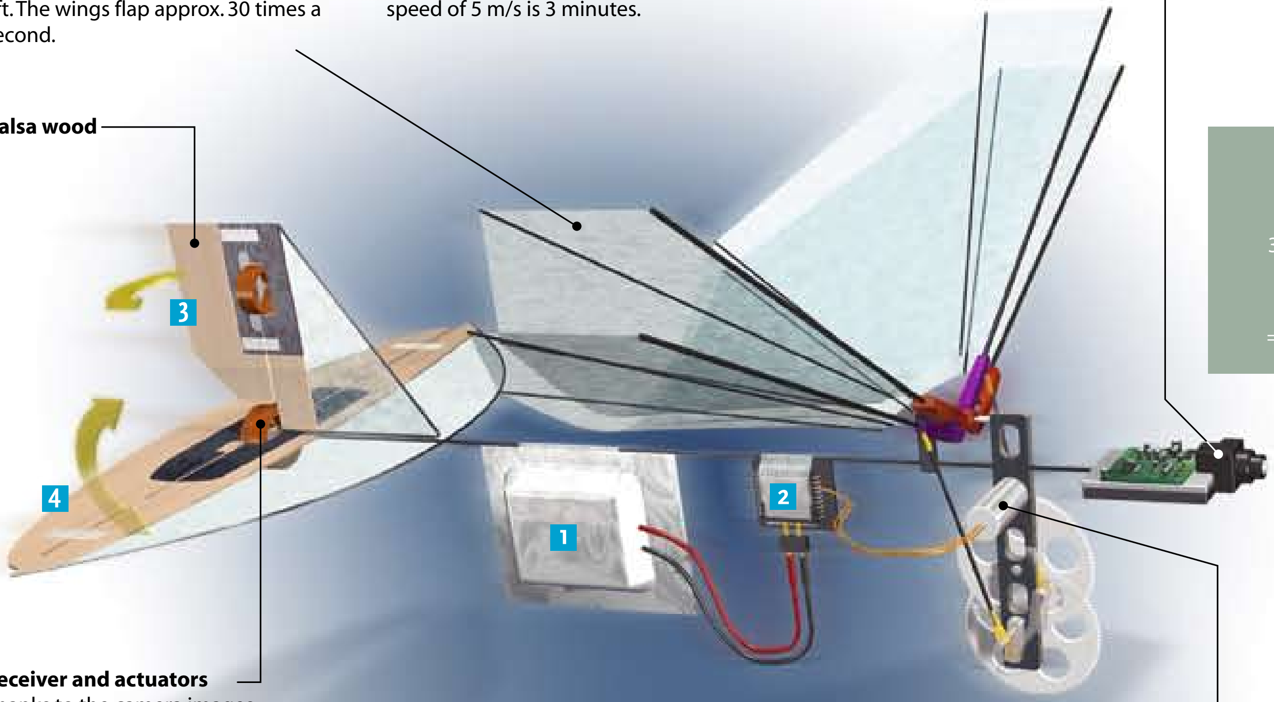
Battery 1
Power is provided by a lithium ion battery weighing 1 gramme, the largest and heaviest component of Delfly Micro. The endurance at a speed of 5 m/s is 3 minutes.

Camera
A very small endoscope camera is mounted in Delfly's nose. The camera and its transmitter weigh 0.4 grammes. The camera transmits TV quality images back to the ground. The range of the transmitter is about 50 m.

Span:
10 cm

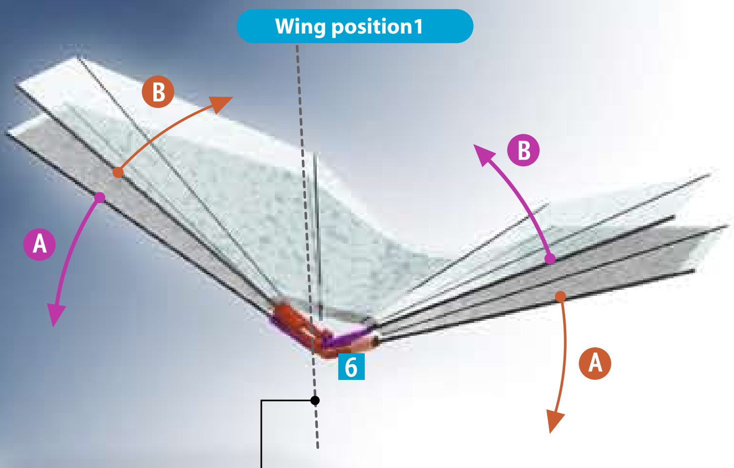
Weight:
3,07 gram

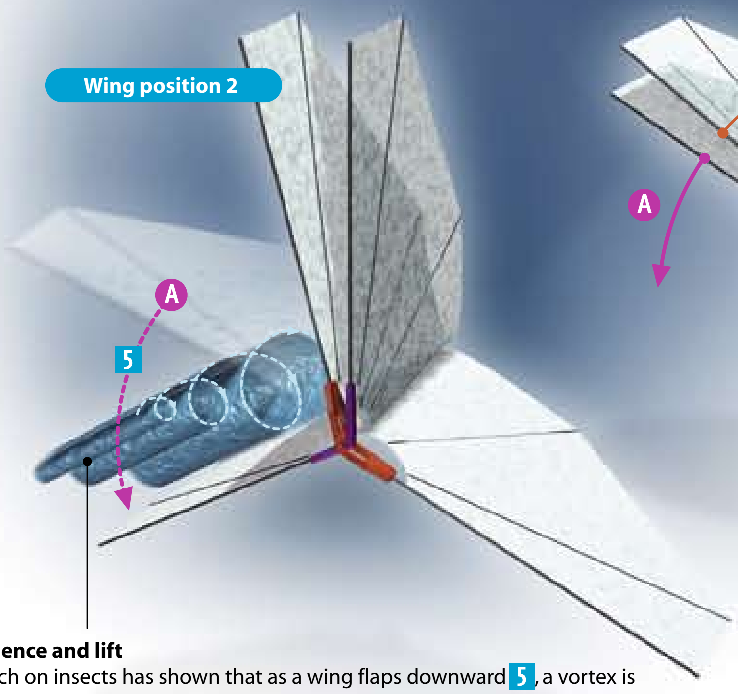
Speed:
5 m/s
= 18 km/h



Receiver and actuators
Thanks to the camera images the DelFly can be remotely controlled. A 3-channel 868 MHz receiver 2 with a range of approx. 30 m) picks up signals from a ground-based computer and (using electronics) controls the two magnetic actuators (small solenoids) of the rudder 3 and elevator 4.

Motor
A DC motor (3000 rpm; 0.45 g) drives the two pairs of wings through three gears (to reduce the rotational speed) and two crankshafts.





Turbulence and lift
Research on insects has shown that as a wing flaps downward 5, a vortex is created along the wing. This spiral tornado grows as the wing is flapped, but ultimately becomes detached from the wing shape. The vortex is an unstable initial phenomenon. The high vortex speeds are accompanied by low pressures that create a lifting force on the wing.

Counteracting wings
The two pairs of wings on Delfly Micro move against each other. On each side as one of the wings moves down A A, the other wing (on the other side of the imaginary mirror line) move up B B, and vice versa.

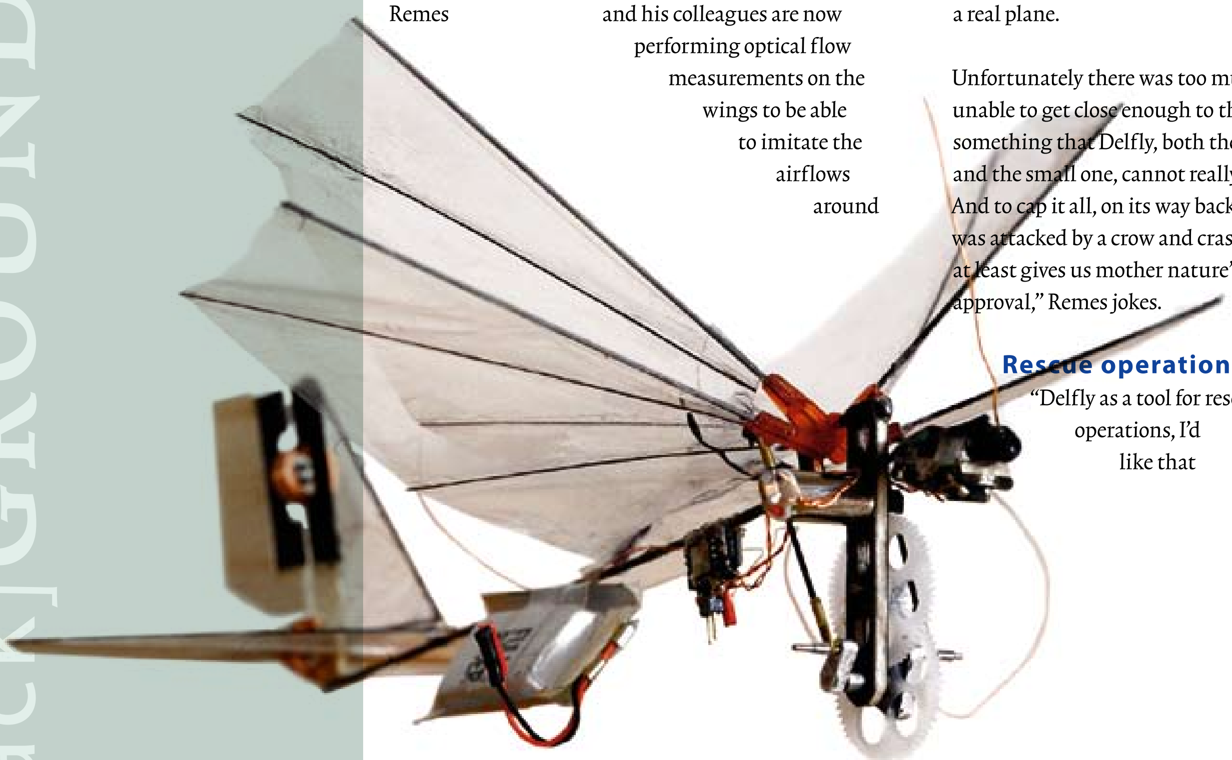
Wing joint 6
The symmetrical wing joint is produced by means of stereo lithography. The two halves of the joint move through each other.

illustration & text: Eric Verdult, www.kennisinbeeld.nl © 2008

‘In a few years we intend to finish Delfly Nano, weighing only one gramme, and with a wingspan of five centimetres’

and distort the wings so that the vortices adhere to them a bit longer. “We need to get experimenting with that too,” Remes says. “The problem is that computer models cannot yet simulate how the wings are distorted and what the effect of the distortions is on the airflow.”
Remes and his colleagues are now performing optical flow measurements on the wings to be able to imitate the airflows around Delfly’s wings in a computer in the future. Using so-called particle image velocimetry they can create images of the vortices along the wings. This technique uses small particles (often in the form of smoke, or plastic or glass droplets) mixed with a gas. The gas is then directed along the wings, where a laser is used to illuminate the particles as they flow past.
Until computer simulations become a reality, improving the flight characteristics of Delfly will remain mostly a question of trial and error. “This is why one of our main aims at the moment is getting to understand how ornithopters fly,” Remes says.
To show what the Micro should eventually be capable of, Remes would have liked to have flown Delfly II through the burnt-out hulk of ‘Bouwkunde’, the Architecture faculty, before the presentation to the press. As a pilot in a kind of virtual cockpit he could have flown through all the rooms and passages, for in addition to autonomous flight Delfly II is capable of being controlled manually. A small camera in the nose of the aircraft sends the images to a helmet and goggles. The wearer of this viewing set can see from miles away what the Delfly sees. A joystick connected to a computer controls the aircraft, just like in a real plane.

Unfortunately there was too much wind, so he was unable to get close enough to the building. Wind is something that Delfly, both the large one and the small one, cannot really cope with. And to cap it all, on its way back the aircraft was attacked by a crow and crashed. “Which at least gives us mother nature’s stamp of approval,” Remes jokes.



Rescue operations

“Delfly as a tool for rescue operations, I’d like that very much,” Remes continues. A flight though Bouwkunde would have enabled him to show what Delfly is capable of. “But to be honest, we don’t spend much time thinking of possible applications. Perhaps we should do so more often so we could raise more money for the project,” he laughs.
While building Delfly II, and during the initial stages of Micro, the MAV Lab received support from TNO, but this source of funding has now ended. The team are currently trying to set up collaborations with research groups


Photo: Botanical Garden

Botanical Garden celebrates centenary

The Sleeping Beauty awa-kes

A century ago it was decided that Delft was in need of a garden with 'technical plants'.

This summer the Botanical Garden that resulted celebrated its centenary with a world conference. After being neglected for decades, the garden now looks forward to a flourishing period.

Jos Wassink

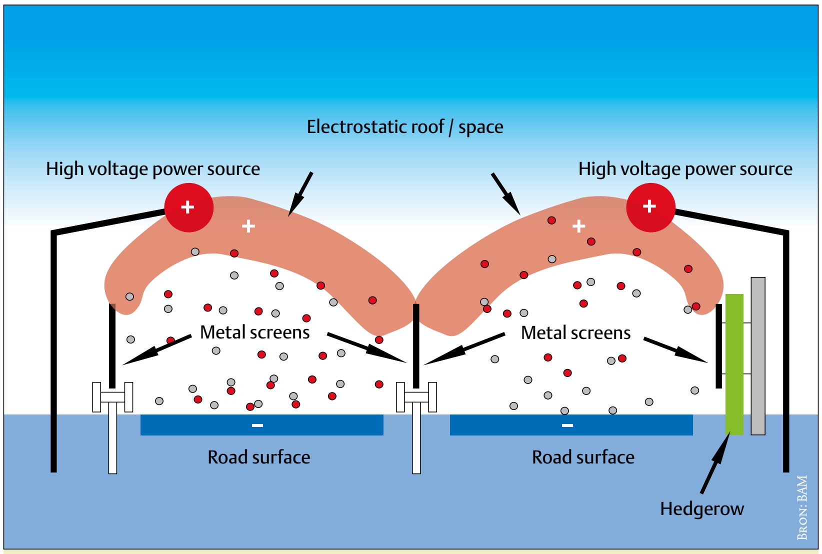
"In actual fact the garden was laid out in 1917," scientific director Bob Ursem admits over the noise of a percolating coffee machine. "but the concept of the garden dates back to 1908, when Professor Van Iterson came up with the idea." The interview starts in a hurry, which turns out to be typical of Ursem, who is bubbling over with stories and ideas, constantly interrupting himself when even more important ideas present themselves. From his office Ursem enjoys one of the best views of the entire University of Technology, with lush greenery (which he is immune to) and an instrument-bedecked tree that is part of a test. Nature and technology go hand in hand in the field of technical botany.

'For the future engineer to fully understand the processes that are required to obtain the precious products from plants he must be given the opportunity to study the crops that form their basis in the way they are presented to the industry, alive in most cases', to quote Professor Gerrit van Iterson Jr of the Department of Chemical Technology and Mining of the Delft Institute of Technology in 1908.

Van Iterson had graduated seven years earlier in Delft, at what was then still known as the Polytechnic School. His teacher had been former botany lecturer and professor of bacteriology Beijerinck, who is regarded as the person who started green thinking in Delft.

Paper was one of the most important fibre-based products.

Van Iterson became Beijerinck's assistant, and in 1907 obtained his doctorate for his research on phyllotaxis, the mathematical patterns that occur in nature, such as the pattern of the seeds in a sunflower, the arrangement of leaves on a tree, and the structure of heads of broccoli. That same year Van Iterson was appointed professor of microscopic anatomy. In 1908 he wrote his proposal for the construction of greenhouses ▸▸



Fine dust magnet

The freshness that follows a thunderstorm and the pine scent in a wood are all to do with the electrostatic fields in the atmosphere, says Dr Ir. Rein Roos (Applied Physics). He wrote a book on the subject ('The Forgotten Pollution'). Based on the phenomenon of pine terpenes after a thunderstorm and the way fog droplets are carried aloft by the electrostatic repulsion produced by the sea buckthorn bushes in the dunes of Voorne, he conceived the fine dust filter which the Botanical Garden is now developing in collaboration with the BAM construction company. TUD's Bob Ursem, Rein Roos, and Jan Marijnissen have since been busy perfecting the CleanAir fine dust filter. Last spring the idea received the Intertraffic Innovation Award 2008.

The system, known as FDRS-PM10, uses high-tension wires carrying 25 to 35 kV strung over a road to create an electrostatic field. The electrically charged field repels the positively charged airborne fine dust particles. Earthed screens alongside the road as well as nearby trees attract the dust particles and remove them from the air. Mother Nature herself uses the same cleaning principle with a dust-repellent positively charged layer, called the electrosphere, at an altitude of fifty kilometres in the ionosphere, but the field of the fine dust magnet is hundreds of times as strong. A small demonstration set-up can cause a mist to settle at a spectacular rate. This autumn BAM intends to conduct the first field tests with the system to see if the full-size variant works equally well.

FOCUS

Giant banana plant leaves as seen in the fully restored Van Iterson greenhouse have long been used as a source of long fibres.

and an agricultural garden in his laboratory at the Oude Delft, which had only a small garden at the back. It would take until 1917 before the new building for Technical Botany at the Julianalaan and the garden could be realised. Today the building houses the Kluyver Laboratory of the biotechnology department of the Faculty of Applied Physics.

Hair tonic

So what does a university of technology want with a garden? At the time the garden was conceived a question like that was a no-brainer. The Netherlands had interests as far afield as the Dutch East Indies, Surinam and the West Indies. The overseas territories had long been providers of herbs and spices, and they had also become an increasingly rich source of raw materials. Ursem: "They provided us with new types of timber, fibres, gums, and resins for use in the rubber and paint industries. In the 1920s these raw materials were of major industrial significance and formed the source of many innovations. The garden played a crucial role in this."

Van Iterson stood at the cradle of many of these innovations. He was the managing director of the National Rubber Service, established in 1910 to inspect and promote the natural rubber produced by Hevea brasiliensis in the Dutch East Indies. In 1918 Van Iterson was also appointed chairman of the 'Committee for setting paper standards'. Paper was one of the main products obtained from fibres, and a need for production standards was felt. In 1937 a chair of paper manufacture was even established. The timber growing industry also received the attention of Van Iterson. Courses on the anatomy and recognition of timber were given at the Laboratory for Technical Botany. The participants agreed with Van Iterson that timber was an important structural material for engineers. For the Department of Public Works, Van Iterson supervised research to find suitable types of timber for harbour construction and he introduced a process for adding lignin to improve timber's resistance to wear and make it more elastic.

Some of the trees from those early days are still around, according to Gerard van der Veen, who came to the Botanical Garden to work as a gardener 37 years ago. Gradually the scope of his work broadened and he is now responsible for education, public relations, marketing, and communication. Nevertheless his hands are those of a gardener rather than an office clerk, and his Delft accent betrays his roots. He sums up a few of the garden's timber suppliers with ease: beech, oak, walnut, sequoia, maple, and poplar. To Van der Veen the trees are old friends, like the sequoia from the Himalayas that was planted here in 1952, or the giant poplar that has stood here for the last ninety years. Then there is the birch which, when you lop off a branch in January, will bleed so profusely that the birch juice comes gushing out. The juice was once used as a hair tonic, not that Van der Veen ever tried it himself. His crew cut doesn't need any tonics.

Hibernation

The tide turned for the Botanical Garden as the Dutch connections with the East Indies changed, just after the Second World War. On 17 August 1945 Indonesia declared its independence, but it wouldn't be until 1949 before the Netherlands relinquished sovereignty. The flow of colonial produce, including fibre, timber and rubber declined, and with it the importance of research on 'technical' plants in the Botanical Garden. Mineral oil became the prime raw material, and synthetic chemistry was seen as the way of the future.
In 1964 it was decided to close down Technical Botany. The collection was transferred to the National Herbarium in Leiden, and the garden came under the management of general affairs at the department of biotechnology.
The garden entered a period of hibernation that would last over thirty years, during which the rearmost section of the garden and the adjacent geodesics building were sold to the Department of Public Works, leaving slightly over half of the original garden (2.7 hectares). During this Sleeping Beauty era

During the hibernation period, the rearmost section was sold to the Department of Public Works

the garden remained a well-tended location for graduation parties and other gatherings, with an increasing number of members of the public being granted access.
This was the time when people believed everything could be made and that Technology reigned supreme over nature. Scientists turned their backs on the garden and stuck to their laboratory benches.
Not all scientists, though. At one point professor of organic chemistry Dr Ir. Leen Maat was the only researcher to visit the garden. During the 1970s he was working on a synthetic version of morphine, and for purposes of comparison kept a number of specimens of Papaver somniferum, the opium poppy, in the Botanical Garden. The synthesis was ultimately successful, but as poppies were grown in such great numbers during the late 1970s, the price of morphine dropped to two hundred dollars a kilo. Synthetic production cost more than ten times as much.
Another pharmaceutical research project in the early 1990s was that of Dr Ir. Jan Marijnissen (DelftChemTech, nanostructured materials). His aim was to extract from the yew tree, ▸▸

Dam

Research in the Botanical Garden reveals the special qualities of trees and grasses for use in coastal defences.
Mangrove forests for example play a key role in the defence of coasts along tropical and subtropical seas. The mangrove tree (Aegoceras majus) grows in forests on marshy land where salt and fresh water meet. The trunk, supported on curved aerial roots, will often start a long way above ground level. The characteristic network of tough roots breaks the waves as they come rolling in. In the area hit by a tsunami in late 2004, over twenty percent of the mangrove forests had disappeared, beginning in the 1980s. The straightening of rivers, industrial growth, agriculture, and fish farming have been named as the major causes.
At the Botanical Garden a mangrove cultivation programme is underway. As soon as the plants have grown big enough, they will be tested in a wave basin for their specific qualities as coastal defences.
Quite a bit more is known about the tough Vetiver grass. It is a type of grass with long stiff leaves and stems that grow up to two metres in height. The most important contribution made by Vetiver (Vetiveria zizanoides) is undergound, however, where its roots go down vertically to depths of as much as four metres and spread out horizontally. It's pretty hard to think of any better way to reinforce a dyke. Not only does Vetiver protect the dyke against erosion by swells and breakers, it is also very good at slowing down the incoming water, draining it of three-quarters of its energy, as shown by research carried out by the Garden together with the hydraulic engineering section of the Faculty of Civil Engineering and Geosciences). The result is that the amount of water breaking over a dyke is reduced by more than half. Or, a dyke reinforced with Vetiver grass could be twenty percent smaller (less volume) than an unplanted dyke to afford the same level of protection.

Cutting branches in the Van Itterson glasshouse – otherwise they grow through the roof.

UV filter

Why does UV radiation cause paint to peel, whereas a pine tree can grow high up in the mountains with impunity? The ultraviolet radiation is much more intense at altitude — as any ski enthusiast will tell you — and on top of that it is increased by reflections from the snow. This question that had formed in the mind of Bob Ursem resulted in a biological UV filter which in November 2005 won first prize in the sensor technology category of the annual ID-NL innovation festival.

As a student Ir. Urjam Jacobs managed to demonstrate the active component in the branches of Pinus mugo, a mountain pine, which Ursem had collected. The substance collects ultraviolet radiation, and converts it into blue light by means of fluorescence. This does not change the structure of the molecule, and so the substance remains intact. This is where it differs from today's artificial UV filters that usually consist of ring-shaped molecules with an iron atom at the centre. If a UV photon hits the molecule, the metal absorbs the energy and separates from the molecule. As a result the molecule can only work once, so the UV filter will have to be replaced at regular intervals. Ursem can see all sorts of applications for the long-life, natural UV filter: "It will affect plastics, new waxes and creams will be developed, latex can be made durable, as can bitumen and asphalt. It could even be used to improve the efficiency of solar panels. It really is incredible!"

To commemorate the quinquennial botanist conference the Botanical Garden planted eight hundred sunflowers.

Taxus baccata, a substance that was to become the precursor of the extremely expensive cancer-suppressing drug, Taxol. The alternative was to extract the substance from the bark of the tree, resulting in a rapid decline of the tree population. Marijnissen managed to 'milk' the needles by means of an electrostatically charged plate that draws the substance from them, as it were. According to Maat, the method works, but has not yet been adopted by industry.

Car park

The garden's nadir came around 1995 in the form of plans to close it and turn the site into something else, such as a car park. To chemical engineer Maat and garden supervisor Hans van Loon this was the reason for setting up the Association of Friends of the Botanical Garden. They were supported in their endeavours by a report published by Dr Pieter van Mourik at the request of the dean, Professor Karel Luyben, which sketched several future scenarios for the garden. In a 'lively discussion' Maat urged the Governing Body to appoint a managing director for the Botanical Garden, which they did in 2001 in the person of Bob Ursem. As Maat (now 75) puts it: "A bloke with vision and an incredible amount of energy."

"The garden currently hosts twenty research programmes," Ursem states. And it is true that since 2000, researchers besides organic chemistry engineers have also discovered the garden, and in some cases rediscovered it. Riding the wave of sustainability, cradle-to-cradle, biofuels, and nanotechnology, science has regained an interest in what nature has to offer. The research includes a number of projects by the Faculty of Civil Engineering and Geosciences for sustainable coastal

Aerial view of the Botanical Garden in 1975. The section on the right hand side of the picture has already gone.

Managing director Bob Ursem sees plenty of new possibilities for the garden. His ideas have already resulted in a number of patents.

defences. Vetiver, a species of grass from south-east Asia has extremely long roots that make it the perfect plant to provide a natural means of reinforcing dykes. In combination with mangrove trees it could even make dykes capable of withstanding a tsunami. The department of biotechnology

'If Bob sets his mind to something, it's bound to work out all right'

at the Faculty of Applied Physics is conducting research into the production of biofuels from vegetable waste and algae. The Faculty of Architecture is investigating the effect on a building's interior climate of ventilation through a facade vegetation screen. And projects by the Faculty of Industrial Design include research on the sustainable production of flax-based shoe soles and on a biogas-producing garden waste container (called the Powerbin).

The research has already resulted in a number of awards and patents. The discovery of a sustainable UV filter based on the protective mechanism of a species of mountain pine, Pinus mugo, in 2004 received acclaim as the best innovation in the field of sensor technology. In 2008, together with Jan Marijnissen and Dr Ing. Rein Roos (Botanical Garden), Ursem won the Intertraffic Innovation Award for a fine dust reduction system, which reduces the amount of airborne fine dust by means of a positively charged field that direct the dust particles to the ground.

Even so, the threat to the garden is far from over. In 2012 the department of biotechnology will be abandoning the Kluyver Laboratory along the Julianalaan. A property developer is hoping to fill the site with a high-rise development and build an underground car park below the garden, Maat explains. "That would be the end of the garden," was the response by Gerard van der Veen when asked by the Algemeen Dagblad newspaper.

Ursem intends to look ahead and re-use the empty Kluyver Laboratory building for am entirely new laboratory to house all his research projects. "We will soon be able to do so with the money our patents will bring in. I just know we will."

Sceptic versus Nobel laureate

A decade after he first voiced his opinions in publications, Björn Lomborg still manages to irritate fellow scientists. He did so at the opening of the anniversary conference of the Botanical Garden with Nobel Prize winner Andreas Fischlin.

Danish political scientist, author, and environmental activist Lomborg (43) is hard to categorise, which is part of the controversy surrounding him. In a blue T-shirt and jeans he cuts a boyish figure as he marches across the rostrum. A microphone arrangement à la Britney Spears ensures that he can reach his audience. It's all very different and high-tech, but the things he says are lapped up by the established industries and the relatively conservative periodicals such as Elsevier and The Economist. They like to quote from Lomborg's books 'The Skeptikal Environmentalist' (2001) and 'Cool it' (2007) to oppose the Kyoto protocol and CO_2 reduction measures.

To Nobel Prize winner Andreas Fischlin (58) things are very different. The Swiss ecologist is one of the main authors of the IPCC report (International Panel on Climate Change) about the way ecosystems are being affected by climate change. Last year the IPCC was awarded the Nobel Peace Prize together with climate lobbyist Al Gore ('An Inconvenient Truth').

Fischlin is another person who assumes that the climate change is largely caused by human activity. Contrary to Lomborg however, Fischlin's point of view is that the changing climate will lead to calamities unless we do something to stop it. The IPCC author also assumes that we still have some control over the climate change.

So do Lomborg and Fischlin have anything in common? Yes, they do, since both advocate investing in sustainable energy. Lomborg, like the IPCC, would like to put aside 0.05 percent of the world's income for carbon-free energy projects. At 2500 billion dollars a year that would be only one seventh of the cost of the Kyoto protocol, while at the same time releasing ten times the amount of money for energy research we are now spending on it. To commemorate the centenary of the Botanical Garden of Delft, the conference 'Challenges in Botanical Research and Climate Change' was held from Sunday 29 June to Friday 4 July.

FOCUS

So does Maat believe in that vision? "If Bob sets his mind to something, it's bound to work out all right."

INTERVIEW

The art of tea drinking

The 'ideal' refugee camp doesn't get designed on the drawing board. "Many refugee organisations just build something, " says Dr. James Kennedy. " When building a camp, the long term perspective is missing."

Saar Slegers

INTERVIEW

There's really never enough time to design a refugee camp. Whenever people are forced to flee to avoid political conflict or natural disasters, refugee organisations have to be ready to provide a safe haven today rather than tomorrow. Supplying thousands of homeless with emergency shelter, medical aid, and food is difficult enough; making sure the situation in a refugee camp remains tolerable in the long term is an even bigger job. British structural engineer Dr Ir. James Kennedy, who in June 2008 completed his doctoral study at the Faculty of Architecture, spent three months working in a refugee camp in Kenya to find out how refugee organisations go about building a refugee camp and how they might improve their methods.

Who is James Kennedy?

James Kennedy is a jack-of-all-trades. He studied Chinese and Japanese in London, and attended the film academy in Beijing. His next port of call was the United States where he spent a few years working in an architect's office. He then went to Louvain to get his Master's degree in urban planning. He became fascinated by the planning and construction of refugee camps – "the most extreme form of urban planning around" – and for some years worked as a consultant on emergency shelters in disaster areas. His experience in such countries as Sri Lanka, Indonesia, and Pakistan convinced Kennedy that he wanted to remain active in this field. At the same time he realised that he would not be able to do this kind of work without taking a critical look at the way refugee organisations work. As Kennedy puts it: "Many refugee organisations are just mucking about. They are always working against the clock, and the needs are so acute, that aid workers simply go by their own previous experience, or they fall back on the universal guidelines drawn up by the United Nations. The problem is that nobody has ever checked the quality of those guidelines. A lack of reflection leads to all kinds of problems that could have been prevented."

What kind camp was it?

"I was working in Ifo, a camp within a complex of refugee camps at Dadaab, not very far from the Somali border. Ifo was built in 1991 to receive Somali refugees. The original plan was for the camp to be used for about six months, after which time the refugees would return to their country. But when I was doing my research in 2007, the camp was still there. Today the number of inhabitants is about 70,000, half of whom were born in the camp. It has almost become a real town, with markets, schools, mosques, internet cafés, everything."

What did you do at the camp while you were doing your research?

"I wasn't just a researcher, I was also working for the Norwegian Refugee Council as a shelter manager, supervising the construction of a new section of the camp, among other things. The new section was needed because part of the original camp had been built in a flood area. At the time the planners hadn't considered it a problem, because they thought the camp wouldn't be in use for more than a couple of months. The result is that part of the camp gets flooded every couple of years. Every time that happens a large number of shelters are destroyed, and the people in the camp are exposed to severe health risks."

What was done about it?

"The UNHCR (the United Nations refugee organisation) and the other responsible aid organisations decided to move the refugees living in the areas with the greatest risk of flooding to other, higher areas. I was given the job of supervising that process. My position gave me the opportunity of walking around in the old section of the camp and seeing how the settlement had developed over the past sixteen years. I could see how the camp had been adapted bit by bit and how whole pieces of it had been rebuilt. At the same time I could take part in the construction preparations for a new part of the camp in the area on higher ground. It was a win-win situation, with me gaining a lot of knowledge that would come in useful for my research while at the same time having a job that gave me my means of financial support during my doctoral studies."

So you were both researcher and aid worker at the same time. Didn't that make your position awkward?

"Yes, it did from time to time. As an employee of a humanitarian organisation you have a certain code of behaviour you have to stick to. For example, according to the protocols you mustn't be in the refugee camp in the evenings and at night because of the safety risks involved, but as a researcher you really want to know what goes on inside the camp at night.
On the other hand, if I had not been an employee, I would not have had access to a great number of activities. My position as a professional opened doors for me as well closing others. But you have to be very clear on this point when you present your research results."

You have been critical of the universal guidelines for planning a refugee camp. What's wrong with those guidelines?

"The problem is that a single concept has grown into the one and only standard design for refugee camps. According to the UN guidelines the shelters in a camp must be grouped around small squares. The idea behind this concept is that the squares will act as communal areas where families can mind one another's children and create gardens. This led to the creation of small, semi-autonomous communities within the larger whole of the camp. This is a concept that works for people who come from communities in which the public and private spheres tend to overlap – as is often the case in West Africa or South America. But in other types of communities this kind of layout doesn't work at all." ▸▸

INTERVIEW

'In an emergency situation the last thing people need is a spectacular, architecturally pleasing structure'

Why not?

"Take for instance the camps for Afghan refugees in Pakistan. When these refugees were given materials to build their shelters, they didn't start by putting up a roof. What they did was to build walls around their allotted piece of land to protect their women from the prying eyes of outsiders. To them the protection of their privacy was more important than any protection from the elements. People feel the need to arrange their environment so as to feel at home as much as possible. In many cases you can't plan for that."

Another problem you describe in your thesis is the lack of any long-term perspective when a refugee camp is built.

"When they design refugee camps, the planners assume that the camp will be used exactly as they expected it to be. They design a camp to be lived in for a couple of months by a certain number of people. In real life camps tend to remain in use for longer than planned, and their population grows over time. The camps simply aren't built to cope with that and soon become overpopulated."

How could matters be improved?

"Since one cannot determine in advance what the best layout for a camp is, aid organisations shouldn't design a camp in one go. It would be better if they went about it one step at a time. In my thesis I call this the cycle of intervention. Setting up a camp starts for example with deciding where the water wells should be located. Once you have made that step, you wait a while to see how the layout of the settlement develops. You observe how the first groups of refugees arrange their surroundings. Where do they build shops? Where are the schools? You look at the emerging patterns and decide where you need to intervene. You have to make sure that the layout remains safe and that it retains a modicum of efficiency. You have to have firebreaks for example, and you want food stores and hospitals to be readily accessible. The situation constantly needs to be evaluated in order to enable the original design to be adapted step by step.
To many structural engineers this is not a satisfactory solution. They would prefer a perfectly conceived design that can be universally applied. It just doesn't work like that in practice.

The social and cultural context of the refugees simply varies too much."

In your role as aid worker at the Ifo camp, did you have the opportunity to put this 'cycle of intervention' into practice?

"I wasn't given carte blanche to do exactly what I would have liked to do. There already was a rough design for the new section, and I had to stick to that as much as possible. But I was able to influence the construction process of the new camp section. For example, because initially we had only few materials available, in my capacity as shelter manager I had to decide our priority, huts or schools. I decided to start with the schools, because I knew that the refugees were capable of constructing their own huts, and because the presence of schools would motivate the refugees to move to the new area. It wasn't long before other economic and social initiatives were launched. Shops, madrassas (Islamic schools), and mosques were soon being built."

Did everything go well of its own accord?

"My method did pose a few problems from time to time. There was one occasion when some refugees wanted to build a mosque on a spot that the planners had singled out as a landfill site. We had had quite a heated discussion about that."

Did you have much contact with the people in the camp?

"When you walk through the camp, people will come up to you to talk to you. This was how I immediately found out during my first week in Ifo that people were reluctant to move to the newer sections of the camp, because they didn't feel safe there. The reason for their fear was simple: the new sections didn't have police patrols yet. Why was that? Simply because there were no police posts where the policemen could change shifts and find a lavatory. That's what I spent my time doing during my first week in the camp: supervising the construction of police posts and lavatories.

Some staff members are always so busy that they don't take the time to talk with the refugees themselves. That's silly, because those contacts are extremely important for the quality of your work."

How do you maintain those contacts?

"My motto is that there is always time for another cup of tea. Once you sit down to drink tea with the population, you soon start to notice other things. You get to know the people, you get to hear who visits which mosque, you notice where children play and where they don't. If you notice that some groups are hard to reach, you need to ask yourself why this is. Are the people who approach you in the street all men? Just go to a market to buy a pound of tomatoes, and ask the woman selling them where she grows the tomatoes and how often she gets a crop. Just by making conversation with people all over the place you can find out quite a bit about life in the camp."

Is there much contact between the refugees in the camp and the local Kenyan population?

"The local population has mixed feelings about the refugees. On the one hand there is a kind of kinship. Ifo is in an area with many Somali inhabitants, and culture-wise there aren't that many differences. At the same time there is a great deal of anger. The Kenyans consider it unfair that the refugees are given new schools and free food by the international community, while the host community receives nothing. With the advent of the refugees the pressure on natural resources has increased considerably. The refugees use the water which the local people need for their camels and goats, and they chop down trees for construction materials and firewood. On the other hand the presence of the camp gives an economic impulse to the area. Many Kenyans are now working in the camp, and a lively trade has sprung up – and it includes materials that the refugees were given by the UN."

Such as?

"Plastic tarpaulins. There are stories of UNHCR employees handing out plastic tarpaulins, and refugees loading the tarps onto a truck a few yards further on to sell them on the black market. The Kenyan authorities have forbidden the refugees to make a living by any legal means, so in order to make a little money many refugees sell the goods they receive from aid organisations."

If refugees sell on the plastic tarpaulins, what do they use to build their huts?

"People use what they can find, branches, straw, and loam."

To many people a refugee camp is all about living in tents. Apparently that is not the correct image.

"No, it isn't. Tents have quite a few drawbacks. To begin with, they are far from durable, lasting no more than six months, or nine at a stretch, after which you can throw them away. Also, tents offer very few possibilities for expansion. The composition of a household changes over time, and people need to be able to adapt their living environment accordingly. You cannot simply tack an extra room onto a tent. If you look at the world in general, you'll see that there are very few non-nomadic peoples living in tents on a long-term basis. People prefer to go out in search of other materials to built a dwelling with."

As a structural engineer, do you have any say in the construction of the refugees' huts?

"People in refugee camps usually build their own dwellings, but I have supervised the construction of schools and police posts. These tend to be simple structures, but you have to remain creative when building them. In some areas in Pakistan for example, the primary concern is that buildings need to be resistant to earthquakes. It's just one example of how local conditions should always be taken into account. And of course, there's no money to spend, and time comes at a premium."

It sounds like a real challenge, but is there any joy in it for a structural engineer?

"Refugee organisations are often sent designs by architects proposing the world's most amazing shelter. Most of them are totally unfeasible and in actual use would create more problems than they would solve. In an emergency situation the last thing people need is a spectacular, never-been-done-before, architecturally pleasing structure. What people want is a house, a place they can feel at home in."

The rolls of material are bone dry as they emerge from the dyeing machine invented by Dr Ir. Martijn van der Kraan. Instead of water, the device uses carbon dioxide. This saves a good hundred litres of clean water per kilo of material.

Inside the machine the dye is dissolved in supercritical CO_2. This is formed at a high temperature and under high pressure, and behaves both like a liquid and a gas. This makes it eminently suitable for dissolving powdered dye. The industrial version of the machine, which still awaits construction, will have a capacity of 1,000 litres. In two hours' time the machine will pump dye past every fibre.

One of Thailand's leading dyers of sports clothing has purchased the machine. Van der Kraan expects to be selling more of these machines in South-East Asia. "It is the world's centre of textile dyeing, and at the same time it is an area with a shortage of clean water."

Photo: Sam Rentmeester/FMAX

When Government Architects did the actual building

Former Ministry of Justice, Den Haag.

These days the Government Architect is an influential consultant, who gets the attention of a number of government ministers. A Government Architect doesn't find much time to do any actual building though, and the same will be true for the new Government Architect, Liesbeth van der Pol, who was appointed in August.

A look back at the 'old-fashioned' Government Architects and their predecessors.

Joost Panhuysen

When does this story begin? Perhaps at the moment when a twenty-year old is sent to the Netherlands by his dominant brother Napoleon to become king. He's sent against his will, since the damp Low Countries seem to him unhealthy. But it's hard to say no to emperor Napoleon, even if you are his brother.

It is June 1806. Louis Napoleon's arrival in The Hague cannot have been much of an event. After nine years of tolerating the Batavian Republic, France has resolutely decided to put a stop to it. The Batavian Republic was inspired by the ideals of the French and American revolutions, but as an attempt to keep the French at some distance from the centre of power in The Hague it proves to be futile.

Thus the Republic, which opposed the absolute power of monarchs, makes way for a new king. And of all people, this king turns out to be a reformer. Louis Napoleon makes sure that the Netherlands acquires a Royal Academy of Science. Thanks to Louis Napoleon the Rijksmuseum is also founded. And when in January 1807 a barge loaded with tons of gunpowder explodes and blasts part of the centre of the town of Leiden from the face of the earth, the imported monarch is quick to arrive on the scene and organise help.

Nonetheless, Louis Napoleon is regarded with suspicion by the Dutch because of his predilection for residences of royal stature. He brings the French court architect, Jean-Thomas Thibault, over to the Netherlands to make alterations to the Binnenhof and Paleis Het Loo. The young king also turns out to have a fickle streak. He keeps moving to new places of residence: first the Binnenhof, then Huis ten Bosch, then a brand new white palace on the Wittevrouwenstraat in Utrecht. Finally he has alterations done to the Palace on the Dam in Amsterdam, adding a balcony to the front among other things.

A Department of National Buildings had already been established during the Batavian Republic but the king now creates a Department of Royal Buildings, thus laying the foundation for the function of Government Architect and the Government Buildings Agency.

The emperor Napoleon is annoyed by the extravagance of his brother, whom he also considers a bit too pro Dutch. In 1810, reluctantly, Louis Napoleon has to give up his position as king of the Netherlands. Three years later the Netherlands becomes an independent nation again. On the beach at Scheveningen, William I is welcomed as the new head of state by a jubilant population. Bartold William Hendrik Ziesenis, as 'Architect of Royal Palaces and National Buildings' has the honour of making the necessary alterations to what we now know as the Noordeinde palace to make it fit for the new king of Orange. However, the commission turns into a nightmare for the underpaid Ziesenis, Government Architect before the term was even coined. The palace is found to be filthy and – especially after some pile-driving work has been done – dangerously unstable. The costs escalate to the point where in 1816 Ziesenis is more or less relieved of his task. His successor is Charles Vanderstraeten, who in turn in 1825 meets his Waterloo in yet another construction project that runs off the rails, the Royal Palace in Brussels, originally intended for William I.

"So where were the engineers from Delft?" you may well be wondering. Well, it is true that Ziesenis and Vanderstraeten received a training that was mostly artistic. And of course, the precursor of the Polytechnic School wasn't established until 1842. And even when the Polytechnic School became reality, architecture remained a secondary training for civil engineers. It wouldn't be until the twentieth century that architecture in Delft comes to fruition.

Louis Napoleon lays the foundation for the position of Government Architect and for the Government Buildings Agency

Even so the engineers of the Department of Public Works play a major part during the period around 1830, when the government thinks it can dispense with the office of Government Architect. However, as it turns out, the engineers have no aptitude for public buildings, and a period of glory for national architecture fails to materialise.

And then William Nicolaas Rose steps into the ▸▸

[looking]BACK


Former Ministry of Colonies, alias 'The Birdcage', Den Haag.

The engineers of the Ministry of Public Works play a major part around 1830, when the Dutch government thinks it can do without a Government Architect

story. Military background. Architecture lecturer. One of the driving forces behind the new, influential Society for the Promotion of Architecture. He is an architecture theoretician, searching for an aesthetics for architecture now that neoclassicism has outlived its usefulness.
And above all, Rose is the Director of Architecture of Rotterdam, a town with a rapidly increasing population. In order to prevent new cholera epidemics, Rose devises a Water Plan, which includes the construction of a system of canals on the perimeter of the town. In 1851 the Coolsingel Hospital he designed becomes the talk of the town as suddenly the Netherlands has the most modern hospital in Europe.
Interestingly enough it is not the political reformer Thorbecke who appoints Rose as Government Architect. Thorbecke's constitution of 1848 made the Netherlands a modern democracy, but government support for the arts and sciences was not this nineteenth century liberal's cup of tea. Rose is appointed in 1858, during a period between two Thorbecke-led cabinets. He stipulates that as a consultant he must also remain involved in the great renovation of Rotterdam.

Fool's cap

The Birdcage. That's the name given in cartoons to the new Ministry of Colonial Affairs designed by government architect Rose in 1861, even before it is completed. Next door, his building for the Council of State is nick-named the Doghouse.
Rose's innovative use of cast-iron structural elements does not meet with general approval. The Ministry of Colonial Affairs is one of Holland's first modern office buildings, but there are too many teething problems. Rose would appear to be too far ahead of his time.
The renovation of the dilapidated Binnenhof (Inner Court) turns out to be a risky business for Rose. He finds the young lawyer Victor de Stuers in his way, a man who will reappear later in this story. De Stuers, a pioneer in the field of heritage conservation, advocates a careful restoration rather than demolition. When in 1860 Rose replaces the timber roof of the medieval Ridderzaal (Knights Hall) with a cast-iron canopy – albeit not without explaining his reasons – he is bitterly criticised. His sins are compounded when the original roof eventually turns out to have been a thirteenth century rather than sixteenth century structure. The head of the stately Ridderzaal has been topped with a true fool's cap, the critics scorn. By the time an exact replica of the original roof is placed on the Ridderzaal twelve years later, Rose has long ceased to be government architect. Because his term as Government Architect has proved to be such a disaster, there is no successor. His plans for a radical renovation of the Binnenhof will never be realised.

Infiltration

In 1876 an architect who specialises mainly in churches, Pierre Cuypers, is given the most prestigious architectural commission of the whole nineteenth century in the Netherlands, building the Rijksmuseum in Amsterdam. This is remarkable, because two years earlier Cuypers took second place in the competition for the project. Are there dark machinations involved? Cuypers has certainly received support from his friend, admirer, and fellow catholic, Victor de Stuers. De Stuers, who had risen to a high position in the Ministry of Home Affairs, managed immediately to have Cornelis Peters appointed as government engineer for the building of the Ministry of Finance. Peters learnt his trade from Cuypers.

Unlike Thorbecke, who died in 1872, De Stuers considers the arts pre-eminently a government matter. The title of one of his articles written in 1873, which roughly translated, would now be 'How small-minded can Holland get?' is still quoted to this very day. De Stuers dreams of a Dutch state which reveres the traces of the past, sets great store by the arts, and builds a succession of beautiful government buildings for no other reason than 'a natural need for beauty'.

And since De Stuers is not only an idealist but also a nimble political player, he manages to leave his mark on the architecture of the last quarter of the nineteenth century. Some accuse him of nepotism. Worse, some people consider Cuypers' gothic revival style, which flirts with the Middle Ages, a symbol of 'catholic infiltration', attempts by an increasingly self-aware Catholic section of the population to push the Netherlands back to the times before the Eighty Year War, three centuries earlier. It is no coincidence that Peters, who himself is a Protestant from the north, matches the style of his Ministry of Justice (1883) to that of the Rijksmuseum. De Stuers and Cuypers would have loved to build Ministries in the same style all around the square. 'St Victor's Monastery' is what his opponents call the building as they heap scorn on it because of its excessive cost. De Stuers immediately launches a counterattack, writing that thank God the Dutch Virgin, traditionally a symbol of Holland's unity, is not so destitute that she has to appear wearing clogs. A decade later his contemporaries will denounce Peters' main post office building in Amsterdam (1899) as far too extravagant, nick-naming it the 'Pear Castle'.

Laboratory style

Apparently on the sidelines of these polemics, the 'government engineer for the buildings of Education etc.', Jacobus van Lokhorst, is working on an impressive portfolio of laboratories, including the Geodesics building in Delft along the Kanaalweg. Before starting his design work, Van Lokhorst, who is another of Cuypers' protégés, discusses the buildings in great detail with the professors, and single-handedly creates a Dutch 'laboratory style'.

At the Ministry of Justice, Johan Metzelaar, engineer-architect for prisons and courts of law, manages to ▸▸

Binnenhof, 'The Knight's Hall', Den Haag.

[looking]BACK

Station Post Office, Den Haag.

stay outside the reach of Victor de Stuers, assisted by his son and ultimate successor, Willem Metzelaar. There is no shortage of commissions. Before the Penal Code comes into force, many prisons will have to be built during the 1880s. From the United States has come the concept of locking prisoners in cells for their own good, so they can contemplate the error of theirs ways in solitude. The architect now has to design prison buildings in which all these cells can be easily monitored from a central position. The domed prison in Haarlem (1902) by Delft graduate Metzelaar Jr. is considered a prime example of this concept.

Even before the government cutbacks hit in the early 1920s, Government Architect Henry Teeuwisse manages to secure a number of talented exponents of the Amsterdam School for his company. One of them, Jules Luthman, designs the 'Cathedral' (1923), the magnificent main building of the Radio Kootwijk transmitter complex. The laboratories in Wageningen by Cornelis Blaauw are also favourably received.

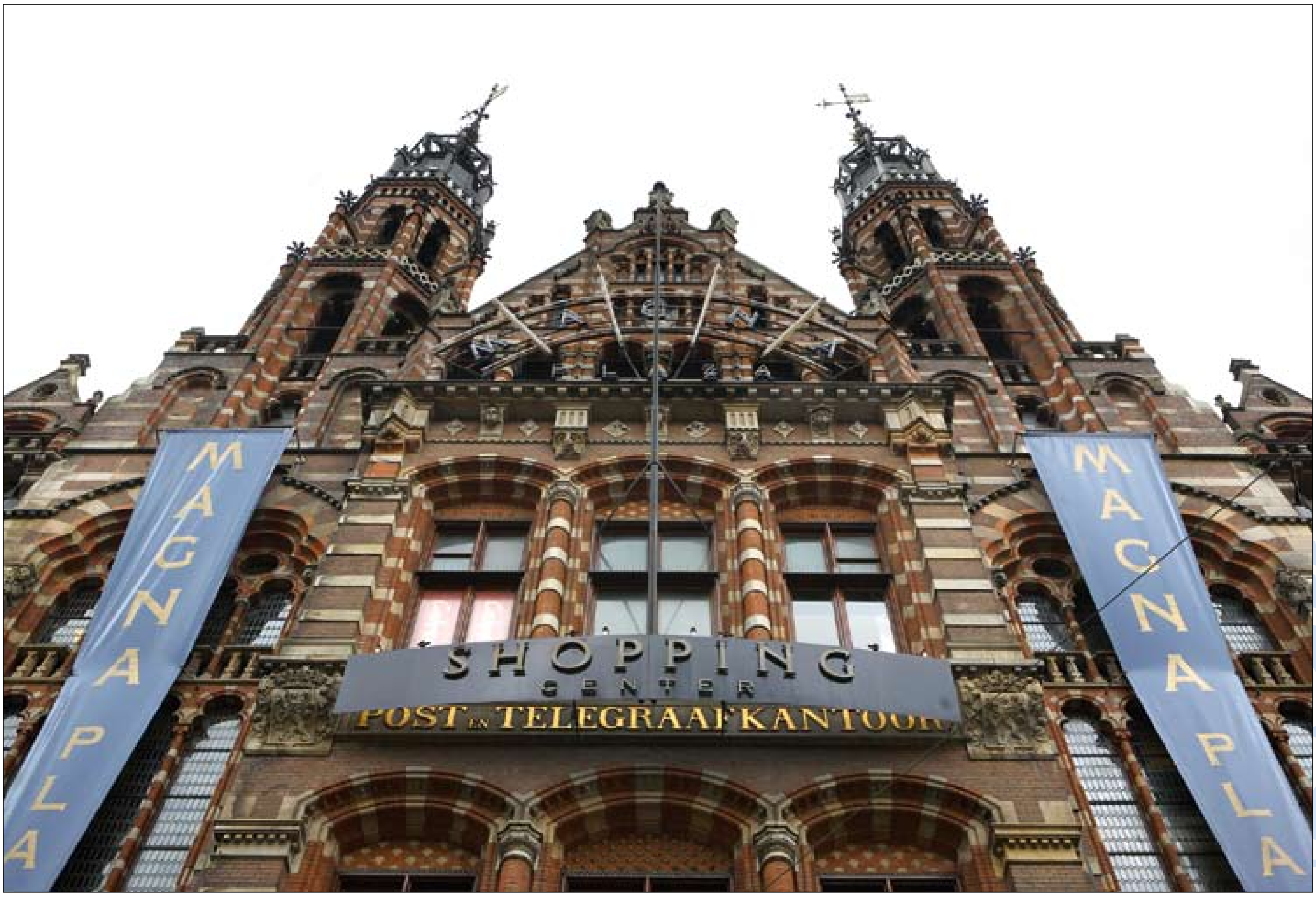
Nonetheless, major cutbacks loom on the horizon. Joop Crouwel is forced to considerably tone down his design for the Government Office for the Amsterdam Money and Telephone Company. Teeuwisse leaves just before a top civil servant at the Ministry of Finance, Carel baron van Lynden, becomes the head of the main government building agencies, which under his supervision have just been combined into a single organisation.

Van Lynden intends to tackle corruption and extravagance, but plunges the agency into a long-running crisis. Many talented people are dismissed. Hardly anything gets built any more. It seems as if ambition has also been lost. Government Architect Kees Bremer, appointed in 1924, almost immediately falls out with the authoritarian Van Lynden, but eventually remains in his position for over twenty years.

Bremer studied architecture in Delft, just like practically every Government Architect to succeed him. During the 1930s he is given the opportunity to build a few striking buildings, the futuristic station post office at Hollands Spoor station in The Hague, and the new building for the Council of State, which features a row of statuary. Being considered too nationalistic after the war this will eventually be demolished.

The head of the stately Ridderzaal has been topped with 'a true fool's cap

Van Lynden's spate of cutbacks in 1939 is vetoed by the Ministry of the Interior when he tries to have the designs altered for the camp at Westerbork, which at the time is still intended to receive Jewish refugees. He considers them far too luxurious, calling the plan a 'holiday camp'



Magna Plaza, formerly Central Post Office, Amsterdam.

rather than a ‘temporary emergency shelter’. His point of view had nothing to do with Nazi sympathies, for when the war comes, Van Lynden resigns on grounds of principle.
During the war the Government Buildings Agency under Bremer attempts to avoid unsavoury commissions as much as possible, with varying degrees of success. A particularly unpleasant episode involves the production of thousands of signs bearing the legend ‘No entry to Jews’, an order which the Government Building Agency tries to put off for as long as possible.

Stalinist

When Gijsbert Friedhoff is appointed as the new Government Architect after the war, the government is more aware than ever of the value of having a Government Architect. Friedhoff in his turn values monumental government architecture that radiates ‘dignity and tradition’ besides not being overly expensive. He has an eye for details, as is evident from the building for the Ministry of Agriculture and Fishery (1956) with its bronze balustrades, leaded glass windows, and a ceiling painting by Escher in the room of the secretary-general.
There is a sense of the tragic about Friedhoff’s term as Government Architect. He is the last Government Architect who can still build to his heart’s content, and second to last Government Architect to hold the position for more than a decade. He introduces a degree of innovation by being the first Government Architect to employ private architects on a large scale and by ensuring that henceforth 1.5 percent of the construction price of large government buildings will be set aside for contributions by artists.
However, his traditional point of view clashes with the new age. Eventually, the campus of Delft University of Technology will be much more the product of the Van den Broek & Bakema design office than Friedhoff envisaged.
The dissatisfaction gradually mounts, and when Friedhoffs’ own design for the tax offices at the Wibautstraat in Amsterdam is completed a year after his retirement, a storm of protest is unleashed. Writer Simon Carmiggelt devotes one of his ‘Kronkel’ columns in the Parool newspaper to the building. The word ‘Stalinist’ is even used. Apparently this kind of rigid government architecture is no longer acceptable. A new era has dawned.

◂◂

Auke van der Woud –
‘Truth and character: the architecture debate 1840–1890’ (1997)

Corjan van der Peet and Guido Steenmeijer –
‘The Government Architects’ (1995)

Government Architect Kees Rijnboutt -
‘Government Architect is not an easy job’ (The Architect, May 1990)

Photo's: Hans Stakelbeek/FMAX

MASTERMIND

Peter Kroes

"We sometimes analyse a subject to death just by getting stuck on the words."

Well-balanced

Prof.dr.ir. Peter Kroes (1950) graduated at the Faculty of Applied Physics of the University of Eindhoven in 1974. At that point, he says, his life took an unexpected turn. Kroes changed course to pursue a doctorate in philosophy at the Radboud University of Nijmegen, where in 1982 he obtained a doctorate for his thesis on the philosophical problems associated with the notion of time in the science of physics. He then became a lecturer on the philosophy of science and technology at the Technical University of Eindhoven. He has been professor of the philosophy of science at TU Delft since 1995.

Robert Visscher

How would you describe one another?

Kroes: "Lotte is a spontaneous and cheerful doctoral student. She has a very disarming laugh. In discussions she will often make a funny remark. I have never known her to be anything but cheerful. I really enjoyed having her in my group. It was she who arranged for doctoral students within our department to organise dinner parties in order to improve social contacts."

Asveld: "It's hard to put Peter off balance. He is good at managing his time, and he has his work under control. He always has time to read my articles and he was never too busy or under stress. His whole career is built on a stable foundation. It may sound rather dull, but it certainly isn't. Philosophy is an exciting field that takes a lot of creativity. That makes Peter's stability even more admirable."

What sets the other person apart?

Kroes: "Her fresh way of regarding things. Lotte looked at how society handles technological changes. That is quite a tough nut to crack. She is not afraid of tackling a problem subject."

Asveld: "Peter is a good philosopher as well as a good manager, which is a rare combination. He always manages to create the right balance. He finds the time for both things, even though he also likes to complain about lack of time for his research. As my supervisor he gave me the right combination of autonomy and supervision. At first he set me loose, but as the work progressed he upped the pressure. Although he could be demanding, I never had the feeling I was doing the research on his behalf."

What did you learn from one another?

Kroes: "Philosophers tend to weigh each individual word. We sometimes analyse a subject to death just by getting stuck on the words. Lotte simply goes to work regardless. She notices the complexity, but she doesn't get stuck in details. Lotte always went back to the problem itself; I learned that from her."

Asveld: "I learned how to put my thoughts as a philosopher into words, how to discourse clearly, and how to work as a scientist. He also taught me that you cannot cover every aspect. You just have to make some assumptions and start from there, but you mustn't milk them to death."

What's the essence of a good teacher-student relationship?

Kroes: "Oh, the word, teacher! When I was asked to do this interview, I sent Lotte an e-mail message saying how I disliked the word. Lotte replied in a message in which she called me 'master', and added a smiley. I don't like the word teacher because my doctoral students also teach me a lot. In philosophy the teaching is that you set out on a journey together, but you never know in advance where you will end up."

Asveld: "Respect is very important to me, both from students for their teachers, and vice versa. Without respect a student would find it hard to accept anything

In the **Mastermind** series a professor and a (former) student each answer the same questions to create a double portrait.

Lotte Asveld

"I learned how to put my thoughts as a philosopher into words, how to discourse clearly, and how to work as a scientist."

Disarming

Having graduated as a student of cultural and scientific studies at the University of Maastricht in 2001, dr.drs. Lotte Asveld (1976) started work as a freelance journalist, contributing to magazines catering to a wide range of interests. In 2003 she started her doctoral research on the decision-making process associated with technological risks and how the process could be improved. Among other fields her research focused on UMTS, biotechnology, and vaccinations. She gained her doctorate this summer. Since December 2007 Asveld has been working as a senior researcher for the Rathenau Institute. She is also a regular contributor to Delta, TU Delft's newspaper.

from a teacher. And if teachers make a bad job of reading the documents, you also lose confidence in them."

Is your relationship like that of a father and daughter, or more like a married couple?

Kroes: "During the last stages of her thesis we would often discuss the chapters in my room, where from time to time I would hear her sigh very deeply after hearing my comments. We have an open relationship and we are comfortable with one another. Lotte has always managed to put my comments to good use. We do not have a father and daughter relationship, but we're not standoffish colleagues either. I would be very disappointed if Lotte were to find it difficult to knock on my door."

Asveld: "We don't discuss our deepest thoughts with one another. There is a certain distance. I like that, it's part of a respectful relationship. I had a baby while I was doing my research, and Peter had a grandchild, and we did talk about them, of course."

Can you recall an incident of good or bad luck that stuck in your mind?

Kroes: "Her research on the public health issues of UMTS aerials. Some people insist that the radiation is making them ill. Scientists deny this. Lotte immediately contacted people who suffered from complaints as well as people who work for the authorities and for UMTS providers. I have had previous doctoral students ask me to introduce them to others, which is something I've never had to do for Lotte. She is very good at getting to know other people."

Asveld: "At the initial discussion of my research proposal I was not at all certain whether it was up to scratch and I wondered if my research would be at all useful. When the meeting started, Peter said: 'We will now discuss whether Lotte can proceed with her proposal'. That really frightened me. He came up to me afterwards and realised that without knowing it he had expressed himself in far too negative terms."

Do you socialise?

Kroes: "No, I have that as a general rule. I like to keep business and pleasure separate. My work already plays a major role in my life, and I don't want it to become even more important."

Asveld: "No, and I like that. After all, Peter is the one who has to assess my work."

Name one another's best habit.

Kroes: "Lotte never gave up without a fight when we were discussing her thesis. She was good at fighting tough battles."

Asveld: "He can be very tenacious in his comments. Whenever I change something he will always go back to them. Nothing escapes his notice."

And the worst?

Kroes: "I have no idea. Lotte will often come up with hard questions, but then I like a person to do that. I'd ▸▸

In 2003 Lotte Asveld began her doctoral research of the decision-making process associated with technological risks and how to improve this from an ethical perspective.

rather have that than to constantly find myself in agreement with somebody."
ASVELD: "I really can't think of anything."

What is your favourite television programme?
KROES: "The news and current affairs programmes that keep me up to date."
ASVELD: "The English thriller series, 'WAKING THE DEAD', because they spotlight the vagaries of the human mind and show idiosyncratic characters. And I like a good puzzle."

Which television programme would you scrap?
KROES: "Programmes like 'THE GOLDEN CAGE' and 'BIG BROTHER'. I get annoyed by this accepted form of exhibitionism."
ASVELD: "BNN's 'RANKING THE STARS', a programme about Dutch celebrities discussing Dutch celebrities. Who cares?"

What is the other person's significance in professional terms?
KROES: "Lotte focused on what we now call an autonomous person. For this purpose she developed narrative autonomy. What makes a person is partly determined by the stories people tell about themselves and by what others tell about them. Working out this concept is going to be a very big thing in our field."
ASVELD: "The development of the philosophy of technology. Technology often gets explained in terms of sociological processes. Peter decided to use the artefact itself as the basis. Philosophers and sociologists often wonder how the screwdriver became a screwdriver? That is a very descriptive process. Peter prefers to look at what makes a screwdriver a screwdriver, and at the underlying criteria. His line of questioning no longer focuses on an object's development history. That is a major difference in our kind of field."

Do you ever fall out?
KROES: "We do in some ways, by challenging the other person to be clear and more acute. I'm always in the mood for a good battle between philosophers. A good argument does need to be conducted with the right amount of dedication, because it's not a game, and the debate can be very heated. It doesn't involve people slamming doors though. It's the ideas that count, not physical prowess. Slamming doors does not win arguments."
ASVELD: "I'll miss those arguments."

◂◂

Marital status
Kroes: Married
Asveld: Married

Hobbies:
Kroes: Running, fitness, and reading
Asveld: Writing poetry, playing squash, and running

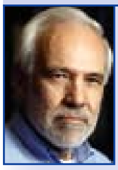
Favourite newspaper and magazine
Kroes: NRC Handelsblad, none
Asveld: NRC Handelsblad, New Scientist

Best book:
Kroes: 'MY NAME IS RED' by Orhan Pamuk.
Asveld: 'HYPERION' by Dan Simmons

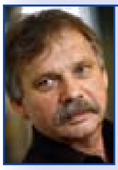
Invention you'd like to be yours
Kroes: A drug to cure asthma
Asveld: An environmentally friendly airplane

PEOPLE

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

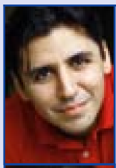


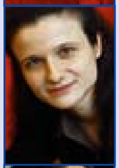
"The field of 'system and network theory' is only just at the start of a long development." These were the words of Professor **Dr Ir. Patrick Dewilde** on the occasion of his retirement on 20 June. The prominent scientist in the field of system theory had retired from his post as scientific director at the ICT-Delft Research Centre earlier in the year in January. For over thirty years Dewilde held a professorship at the Faculty of Electrical Engineering, Mathematics, and Informatics. Since 1993 he had also been head of DIMES, the Delft Institute of Microsystems and Nanoelectronics.



Doctor Honoris Causa. This honorary title was bestowed upon **Dr Ir. Jurek Duszczyk**, head of the biomaterials research group at the Faculty of Mechanical Engineering, Maritime Engineering, and Materials Engineering), on 7 July by the Technical University of Iasi. Duszczyk has been working for a decade with researchers of Romania's largest technical university but one. "One of the reasons I received the honorary title was my work on porous coatings, which can be used to manufacture medical implants," the scientist says. Duszczyk is the second Delft scientist to be given this title by a Romanian university. The first, two years ago, was inorganic chemistry professor Dr Joop Schoonman.

This summer Spinoza Prize winner **Professor Dr Ir. Leo Kouwenhoven** of the Kavli Institute for Nanosciences was awarded a grant by the European Research Council. The ERC Advanced Grant is given to experienced researchers engaged in innovative and pioneering research. Kouwenhoven is expected to receive 1.8 million euros to go on developing his research into quantum optoelectronics over a period of five years. On 1 September the researcher also received the annual Teacher Prize from the Delft University Fund for his work.





In August four Delft researchers were awarded the Veni grant by the Dutch Organisation for Scientific Research (NWO). **Dr Nika Akopian** of the Kavli Institute for Nanosciences is using the grant to create a photon-based transistor. 'Sticky tongs' is the subject **Dr Dimitra Dodou** will be tackling over the next three years using the NWO grant of over 200,000 euros. Current medical tongs have sharp edges that can result in damage to tissue. At the Faculty of Mechanical Engineering, Maritime Engineering, and Materials Engineering the researcher is developing a new gripping method inspired by sticky materials found in the natural world. Dr Enrique Jimenez-Melero of the Applied Physics faculty will be developing new self-strengthening metals for cars and studying them using an x-ray microscope. And **Dr Niki Kringos** of the Faculty of Civil Engineering and Geosciences intends to map and model important chemical material interactions in building materials.

With his research on the shapes of heads and faces of Chinese people **Roger Ball**, a doctoral student at the Faculty of Industrial Design, managed to win one of the International Design Excellence Awards (IDEA) 2008, last July. His name appears in the same context as Apple's iPhone, one of the other winners. Consumer products such as sunglasses and crash helmets are currently being designed using data based on people living in the western hemisphere. The drawback of this practice is that the products are less suitable for use by the Chinese. Ball intends to change all that with his 'Size China' project. The gale-resistant Senz umbrella, also conceived at TU Delft, also received an award. The Senz, whose asymmetrical shape enables it to cope with strong gusts of wind, is an invention by the Delft technostarter company of the same name.

The Faculty of Architecture gained two new professors on 1 September. **Professor Ir. Thijs Asselbergs** and **Professor Dr Dipl.-Ing. Patrick Teuffel** were appointed to the chair of architectural engineering. Asselbergs is a former town architect of the city of Haarlem and a leader of the international Archiprix, a competition for the best architectural graduation projects. Teuffel hails from the school of Frei Otto and Werner Sobek in Stuttgart, and runs a firm of consulting engineers specialising in lightweight structures and high buildings in the same city.

[HORA•EST]

Propositions

The quick-and-dirty experiment is also a quick-and-dirty waste of time.
Robert Andersson
Physicist

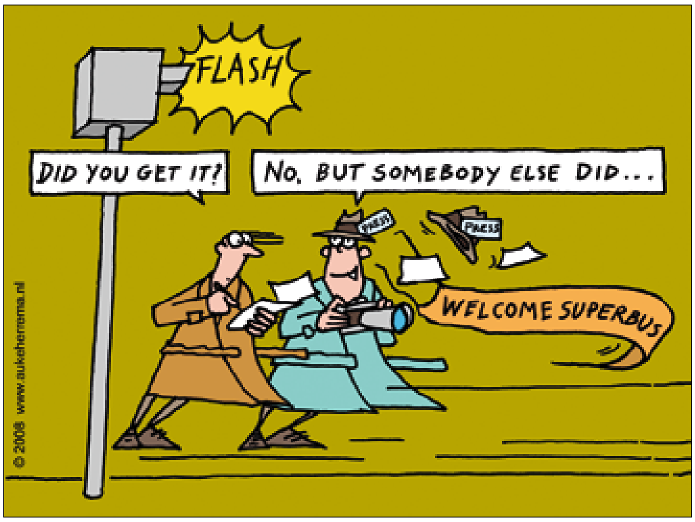
Together with the efforts on the development of truly sustainable energy sources, government and scientists should re-educate the worldwide population on an accountable use of it.
Eliane Kühne
Chemical engineer

Inventors of new materials must be obliged to also devise a procedure for the recycling of that material.
Ivan Shevtsov
Railway engineer

PhD theses are never finished, they are set aside.
Emile Scheepers
Chemical engineer

Speaking with a 'Limburgs' accent in the Randstad area is of advantage when you are proud of your roots and is of disadvantage when you feel ashamed.
Saskia Ossen
Traffic engineer

God could not reasonably expect Adam and Eve to leave the forbidden fruit untouched.
Ralph Smeets
Nanotechnologist



The Superbus, even if it is realized, will not contribute to the development of Groningen.
Gerrit Elsinga, Aerodynamics Engineer

[Sound]BITES

"No doubt the high price of oil will also push up the price of plastic chairs at your local garden centre. We will just have to make do with the old set for another year. It doesn't worry me, which I suppose is just as well. I think that the positive effects of the high oil price will eventually prevail."
Energy expert Dr Aad Correljé in DE VOLKSKRANT

"A rise in mortgage interest rates from five to six percent, as we have just seen happen, means that the cost of tax deductibility will increase by twenty percent."
Peter Neuteboom of the OTB research institute in HET PAROOL

"The importance of nanotechnology for new batteries is best explained in plain language. You make lots of little chambers in a certain material. This increases the volume at the surface, the active material that become available for reactions."
Ir. Ing. Tim de Lange, aerospace engineering lecturer in NRC HANDELSBLAD

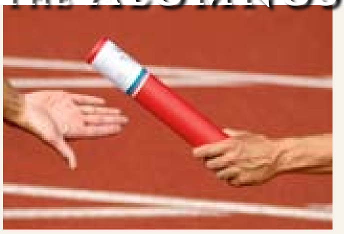
"I was right in one respect though, the dollar had to go down, and substantially so. This would result in turbulence in the markets. Any investor worth his salt could have taken advantage of this insight, but hardly anyone did. That's what you get when a growing number of so-called financial experts are no longer trained in economics."
Innovation economics professor Dr Alfred Kleinknecht in NRC HANDELSBLAD

Photo's: Sam Rentmeester/FMAX

Proposition
Perfect recognition is not required for usable speech recognition as long as the errors appear human-like.

Defence
"In conversation, it is acceptable for people to confuse a word with another word that resembles it and is equally plausible in the context. These are human mistakes. Speech recognition machines often fail to recognise the context. This causes them to make strange, non-human mistakes. The funny thing is that users find this hard to accept, even though the mistakes are seldom serious. If you're buying tickets for the cinema from a speech recognition machine, it may decide you want one ticket instead of two. This is not a real problem. A well-designed dialogue system will let you correct the error, if need be, by means of a yes-or-no question. The idea that speech recognition does not work is incorrect. Major progress has been made."

Pascal Wiggers
Informatics Engineer



A TU Delft alumnus writes a column and passes the pen to another alumnus of his or her choice.

I never knew what I wanted to be. I did know what I wanted to do though. I absolutely had to go to university. I had the brains and I wanted to taste the 'real' university life. Having done sciences at school, I automatically ended up going for a technological subject. It was to be Civil Engineering in Delft. I soon discovered that civil engineering wasn't quite my cup of tea and so I went looking for more creative opportunities in a faculty a bit further down the road (which has sadly burnt down since). Architecture was fun. Although it didn't involve much technology, it was creative and inspiring and easy to combine with life as a student. For the time being I knew what I wanted to do.
But then being a student is only a temporary career, so what next? Should I go for the 'real' life and start a career? First do a little practical work in my field of expertise, then go on to coordinate and supervise projects, perhaps rise to become project manager? Pretty standard. I soon started to ask myself whether that was what I wanted.
I now know better. Pursuing a career is not my style. Hands-on experience is much more fun than monitoring and supervising. Perhaps I even prefer doing manual labour to working with my mind. That's how a hobby got so out of hand that it grew into a part-time one-woman business. I still spend three days a week working with much pleasure as an urban designer for FAME Architecture & Urban Design in Arnhem, where I still get that hands-on feeling. The other two days are for my 'baby', designing and making furniture. I will be completing my two-year part-time furniture-making course at the Wood and Furniture Academy in Rotterdam in September.

I still know what I want to do – although that does tend to change with time – but I still don't know what I want to be. Don't ask me where I want to be in five years' time, like employers do in their personal development plans. I don't care. Just enjoy what you're doing now, what you've got, get, and give. Don't fret about what you want to achieve or become in the future. If you ask me, it will only bring you stress rather than pleasure. For the time being I've found my niche. What a delightful combination, working with mind as well as matter. Everybody should give it a try!
As for the future, well, I prefer to remain myself rather than become some successful businesswoman to fit in with the ideals of western society.

Mireille Woortman (38) is an urban designer and furniture designer and maker. She studied civil engineering for six months followed by architecture at Delft University of Technology (1988-1994). She passes on the baton to former softball team-mate and mechanical engineer Josanne Heeroma.

www.interieur-a-la-carte.nl

Sterile surgery

The risk of infection as a result of the surgery itself can be drastically reduced, according to biomechanical engineering student Tim Horeman.

Tomas van Dijk

A sterile incision instrument shrouded in a plastic bag and a small, flattened balloon filled with sterile gas that is applied to the body with a sticker. Connect the two parts and you have the extremely simple, practically sterile surgery system that Horeman hopes will conquer the world of medicine. Together with some colleagues he has set up a technostarter company, TIME (Technological Innovation in Medical Equipment).
Sterile and simple, those are the two key factors to success, according to Horeman. "The medical market is conservative. Surgeons want the simplest possible solution with the least amount of electronics and maximum freedom of movement."
In his office Horeman demonstrates how the system works using a large plastic dummy full of holes. He applies the sticker with the sterile gas-filled balloon over one of the holes and then he attaches the incision instrument to the sticker part, creating an airtight connection. The incision instrument is known as a trocar, a kind of hollow punch that reaches into the body through a hole and acts as a guide tube. Through the tube the medical instruments, such as snippers and pincers, are introduced into the body on long stems.
At no point during the procedure does an instrument come into contact with the polluted ambient air. The surgeon pushes the trocar into the balloon through a rubber airlock. The trocar cannot be disconnected from the balloon until it has been fully retracted past the rubber airlock, along with any other instruments the surgeon introduced into the body through the tube, , at which point the instruments are again protected by the plastic shroud. The only bacteria or viruses to be found inside the plastic shroud will have come from the patient.
Instruments in operating theatres are rarely this clean. "The probability of getting an infection in a Dutch operating theatre during a laparoscopy is between 1.5 and 4 percent," Horeman says. "My system reduces that to 0.4 percent.
But the system will also have to prove its worth outside the operating theatre. During surgery outside operating theatres, which is common in developing countries with a lack of such facilities, small tents are often erected around the body. Within the tent, surgeons can work in a sterile environment, though restricted in their movements. Horema's invention would provide a welcome solution.
The second prototype is soon to be clinically tested."

More information:
www.timedelft.com.

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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