Delft Outlook

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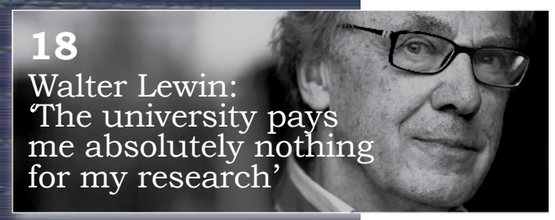
Quantumcomputer
The next level

Walter Lewin
Theatre in the classroom

The View
Energy from cars

Climate change
Threatening or not?

no. 5 2011



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Consensus

Consensus is fatal to new ideas in science. This is the argument put forward by Daniel Sarewitz of Arizona State University in the magazine *Nature* (article doi:10.1038/478007a). Ask a panel of experts to reach a single point of view and the result is almost sure to be bland and predictable. This is why *Delft Outlook* decided to spice up the climate debate by pitting Emeritus Professor Salle Kroonenberg and TU Delft alumnus Pier Vellinga against each other. They crossed swords in a lively debate on climate problems and solutions. Another TU Delft alumnus who has no use for consensus is Walter Lewin, a professor at MIT for many years now. In between his TV appearance on *De Wereld Draait Door* and swinging about on ropes in the lecture hall, he talks of his aversion to Dutch consensus. Prof. Lewin concludes that TU Delft could never measure up to MIT because of the political climate in the Netherlands, where one gets cut down to size if daring to grow too tall. For top-level science, the Netherlands needs to allow the creation of 'centres of excellence'. Could a merger between the universities in Delft, Leiden and Rotterdam be the answer to this? In this edition you can read what staff and students think of this idea. "Science is not a democracy," Prof. Kroonenberg says. Put up your hand if you agree. The majority rules!

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Colophon

Coverphoto
Sam Rentmeester/FMAX

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Delft in Brief

High-level lecture

For his TEDx lecture on 7 November, BioRobotics student Tim Zaman (age 22) wanted to transport his audience to great heights. Just 45 minutes earlier he had launched his flying robot attached to a helium balloon. The device contained a camera, GPS receiver, GSM unit, an ARM processor (familiar from the iPad), batteries and a miniature transmitter (10 mW, about a hundredth of the capacity of a mobile phone). Using three circuit boards, he assembled all the components into a whole which he could then use to transmit live images from the balloon. On 11 September he performed a successful test flight with his space Camera 1. He was unable to receive images during the lecture because contact with the balloon had been lost. No problem – tweeted his audience – it didn't spoil an interesting talk.

www.hollandsehoogte.nl; www.tedxdelft.nl


Photo: Tim Zaman

Smart power grid

How can we best prepare the existing power grid for a future in which power generation is more spread out and there are more fluctuating sources? This was the research question behind the innovative research programme on electromagnetic power technology (IOP EMVT), which concluded in October with the presentation of the book, *Opgewekt door de buurt* (Generated in the neighbourhood). "The development of smart power grids is progressing on two fronts," says project leader Professor Lou van der Sluis. "There is a lot of small-scale generation from solar panels, but there is also a growing degree of international exchange of energy through large-scale wind parks." Prof. Van der Sluis, who led the programme with colleagues from TU Delft and TU Eindhoven, feels that tomorrow's power grid needs more ICT. You can order the book from geertwessel.boltje@agentschap.nl.

The pressure is on


Photo: Tomas van Dijk

Even the steam engine is entering the high-tech era. In order to convert heat into movement and electricity, large power plants use water and steam. In smaller-scale units, which are often powered by biomass, solar energy, geothermal energy or energy from waste, the water is often replaced by an organic liquid with a low boiling point and a large vapour volume. Hence the name: Organic Rankine Cycle, or ORC. The idea is to improve the efficiency of converting heat into energy from 20 percent to 30 percent. In early September, Professor Piero Colonna (3mE) held a congress for his 300 colleagues in the field.

www.orc2011.nl, www.delta.tudelft.nl/23809

Operating theatre of the future

Jenny Dankelman delivered the first Van Leeuwenhoek lecture, on the operating theatre of the future. Dankelman and her colleagues are collaborating with clinicians to improve minimally invasive operating techniques. Take the steerable needle for example. "This doesn't exist yet, but when, for example, a doctor is taking a biopsy, he needs to be able to adjust the position if it's not quite right first time. The biggest problem with a steerable needle is that it also needs to be rigid. There are some great challenges for us there," says Dankelman. The Van Leeuwenhoek Lecture was formerly known as the Hippolytus Lecture and is open to everyone in Delft who wants to know more about technology.

www.delta.tudelft.nl/23814

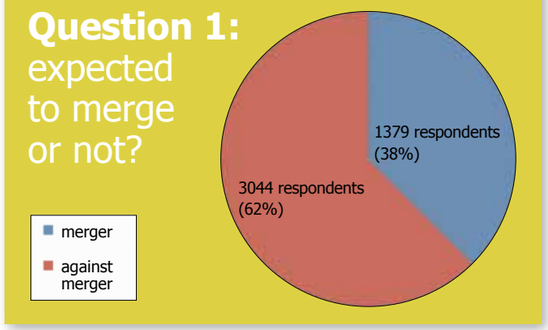
Photo's: Collegerama

Majority against merger

72 Percent of TU Delft's students and staff are to a greater or lesser degree against a planned merger with the universities of Leiden and Rotterdam. This was revealed in the results of the questionnaire which Delta sent to the entire TU Delft community. The questionnaire was completed by 4,871 people. President of the Executive Board Dirk Jan van den Berg said in a short response that "talks were continuing within the university community about the possible results of further collaboration. As the respondents also indicated: the plans need to be shaped from the work floor."

www.delta.tudelft.nl/24017 en 24019

Question 1: expected to merge or not?



In the press

'Millions were lost through real estate, government funds were misappropriated and low priority was given to integrity,' reported NRC Handelsblad at the end of October. In a response addressed to TU Delft staff, the Executive Board stated that the article 'sketched a distorted and outdated image and contained many inaccuracies'. Later, President of the Executive Board, Dirk Jan van den Berg, provided an extensive response to these allegations. In an interview in Delta he also spoke about the reports of allowances received by him and his fellow board members. State Secretary Halbe Zijlstra asked for further clarification and had a conversation with Van den Berg and the President of the Supervisory Board.

www.delta.tudelft.nl , dossier conflicts of interest


Photo: Hans Stakelbeek/FMAX

Egg beaters and ice caps

No fewer than 12 talented TU Delft researchers have received Veni grants from the Netherlands Organisation for Scientific Research. They will receive a maximum of 250,000 euros and will spend three years engaged in research and development. Their subjects range from melting ice caps and a study of skeletal disorders to the development of models for more efficient wind parks. Amelia Barreiro's research proposal, 'Quantum Transport in Novel Heterogeneous Layered Materials', was also deemed worthy of a Veni grant. However, in the meantime, Barreiro had accepted a prestigious Catalonian 'Beatriu de Pinos' grant, so she had to turn down the Veni grant. A vertical axis wind turbine, nicknamed the eggbeater, is the research subject of Veni laureate De Carlos Simão Ferreira (AE).

www.delta.tudelft.nl/24007


Photo: Dr Carlos Simão Ferreira


Photo: Tomas van Dijk

Flying

Using a joystick to land a Cessna in the Science Centre is not quite the same as gaming on the couch at home. This autumn a group of secondary school pupils experienced this firsthand during a sneak preview of the Simona flight simulator, which was officially launched on Tuesday 11 October. The pupils passed the test and Simona was pronounced operational and ready for the public.

Nuna6 in second place

On Thursday, 20 October the Nuon Solar Team finished in second place in the 2011 World Solar Challenge in Australia, just one hour behind the team from Japan's Tokai University. In 2009 the TU Delft team also finished in second place behind Tokai, although the time difference then was much greater. This year the solar racers had to contend with forest fires along the Stuart Highway. "The fire was clearly visible along the first section of the route," wrote Nadine Rodwijk in the Nuon Solar Team blog. Grass and trees were on fire right up to the verge of the Stuart Highway.

Photo: Nuon Solar Team

Delft roots

Jo Dijksman (1915-1996) worked in the organic chemistry department from 1948 to 1980. The collection entitled *'Een geschoren garibaldi'* ('A shaven garibaldi') includes descriptions of his time at the then Technical College Delft. The 140 recollections cover his life in Delft – how, as a small boy, he played in the newly-constructed buildings on Julianalaan, in the same area where he would later play tennis with his colleagues during lunch breaks, how he burnt his fingers on hot tiles in the Royal Delft factory, how he learnt to shave on a bowler hat, and how he exchanged tobacco ration stamps for milk or coal during the war. The book *'Herinneringen aan Delft'* ('Memories of Delft') appeared in 1995, featuring 46 of these accounts. All 140 are included in *'Een geschoren garibaldi'*. The book costs 12.50 euros and can only be ordered from www.mooilimburgswebshop.nl/products/211944.

Nanomotor

Take a flat molecule with opposing electrical charges on either end, place it between two gold plates and subject the whole thing to an alternating electric field. This is how Dr Ferry Prins and Jos Seldenthuis (Applied Sciences) are trying to create the smallest-ever electric motor, a motor with molecular dimensions. Chemist Prins feels very excited that current technology is making it possible to create devices at a molecular level. He was previously successful in creating a molecular switch (handy for even smaller memories) and a light-sensitive quantum dot that seems to offer potential for solar cell applications.

Beer crate bridge

It was touch and go for a moment, as one crate wasn't quite in position, but a student in a cherry picker pushed it into place. With their 14-metre high bridge built on Delft's main square at the beginning of October using 14,000 beer crates, students of the Civil Engineering students' association, 'Practische Studie', broke the official world record for beer crate bridge building.

Film: delta.tudelft.nl/lightbox/gallery/31

Photo: Tomas van Dijk

Climate
as an indicator

They both have Delft roots, but their standpoints in the climate discussion are by no means similar: Professor Pier Vellinga worried publicly, whereas Professor Salle Kroonenberg qualified climate change. Strangely enough, they do agree on the solutions. “If you take a long, hard look,” Prof. Vellinga says, “climate is an indicator of the need to adopt a different approach to nature.”

Jos Wassink

Let’s start with the statistics. Scientific literature reveals that over the last 200 years the CO_2 concentration in the atmosphere has risen from 275 parts per million (ppm) to 392 ppm today, and continues to rise by 2-3 ppm per year.

Vellinga: “The CO_2 concentration is rising by 1-2 percent per year and is currently 400 ppm, I believe. But that doesn’t make much difference.”

Temperature change and atmospheric CO_2 concentration go hand in hand, don’t they?

Kroonenberg: “No, they don’t. It depends on which time scale you use. Between then and now temperatures have risen. But if you look more closely, you’ll also see fluctuations.”

Vellinga: “Generally speaking, a high CO_2 concentration does indeed mean a higher average temperature. Yet both are in the air and subject to all kinds of effects.”

I read that parallel to the CO_2 increase over the last 200 years, temperatures have risen by 0.8 degrees. Is that right?

Vellinga: “Broadly speaking, on average, yes. I have a 20-year old publication here, which states: ‘based on the theory of greenhouse gases, we expect temperatures to rise’. Now, 20 years later, we see that temperatures have indeed risen, more or less as expected. It is not proof, but it does further substantiate the assumption that greenhouse gases have a warming effect.”

Kroonenberg: “In physical terms, CO_2 is a greenhouse gas, that is a totally accepted fact. In a laboratory you can see how CO_2 absorbs the infrared radiation emitted by the Earth. The question is: how much is the Earth warming – we call this climate sensitivity. How much will the temperature rise if the CO_2 concentration doubles? This is a continuous point of discussion. Besides which, many other processes are also involved.”

Vellinga: “Salle points at clouds, volcanoes and vegetation. We knew all that back in 1990. I’ve examined those calculations and see that the figures for 2010 were almost exactly as predicted. My conclusion therefore: despite the complexity, the calculations reflect the greenhouse gas effect fairly accurately.”

Kroonenberg: “The Intergovernmental Panel on Climate Change (IPCC) says you can see the human influence over the last 50 years. But if I examine the statistics myself, I can see that for half of that 50-year period the direct correlation between CO_2 and temperature does not hold. Apparently there are other processes which have a counter effect on the rising CO_2 concentration. Either that or the effect of CO_2 is less than we initially thought.”

Vellinga: “I agree with Kroonenberg that there is a natural variation in climate which we only partially understand. But we also see a rising trend over and above that normal variation. I see it as an uphill climb in a hilly landscape. On average there is an overall rise, but for 30 to 40% of the time there is a fall. Kroonenberg says: look, you often go downhill, too. To which I say, that’s all very well but the trend is still a rise.”

Despite the uncertainties, CO_2 concentrations have been translated into political objectives, such as a 20% reduction in emissions by 2020, which will reached by promoting energy saving with electric transport, low-energy light bulbs, and building insulation. Is this worthwhile?

Kroonenberg: “I believe so, although I’m not sure all measures are equally significant. As I see it: we owe it to future generations to use fossil fuels sparingly. It’s absolute lunacy to think that we’re burning all that fossil fuel, when in fact we use those same fossil resources to produce our plastics, medicines and cosmetics. Regardless of how you view energy transition, we must make an all-out effort to produce renewable energy, especially solar energy. If that helps the climate by emitting less CO_2 into the air then that’s an added bonus. And if it doesn’t help, you will at least have saved some raw materials.”

Vellinga: “I respect that reasoning, but my argument is that you really must reduce energy consumption for

Photo: Sam Rentmeester/FMAX

Shell refinery in Pernis near Rotterdam.

environmental reasons: CO_2 emissions, air pollution, transportation, and working conditions. I believe this will lead to a more sustainable economy in terms of energy."
Kroonenberg: "I believe that investing renewable energy will also boost technology tremendously. Even if you think

'Temperatures are rising, and with the resulting rise in sea level, this poses a considerable threat'

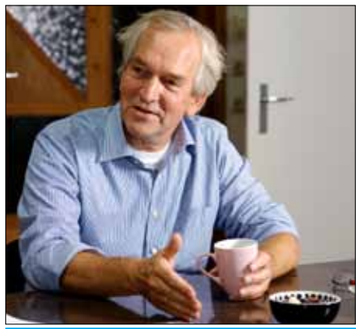
it's too expensive now, solar cell prices are falling rapidly. I find it incredible that we do invest in the underground storage of CO_2 but not in the development of solar cells. That's ridiculous reasoning."

Why do you say that?
Kroonenberg: "Because I'm not convinced that CO_2 is so important that you should devote so much energy into storing it underground. What if it doesn't help (combat climate change, ed.), then we'll have gone to all that trouble for nothing."
Vellinga: "Why do the conclusions you reach differ from those of most other climate scientists? Before coming here, I visited the websites of NASA, NOAA, Max Planck Institutes, the Dutch meteorological institute (KNMI) and the Belgian and French meteorological institutes. They all hold a different opinion to Salle. They say: CO_2 certainly does seem a problem to us. Temperatures are rising, and with the resulting rise in sea levels, this poses a considerable threat. With all due respect, I feel that an individual researcher, former-researcher, geologist in fact, is entitled to have a different opinion. However, policymakers should also consider NASA, NOAA and the KNMI. You cannot base climate policy on the views of a few people who say things might not be that bad, and the effect of CO_2 perhaps not that strong, when specialised knowledge institutes, such as meteorological institutes and universities, have identified huge risks."
Kroonenberg: "Science is not a democracy. The KNMI also has a certain way of presenting its information. For example, they state that the last ten years was the warmest decennium in the past century, and indeed it was, but they neglect to say that temperatures did not actually rise over the last ten years, not even in De Bilt. I realise that these institutes themselves have an interest in both the discussion and the research continuing."
Vellinga: "For a whole year I wondered whether the climate sceptics might perhaps be right."

When was that?
Vellinga: "After *climategate*, so around January 2010. For a year I re-read all the articles and blogs by climate sceptics and wondered how things had been in the past. Was it true that environmental scientists often exaggerated the situation? I tried to put it all into more perspective, but my final conclusion is clear: the supporting data that underpin the theory that greenhouse gases lead to global warming, and that global warming leads to a worldwide sea level rise, is so almost certain that I consider it legitimate to invest substantially in a more sustainable, climate-neutral energy supply."

Concerned
In recent years, Professor Pier Vellinga (1950) has often expressed his concern about climate change, especially in combination with sea level rise. He graduated from Delft University of Technology as a civil engineer in 1976 and obtained his PhD in 1984. He worked for the Ministry of Housing, Regional Development and the Environment (VROM) as an advisor on international climate policy and as director of the national climate programme. In 1991 he was appointed full professor in Climate Change at the VU University Amsterdam. He was later also appointed professor in Climate Change and Water at Wageningen University Research. Following the unsuccessful climate summit in Copenhagen (December 2009), he weighed everything up and wrote the book, *'Hoezo Klimaatverandering – feiten, fabels en open vragen'* ('Climate Change, What Climate Change? - facts, fables and open questions')

Relativistic
Professor Salomon 'Salle' Kroonenberg (1947) became particularly well-known as a climate sceptic. He prefers to describe himself as a 'climate relativist'. In his award-winning book, *De menselijke maat (The Human Scale`)*, which was published in 2006 and has sold 25,000 copies, he explains that, from a geological perspective, climate change is perfectly natural. From 1996 to 1 September 2009, Prof. Kroonenberg was professor of Geology in the faculty of Civil Engineering and Geosciences. He earned a reputation as "an agreeable and wise talker who demonstrates just that little bit more vision, wilfulness and individuality than the average professor". This spring saw the publication of his book on the mythology and geology of the underworld: *Waarom de hel naar zwavel stinkt (Why Hell Stinks of Sulphur*).


Prof.dr.ir. Pier Vellinga.


Prof.dr. Salomon Kroonenberg.

Tata Steel in IJmuiden.

A lot of climate-related research is currently being conducted at TU Delft: climate-proof dykes, living on water, as well as hydrogen storage, solar panels and electric transport. What do you think of this orientation? Too much or not enough?
Vellinga: "Climate change is not expected to really impact for another 40 to 50 years. But once it does, there's no turning back. That's why we have to adopt emission restrictions now. So what do you do? Preferably things that will also have a short-term effect. So we change our ways, not only to benefit the climate but in ways which will also create some social value. Like our eating habits, for example: a meat diet produces around six times as much greenhouse gas as a vegetarian diet. So switching to a more vegetarian diet is better for the climate, but it also makes a lot of sense as regards health and biodiversity. If you take a long hard look, climate is an indicator that we need to adopt a new approach to nature, raw materials, water and practically everything else we extract from the Earth."

Climate as an indicator. I like that comparison. Salle?
Kroonenberg: "I'm always in favour of research, regardless of what it's about. As far as I'm concerned, you can research underground CO_2 storage, so long as it's innovative and generates new knowledge. I do feel that TU Delft is somewhat behind the times, presenting itself so distinctively in relation to climate at this late stage of the discussion, because I believe that the whole subject will become much less an issue of social debate than is now the case."

'I find it incredible that we invest in the underground storage of CO_2 but not in the development of solar cells'

Vellinga: "Social interest fluctuates. Ultimately, and you have to be honest about it, the benefits of CO_2 reduction will not be felt in terms of a better climate for around another 40 to 100 years. Throughout the history of mankind, we have never been very inclined to invest hugely in something that will not yield a profit for another 30, 40 or 100 years. Unless it was a religion."

Velox, TU Delft's super-fast bicycle

Nevada desert, 15 September 2011
A small dot appears on the long straight road and rapidly approaches in a matter of seconds before racing by, emitting a noise like that of a passing jet aircraft. That was Sebastiaan Bowier, clocking up a speed of 129.61 km/hour during the World Human Powered Speed Challenge held at, the aptly-named, Battle Mountain. This was the climax of a year-long process that saw 15 TU Delft students, together forming the Human Power team, designing, building and testing a covered recumbent bicycle, the Velox. By using wind tunnel tests and advanced computer programs, they aimed to minimise their bike's wind resistance and bid for the world record, held by a Canadian, Sam Whittingham, riding the Varna Tempest. Bowier and the Velox remained ahead of the other teams during the race, including Whittingham, but his record of 133.27 km/hour, set in 2009, was not to be surpassed. The Human Power team returned to Delft at the end of September, but even before they got back, new ideas were already being voiced as to how they might improve their speed next year. A second team is now making preparations to that end.
But let us first take a close look at the world's fastest bicycle for this year. **www.hptdelft.nl**

2011
HUMAN POWERED SPEED CHALLENGE
Sprint competition on a straight road
8 km to get up to speed, then the average speed over 200 metres.
Winning speed
129,61 km/h (by Velox)

Assistants
Because the cabin is enclosed, the cyclist is unable to put his feet on the ground. Consequently, when he is about to start moving, assistants hold the cabin while the rider climbs into the seat. They then attach the second half of the cabin to the first part. The tape must be pressed on firmly in order to keep the wind resistance down as much as possible. The assistants push the bicycle before letting go once it has reached a speed of about 15 km/hour. Upon arrival, the assistants are again on hand to meet the bicycle.

Support vehicle
The power supplied by the cyclist is continuously measured (on the crankshaft) during the race. The coach in the support vehicle gives the cyclist instructions on how to achieve the optimum result.

Insnoeren
Cyclists with broad shoulders must be strapped into the seat. This prevents the exterior shape of the covers 4 from becoming distorted, which would increase wind resistance.

Carbon fibre cabin
The bicycle cabin consists of two halves, made of carbon fibre. One 1 is fixed permanently to the frame, and the other is attached using special tape. It took five students two weeks to make the two composite cabin covers. A layer of Kevlar on the inside prevents the carbon from splintering in the event of a collision and thereby injuring the rider.

Frame
The bicycle frame is a single entity: pieces of foam are stuck together and wrapped in carbon fibre.

2011
HUMAN POWERED SPEED CHALLENGE
Hour-long test on car-racing track
Average speed over an hour.
Winning speed
92 km/hour
Speed of Velox
88 km/hour

Unfavourable weather conditions

Each of the teams cycled in succession, after which the results were compared. The weather conditions, which were constantly changing, had a significant potential effect on the results. For example, there is greater wind resistance when the outside temperature drops (because air humidity rises), while cold weather makes the tyres less elastic, causing an increase in rolling resistance. During the hour-long trial, the speed of the Delft Velox fell from 94 km/hour to 88 km/hour because the temperature dropped. Although the power being supplied by the cyclist was the same, the lower speed meant that the record was not surpassed.

Top speed
Racing bikes can reach a top speed of around 50 km/hour. The recumbent bicycle cabin reduces wind resistance to 0.1, allowing it to attain a top speed of about 130 km/hr. At this speed, the motion made by the legs and feet is the same as with a racing bike, which means the sprocket wheel on the axis of the wheel being pedalled must be more than 2.5 times larger than that on a racing bike (104 teeth, instead of 42). The transmission from the sprocket wheel 2 to the derailleur 3 to the wheel occurs in two stages. To the rider, the lightest gear on the recumbent bicycle feels the same as the heaviest gear on a racing bike.

Winfactor 1
During the design phase, a great deal of attention was paid to the shape of the Velox's cabin. The optimised aerodynamic form was actually the starting point for the design of the rest of the bicycle, with the bicycle required to fit the cabin. But care was taken ensure that enough space remained for making the pedalling movement.

Limited steering
There is not much room in the cabin to turn the front wheel (no more than five degrees either way), which means the bike can only take wide turns. However, this is perfectly adequate for making a rapid sprint on the straight roads of the Nevada desert.

Winfactor 2
With most other teams, it was the designers themselves who rode their own bicycles, but the team from TU Delft conducted an extensive selection procedure to find the best cyclist. Dozens of candidates were tested to see if they could deliver the power needed for the hour-long test and the sprint. They then spent six months practising for four hours a week on a recumbent or training bike. Only those not affected by claustrophobia were suitable.

Wheel cover
The rear wheel is enclosed by a carbon fibre cover to reduce wind resistance. Without a cover, all the air in the cabin would have to be moved around. After all, the air around the wheel has to move in the same way as the wheel. No cover has been fitted around the front wheel due to lack of space: the wheel must be able to turn to the left and right.

Disc brake
When the cyclist squeezes the handbrake, two brake pads 5 press against the sides of a special disc brake, causing the bicycle to stop.

Ultra-fast calculations using diamond

TU Delft researchers have managed to use a piece of diamond to hold four quantum bits that can be spun, flipped and entangled with each other. This is an important step towards a working quantum computer.

Tomas van Dijk

Photo: Sam Rentmeester/FMAX

Ronald Hanson: "When we get quantum error correction to work, our work on the quantum computer will be finished."

Atoms trapped by a laser beam, superconducting rings, carbon nanotubes: a whole range of possible elements for building future ultra-fast quantum computers has been proposed over the years.

Because of their adjustable quantum states, such as spin, charge, current direction and polarisation, these particles can be used to represent information in the form of bits with special properties. A quantum bit or qubit is not limited to just two states, like the transistors of today's computers, which can only be 1 or 0. A qubit can have several states simultaneously.

'From a microsecond to a millisecond is a huge difference'

In the wonderful world of quantum mechanics, electrons can, for example, have a left and a right spin at the same time. The possible combinations are unlimited, for example some right spin and a lot of left spin, or vice versa. Theoretically, this means that certain types of calculations can be performed extremely quickly.

Progress however is only being made a step at a time; for example, first researchers succeeded in keeping a quantum computer's switch in a stable position for a millisecond rather than just a microsecond, and later they managed to read out the quantum-mechanical state indirectly, without disturbing it.

Over the past ten years, press release has followed press release. Each time it is announced that the quantum computer is now a step closer to feasibility. But will a quantum computer ever actually be built? Dr Ronald Hanson, of the Kavli Institute of Nanoscience, laughs when asked this question. After all, the field is developing rapidly. "Ten years ago, we weren't able to do anything," he says. "But now look at how we can spin and manipulate atoms and electrons. When I tell my friends about this, they're amazed." Dr Hanson is hopeful that future quantum computers will be made using diamond.

Quantum states are difficult to measure, partially because they are "drowned out" by noise from their surroundings, for example from neighbouring atoms that are also vibrating and spinning. Most research into quantum phenomena is therefore carried out at extremely low temperatures. However, a computer that only operates at temperatures just above absolute zero does not seem a very practical proposition.

Room temperature

Qubits turn out to be very stable in a diamond. Hanson and his colleagues have been working for years on qubits in diamond chips. Some of their experiments are conducted at room temperature.

Recently, the researchers succeeded in very accurately reading out a "mini-quantum computer" – a computer consisting of four qubits. This was a breakthrough, and their research was published in Nature last September (first author: Lucio Robledo).

The TU Delft team is working with synthetic diamond in which a few nitrogen atoms are distributed. Wherever a nitrogen atom occurs, an open space or hole arises in the crystal structure of the diamond, with each hole containing an electron.

The trapped electron is one of the four quantum bits. The three other quantum bits are the nitrogen atom itself and two neighbouring 13C carbon isotopes.

The atomic nuclei form very stable quantum bits because they hardly interact with their surroundings. This is because most of the diamond consists of 12C isotopes, which do not have any spin. This makes diamond a material suitable for building a quantum computer that works at room temperature.

In order to read out the states of the atoms, the researchers had to open up a new bag of tricks. "Atoms are relatively unaffected by the magnetic noise of their surroundings, because they only have a small magnetic moment," explains Dr Hanson. "This makes them stable but also difficult to read out. Electrons have a much larger magnetic moment. To read out the state of atoms, equipment needs to be a thousand times more accurate than for reading out electrons. For this reason, we chose an indirect method by using the electron trapped in the hole."

The scientists thus use the trapped electron as an intermediary in making the measurement. First they perform a so-called quantum operation, in which the electron enters an entangled state with the atomic nuclei. This means that information is transferred from the nuclei to the electron. The researchers are then able to read out the state of the electron and deduce the original state of the nuclei.

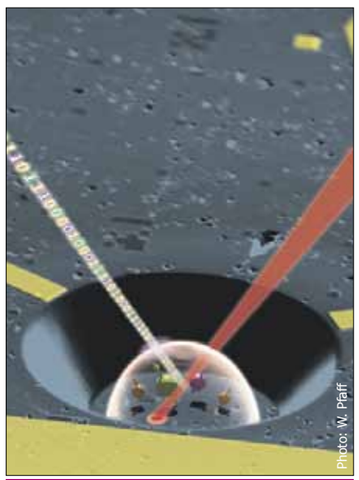


Photo: W. Pfaff

The four quantum bits of spins (the spheres with arrows) are read out by firing a red laser light at them. Information about the state of the spins returns with the light.

In order to read out the state of the electron, the researchers fire laser pulses with very precisely adjusted wavelengths at the electrons. They do this eight times, because the electron may have taken on eight different spin velocities, depending on the spin states of the nuclei of the atoms with which it has become entangled.

The electron will absorb a photon from only one of the eight pulses. When the electron does this, it subsequently emits a photon, and this event can be detected.

Dr Hanson: "In other words: eight times we ask the electron a question about its state, which it can answer with yes or no."

Noise

The measuring technique is remarkable, because it does not alter the state of the atomic nuclei. This method is also suitable for setting up atomic nuclei for further calculations.

The researchers did not perform this particular experiment at room temperature, but rather at 10 kelvins. Unlike the atomic qubits, the electrons are very sensitive to noise.

"If we ask the electron, 'Are you in this particular state?', we do not receive a clear answer at room temperature," Dr Hanson explains. "We can probably solve this problem in the future by asking the question a hundred times and then averaging the answers we receive."

Dr Hanson is not concerned that this statistical trick will make the quantum computer slower: "Calculations can be performed so much more efficiently using quantum bits that it will always be faster than a conventional computer."

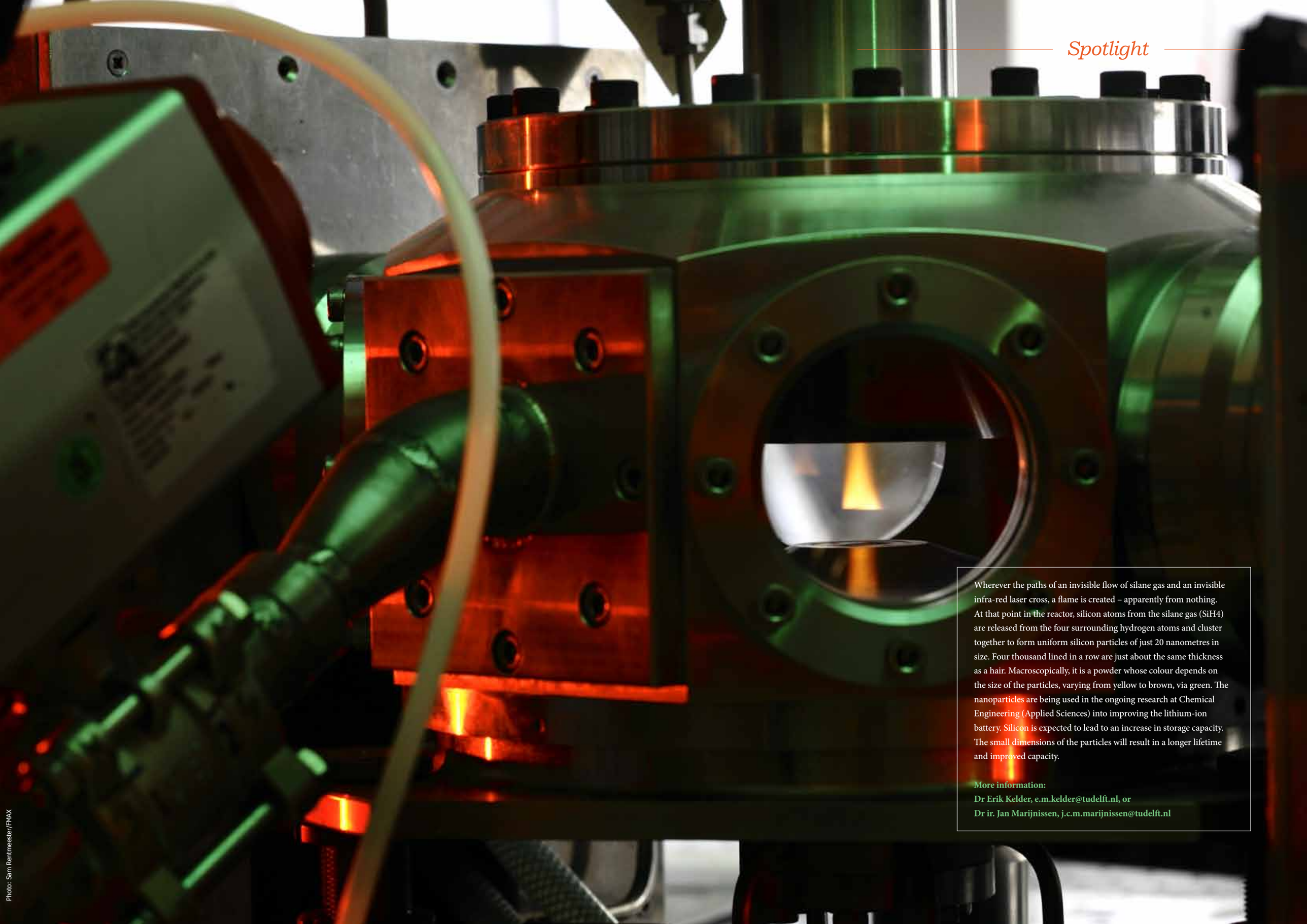
He adds that the great remaining challenge is to maintain the quantum bits indefinitely, using a sort of self-correcting mechanism in the chip.

A few years ago, Dr Hanson's team succeeded in maintaining quantum bits in a stable position for a millisecond rather than just a microsecond by exposing them to microwaves. This breakthrough was published in *Science*. "From a microsecond to a millisecond - this is a huge difference.

The 'holy grail' is to maintain the qubits indefinitely using quantum error correction," Dr Hanson continues. Using this technology, information that is actually carried by only a single quantum bit is encoded in the form of several bits. If one of the bits enters a different state during the calculation, this can be detected using a clever reading-out method, which does not require reading out the states of the bits (which would interfere with the calculation). A deviating bit can be set to the proper state using microwaves.

"When we get quantum error correction to work, our work on the quantum computer will be finished," Dr Hanson concludes. "After that, we will work on remote quantum entanglement, or teleportation."

Lucio Robledo, Lilian Childress, Hannes Bernien, Bas Hensen, Paul Alkemade & Ronald Hanson. DOI 10.1038/nature10401



Wherever the paths of an invisible flow of silane gas and an invisible infra-red laser cross, a flame is created – apparently from nothing. At that point in the reactor, silicon atoms from the silane gas (SiH4) are released from the four surrounding hydrogen atoms and cluster together to form uniform silicon particles of just 20 nanometres in size. Four thousand lined in a row are just about the same thickness as a hair. Macroscopically, it is a powder whose colour depends on the size of the particles, varying from yellow to brown, via green. The nanoparticles are being used in the ongoing research at Chemical Engineering (Applied Sciences) into improving the lithium-ion battery. Silicon is expected to lead to an increase in storage capacity. The small dimensions of the particles will result in a longer lifetime and improved capacity.

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Dr ir. Jan Marijnissen, j.c.m.marijnissen@tudelft.nl

Photo: Sam Rentmeester/FMAX

‘MIT pays nothing towards my research’

On 26 October, Professor Emeritus Walter Lewin (MIT) delivered one of his legendary lectures about rainbows and blue skies to a packed lecture hall at TU Delft. He himself studied here 45 years ago. How does he view the difference in quality between TU Delft and MIT?

Jos Wassink

This morning you began by inspecting your lecture room. What condition was it in?

“When I entered I thought: ‘Oh my God, this is going to go horribly wrong’. For the rainbow demonstration I need a sun, as I use a carbon light to achieve the enormous luminosity, but the carbon light didn’t work properly and I couldn’t adjust it. The slide projector didn’t work either – they had had four months to get that organised. The second projector also didn’t work, but eventually the third one did. Then I have an experiment with smoke which, as I’d explained, cannot possibly be done against a shiny background. So what was the background today? Shiny. So that had to be changed. I spent the first half hour thinking: ‘O God, this is not going to work’. After about an hour I regained a little confidence. And after two hours I felt there was a reasonable chance that the two experiments would indeed work.”

Why do you attach such importance to demonstrations during lectures?

“I don’t particularly. If you teach physics, then step by step you gradually derive formulas, but formulas are just lifeless figures on a blackboard. It’s important to be able to say: this is what we’ve derived, now let’s see what the consequences of the formula are. I spotlight a few examples - I’m good at that – to encourage students to look beyond those formulas. Let me give you an example: if I derive the formula for the time of oscillation of a pendulum of a certain length and weight, then - and this is something no one notices at first - the weight is not even in that formula. So I ask: isn’t that strange? My students usually then say that they would think it logical for the time of oscillation to depend on what was suspended. I then take a 5m length of rope, from which I hang 15 kilograms. I then measure the period of a full oscillation from left to right and back again, very accurately. I measure the time of ten consecutive oscillations, in order to increase the accuracy to one-hundredth of a second. What do I do next?”

You sit on it.

“I hang from it and measure another ten oscillations. They’ll remember that for the rest of their lives. This formula now means something to them, and they know that it does not involve the mass. You said that I attach importance to demonstrations, but that’s not the way it is. The demonstrations are necessary to show the students what the formula means.”

But you take it to the extreme.

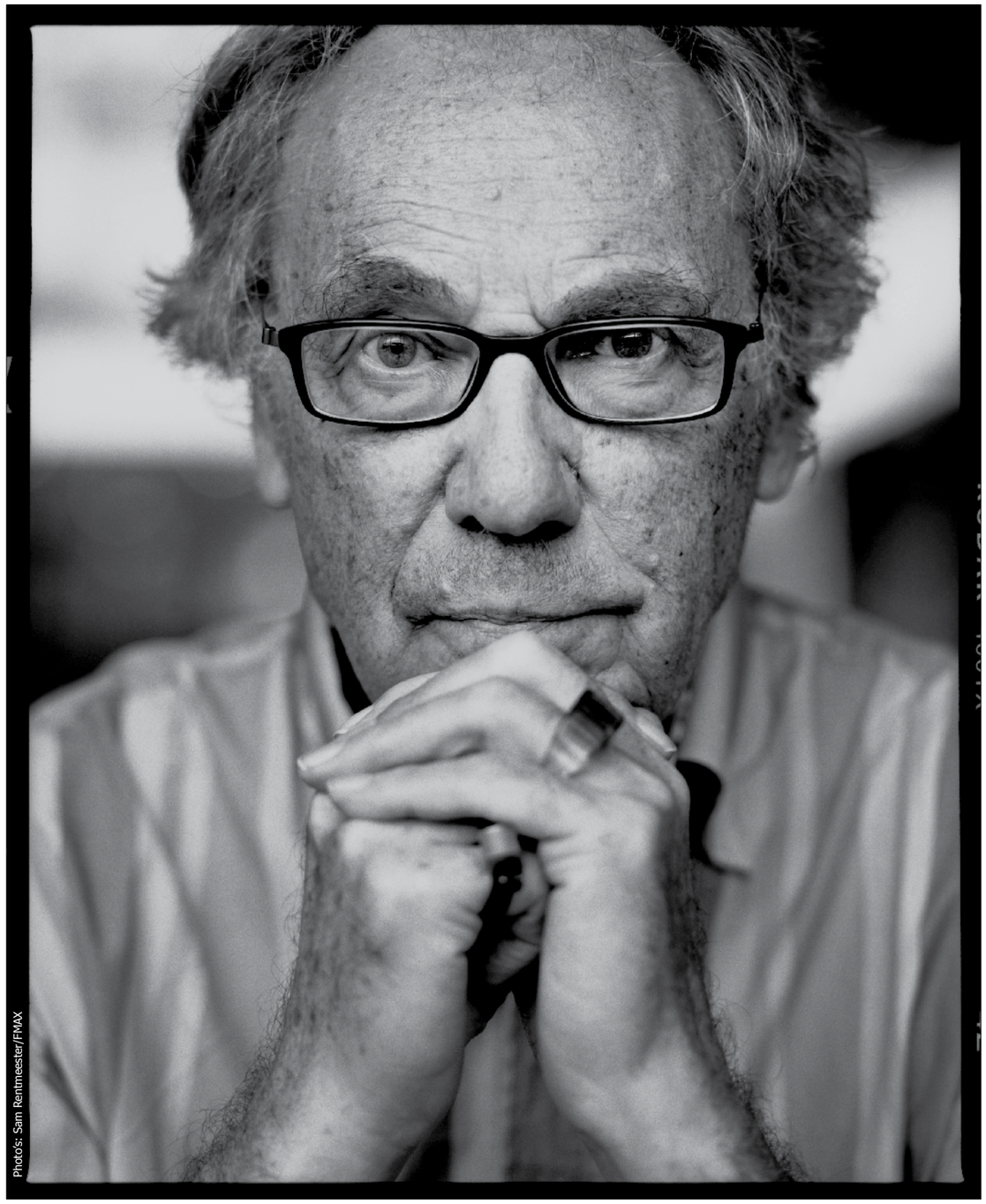
“That’s why 2 million people watch my lectures every year. I don’t know if you want to call that extreme. I think that, in the long run, I’ll influence the way many physics lecturers work. I notice that now already, with around 20 to 30 fan emails a day. By which I mean physics lecturers who write to say: ‘you made us realise that we have never taught physics as it should be taught’. So I influence the way physics will be taught in the classrooms.”

Only now, after 50 years of teaching?

“I’ve only been doing these online lectures since 2003 - seven years. Initially there were 300,000 viewers a year, now there are 2 million. So it’s expanding and increasing more and more. “

The disadvantage is that a good demonstration takes so much time to prepare. Are lecturers prepared to make that effort?

“No, most of them are not. In interviews they often ask me: what’s the secret of your success? There is no one thing, no magic pill. It starts with your lecture structure: where you start, how you start, which examples you choose and where you want your lecture to gradually lead to. That may mean weeks of preparation. I think about it on the beach. I call it the architecture of my lectures. You then have to conceive demonstrations to support your lecture. After that, you work out some kind of script which you try out in an empty lecture room. That lasts, say 65 minutes, and you only have 55. So some things have to be cut. That often takes me another week. I then do the whole lecture again, and this time it’s a lot nearer to 55 minutes. At 5 a.m. on the day of the lecture, I go back to that empty classroom and do my third dry run. By now my timing will be perfect, and a few hours later I will deliver the lecture as a kind of performance.”



Photo’s: Sam Rentmeester/FMAX

‘*You do not allow the creation of centres of excellence that’s a dirty word in the Netherlands*’

Many professors have difficulty finding time to teach, besides their research and management tasks.

"Let me tell you, I usually have two post-docs and two or three PhD students. I meet with them every week. Then, when I do those lectures in the autumn, they know Walter will be working 80 hours a week and that they won't see much of him. By then the group is so well-oiled that all runs smoothly. But I cannot do that again in the spring, as I have to write research proposals. That's hard business in America. I can send a proposal to NASA, but if someone else writes a better proposal, they get the money and I don't. The university pays me absolutely nothing for my research. Nothing! In other words: every telephone call has to come out of external funding. I need roughly half a million dollars a year. I use that to pay my postdocs, the MIT overhead, my PhD students, my travels and conferences – I have to keep the money coming in. We professors - and that's the principal difference with the Dutch system - we keep the university going. The university couldn't exist without our overhead, so, consequently, it's vitally important to them that we write good proposals. This is why we have such tremendous freedom. They are very aware that if we can bring in half a million a year – and some of my colleagues bring in ten million a year – that MIT will get 65 percent of that, which generates enormous incomes. In return they offer us an incredible amount of freedom."

Is that the US system?

"That's the situation at top universities. There are around 10,000 colleges that offer Bachelor's degree programmes, ranging from stuffy to stupendous. The stuffy universities do not do any research and they receive no income at all from their professors. Conversely, such a professor may receive 10,000 dollars a year, but can't do anything with it, of course. In other words: in the Netherlands, the standard of the universities is fairly consistent. There's little difference between Groningen, Utrecht and Amsterdam, for example. In the US the difference is so enormous that comparing a university in the hinterland with say MIT, Caltech, Columbia or Princeton, would be like comparing apples with coconuts."

And at the top universities, the professors have every freedom to set up their own research?

"Yes, because the people they recruit must be among the very best in the world. At some point you're offered a professorship for a period of five years, after which the university will decide whether you should be allowed to stay, whether to give you what we call tenure, which is for life. They will write to the top 15 people in the world in your field, and if two of those 15 say, 'Walter has done good work, but so has Piet', then Walter will not get tenure. You're out. You will not be allowed to stay."

You speak of the tremendous freedom, but doesn't that also place tremendous pressure on you?

"You bet it does, because if I don't win enough proposals every year, I'll have to dismiss postdocs, dismiss PhD students, because I have to provide for them. Naturally, I have sleepless nights about this. Absolutely. You bet your life. It places tremendous pressure on us."

TU Delft likes to emulate MIT. If the Executive Board were to ask for your advice on how TU Delft could become more like MIT, what would you say?

"It's impossible. Your politics determines that. You do not allow the creation of 'centres of excellence'. That's a dirty word in the Netherlands. You don't have a university that you could turn into an Oxford, Cambridge or MIT, because you can only achieve that if you resign yourself to the fact that other universities would then become second- or third-rate. That is an entirely different approach. Asking what TU Delft could do to become more like that is asking the impossible."

The Netherlands is more of an equality model?

"If you grow too tall you get cut down, and if you're too short they pump money into you to help you grow. I can't stand that. We do things differently at MIT. A whole new world opened up for me in America."

As he reaches the door, the professor pauses, turns around, and adds one final comment: his grandfather could neither read nor write. The Netherlands made it possible to develop from illiteracy to a professor at MIT within two generations. Professor Lewin considers that a great credit to Dutch education. But he is nevertheless glad he left at the right time.

Who is Walter Lewin

Scruffy hair, bright yellow jacket and large plastic rings on his little fingers, Walter Lewin (The Hague, 1936) is not exactly your average professor. After a frightening childhood as a Jewish lad in The Hague during the Second World War, Lewin studied Physics at Delft Technical High School, while working as a physics teacher at a grammar school in Rotterdam, and obtained his PhD in 1965. He went on to join Bruno Rossi's research group at Massachusetts Institute of Technology. The freedom and lack of bureaucracy there were like a breath of fresh air to him – he's still there today. From the outset, Professor Lewin has been involved in the development of X-ray astronomy, publishing some 450 scientific articles in 43 years. He also made a name for himself with his theatrical lectures that students will not readily forget. His lectures have been available online as OpenCourseWare since 2003, which enabled him to reach a whole new audience: two million viewers per year. His biography, *For the Love of Physics*, was published this year by Free Press in New York.

'Ir.' Title

Tonie Mudde (1978) studied aerospace engineering and is a science journalist and writer. His work has been published in Quest, nrc.next, and Het Parool newspaper and elsewhere. In 2009 he was awarded a Tegel, the annual prize for journalism. Last year saw the publication of his debut novel, *Spaghetti Spoetnik* (Spaghetti Sputnik).

"Where can I find out whether anyone rightly uses the title '*ir*'?" This question was asked on the LinkedIn forum for TU Delft alumni last year, but for some reason it keeps crossing my mind.

I once lived in the same student house as P., an eccentric character who had fooled everyone into believing that he had just graduated and was looking for a home of his own. That shouldn't have been a problem, as he was newly employed by TNO and earning a good salary working on wind tunnel research. He left for work every morning, in a smart suit and carrying his laptop bag. Nobody suspected a thing until a bailiff appeared. P. was found the same day, crying in his car in a remote car park. In his smart suit with his laptop bag. He had failed a couple of subjects but failed to tell anyone; hence, he became entangled in an ever-increasing web of lies.

Photo: Sam Rentmeester/FMAX

What I mean is: some Ps live the lie for a lot longer, maybe even for their entire careers.... On LinkedIn, alumni have suggested various ways of unmasking these frauds. Simply ask to see their diplomas, someone commented, a suggestion which reminds me of the 'authenticity documents' that accompany Old Master paintings. If anyone is able to forge a Vermeer, complete with 17th century craquelure, then surely he could also manage to forge an A4 document with a few stamps on it. I had another look at my own diploma: easy enough to photoshop into a fake that any unsuspecting employer would accept.

A digital archive perhaps? A public website with the names of all Dutch '*ingenieurs*'? Hardly seems watertight, either. Look at Wikileaks, and the recently hacked DigiD site: the power of a nerd with a laptop knows no bounds. He can erase your title at the push of a button. Or worse still: change the '*ir.*' in front of your name to '*drs.*'.

I'm afraid we'll just have to accept the situation. Unless you have an army of detectives to verify every CV, you'll never know for sure whether or not an applicant is telling the truth, although my advice would be: if in doubt, trust your intuition. I mean, suppose someone claims to have a degree in aerospace engineering, but the most he can do is to type frivolous columns. Now that would set off my warning bells.

www.twitter.com/toniemudde

Photo: Sam Rentmeester/FMAX

Students at the faculty of Architecture searched for aspects and potentials of the ultimate European skyscraper. This research resulted in a collection of 676 models of Lego in scale 1:1000, which are presented as a grid of 26 linear iterations. This midterm review is a project of Eurohigh design studio, of The Why Factory. This international think tank is run by Delft University and MVRDV Architects.

NanoNextNL: Big in small things

With a total of 44 projects in ten different themes, TU Delft is a major participant in the NanoNextNL research programme, which was officially launched this summer. PhD students and postdocs are currently being recruited for research work due to last until 2016.

Jos Wassink

The NanoNextNL programme focuses on the development of nanotechnology in the broadest sense of the word: from nanomedicines and sensors, to energy applications and health risks. At TU Delft, projects have been submitted by the faculties of Applied Sciences (AS), Mechanical, Maritime and Materials Engineering (3mE), and Electrical Engineering, Mathematics and Computer Science (EEMCS), in particular, followed by the faculty of Technology, Policy and Management (TPM).

The research programme chaired by Dave Blank, a professor at the University of Twente, follows on from the previous BSik programmes MicroNed (approximately 56 million euros) and NanoNed (180 million euros).

According to the nanonext.nl website, the objective of the new research programme, in which universities, knowledge institutes and companies collaborate, is to create "an open, dynamic and sustainable ecosystem for research and innovation, with which the Netherlands can continue to play its leading role in the world, and can extend this role further, in micro and nanotechnology".

The total budget for the programme is 250 million euros, of which half will be contributed by the universities, knowledge institutes and companies, primarily in the form of man hours and the use of facilities. The other half will be funded by the Ministry of Economic Affairs, Agriculture and Innovation, paid from the natural gas profits (Economic Structure Enhancing Fund (FES)).

The Delft micro/nano community has submitted 44 projects with a total budget of nearly 24 million euros. The participation of the other Dutch universities is comparable: the University of Twente has submitted projects worth 27.6 million euros, and Eindhoven University of Technology projects worth 16.9 million.

"The universities of technology and Wageningen University are active on a wide scale," observes Dr Leon Gielgens, Programme Office Director of NanoNextNL at STW. Professor Fred Keulen (3mE), vice-chairman of NanoNextNL, agrees: "These universities contributed greatly to the MicroNed and NanoNed programmes and consequently played a significant role in designing the NanoNextNL programme. As a result, several hundred PhD students are being educated there, and they will be our future knowledge workers."

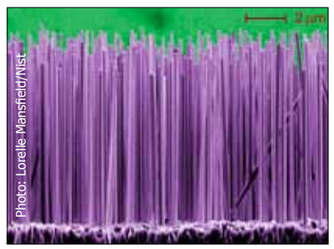
www.nanonextnl.nl

Hugo Perez Garza at work in the cleanroom of the Van Leeuwenhoek Laboratory.

More than Moore

The law of Moore (the number of circuits on a microchip doubles every two years) has applied since the 1970s. By the same law, semiconductors have become ever smaller, currently approaching molecular scale, which is when things become really interesting, writes theme coordinators, Reinout Woltjer (NXP) and Derk Reefman (Philips). This increasing miniaturisation has reached a point where researchers can bridge the gap between electronics and molecular processes using light, chemistry, magnetism and spin. This offers new perspectives, such as the detection of separate photons, interaction with living cells, and manipulation and reading of spin states. A few examples: Professor Herre van der Zant (Applied Sciences) and Dr Sven Rogge want to further develop nanowires in order to detect biological molecules. Molecule binding, for example, is measurable because the mass and hence the resonance frequency of the wire changes.

At 3mE, Professor Fred van Keulen and Dr Hans Goosen will work on making the gossamer thin sensors in nano electro-mechanical systems (NEMS) more stable and easier to calibrate. These are used to measure masses of 10-21 gram (50 carbon atoms) and displacements of 10-15 metre (one tenth of an atomic nucleus). Improved stability is a precondition for reliable and quantitative readings, the researchers claim. Finally, Dr Val Zwiller (Applied Sciences), will aim to use nanowires to produce lasers on a molecular scale. He will do this in collaboration with colleagues in Utrecht and at Harvard.

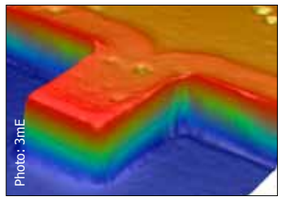


Nanowires of semiconductor material (gallium nitride) as a basis for nanolasers. Colour added to electron microscope image.

Nano manufacture

Nano-research is all very well, but before it can really be applied the gap between concept and economic activity must be bridged, explains Frank de Jong, of electron microscope manufacturer FEI. De Jong is the Nano manufacture theme coordinator, a position which entails overseeing the development of equipment, processes and technology that will make it easier to manufacture nanostructures for countless applications. On the one hand, this is by no means easy, as it concerns structures smaller than 100 nanometres and involves spatial atomic structures. On the other hand, such technology is very important to specialised companies like FEI, Philips, AMSL and Mapper, which are in the global vanguard.

The programme distinguishes between the inspection and the manufacture of nanostructures. Examples of inspection include the programme Professor Lis Nanver (EEMCS) and Dr Jacob Hoogenboom are working on in collaboration with FEI, seeking to enable the detection of (soft) biological molecules with an electron microscope. Hoogenboom also has several projects in which he aims to combine optic (fluorescent) microscopy with electron microscopy. Examples of the manufacture of nanostructures include the projects of Professor Pieter Kruit, supported by Marco Wieland (MSc) of Mapper, which aim to not only position the 13,000 electron rays of the appliance relatively, but also individually, to within 2 nanometres. Together with Dr Kees Hagen (Applied Sciences), Prof. Kruit is also developing a technology to write ultra-fine lines (in platinum and carbon) on silicon using the beam of an electron microscope.



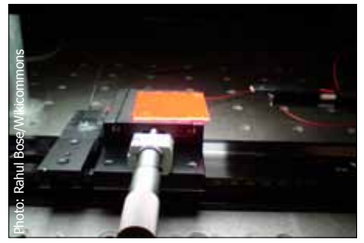
Set of 40nm monocrystalline silicon cantilevers suitable as an ultra sensitive sensor.

Energy

Theme coordinator, Dirk Smit (Shell), believes the challenge for the 21st century is more energy, less CO_2. The research programme aims to focus on this in two ways: more efficient generation of renewable energy plus more efficient and cleaner use of fossil energy.

Starting with the first: nanotechnology can improve solar cells in several ways, according to Programme Director, Professor Wim Sinke (University of Utrecht). In the 'luminescent' solar cells, for example, phosphors and colours convert high-energy photons into more, low-energy photons. To enable as many of these photons as possible to be absorbed by the silicon, Professor Paul Urbach (AS), in collaboration with Philips, aims to develop thin nanostructures and filters to guide the light as optimally as possible to the light-sensitive layer.

Reducing energy consumption and CO_2 emission demands more efficient methods of converting fuels into usable forms of energy and removing unwanted components, explains chemist and Programme Director, Professor Freek Kapteijn (Applied Sciences). Nanotechnology may provide the solution by making materials which improve fuel conversion efficiency. The programme also includes the improvement of hydrogen storage and the capture and conversion of CO_2.



Concentrator gives extra light under the solar simulator.

A refreshing liquer

This year Limoncello di Fiorito was acclaimed as one of the best limoncellos in the world. Benno Fiorito and his brother Franco are now looking to increase production of this lemon liqueur based on a family recipe.

Photo: Sam Rentmeester/FMAX

In Italy everyone makes their own limoncello. “Every family has its own recipe,” says Benno Fiorito (age 31). And he should know, as his grandfather is Italian. During a visit to his family in Sicily in 2007, Fiorito tasted a glass of homemade limoncello. He was impressed. “You can buy limoncello in the Netherlands, but it doesn’t taste good,” says Fiorito. He asked his aunt for the recipe and then had a go at making it himself.
After a few tips from the family, he produced a good end-product. “When friends came to dinner they’d say: ‘Great, will you be serving the limoncello?’ Strangers who had heard about it by word of mouth asked if they could order a few bottles.”
And then his hobby began to get out of hand. And it was a hobby, because at the time Fiorito was studying Systems Engineering, Policy Analysis and Management, with a specialisation in Transport and Logistics. His graduation project involved redesigning the KLM cargo terminal, and he is currently a demand chain planner at DSM, where he is optimising the supply of microbial cultures. When catering

‘Limoncello should be drunk ice cold’

establishments began to show an interest in the limoncello, Benno and his brother Franco, a 33-year-old tax economist, thought about starting a business. “I thought we could rent our own premises and set up a production site. I’ve had experience with that at DSM.”
But this wasn’t so easy, because of all the red tape involved. “The limoncello is now made by a distillery in Schiedam. I’m involved in the production and product quality.”
The Fioritos chose a bottle with a swingtop cap, as limoncello should be drunk ice cold, and corked bottles do not chill well. And then things really took off. “We found a great Italian restaurateur – Toscanini in Amsterdam – who thought our limoncello tasted really good. He agreed to include us in his product range”. Other businesses soon followed.”
The Fioritos then heard about the International Wine and Spirits Competition and submitted a couple of bottles in May of this year. “I was honeymooning in Sardinia at the end of July when my brother phoned to say we’d won the silver medal!
Enthusiasts can now taste the liqueur in some 20 to 30 restaurants. (CvE)

www.limoncellodifiorito.nl

Cars as power plants

Paid parking, who *doesn’t* hate it? Nevertheless, it will soon be a fact of life at TU Delft, too. Perhaps the only person who cannot wait for this is Professor Ad van Wijk. The newly endowed professor of Future Energy Systems predicts that the familiar scenario will be turned on its head and instead he will be paid to park his car.

Professor Ad van Wijk, who is also the director of the Green Campus Company, is seeking investors and bright minds to transform the campus into an icon of sustainable technology. One of his hobbyhorses is an idea for multi-storey car parks that pay out.
“Multi-storey car parks are our future power plants,” the professor says. “It might take another ten or 15 years but sooner or later many cars will be fitted with fuel cells. These cars generate electricity more efficiently than large power plants. And that electricity can easily be tapped in car parks which have the appropriate fuel supply, such as natural gas, biodiesel or hydrogen. Paid parking suddenly takes on a whole new meaning; that is, you get paid to park your car.”
Prof. Van Wijk beams, and then makes a quick calculation: “A car generates an average capacity of 80 kilowatts, so 500 cars with fuel cells would generate 40 megawatts. Suppose those cars are parked for eight hours a day, 300 days a year: this would generate a total of nearly 100 million kilowatt hours, which is twice the campus’ power consumption.”

‘So 500 cars with fuel cells would generate 40 megawatts’

The green entrepreneur also hopes to realise plans for a hotel on campus in the foreseeable future. “I always say within five years,” jokes the professor, before continuing. “If you want to realise sustainable projects with companies, it’s important to create an environment in which you can negotiate with the CEOs. Every university abroad has its own hotel where meetings are held. You cannot treat commercial contacts to lunch in the canteen – they’re not students, after all.”
Naturally, the campus hotel will be sustainable, with an electricity-generating dance floor and gym where the people exercising can convert their hard work into electricity. The fitness equipment registers the amount of generated electricity on a card, which the owner can then use to pay for a coffee, for instance. All the artificial lighting will be from LEDs, fitted in the walls, furniture and even the glasses.
Prof. Van Wijk also foresees an enormous harp-shaped windmill situated at the motorway exit to Delft Zuid and a sound barrier along Kruithuisweg, full of little wind turbines and solar panels. And the people who earn a little extra money by parking their cars in a car park on the outskirts of the campus can then travel to their offices via a mono-rail suspended from the sound barrier. (TvD)

Photo: Sam Rentmeester/FMAX

The excellent quality of our drinking water sector may be under threat from company takeovers, cutbacks and the erosion of expertise. Thus argued Professor **Hans van Dijk** (Drinking Water Supply) in his valedictory address in September, in which he looked back at developments in the drinking water sector over the last 40 years.

Professor **Kees van Weeren** could hardly have wished for a better case study for research and teaching-purposes than the fire at the faculty of Architecture. This autumn the professor of Structural Design bade farewell. During his valedictory address, he spoke at length about the fire. According to him, “there are few large fires whose progress has been so closely monitored.”

Professor **Marcel Stive** (Hydraulic Engineering) was awarded an ERC Advanced Grant worth 2.9 million euros by the EU. Over the next five years he will use this funding to enable better predictions to be made about coastal changes. Current models are still too elementary. He aims to catalogue the physical processes involved on a smaller scale, using satellite and video observation.

In the world of wind energy he is known as the Smart Rotor Professor. In late October, professor of Wind Energy, **Gijs van Kuik**, was awarded the EAWE Science Award by the European Academy of Wind Energy. The academy presents this annual award to scientists who have made a significant contribution to wind energy research.

After ten years, the department of Ship Hydromechanics and Structures (3mE) once again has a professor: Professor **Mirek Kaminski**, the Dutch shipping and offshore industry. “Our students’ knowledge regarding the construction of ships and offshore facilities has gradually deteriorated over the years. The industry wants to turn this trend around,” said Prof. Kaminski in *Delta*.

Dr **Bert Geerken** has been appointed the new dean of the faculty of Civil Engineering and Geosciences. Geerken studied Applied Sciences at the University of Twente. He is presently the acting managing director of the Netherlands Institute for Neuroscience (NIN) of the Royal Netherlands Academy of Arts and Sciences (KNAW). Prior to that he was the general director of Naturalis.

According to the Dutch Network of Women Professors (LHNV), she really shines in her field, which is why Professor **Nynke Dekker** of the department of Bionanoscience (Applied Sciences) was awarded a certificate and 5,000 euros by the LHNV.

As of 1 December, **Annemieke Wisse** will be the new director of YesDelft. Among other positions, she was previously the director of New Venture, the national business plan competition. Wisse will lay the foundation for the further development of YesDelft, which is in her eyes the formula for success for high-tech start-ups.

Soon the government may be able to find your personal data and your exact position with just a couple clicks of the mouse: efficient but worrying, feels professor of Systems Engineering, **Frances Brazier,** of the Faculty of Technology, Policy and Management.
Prof. Brazier, who delivered her inaugural address as professor of Engineering Systems Foundations on 14 October, is researching how still-to-be-designed technology could strengthen the position of the citizen. “It is no longer possible to impose matters on the citizen from above.”
A disaster is imminent in Rotterdam and the population needs to be evacuated immediately. Brazier used this scenario in her inaugural address to illustrate how phenomena such as Facebook and Twitter have strengthened citizen’s autonomy.
“Until now the authorities could have evacuated Rotterdam one district at a time. This type of central coordination is now much more difficult. Social media enable groups of people to not only be more quickly informed about what is going on, but also to organise themselves more quickly. The use of these technologies is changing the dynamics of society. I feel that people can demand the right to take up their responsibility within a complex, dynamic system. And they must have access to the right information in order to be able to exercise this responsibility.”

Scholarships for top talent

Attracting top talent is crucial to TU Delft. Outstanding international students often apply to multiple universities around the world. In an effort to attract them to Delft, the university offers various Excellence scholarships.

Attracting highly talented students is vital for maintaining consistently high standards in the lecture rooms, but also with a view to progression to academic careers with the university. Excellence scholarships are full scholarships covering both the student's tuition fees and living expenses. The faculties also offer a number of smaller scholarships. This year seven students were awarded the Justus & Louise van Effen Scholarship. What makes this scholarship special is the fact that the money comes from a legacy. Up to the day he died, in 2007, TU Delft alumnus Justus van Effen firmly believed in the importance of technological developments to solving global problems. He and his wife left a legacy for academically excellent students from abroad who are unable to finance their own Master's degree programmes. Next year, each faculty will be able to nominate two students for a scholarship from this legacy. The rest of the money has been invested to ensure TU Delft can continue to attract top talent in the coming years.

Delft Research Initiatives

A different kind of scholarship is directly related to the DRIs, the Delft Research Initiatives. These are the key research fields in which TU Delft aims to excel: Energy, Health, the Environment and Infrastructures & Mobility. These scholarships are funded by the university itself. Sixteen DRI scholarships were made available this year, with professors playing an active role in allocating the scholarships while also personally committing themselves to supervising the students concerned. Once again, these scholarships are only available to the very best international students. One such student is Vasudevan Lakshminarayanan, from India, who obtained his Bachelor of Technology in Chemical Engineering in his native country and first became acquainted with Europe in the summer of 2010. "I was offered the opportunity to work at the Institute of Material Physics of the University of Münster, in Germany, where I was awarded the Daad Wise Scholarship. I became interested in European culture and enrolled for a Master's programme in Chemical Engineering with TU Delft, specialising in


Photo: Sam Rentmeester/FMAX

Vasudevan Lakshminarayanan: "I want to focus on the use of nanomaterials in the medical sector."

Molecular Engineering." He chose TU Delft because the university has a good reputation and because of the high quality of research into nanotechnology. "I want to learn to understand the molecular phenomena in physical processes, focusing on the use of nanomaterials in the medical sector. Ultimately I hope to discover a medicine for cancer."

Hugely enriching

"During my holiday I spent three weeks at the Nanjing Hydraulic Research Institute to see how they do things there. This a large institute, housing one of China's most important national water laboratories. I think that this wonderful experience worked in my favour when I applied to TU Delft." Without the DRI Scholarship, Rebekah Wagoner, from the United States, would not have been taking a Master's degree in Architecture in Delft. She studied architecture for five years in the US and already obtained a Master's degree there. "The approach to my field is so different here compared to in America – it's hugely enriching." Another eight special scholarships will be introduced in 2012 for the new research themes: Transport, Climate, Robotics and Process Management. With this range of 40 interesting scholarships, TU Delft clearly demonstrates that it really does invest in talent.


Photo: Sam Rentmeester/FMAX

Arnoud Greidanus is awarded the title 'alumnus of the year'.

Top-level sports and science

As a rower with Olympic A-status, Arnoud Greinadus has been performing at the highest level for years. His dream is to win gold at the London Olympics. When the 'Netherlands Four' lost in the semi-finals of the Olympic Games in Beijing, Greidanus took it as his inspiration for his PhD research at TU Delft. The probable cause was a fragment of algae that got stuck to the boat. This prompted Greidanus to search for another material or coating that would minimise the risk of things getting stuck to it. In particular the rowers in the Olympic Games in Rio de Janeiro will be able to reap the fruits of his research, but so too will the shipping and aviation sectors. During the alumni symposium, Greinadus was awarded the title 'Alumnus of the Year' for the unique way in which he combines top-level sports and research. He received a sculpture of Prometheus, the symbol of TU Delft, and 2,500 euros. He may also spend three times that amount on a Delft research project of his choice. Greidanus decided it should go to 'Research and Innovation in Water Sports'.


Photo: Sam Rentmeester/FMAX

Zamorah Getrouw won the Marina van Damme Scholarship.

Architects in the background

Zamorah Getrouw is the winner of the twentieth 'Marina van Damme Scholarship. She attracted the attention of the jury for her "well thought-out plan, her enthusiastic commitment to the field of architecture, and the way she envisages her future". Currently, in most cases, architects are only ever involved in the design stages of a project. In Getrouw's opinion, the consequence is that architects are becoming less essential, as they increasingly fade into the background.
To prevent this, she feels architects should also be able to supervise the execution of their designs. This would lead to creative solutions and lower costs for the commissioning party. Getrouw plans to spend the 9,000 euros in prize money on a KOB study programme for graduates of management and enterprise in the building sector. During this programme she will learn to lead a construction company and build projects responsibly in terms of management and business economics.

'More than just the top sectors'

On 7 October around 500 alumni gathered in TU Delft's Aula for an alumni symposium. Big names from the worlds of politics, business and science came together to debate the government's innovation policy and its effects on science in the Netherlands.

Robert Dijkgraaf, president of the Royal Netherlands Academy of Arts and Sciences (KNAW), expressed his concern about the government's innovation policy. "In recent years we have created a healthy and competitive scientific climate in the Netherlands. The Netherlands Organisation for Scientific Research (NWO) has played a key role in this for all fields of science. The decision to fund the 'top-sector policy' with exclusively existing means is going to cause problems. Before you know it, the entire NWO budget will be used to finance the top-sector policy. That would be a disaster for science policy in the Netherlands." Dijkgraaf believes there is more to science than top sectors alone. "There is also a degree of biodiversity in science. We have many disciplines. If you look at where the fundamental breakthroughs were made in the long term, some occurred in unexpected areas. That is why we need to protect that biodiversity. Key questions, such as how the world works, ultimately lead to answers with enormous implications. We must protect this culture of science."

Dangerous

Frans Heemskerk, former State Secretary of Economic Affairs and member of the Executive Board of Royal Haskoning, shares Dijkgraaf's concerns and regards the NWO cutbacks as dangerous. Rein Willems, the chair of the top team for the Chemistry sector and former Member of the Senate for the CDA party, stated that less money will indeed be available for innovation, but the plan does not mean less funding will go to science and research. "We will fight to maintain the high standard of fundamental, curiosity-driven research at the NWO." However, he does feel that it should focus more on the top sectors. "This means that we will no longer do everything in the Netherlands. Ultimately, however, the balance between fundamental and applied research should not change.
In addition to this debate, there were also presentations by Delft scientists, lectures and a Coach Café. Reactions to the alumni symposium were largely positive. Most respondents found the plenary component particularly interesting. The use of Twitter combined with propositions that were advanced led to an interactive meeting. The alumni felt they would have liked the panel discussion to have gone on for longer.


Photo's: Roy Borghouts

Robbert Dijkgraaf, Frank Heemskerk and Rein Willems debating at the alumnisymposium.

Propositions

A Ph.D is the proof of its holder's stubbornness.
Fabio Sebastiono,
mechanical engineer

Patience under stress is the foundation of success.
Sheng Li,
health engineer

Allowing passing on the right improves traffic flow.
Sander Dorenbos,
physics engineer

In the scientific community, quoting yourself is seen as pathetic, but quotes of others are presented as truth.
Martijn Carel Westhoff,
physics engineer

The distribution of population over the earth is not only temperature dependent but also moisture dependent.
Xiaosong Ma,
mechanical engineer

All models are wrong; some models are useful.
Jeanette Hussong,
materials engineer

Proposition

When PhD students regularly give lectures on their research, this enhances the progress they make towards gaining their PhD, both in terms of duration and quality.
Marian Bosch-Rekveldt, mechanical engineer

Defence

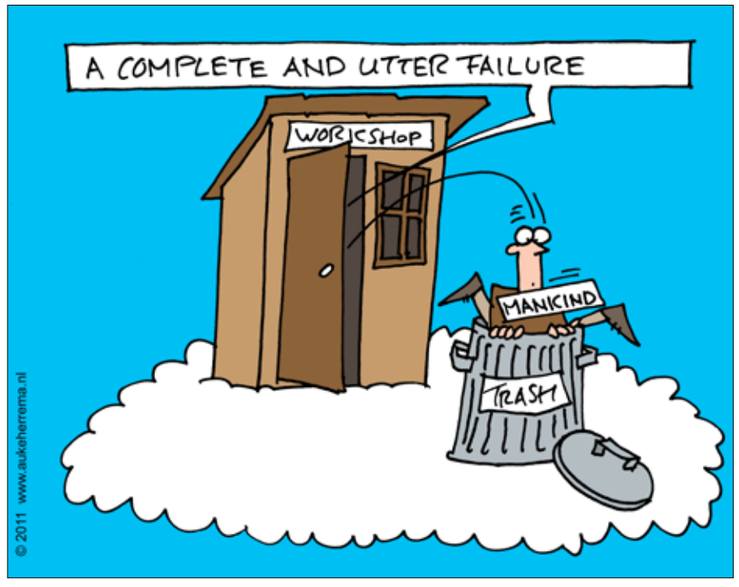
"Personally, I have found that it can help enormously to explain to others what I am actually doing. Often that is the moment when the penny actually drops, where true comprehension starts. In my opinion, PhD students are 'protected' from teaching too much and too often, the pretext being that 'you should concentrate on your research, so you can finish it more quickly'. It is my assertion that that strategy is counterproductive. Teaching takes up time, of course, but the act of explaining also helps you make great strides in your research."

Sound Bites

"I must admit I'm not looking forward to the moment when I'll have to actually use one either, but when it comes down to it I'd rather have a bag to urinate in than nothing at all. The 'bag toilet' is a cheap alternative to a conversion operation which is set to cost millions. And this is better for me as both a Dutch train user and a taxpayer as the cost of converting the trains would surely be reflected in the price of my next season ticket and in the dividend to be paid to the treasury."
Dr Caspar Chorus, associate professor in the Transport and Logistics research group, in NRC Handelsblad.

"Of course they're not real people, so a discussion on the theory of relativity would be tricky. For every question we have around three answers: one unpleasant answer, for challenging patients to face their fears; one pleasant answer; and a neutral one. If the avatar asks someone their name and that person replies 'none of your business', then the avatar will say: 'Right, let's talk about something else then.'"
Dr Willem-Paul Brinkman in Trouw about using avatars in virtual therapy for conquering phobias.

"We are getting better and better at determining the positions of the satellites themselves. This means that the next generation of satnav equipment will even be able to see which lane you're in. Relative distances – between two transmitters – can be measured to the nearest decimetre or even centimetre."
Satellite navigation researcher Dr Christiaan Tiberius in NRC Handelsblad



'The argument that human beings are so complex that a higher power must have created them reveals the level of arrogance that human beings can portray. '

Janneke Blijlevens,
engineer industrial design

Passion for water

This summer, in the heart of Amsterdam, next door to a climbing centre along the railway line, saw the opening of a slow food restaurant, Hannekes Boom. With thanks to three former TU Delft students. Pim Evers is one of them.


Photo: Sam Rentmeester/FMAX

Built of salvaged wood and with an interior made of as many recycled materials as possible, the building most closely resembles a hippy colony. Pim Evers (38) and his mates built the catering establishment with their own hands. Hannekes Boom is more than just a restaurant. Dances, parties, theatre, children's activities and exhibitions are also held here, and there's also a large, waterside outdoor seating area. Hannekes Boom has been popular since the day it opened. The menu changes nearly every day, the ingredients are sustainably produced and the possibilities boundless. For the next five years, that is. The building will then have to make way for new housing.
What's the secret of their success? "As soon as we sit down together, ideas are born," Evers says. "I've always been involved in business activities with people I click with."
This wasn't yet evident when he chose to study electrical engineering in 1993, but after transferring to study technical management at The Hague University of Applied Sciences, Evers soon proved to be good at selling projects. His graduation project with the former Formula 1 sports timing company, AMB i.t. (now Mylaps), was a success. He was awarded a 9 (90%). Together with five friends, Evers then set up the New Amsterdam IT Group. "We wanted to set up our own network to watch videos at home. Within two years our workforce had grown from 6 to 86, but when the internet bubble burst, so did we."
Evers then set up an internet consultancy with two friends from Delft:

'My idea factory is working again'

PRO-XS Consultancy, a company that did well. In 2004, Evers and his partners had a difference of opinion: "I wanted to do highly specialised projects, they wanted to standardise. I went my own way and set up my current communication consultancy, Indysign."
Having a passion for water sports and leisure, he designs websites and house styles for nautical projects, in addition to which he set up the Amsterdam Waterstad foundation to promote water sports and leisure. Evers also manages the website: AmsterdamBootHuren.nl, which compares the prices of 70 boat rental companies. He is currently working on a new waterways map of Amsterdam.
On top of all that came the plans for Hannekes Boom in 2010. That's a tall enough order for a healthy person, but it's an even taller order for Evers. He had a nasty road accident in 2006. The nerves between his neck vertebrae are now severely damaged. He still can't work more than half a work week, but he stays positive: "I've learned to stay close to my passions: sailing, sports and inspiring people. And my idea factory is working again." That's true enough. Evers is full of plans for Hannekes Boot, which is set to become completely 'cradle to cradle'. (SB)

www.delta.tudelft.nl/24134

The meat fraud affair

The Dutch scientific world is staggered. The renowned psychologist Diederik Stapel, who recently told the world that he and some colleagues had found that meat-eaters were more egotistical than vegetarians, admitted to having made up the research data. He said that he had been making up data for years.

Is this fraud committed by Stapel, who worked at Tilburg University, a rare and sad excrescence of science? Or is it just the tip of the iceberg? Biophysicist, Professor Cees Dekker (AS), believes that scientific fraud is very rare. "If you publish false data in high level journals, you are bound to get caught," he says. "It's a stupid strategy. People who do it have a twisted mind."
In 2003 Dekker was himself involved in the unmasking of fraud, which lead to the so-called Schön scandal. A post doc in his group tried in vain to redo certain experiments done earlier by the German physicist, Jan Hendrik Schön. Schön unjustly claimed that he had developed a transistor on the molecular scale using organic material.
Material researcher, Professor Barend Thijsse (3mE), also believes that fraud is rare. He attributes that fact to peer review, but not just the standard type of peer review in which scientist assess papers of their peers prior to publication. He believes scientists are always looking over each other's shoulders. "The whole idea in science is that people can elaborate on each other's work", he explains. "So scientists always keep in mind that they have to perform their research in such a way that it can be repeated."
Prof. Thijsse however also believes that the pressure to publish is increasing: "You either publish or perish. Research money is being distributed via a system of competition. You only get money if you have proven to be better than the others. When I was young, research was more of a fair game."
According to hydrologist, Professor Huub Savenije (CEG), this fraud had nothing to do with publication pressure, but rather "with a craving for media attention". "The fact that Stapel got away with it for such a long time may also say something about his research field," Prof. Savenije adds. "I cannot image getting away with fraud in hydrology. This could in part have to do with the fact that in physics and earth sciences experiments are often relatively easy to repeat. In psychology, experiments can be vague and hard to repeat under the exact same circumstances."
But scientific misconduct isn't always that straightforward, as in the meat fraud affair. All scientists cope with outliers, data that do not fit the rest of the numbers, presumably because something went wrong with an experiment. The boundary between good research and falsification can then be very subtle.
Prof. Dekker however believes that is a different debate: "In our group we have daily discussions about outliers and about the way we present our results in general. We seek the way things are, not to fabricate a way things should be. There is no hint of fraud in that." (TvD)

who & where

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

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Central Library

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

For further information:
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Information on research fellowships:
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