university of groningen

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SPECIAL

Broerstraat 5

Ben Feringa

Winner Nobel Prize for Chemistry

Big in the supersmall

Verder denken over de waarde van filosofie in uw praktijk

We worden dagelijks overstelpt met informatie. In die veelheid van feiten, trends en aannames, raakt de essentie nogal eens uit zicht. Waarom bestaat uw organisatie en waar wilt u naartoe? Wat is uw antwoord op vragen over de essentie van uw organisatie? Hoe duidelijk heb u uw verhaal nog voor ogen?

Wilt u nadenken over fundamentele vragen met betrekking tot uw organisatie en schrikt u er niet voor terug deze vragen ook aan uzelf te stellen? In de leergang **Filosofie in Organisaties** gaat u op zoek naar uw eigen verhaal, dat functioneert als kompas en houvast. U leert vragen te stellen bij antwoorden, zodat ook paradoxen en tegenstellingen hun plek vinden in dit verhaal. Zo werkt u door verrassende inzichten en denkwerk aan een slagvaardigere organisatie.

Na de leergang Filosofie in Organisaties:

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- ✓ bevordert u uw zelfstandig denken waardoor u beter in staat bent om te reflecteren op waarden en principes. Uw leiderschapsrol binnen de organisatie wordt daarmee versterkt.

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EDITORIAL

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'Slight is the subject of my work, not slight shall be its fame.' It was the poet Virgil who said this, some two thousand years ago. It could just as well have been Nobel Prizewinner Ben Feringa, if he wasn't so modest. As a proud university we are happy to talk about this man's scientific fame and the subject of his work – nanotechnology and the building of new, organic molecules.

It's not hard of course to draw to people's attention so big a subject as winning the Nobel Prize. Photos, film clips, stories, a bust, a banner or this special edition of *Broerstraat 5*, they have all made a contribution. But highlighting something on a nanoscale, like a molecule, is much more problematic, even if it is a 'four-wheel drive'. After all, a nanometre is no bigger than a millionth of a millimetre. But chemists have found a way around this problem: they have blown up reality by making models of coloured plastic spheres and rods, which represent atoms and their interconnections. And it's an even simpler matter to leave out the rods and make a nanocar that at least gives some idea of the enormous, revolutionary breakthrough that Feringa has made in chemistry. This already iconic model will be on display – on a racing-car scale – at various locations in the city of Groningen.

And yet thanks to a special refraction of the light, everyone has at times observed something of nanometric proportions with the naked eye: a bubble. While bubbles may horrify economists, in the eyes of children, scientists and artists, they are a marvellous phenomenon – a fragile sphere, dancing in the air, surrounded by a membrane that is just a few nanometres thick.
This is a lovely image for a special branch of science, something to think about over Christmas.

We wish you a happy festive season.

COVER **BEN FERINGA**, WINNER OF NOBEL PRIZE IN CHEMISTRY 2016

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COVER REYER BOXEM

Ben Feringa about winning the Nobel Prize

‘This award is so special, almost magical’

Since the news broke on 5 October, there has been a storm of public and media interest. All eyes are now on **Ben Feringa** as the hero of the University, and even beyond it. Here is the scientist’s story in his own words. He describes his career so far, the amazing events of the last few weeks and where he would like to go afterwards.

'Chemists will be sorely needed to achieve a sustainable future under these circumstances'

ELLIS ELLENBROEK REYER BOXEM

NOBELPRIZEWINNER

The UG plans to name a building after you and to have a copper bust cast. Everywhere we go, we are greeted by waving banners with your face on them, and you probably must have had one or two of the 28 thousand cakes that the University had baked, with your name on them. How do you undergo this?

'This elaborate tribute was not my idea, of course, but I understand that this award is so special, almost magical, that the University and Dutch chemistry want to showcase it. That's fine. I'm more than happy to cooperate and am delighted with the tribute. It is such an enormous honour that our new building will carry my name. In November, I was in China for eleven days of lectures and conferences. That trip had already been planned a year ago. Even in China, I saw banners with my picture on them. Quite an extraordinary experience. Students wanted to take selfies with me afterwards. After a lecture, they came running at me, fifty at a time.'

What about fan mail?

'In the first hour after the announcement, I had already received 350 e-mails from all over the world. A thousand more came in later that day. Shoe boxes full of postcards and letters. Overwhelming. I have only been able to look at part of the congratulations, reactions and requests. It will take me until the Christmas holidays to answer all my mail.
There is mail from people who collect autographs and photographs of Nobel Prize winners or other celebrities. They've got Obama's, so they write me, and include a stamped return envelope. I've also received very moving letters, asking whether my nanomotor can help detect tumours at short notice. I have to disappoint these people: this is fundamental research for the long term.'

Bob Dylan will not be collecting his Nobel Prize for Literature. Can you understand that?

'Who am I to judge? But I find it regrettable. I think it is sad that he doesn't appear to realize that accepting the Nobel Prize can contribute to the standing of literature and pop music. A pop musician receiving such an award is good news to young people, culture being under pressure so often as it is.'

What does music mean to you?

'I don't have enough time for it, otherwise I would listen to music more often. Music distracts me when I need to concentrate or write. But the young people in the labs here have music on all day. Chemistry is a very sociable programme. People forget that sometimes , and think: ah, those solitary scientists. But we work in teams here. Students, PhD students and postdocs spend the entire day together, challenging each other and having a whole lot of fun in the process. When they heard that Dylan had received the Nobel Prize, they played his music all day. I still have a few of his LPs from my student days. In those days, the seventies, he was one of my favourites too, together with The Who, The Rolling Stones and Creedence Clearwater Revival. LPs are hot again. My daughter just bought a record player. She plays my old records now.'

You've said several times: 'Now I know how Epke Zonderland must have felt when he won the gold medal at the 2012 Olympic Games.' But Epke knows all about disappointment too. How disappointing can your profession be?

'If you cannot handle frustration, you should not become a researcher, as there are many disappointments: not every funding application makes it to a grant. Spending the entire Pentecost weekend writing an application and getting a rejection back – that sure puts you in a lesser mood for the rest of the day, I can tell you that. Or receiving the funding but finding out that many things don't work the way you expected they would. Nature often gets the better of us. Or not being able to manufacture the materials, construct the molecules. We worked on the nanocar for seven years. Another example from our research is a discovery in catalysis. The Nobel Prize was not awarded for that. We've spent twenty years working on a new method to construct carbon-carbon compounds using a carbon-lithium compound. Twenty years! Sometimes we ran out of ideas, and we only reached a breakthrough three years ago. That is research. I enjoy working on difficult problems, and in a number of cases we don't even know what question to ask. Where should we go? Where will we end up? When you're walking in the dark, you sometimes bang your head on a wall.'

How do you respond to that?

'I need to get that frustration out of my system, but I don't go around slamming doors. I start thinking and inventing something new on my bike ride home, or while jogging. If something doesn't work, we need to do better. It means we are just not good enough. Usually I still have a few ideas up my sleeve, and luckily I am a born optimist. Sometimes something just doesn't work, and we terminate the project. Being the head of a large group of researchers also makes you a psychologist or social worker sometimes. Like that time when I arrived at the lab at quarter past eight: a PhD student walked up to me and shoved an article from our Japanese competitors in my face. 'Look, Ben; published just yesterday.' It was an article similar to the one we were planning to submit to an American journal that same week. The young woman had been toiling on it day after day for a full year. Now, those are the times when you don't put your lab coat on just yet and take care of the student with tears rolling down her cheeks first. It is her future that is at stake.'

Your team currently consists of 35 talented people, most of them young. Are you still on top at age 65?

'I would like for them to be on top. That is exactly what I tell all new PhD students, whether they are from China, Italy or the Netherlands. I tell them: 'Four years from now, you should be better at this than I am.' We invent things together, discuss them, and I give them hints, also based on my experience. But they perform the experiments; they make the discoveries. I love it when they are better than me.'

Continued on page 6 →

'SOMS EVEN STILSTAAN, KAN EEN HELE VOORUITGANG ZIJN.'
STELLING **SONJA VAN DER VEEN** MEDISCHE WETENSCHAPPEN

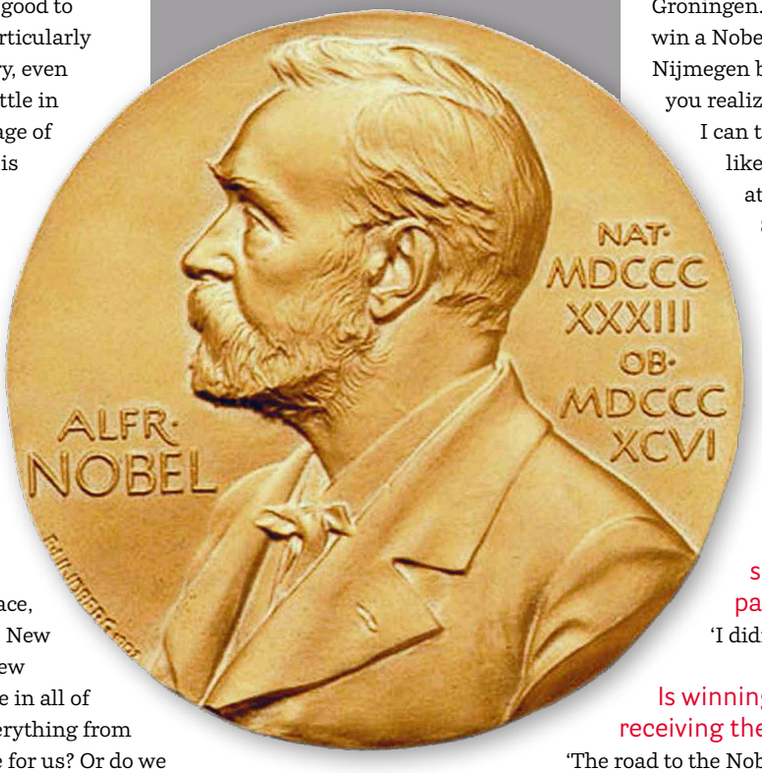
You plan to continue working until you are 70. What are your plans?

'I will continue running my research groups for the next several years, just doing new things. We are currently working on smart drugs, such as nano-scale light switches built into drugs that can be switched on and off. We are also working on an artificial muscle that moves under the influence of light. Another fun thing: self-repairing materials. Cars with self-repairing paint, for example. We'll have those, for sure. In about ten years we'll have them. Or smart glass that cleans itself. Nature can already do it. Look (runs his nail across his arm)! If I scratch here, it heals by itself. You don't have to do anything. I did promise myself to reserve more time to promote science. I've given quite a number of public lectures throughout the years, and I think that it is good to stress the importance of science, particularly fundamental research and chemistry, even more. This country invests far too little in fundamental research. The percentage of NWO grants awarded, for instance, is much too low in quite a few fields; only one in ten receives a grant. We will simply be running behind soon. We cannot compete with China and other countries if we don't maintain a strong base.'

Should we even want to win from China?

'Well, what is winning? If we want to retain our wealth and our manufacturing industries, let alone our ability to judge what is important about technology in the first place, we will have to train people for that. New drugs, clean industrial processes, new materials; chemistry plays a key role in all of them. Do we just want to import everything from China, relying on what they produce for us? Or do we want to have expertise of our own, too? I heard that the world will be using eighty percent more energy in the next thirty years. Eighty percent more, not less. I was in Beijing recently. Do you have any idea of how the number of cars has grown in Beijing alone? By two million in three years' time, so I was told. Chemists will be sorely needed to achieve a sustainable future under these circumstances.'

Ben Feringa (b. 18 May 1951), the second of ten children in a Catholic family of farmers in Barger-Compascuum, wanted to be a farmer. How differently things went is well known. Feringa lives in Paterswolde. He is married to Betty (60), who retired this summer from a management position at the UMCG Centre for Rehabilitation at the Beatrixoord location in Haren. Together they have three daughters: Femke (29), Hannah (26) and Emma (22). Femke and Hannah are PhD students in Amsterdam and Utrecht respectively. Femke performs cancer research, while Hannah performs food and allergy research. Emma obtained her Bachelor's degree in Human Movement Sciences from the UG on the day her father won the Nobel Prize.



With the exception of a few years at Shell, you have been in Groningen for your entire career. You studied there, completed a PhD there and have been a full professor there since 1988. You seem remarkably sedentary for someone of your calibre.

'There have been prestigious universities and institutes who wanted me. I won't tell which ones. I would think about it for a week and decline. Those are personal choices involving family, but also the fact that life wasn't bad in Groningen. Of course they were difficult choices to make. In Cambridge or Harvard you would probably only have top-notch students, and there is more money available there. So, while Groningen is no Harvard or Cambridge, I am enormously proud of the students in Groningen. Moreover, this shows that you can win a Nobel Prize in Groningen, Leiden or Nijmegen by doing your job. It is about what you realize in thirty years of hard work.

I can tell you what my working day looks like: I get up at 6:45, get on my bike at 7:30 and arrive at the institute at 8:15. I work there until seven and usually arrive home at around quarter to eight, where I have dinner, watch the news and work some more until eleven or half past eleven. During weekends, I usually put in another ten hours of work.'

So when did you have time to train for the Elfstedentocht skating tour in which you participated in 1997?

'I didn't train for it.'

Is winning the Nobel Prize comparable to receiving the Elfstedentocht token?

'The road to the Nobel Prize is bumpy, too, with highlights and challenges. You try not to fall and to get up and move on whenever that happens. There are moments of intense cold and beauty. I still remember skating into the city of Dokkum (drums on the table enthusiastically), at exactly eight o'clock. I'll never forget it. The Mayor was just being interviewed live on the national news. Thousands of people were cheering along the way. Well, that gives you a new boost of energy. I drank hot chocolate, still had twenty-four kilometres to go to the city of Leeuwarden, but I knew I would make it.'

More about Ben Feringa on WWW.RUG.NL/NOBELPRIZE

Proud as Punch

RECORDED BY MARJAN BROUWERS ELMER STERKEN

I used my phone to take this photo of Ben Feringa surrounded by cheering students on 5 October and it has gone right around the world. We had just heard that he'd won the Nobel Prize in Chemistry, 63 years after Frits Zernike won the Nobel Prize in Physics. The photo was viewed 73,000 times on Twitter, and Ben appeared on the Dutch talk show De Wereld Draait Door and on the front page of the Dutch newspaper *de Volkskrant*. Technically, it's not even a good photo, but I pressed the button at just the right time. You can see Ben standing there, his usual calm and modest self, and you can see the joy on the faces of the people around him. You can also see what a diverse group they are: there are no fewer than seventeen different nationalities working in his lab. This prize is not only marvellous for Ben himself, for his institute, the Faculty and the University, but for everyone here. What's most important for us is the vitality, the atmosphere, that we exude as a result. Ben Feringa has really put Groningen on the map once more, both nationally and internationally, and that's something we're all immensely proud of.

That wonderful day in October Ben received a standing ovation in the Chemistry lecture theatre that went on for at least ten minutes. It was an emotional moment. And yet he still had the presence of mind, at the press conference that followed, to go on to talk about the importance of science. Conducting fundamental research means venturing into uncharted territory. It takes lots of time and you can't say beforehand what the benefits will be for society, or whether these experiments will even lead to tangible applications. As Ben himself puts it: The Wright brothers didn't know that either when they first flew thirty metres in their 'soap box'. Exploratory research can also fail. But by the same token, an unintended outcome can lead to a wonderful discovery. That's why Ben encourages his students to take risks and to experience for themselves how experiments can turn out differently from what was expected. Scientists like him need to be given time to explore, and to puzzle and try things out. That's incredibly important if you want to make scientific advances. It has to be done, and for that you need courage, persistence, time, people and money.

This Nobel Prize hasn't just come out of nowhere. Ben has won prestigious awards for his research in the past, which makes him a fantastic ambassador for science and for Groningen. Apart from six years working with Shell, he has spent his entire study and working career in Groningen. This prize means a lot to all of us: for our rankings, for securing grants, for our ability to attract international students and for scientists. The Nobel Prize is in fact a stamp of quality for this university.

Ben feels that he has much to be grateful for at the UG – hence his Nobel Prize address in the Martinikerk on 30 November. On 10 December he will be in Stockholm, sitting on the podium with the other winners, though Bob Dylan will not be there, alas. I am deeply honoured that Ben has invited Sibrand Poppema and myself to attend. This is a once-in-a-lifetime experience and I'm really looking forward to it!

Elmer Sterken, rector magnificus

'IF YOU THINK THAT EVERYTHING IS AGAINST YOU, THINK AGAIN!'
THESIS **WIEKE DALENBERG** BEHAVIOURAL AND SOCIAL SCIENCES

Feringa Building

The future teaching and research building for science and technology will be named the Feringa Building. This successor to 'Nijenborgh 4', the outdated physics and chemistry building, will be built on the Zernike Campus in two construction phases between 2017 and 2022. Together with the Stratingh Institute for Chemistry (to which Feringa belongs), the 62,000 m² building will house the Engineering and Technology Institute Groningen, the Zernike Institute for Advanced Materials (ZIAM), the Groningen Biomolecular Sciences and Biotechnology Institute (GBB), the Van Swinderen Institute, the Kapteyn Astronomical Institute and SRON. Ben Feringa: 'It is a unique gesture by the University and an enormous honour for me that, in a few years' time, I'll be able to go to work every day in a building that bears my name.' Information about the construction project can be found at WWW.RUG.NL/GROUNDBREAKINGWORK.

Royal decoration

PHOTO ELMER SPAARGAREN

On 23 November Ben Feringa was appointed Commander in the Order of the Netherlands Lion. He received this royal decoration, an extremely rare honour, from Jet Bussemaker, Minister of Education, Culture and Science, in the Mauritshuis in The Hague. Earlier, in 2008, he had been appointed Knight in the Order of the Netherlands Lion. The news article describes Feringa as 'one of the most influential leaders in his field who may rightfully be called the figurehead of Dutch chemistry. His top-level research excellence and inspiring leadership have led to vitally important breakthroughs in chemistry, putting Dutch chemical research at the centre of scientific attention.'

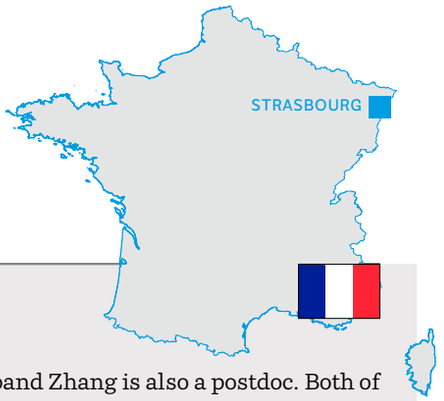
What is a nanometre?

The nanocar that Ben Feringa and his team built in the lab is a fine example of nanotechnology. This chemical construction process involving molecules takes place on the nanometric scale of the building blocks themselves – the atoms. A nanometre (nm) is one billionth of a metre (10^{-9}), or one millionth of a millimetre. The word derives from *nanos*, the Ancient Greek word for 'dwarf '. The smallest atom, the hydrogen atom, has a diameter of 0.1 nanometres, a human hair is 80,000 nm thick, and the film around a bubble – made up of two soap layers with water between them – can range from just a few to more than 1000 nanometres in thickness.

What is organic chemistry?

All the chemists in this *Broerstraat 5* who speak so affectionately about their discipline have organic chemistry as their focus. This is sometimes called carbon chemistry because all organic molecules have a carbon atom base. Most carbon (C) compounds contain hydrogen (H). Methane (CH_4) is the simplest molecule, but sugar and starch are other well-known hydrocarbons. Oxygen atoms can also be attached to hydrocarbon skeletons, as is the case with fats, as well as other atoms such as nitrogen or sulphur.
Living organisms build their organic molecules from carbon taken from the air (as CO_2) or their food. The carbon eventually ends up back in the atmosphere as carbon dioxide through decomposition or combustion (fossil fuels).

Methane molecule, art work by Marc Ruygrok in Slochteren



EDZARD KROL

FOREIGN COUNTRIES

PHOTO PRIVATE

Xiaoyan Zhang and Lili Hou

'Het is niet alleen een grote eer voor Ben, maar ook voor ons'

'I was actually watching the Nobel Prize for Chemistry announcement live when it was revealed that my supervisor was one of the winners', says Xiaoyan Zhang enthusiastically. 'I immediately called all of my colleagues over, and we watched the rest of the broadcast together. I was so happy!'
His wife Lili Hou was just as delighted: 'It is not only a huge honour for Ben, but for all of us, everyone who has ever worked with him. I immediately told everyone I know that my supervisor had won the Nobel Prize this year. That feeling of excitement continued for weeks.'

'It was particularly hard work in the first year after our twins were born', says Hou, who gave birth to two boys in Strasbourg in July 2015. 'Taking care of them takes such a lot of time. Luckily they are able to go to a crèche and their grandmothers take turns to visit from China to help.' The Chinese scientist is currently working as a postdoc at the Institut de science et d'ingénierie supra-moléculaires of the University of Strasbourg, where her husband Zhang is also a postdoc. Both of them gained a PhD in December 2013 with Ben Feringa as their supervisor.

The chemists met each other during their Master's degree programme in the Chinese port of Tianjin. In 2009 Zhang was offered a PhD position in Feringa's group, and his wife Hou was offered one a few months later. Zhang: 'I really wanted to go there because the Chemistry Department in Groningen has a very good reputation.' The pair moved into an apartment in the centre of Groningen. 'It's wonderful that so much of the history of this old city has been preserved,' says Hou. 'And that the standard of living is so high and people are so nice.' They even used bikes to get around. 'Really great fun', says Zhang, 'although we cycled much more slowly than the Dutch. I've also got great memories of playing football with my colleagues.' After they each gained their PhD, they were both able to find a job in Professor Paolo Samorì's group. There they are each working on their own projects in nanochemistry and nanodevices. Feringa has said that he hopes his Nobel Prize will benefit the careers of his students. Is that a realistic expectation? 'Absolutely!', says Hou. 'We will definitely benefit from Ben's reputation. His name on our CVs shows that we have collaborated with one of the best scientists in the world and conducted world-class research.'

Twins Yungong en Yunneng

'DE WAARHEID IS SLECHTS DAT WAT HET BESTE BEARGUMENTEERD IS.'
STELLING **DOETY PRINS** MEDISCHE WETENSCHAPPEN

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CITY OF TALENT

Groningen. The University, but also countless streets, houses, bridges and city squares that harbour memories. Well-known former UG students talk about their special place.

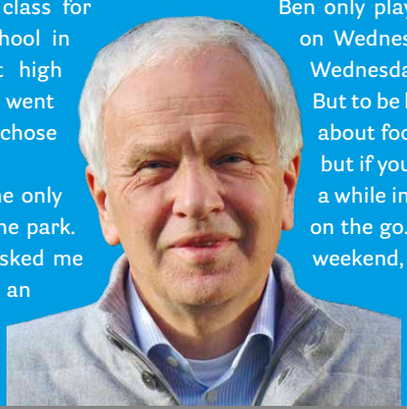
ELLIS ELLENBROEK ELMER SPAARGAREN
PORTRAIT LENNY OOSTERWIJK

'I think the level got too high for Ben'

My cousin Ben and I were in the same class for twelve years – six years at primary school in Barger-Compascuum and six years at high school in Emmen. Then in 1969 we both went to Groningen to study. He opted for chemistry, while I chose maths.

I was a serious student and in those days sport was the only outlet. In summer we played football with a group in the park. Later I played for Forward and I said 'yes' when Ben asked me to play futsal. The ACLO sports organization launched an internal competition in the early seventies. Ben put forward a team of chemistry students – I was the only non-chemist. There were about seven of us.

The teams had the craziest names: Archibald Flopping Doodles, the Yellow Lions. We kept the name 'Team Feringa', which Ben had used when he signed us up.



Herman Feringa (66); cousin of Ben Feringa; retired teacher of mathematics at Lyceum De Grundel in Hengelo; studied mathematics from 1969 to 1977 in Groningen (graduating with distinction); special place: the sports centre where he played in the 'Team Feringa' futsal team.

Ben only played a few matches. After six months we had to play on Wednesday afternoons instead of Friday evenings. For Ben, Wednesday afternoon was for studies – that was his clear priority. But to be honest, I think the level got too high for him. I'm talking about football, you realize. I don't want to push myself forward, but if you ask me, I was the better player. I continued to play for a while in two futsal teams. Ben was pretty enthusiastic, always on the go. In Barger-Compas, where he would usually go on the weekend, he also played in a lower league.

Although Ben stopped playing football in Groningen, Team Feringa continued for years. We were promoted to the first division. The players were always changing. People forgot who named the team, but I think the team mates who read this will remember. I'm delighted to see Ben excel in an entirely different 'first division' – namely science.

Reports about Feringa making molecular 'nanocars' have appeared everywhere in recent months. But how did these cars come about? And what else is his lab producing?

RENÉ FRANSEN ILLUSTRATIONS PAUL DE VREEDE/UG

Ben Feringa's left hands

No, University of Groningen chemist Ben Feringa isn't a car freak, although he was given a toy Ferrari during celebrations on 5 October when his Nobel Prize was announced. The nanomotor is just one of the many molecules that he has made, and probably not the most significant. Nor are motors his only research area. In fact, catalysts, which are what first brought Feringa to the world's attention, were something completely different. He is also working with the UMCG on antibiotics and new materials for radiologists.

The common thread in Feringa's work is the concept of chirality, whereby certain molecules appear in two forms that mirror each other, as with our right and left hands. Although both our hands are made up of exactly the same components (fingers and palm), they are not the same. In the same way, there are molecules consisting of exactly the same atoms, also attached in exactly the same way, and yet they are each other's mirror image.

The desired form

That's an important difference because all living cells have a preference for one of the two variants, the L or left-handed form. Although there are medicines that exist in both mirrored forms, one of the two is usually biologically active whereas the other 'does nothing'. Unfortunately, this isn't always the case, as we saw with the thalidomide disaster (trade name Softenon). It was discovered too late that it was the right-handed form of the drug that had the desired medical effect, whereas the left-handed variant caused birth defects when taken by pregnant women.

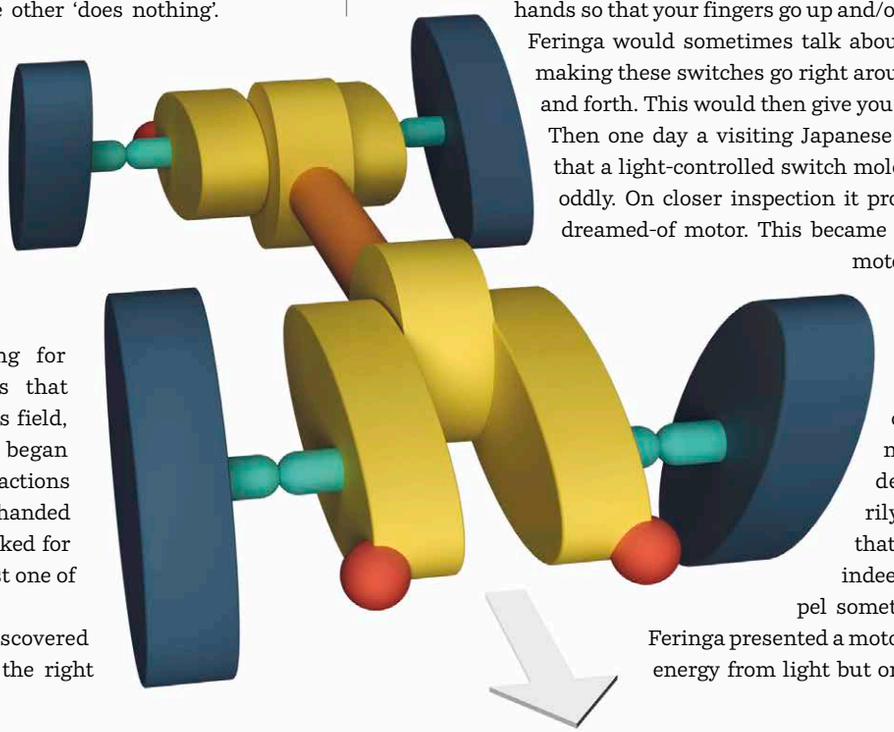
Chemists have therefore been trying for decades to come up with reactions that produce the desired variant. It is in this field, asymmetric synthesis, that Feringa began his career. Whereas most chemical reactions neatly produce left-handed and right-handed variants in equal numbers, Feringa looked for methods that would mainly produce just one of the forms.

In the early 1990s researchers discovered that this could be achieved by using the right catalysts. Catalysts accelerate certain chemical reactions and researchers found that a cleverly designed catalyst could specifically produce the L or R form. The discoverers of this technique (Knowles, Noyori and Sharpless) were awarded the Nobel Prize in Chemistry in 2001.

International prestige

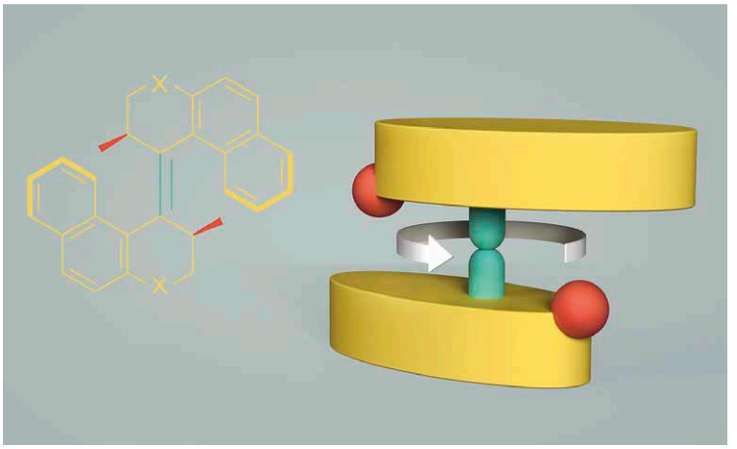
Feringa was also hard at work on catalysts for 'chiral synthesis', the selective production of left- and right-handed forms. He succeeded: in 1996 he discovered a compound that would be the cornerstone of an entirely new class of catalysts based on a metal atom attached to 'phosphoramidites'. If you look up phosphoramidites in Wikipedia, you'll see that the name Feringa features in the four key publications. His international prestige was assured.

From the start of his professorship he worked concurrently on another project involving molecular switches. These are also chiral molecules, which can be converted into a different state by giving them a little 'push' (e.g. with light). These switches usually consist of two similar structures linked by a kind of axle, or pivot. You can get a rough idea by placing the thumbs of both hands against one another (the axle) and turning your hands so that your fingers go up and/or down. In his team Feringa would sometimes talk about the possibility of making these switches go right around, instead of back and forth. This would then give you a motor.

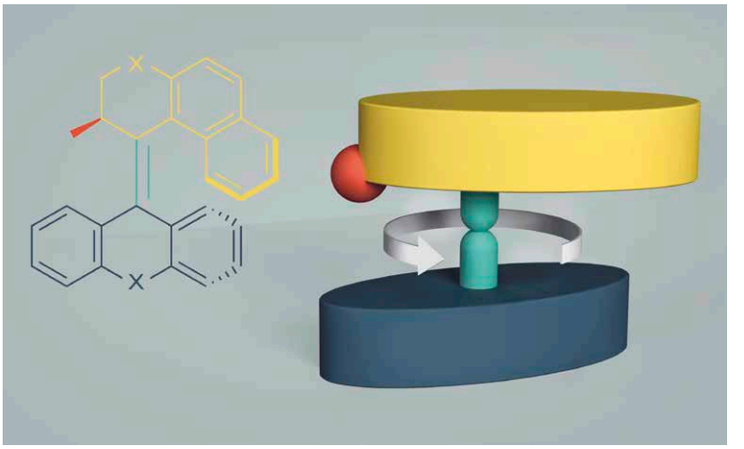


Then one day a visiting Japanese researcher noticed that a light-controlled switch molecule was behaving oddly. On closer inspection it proved to be the long dreamed-of motor. This became the first molecular motor that Feringa showed to the world in *Nature* in 1999. In 2011 four of these motors produced the now iconic nanocar, which was developed primarily to demonstrate that his motors could indeed be used to propel something. And in 2005 Feringa presented a motor that didn't run on energy from light but on chemical fuel. All

Models of molecular motors



Ben Feringa's first nanomotor published in Nature in 1999: two identical halves (yellow) attached to a double C=C compound (green). A side chain (red) ensures that rotation is unidirectional.



Second-generation nanomotor: the top half (yellow) rotates on a generic base (blue). Only one side chain (red) is needed to ensure unidirectional rotation. This molecule is the light-driven 'wheel' of Feringa's nanocar.

instances involve a comparable structure: a molecule that consists of two large 'flaps' attached by a small axle made up of two carbon molecules. The flaps are in each other's way a little, but if you add a small amount of energy to the axle, one flap shoots past the other, making a half turn. A bit more energy and they shoot past each other again, completing the rotation.

Drugs

After the phosphoramidites, Feringa hit the international jackpot for a second time with this motor. He now began concentrating increasingly on catalysis and motors, but he didn't lose sight of switches. Recently, he added a switch to an antibiotic so that the antibiotic could be turned 'on' or off' with the help of light. This means you can target the antibiotic exactly where it is needed, which prevents side effects. And he is conducting similar research on drugs to combat cancer. Meanwhile, Feringa has been working for some thirty years with UMCG radiologists who are looking for improved compounds (tracers) to show the interior of the body – in particular, disease areas such as tumours. As these are mainly organic compounds, Feringa's expertise is much appreciated. He and two colleagues head the UMCG/UG 'tracerlab'.

The nanocar is just one of the many molecules created by Feringa

Concrete applications

These switches and motors, as well as catalysts and tracers, are all chiral molecules. Whereas the motors are still awaiting concrete applications, the switches have made great advances. Feringa is now incorporating them into drugs and tracers. The catalysts he has developed are helping industry to create the right molecules, usually in a cleaner process than with classic chemical synthesis.

A special sideline is his research into how life has developed a preference for 'left-handedness'. As stated earlier, chemical processes generally produce exactly the same number of L and R forms. Somewhere in the development of life, a preference for left-handed molecules must have evolved. But just how this happened is one of the great scientific mysteries.

In late November, Anne Schoonen was awarded her PhD under Feringa's supervision – the first PhD conferral since the Nobel Prize was awarded. She investigated whether certain reactions can lead to a preference for one type of 'handedness'. The findings were not conclusive, but if follow-up research does provide an answer, Feringa could be firmly in the running for a second Nobel Prize. Two left hands can take you a long way!

There's a chemical link between Ben Feringa's nanomotor and a puncture glue that was developed many years ago in the Folkingestraat. The link between these two Groningen inventions is **Hans Wijnberg**, grandson of Jehuda Levi Wijnberg who invented the in the Netherlands famous 'Simson solution'. But Wijnberg was also a world-renowned professor of organic chemistry at the University of Groningen, and mentor and inspiration to a host of PhD students. Twelve of them – including Feringa, Bert Meijer and Kees Hummelen, who still like to talk about him – went on to become professors themselves.

KIRSTEN OTTEN ELMER SPAARGAREN

Mentor

Not afraid of anyone

The life of Hans Wijnberg (1922-2011) seems to have been a series of spectacular events. It is worthy of a book, a view shared by History alumnus Luuk Hajema: 'I knew Wijnberg back in 1984-1989, when I was editor and then editor-in-chief of the university newspaper. At that time he wrote a column 'A different view', in which he regularly ruffled the feathers of the left-wing student population. As a right-minded liberal in the American sense of the word, he was strongly opposed to the communist ideas that some students were so passionate about at that time. I hardly knew anything about him, but he fascinated me even then. A chance meeting in 2012 with one of his sons, lawyer Anthony Wijnberg, gave me the idea of a biography.'

One of the things that Wijnberg campaigned against strongly was the idea that students should have a voice within universities. And initially, he wasn't very enthusiastic about women's emancipation on campus either. It didn't seem to bother him that the slogan 'Kill Wijnberg' was daubed in many places around the city in the early 1980s. Hajema: 'Wijnberg wasn't afraid of anyone and he remained just as perverse as ever. Things didn't always go smoothly with the university newspaper either, but when I was on the editorial team we gave him the affectionate nickname "our right-wing conscience".'

from left to right: Franz Weber, Hans Wijnberg and Fred Mayer

Spy behind the German lines

It was not until 2007 that Hajema read in the Dagblad van het Noorden how Wijnberg and his twin brother Louis (later Luke) had ended up in the US. The Jewish brothers were put on the boat to New York in 1939 by their parents, who feared the impending Nazi brutality. The boys finished school there and then signed up for US military service. After training as a parachutist and secret agent with the Office of Strategic Services (OSS), Hans was dropped onto a snowy mountain top in Austria in February 1945, together with Austrian deserter Frans Weber and the originally German Jew Frederick Mayer. The espionage activities that the trio subsequently carried out under the codename Operation Greenup contributed among other things to the liberation of Innsbruck. These events so captured the imagination that director Quentin Tarantino loosely based his film Inglourious Basterds on them.

After the liberation, Hans and Louis learned that their parents and younger brother hadn't survived the war. The family firm, known for its invention of the Simson puncture repair kit (see inset), was sold and the young men decided to return to the US. Louis – now 94 and living in North Carolina – became a physicist, while Hans opted for chemistry. He completed his PhD in 1952 and eventually became an associate professor at Tulane University in New Orleans. In 1960 Hans returned to the Netherlands with his wife and four children, and was appointed professor at Groningen.

Captivated by molecules

After the war Wijnberg devoted himself to his work. The approach he adopted, together with his important findings (he is regarded as the founder of asymmetric organocatalysis), placed the UG Organic Chemistry Laboratory on the international map. Bert Meijer (now a professor at Eindhoven) and Kees Hummelen (a professor at Groningen) studied chemistry at the UG several years after Feringa. They were also PhD students under Wijnberg. Hummelen looks back: 'It wasn't until my third year, when I went to work with Bert in Wijnberg's lab, that I really started to enjoy my studies.' Meijer adds: 'Wijnberg exerted a magical attraction for some students. If you were just as captivated by molecules as he was and you let this shine through in your experiments, you ended up feeling the same passion for organic chemistry as everyone else in the Wijnberg team. In his unique way Wijnberg was a highly inspiring mentor for his students and PhD candidates.'

The 1970s

Hummelen paints a picture of his student days: 'The 1970s were great. I was a real hippie – long hair, dope smoking. Wijnberg didn't have a problem with that. In fact, he and his wife would sometimes light up a joint too. He struck just the right chord with me. And then

from left to right: Kees Hummelen, Hans Wijnberg and Bert Meijer

one day he said: “I have an idea about what you could work on. If it works, it would be great, because I know that pharmacists are crying out for it.” By pointing out how important it was, he prompted me to think: let’s have a go.’

Meijer: ‘When we came to Wijnberg, he already had an international reputation, as well as being a prominent professor at the UG. By then, he was less preoccupied with his own career and all the more concerned with that of his students.

Valhalla

We came to a kind of Valhalla of scientific curiosity. His desire to constantly work on something new was an essential part of our training. We met his foreign visitors, and there were some very famous names among them. At conferences he asked us newbies to present the latest findings ourselves – we were given a place of honour. That trust, but also the privileges and the freedom we were given, had an enormous motivating effect.’

‘But they were different times,’ says Hummelen, downplaying what happened. ‘My PhD research, for example, happened so easily. These days there’s an entire process that precedes it, but Wijnberg simply said: “that light-giving molecule that we’ve developed, stick that onto something”. And it worked.’

Simson and Syncom

Hans Wijnberg is the grandson of Jehuda Levi Wijnberg, who had a pharmacy in the Folkingestraat in Groningen, and who invented the glue and puncture repair kits that are still sold in the familiar red tins to this day. This ‘Louis’ opened the Simson solution factory on the Coehoornsingel in 1894 before moving his company and his family to Amsterdam. When Hans retired with great reluctance in 1987, it was obvious that an understanding of chemistry and an entrepreneurial spirit ran in his veins too: he founded the chemical company Syncom, and was awarded the Wubbo Ockels Award for innovative enterprise in 1996.

A second father

Although many people had difficulties with the professor’s whims (he was ‘impatient, demanding, provocative’), in his own lab he was well-loved. Meijer puts it like this: ‘For me personally, Wijnberg was like a second father, someone who I could always go to. He was also incredibly important for our academic careers, including for Ben’s. It’s a shame that he wasn’t around for this, but I know for certain that Wijnberg would have been tremendously proud of this Nobel Prize, which in reality belongs in part to him!’

‘THERE IS NO GOOGLE TRANSLATE FROM CHEMISTRY TO BIOLOGY, YET.’

PHOTO

MARKETING GRONINGEN

Montage photo. In the months to come, a life-size ‘nanocar’ will be displayed at various locations in the city of Groningen. The model has been on the Grote Markt since 30 November, the day that Ben Feringa held the Nobel Prize lecture in the Martinikerk. Later it will also appear in the Broerstraat and on the Zernike Campus.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OPHEFFINGSUITVERKOOP
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SPOT
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Nanocar by Ben Feringa
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Nanocar by Ben Feringa
BEN FERINGA
GRONINGEN
GRONINGEN

A modest and affable farmer's son from Barger-Compascuum who remained loyal to his local university – **Ben Feringa** doesn't seem your typical Nobel Prize winner. Who is this man? People close to him describe a scientist in heart and soul, a man with a mission.

BERT PLATZER

ELMER SPAARGAREN (L) AND JEROEN VAN KOOTEN

OTHERS ON FERINGA

Kindled by chemistry

Shortly before the official announcement, assistant professor and UMCG researcher Wiktor Szymański was in a meeting with Feringa and a PhD student when the Nobel committee rang. 'Ben asked us to leave the room, which was an unusual thing for him to do. He had to keep the news to himself until the official announcement and when he called us back about ten minutes later, he went on with the meeting as though nothing had happened. He made some helpful suggestions about the research. Ben is happiest when discussing chemistry with his students, so I think the meeting offered some distraction for what would follow that day.'

It comes as no surprise that Feringa's wife Betty described him in the Dutch newspaper *de Volkskrant* as 'a scientist in heart and soul. Ben lives for his research'. When she married him she knew it would be no 'ordinary marriage'. Ria Broer, a former fellow student and fellow professor (in Theoretical Chemistry at the UG: 'He works really hard. Lots of academics do that, but I think Ben works especially hard. Why? Because he enjoys it!' Broer talks about a PhD student who had submitted a manuscript to Feringa shortly before the Nobel Prize was awarded. 'It was a really hectic time – he had to travel throughout the country to give television interviews. But four days later she got the manuscript back again.'

'Feringa besefte dat hij een revolutie teweeg kon brengen en is doorgegaan'

Kindled

Ben Feringa's story starts in Barger-Compascuum, a Catholic enclave founded by German immigrants who moved to southeast Drenthe as peat workers in the nineteenth century. He was born there, the second of ten children, into a farming family in 1951 – not the kind of environment where you would expect someone to go on to university. But intellectual development was encouraged in Feringa's home.

Feringa says that he was inspired to study chemistry by his chemistry teacher at the Roman Catholic high school. Gerard Stout, one year above him and inspired by the same teacher, also went on to study chemistry at the UG. He explains: 'There was a whole group of teachers at our school in Emmen who had a progressive approach to teaching – no hierarchy or aloofness. They believed they should be there for their students. Ben probably already had an enquiring mind, but that particular teacher, Gerard op de Weegh, kindled it at the right time.'

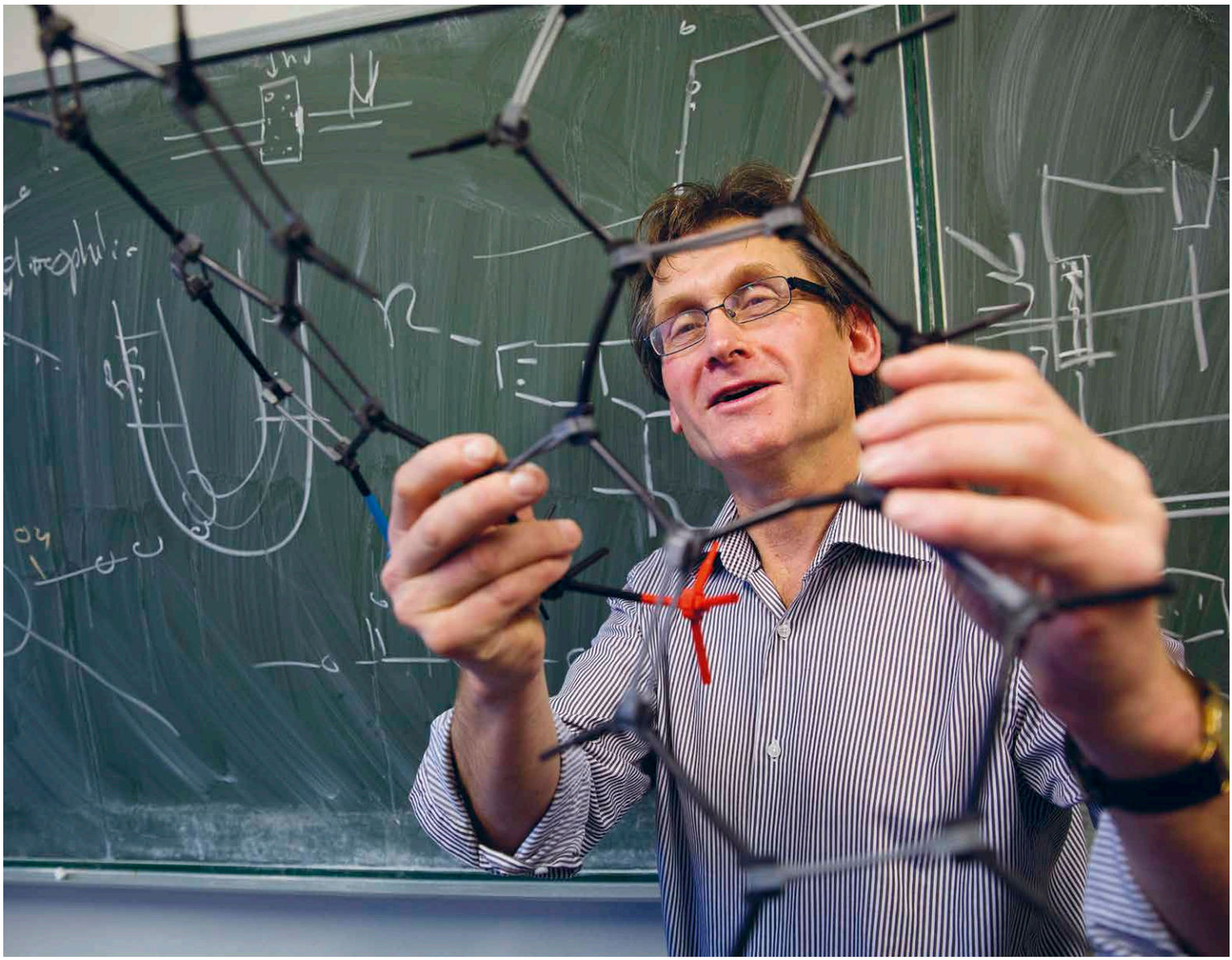
'Feringa knew that he could bring about a revolution and so he kept going'

Zambia

Stout didn't get to know Feringa until he had completed his studies and went to teach for two years in Zambia. Feringa and a fellow student from his village, Ben Nusse, visited Stout for a five-week holiday over summer. 'My cook, who ran the household, lived two hours away on foot from my house. One evening Feringa and Nusse walked home with him and stayed the night. That was out of sheer curiosity – Feringa wanted to imbibe the local culture and see how the man lived with his family in a mud hut.' At the end of the visit, the three of them journeyed by canoe and public transport to Victoria Falls on the border with present-day Zimbabwe. Stout remembers Feringa as 'adventurous, completely unafraid and someone who could relate easily to the local people.'

Mission

Broer also remembers him as being 'an easy-going lad'. 'I got to know him just before we started our degree. The prospective chemistry student with the highest exam marks would be awarded a prize by Ben's later mentor, Professor Hans Wijnberg. That year, Ben, another student and myself all scored the same mark. For the rest, I didn't spend much time with him, but he was someone who stood out. He



asked questions during lectures, he was curious, and he worked hard.' These are the qualities listed by everyone who knows Feringa: easy to get on with, friendly, open, jovial, no-nonsense, affable. Former UG spokesperson and communications officer Jos Speekman also sees him as a man with a mission: 'The remarkable thing about Feringa is that he's a top-level researcher, but he also has a teacher's passion to explain things simply and well, to a wide audience. As well as that, he is on the boards of the Netherlands Organisation for Scientific Research (NWO) and the Royal Netherlands Academy of Arts and Sciences (KNAW). He travels all over the world giving lectures. He truly is a man with a mission – he sees the importance of that kind of work for research, such as creating more research funds.'

Revolution

This conviction also seems to be reflected in the way he deals with publicity. Speekman: 'As a communications officer, I have noticed how people who are in the news a lot often get sick of it after a while and can't stand the sight of yet another journalist. That's not the case with Ben. He continues to be enthusiastic and accessible. At one point he really was constantly on the road, giving lectures or accepting awards.'

As well as a mission, he has a vision: after developing the nanomotor in 1999, Feringa was quick to foresee the practical possibilities of his invention. Bert Weckhuysen, Professor of Inorganic Chemistry and Catalysis at Utrecht University, told the Dutch newspaper *AD*: 'Many scientists would stop after a discovery like that and throw themselves into something new. But Feringa knew that he could bring about a revolution and so he kept going.' Speekman: 'It is fundamental research, without applications as yet, but in his mind Ben has always worked towards applications for his invention, such as delivering drugs to particular parts of the body. His first nano-motor ran on light, but now he has also developed a motor that is powered by chemical fuel, which brings an application in the human body a step closer.'

True to his origins

The fact that Feringa hasn't succumbed to fame is partly because he has remained true to his origins. 'When we're with other people from Drenthe, he speaks the Drents dialect', says Stout. 'Ben still regularly comes to Barger-Compascuum. He's also still regarded as one of the locals. People there are not known because of what they've done, but whether they're good company. The culture here still tends to be one in which you shouldn't stand out from the crowd, wear your emotions or ambitions on your sleeve, or boast about your talents. But Ben has developed his talents to the utmost and shown that it can be done. He's a great role model for the people from south-east Drenthe.'

'THERE ARE MANY THINGS IMPORTANT IN LIFE, THE SUCCESSFULNESS OF YOUR PHD IS NOT ONE OF THEM.'

Ben Feringa was won over to chemistry because his professor took him seriously as a student. More than forty years later **George Hermens** feels the same in Feringa's lab. The Master's student talks about his experiences.

DOUWE VAN DER TUIN ELMER SPAARGAREN

FERINGA AND MASTER'S STUDENT

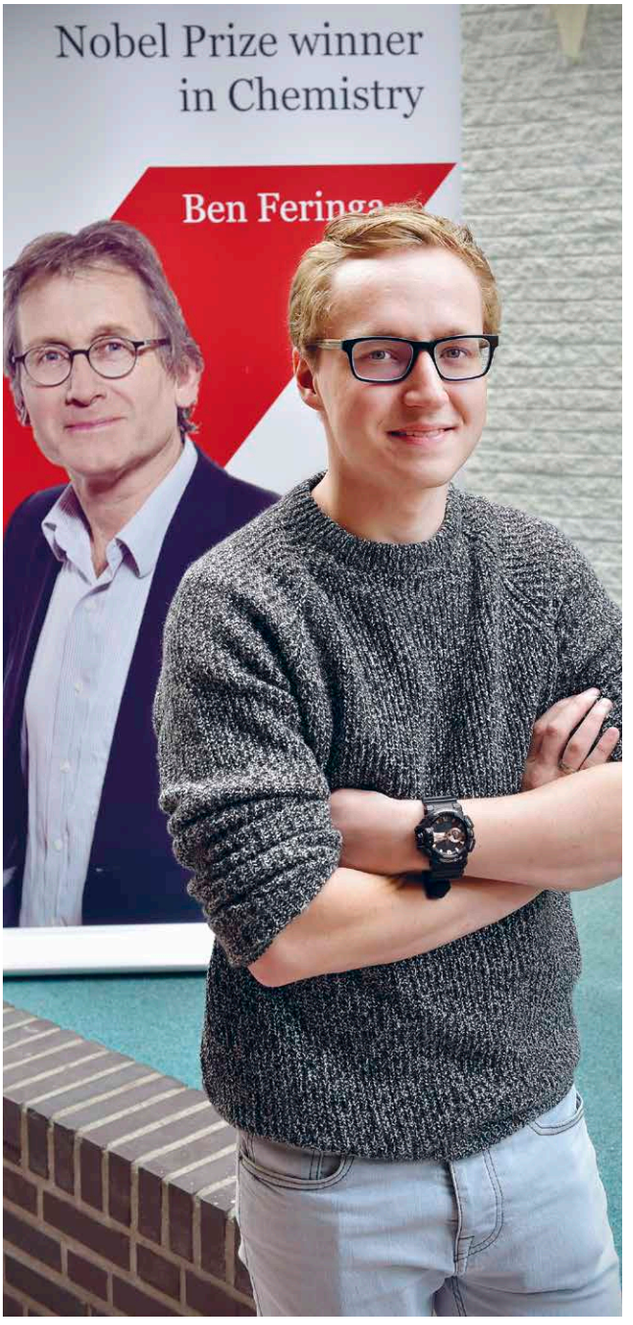
Master's student

'You really belong'

Chemistry was actually my second choice. Dentistry, orthodontics, that's what I was after. These fields attracted me for their rapid results: crooked teeth could be straightened into a perfect line in just 18 months. But I missed out on the ballot and so I decided to choose the subject I liked best at school – chemistry. Conducting experiments, running tests, that's what excited me. I also decided to give it everything I had. And it's proved to be a really good choice.

Right from the start we had the practicals that I'd looked forward to so much. I saw PhD students and other researchers working in the labs and I thought: that's what I want to do, this is where I want to be. The first year I did course units together with maths and physics students. One of the lecture series was given by Ben Feringa. What makes his lectures so special is that he transports you into chemistry by telling stories. Not molecule A reacts with molecule B to make substance C. No, instead he talks about the researcher who discovered the reaction, how the discovery was made and the fact that he's been to the researcher's home. The reaction becomes very real to you and so you remember it. With some formulas I still find myself thinking back to Feringa's lectures.

In chemistry you conduct a proper research study as part of your Bachelor's. I chose Feringa's research group, which is carrying out research on 'light switches'. I liked it so much that I went on to do my Master's research here too. I'm investigating light switches that work as molecular memory. The molecules I'm working on switch from one state to another under the influence of light. In principle, that's the foundation of memory, a 1 or a 0. I'm trying to stack these molecules by sticking extra groups onto them, because it's this stacking that's needed to make molecular memory. It's real pioneering work. If we ultimately succeed in making memory in this way, we'll enable data storage that is many times smaller than present storage methods.



The first time I went to Feringa's room as a Bachelor's student I was quite wound up. But that tension quickly disappeared. He makes you feel at home in the group straightaway. He welcomes you to the team and from that moment you really belong. It also means that he expects input from you. He expects you to contribute problems yourself, which he is then happy to discuss. He sets the bar very high. Feringa marked my Bachelor's thesis himself. Not just a quick once-over, but several times, and with comments and suggestions. You find that passion in the entire team. Everyone helps one another, and you as a student, to make something of your project. There's almost no hierarchy. Perhaps the best example of this is the annual barbecue that Feringa organizes in his garden at home for all the subgroups, where students are always welcome.'

The Groningen professors Sibrand Stratingh and Ben Feringa both conducted chemistry experiments as boys, and they both developed a car. Who was the man who gave his name to the *Stratingh Institute for Chemistry* to which Feringa is affiliated?

ULCO KOOYSTRA UNIVERSITY MUSEUM

Forerunner

Stratingh's car

Sibrand Stratingh (1785-1841) was raised in the family of his uncle. This uncle ran a pharmacy on the A-Kerkhof in Groningen, now the Venema pharmacy. He studied medicine, sat his pharmacist's exam in 1808 and obtained his PhD in medicine in 1809. He married shortly afterwards and took over his uncle's pharmacy. Sibrand soon realized that his interests were much broader than simply running a chemist's shop. He found Professor Petrus Driessen's chemistry lessons of particular interest. With his friend Theodorus van Swinderen he set up the Society of Natural Sciences in 1801, now called the Royal Natural Sciences Society at Groningen. There, and probably in his uncle's pharmacy lab, the young Sibrand and his friends began conducting chemistry experiments. His first publication, which was also reviewed in German and French journals, appeared in 1806.

In 1812 Stratingh was appointed 'essayeur' at the *Bureau van Waarborg,* where he was responsible for testing gold and silver. For this part-time job he was given an office-cum-workshop on the Guldenstraat. The building was dubbed the 'Gold Office' and is still there to this day. In the absence of a textbook for his work, Stratingh wrote his first book: *Scheikundig Handboek voor Essayeurs*, or Chemistry Handbook for Essayeurs.

Several books followed shortly afterwards, about pharmaceutical subjects such as the production of quinine from cinchona bark and morphine from opium, for which he won growing international attention and recognition. In 1826 an epidemic broke out in Groningen, killing 10% of the population within the space of a year, and which entered the history books as 'the Groningen disease'. Stratingh played a key role in combating the disease through the application of a newly discovered bleach. He even set up a factory for the large-scale manufacture of this product. His book about his findings will have been widely referred to when the first major cholera epidemic swept through Europe several years later.

In 1823 Stratingh was appointed professor of chemistry, and in 1827 technology was added to this role. His research was wide-ranging, but focused primarily on applications. He became increasingly interested in electricity, which could be generated chemically using galvanic cells. When Michael Faraday made an apparatus that could generate electricity by a rotating pendulum, Stratingh also had one made, but one that worked better and which initially produced alternating current and later, using a commutator, direct current as well. If you could generate electricity through rotation, the opposite must also be the case: using electricity to produce rotation.

When Moritz von Jacobi became the first person to build an electric motor in 1834, Stratingh immediately thought that he could make a better one, and one with a useful application. That same year he and instrument maker Becker had built a steam-driven vehicle, which they had taken on a sensational test drive through the city of Groningen. What could be more logical than to use an electric motor to propel a vehicle? In late 1834 Stratingh and Becker presented a vehicle to the Society of Natural Sciences that was propelled by an electric motor, probably the very first electric car. The second version from 1835 still survives and can be admired at the University Museum. Stratingh died in 1841, at the age of just 56.

Who could have predicted that the chemist Feringa would also achieve fame through a car, but on a much smaller scale? The Nobel Committee wrote: 'Just as the world was amazed by the first electric motors and steam engines, molecular engines have the potential in the 21st century to experience explosive growth.' Electric motors and steam engines: this brings us back to Stratingh. And that explains why Feringa likes to show Stratingh's car in lectures. We've come full circle.

'THE COMFORT ZONE IS A BEAUTIFUL PLACE, BUT NOTHING EVER GROWS THERE.'

NOBEL PRIZEWINNERS AND THE UG

GERT GRITTER

Out of a total of 573 since its establishment in 1901 (the Nobel Prize in Economics was added in 1969), the Nobel Prize has been awarded to 870 individuals (822 men and 48 women) and 23 organizations. There have been just 21 Dutch laureates, making the achievements of Frits Zernike and Ben Feringa all the more remarkable. Both won the prize at the age of 65, one for Physics and the other for Chemistry.

Before Feringa, Zernike (1888–1966) was the only Nobel Prizewinner who was affiliated with the University of Groningen at the time of the award. He won the prize for inventing the phase-contrast microscope, which made it possible for scientists to study living cells. Prior to that, parts of cells could only be identified under the microscope with the aid of dyes that killed the cells. The contribution of Zernike's phase-contrast microscope to the development of biology and medicine is of inestimable value. Zernike studied chemistry at the University of

Amsterdam, where he obtained his doctorate in 1915. Already then, he was assistant to Jacobus Cornelius Kapteyn at the Astronomy Laboratory at the UG. In that respect his situation differs from that of Feringa, who has spent his entire academic career in Groningen. Feringa did his first degree here, as well as his PhD, and – apart from a few years at Shell – he has always worked here. This is unusual since most Dutch Nobel laureates were working at universities abroad when they won the prize.

Zernicke had developed the principle of the phase-contrast microscope in 1932, and in 1941 the microscope went into production at the German firm Carl Zeiss AG. 1953 therefore seems rather late to be receiving the Nobel Prize for his invention. The situation is quite different for Feringa's research, as applications for the nanomotor still lie in the future. Another difference between the two Nobel laureates is that Zernike was awarded the prize alone, whereas Feringa shares it with Frenchman Jean-Pierre Sauvage and Briton Sir James Fraser Stoddart. Zernike did, however, collaborate closely with renowned instrument maker Caroline Bleeker. She was issued the patent for their invention, while Zernike won the Nobel Prize.

There are other researchers with a UG connection who have won the Nobel Prize (or who just missed out).

Heike Kamerlingh Onnes (1853-1926)

was born in Groningen, where he first studied chemistry and then physics, and obtained his doctorate in 1879. In 1913 he was awarded the Nobel Prize in Physics. At that time he was a professor in Leiden, where in 1908 he was the first person to liquefy helium, at a temperature of -269 °C. For many years his cryogenics laboratory was known as 'the coldest place on earth'.

Albert Szent-Györgyi (1893-1989)

was born in Budapest and studied medicine in Hungary. He worked at various universities, including the UG from 1922 to 1926. Here he laid the foundations for the research that would earn him the Nobel Prize in Medicine in 1937 – biological combustion processes and the isolation and identification of vitamin C. He was a professor in Szeged in Hungary at the time.

Hessel de Vries (1916-1959)

was born in Annen in Drenthe, and studied mathematics and physics in Groningen, where he obtained his PhD in 1942 and was appointed professor in 1950. This brilliant researcher may well have shared the Nobel Prize in Chemistry, awarded to the American Willard Frank Libby in 1960 for his role in developing radiocarbon dating, were it not for the fact that he had murdered his assistant, Anneke, one year earlier after she broke off their relationship. He then took his own life.

Rufus Dingelam (fictional character)

is a professor in Chemical Engineering and the main protagonist in W.F. Hermans' 1975 novel *Onder professoren*. This satirical *roman à clef* is set at the UG, where Dingelam wins the Nobel Prize in Chemistry for something he had invented twenty years earlier – the substance alicodrin, for a whiter wash and to boost male potency. Many characters in the book are modelled on UG staff from that time.

JURGEN TIEKSTRA

ABROAD

FOTO PRIVÉ

Wim Velema

'At lunch time you find yourself queuing up with Nobel laureates'

It's six o'clock in the evening. Darkness has fallen in Groningen. Outside it's bleak and wet. On the other side of the world, on the west coast of the US, Wim Velema (30) picks up his mobile phone. It's nine o'clock in the morning there. The sky overhead is bright blue. The forecast is for twenty degrees. He is at Stanford University campus, close to San Francisco. 'Things here are on a vast scale', he says. 'When I first arrived, I thought: I'm living on campus, so I'll be able to walk everywhere. But that's not possible. You really need a car.' Velema moved to California in 2014 to work in Eric Kool's chemistry lab at Stanford. He is researching a new technique for identifying abnormalities in human DNA that occur frequently in cancers. That same year he had left Ben Feringa's research group, where he had been able to set up a biology lab, in collaboration with postdoc Wiktor Szymański, after completing his pharmacy studies.

With Feringa as his mentor, Velema earned his PhD with distinction for research into antibiotics that can be switched on and off. (The secret lay in the molecules that can be controlled remotely using light, so that they only work in the intended part of the body and therefore have fewer side effects.) 'It was a special time with him. He was a mentor for me, and not just when it came to chemistry. Ben himself is a creative person and highly motivating. I would leave his office very enthusiastic after every discussion with him.'

Armed with an NWO scholarship, he flew to the west coast of the US. At Stanford, a private university founded by the industrialist Leland Stanford, he found a scientific Valhalla. 'This is one of the best universities in the world, certainly in the field of chemistry. At lunch time you find yourself queuing up with Nobel laureates'. The campus is fantastic, everything is beautifully maintained. You can see that there's lots of money here.'

Enormously wealthy

In fact: 'This is a very strange environment. Everyone is so enormously wealthy here and everything is so ridiculously expensive. I pay two thousand dollars for a small studio room. This is Silicon Valley. All the major tech companies are located here and they attract lots of highly qualified people. I read recently that the head of the fire service in San Francisco could no longer afford a house in his own city. I don't think that's how it should be. I've heard that Atherton, a village near here, is the richest postcode in the US. It's 'Center Parcs meets Ritz-Carlton' here. There's a rather strange atmosphere.'

Hillary Clinton recently came to the Valley to raise funds for her campaign, but the real election battle bypassed California. The state has been a Democrat stronghold for years, so there was huge dissatisfaction about Donald Trump's win. The university even sent out a mail drop, which said: 'Regardless of what you think about it, we want everyone to belong: we don't want a climate in which people are polarized and excluded.'

NOTHING TOPS GRONINGEN

You will find members of the UG community all over the world. Some have left Groningen, but others have stayed on. What do they like about Groningen and what do they enjoy doing here? UG staff and alumni give you their tips.

SELFIE

Tineke Kalter-Meuken (1967)

Personal assistant to Prof. Ben Feringa and secretary of his Synthetic Organic Chemistry research group at the Stratingh Institute of Chemistry; I am also a certified civil registrar and a member of *Het Genootschap Onze Taal*.

My main job is to manage Ben Feringa's diary. I act as a kind of buffer because of the many requests that come in. The aim is to allocate his time logically and efficiently. I also try to support him as best I can across all areas so that he can focus on his research. On top of that, I function as a kind of back-up memory. Ben has various executive duties and he travels a lot so it's never a dull moment! He has a large research group and there's a great atmosphere here. Despite it being so hectic, it's an honour and a pleasure for me to work for him.

I LIKE

My favourite place in the province of Groningen is the fortified town of Bourtange. When I first went there as a child with my parents, it was love at first sight. It really is like stepping into history when you go through the gate in the town wall. I still remember thinking 'this is where I want to live when I grow up!' I still haven't given up on that dream. Perhaps it will happen one day... And there are always nice things to do in Bourtange so I always check out www.bourtange.nl.

COLOPHON

WWW.RUG.NL/BROERSTRAAT5

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The name Ben Feringa is synonymous with ‘inspirer of the young’. He has led 112 PhD students to the finish line, and we’re still counting. Doctor number 17 gave his inaugural lecture last month and doctor 112 works for Shell.

ELLIS ELLENBROEK

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GERARD ROELFES (44)

STUDIED chemistry from 1990 to 1995, obtained PhD in 2000 **EMPLOYED** as Professor of Biomolecular Chemistry and Catalysis at the UG, gave his inaugural lecture on 15 November 2016 **LIVES** with wife Alinde (42), a practice nurse; Matthijs (13), Wouter (11) and Koen (7) **HOUSE** semi-detached in Haren **INCOME** about € 74,700 gross per annum

‘Chemistry was one of my three favourite subjects at school. The other two were English and history. With those two, there was a high chance that I would become a secondary school teacher, which didn’t appeal to me. Now I’m a professor and I really enjoy teaching.
I started with chemical engineering, but soon discovered that I wasn’t really interested in designing chemical installations for factories. Molecules appealed to me a lot more. My interest became a passion – the magic of discovery, finding something that nobody before you has discovered. As a professor you have your own group. In my group of about fifteen people we’ve done lots of really exciting things. Our unifying theme is catalysis, accelerating reactions, for example by using newly designed enzymes. One of our three lines of research is developing compounds in order to study processes in cancer cells so that we can perhaps intervene.

We work together with doctors. Without passion you can’t become a professor, or even get a PhD. You really can’t. You have to be highly motivated. After all, it entails a good deal of sacrifice. It’s definitely not a 9-to-5 job, you have to be prepared to do much more than in an ordinary job. And you have to be able to cope with failure, to have the wherewithal to keep starting afresh.

At the University we employ the tenure track system, the American model. When I started here as an assistant professor in 2006, I was given a five-year contract. I had to prove myself in those five years. I was then assessed and it was ‘up or out’. I was promoted to associate professor. If that hadn’t worked, it wasn’t a question of ‘try again next year’, but rather ‘look for another job’. There was a list of criteria that I had to satisfy. I believe I’ve managed them all very satisfactorily. It seems I’m a good teacher, and we are conducting research that leads to publications that are read. And clearly, I’m also good enough at securing funding.’

ANNE SCHOONEN (30)

STUDIED chemistry from 2004 to 2010, obtained PhD on 25 November 2016. **EMPLOYED** since February 2016 as production chemist at Shell, Rijswijk **LIVES** with partner Gerbrand Hop (29) who works for the Dutch Bridge Federation (NBB) **HOUSE** top storey of mansion in The Hague embassy quarter **INCOME** € 52,500 gross per annum (plus a range of ‘fantastic’ benefits)

‘When I heard about Ben’s Nobel Prize, my first thought was: I’m so glad I already have a date for my PhD defence! His diary was always absolutely chocker, and this certainly wasn’t going to get any better. My dissertation was on the chemical beginnings of life, with a philosophical aspect. Why nature makes only one mirror image of a molecule, whereas we always find both variants in our labs. Amino acids in nature are all L-amino acids, counter-clockwise; starches are all clockwise, Type D starches. That’s actually very odd. After all, you don’t suddenly find only left-hand gloves, do you? The suspicion is that the presence of just one mirrored form was a prerequisite for life to evolve. But you don’t find the only true answer to the mirror image question, for that you have to be able to go back as it were to the beginnings of life.

I’m not working on that topic at all at Shell. As a production chemist I have to decide which chemicals work best for getting oil and gas out of the ground. In Groningen they said: fancy the biggest tree-hugger in our group going to work for Shell! I’m not a tree-hugger. People probably take me for one because I voted for Green Left last time and I was a scout leader. I wanted to continue with technology and that’s something I can do here. I was also a bit tired of the uncertainty of working at a university. At Shell they gave me a permanent contract straightaway. I also feel there’s a lot happening at Shell when it comes to new, green forms of energy.
Being able to grow was also something I wanted. The graduate programme that I’m part of offers me that opportunity. It’s a kind of organized pathway ahead for young people.

In ten years’ time I would like to be an asset manager, managing an oilfield or an oil rig. It doesn’t matter where, whether it’s Gabon or Qatar. I’m currently trying to organize a six-month meaningful field assignment – that’s what they call it – in Gabon.’