As the daughter of a Dutch UN diplomat, you grew up mostly abroad. How has that affected your life? For instance, did you ever dream of a diplomatic career?

“Not really. My father was also more involved with technical subjects, like demographic surveys and information technology. He was also a physicist, so you could say I’m a chip off the old block. Even so, my younger years certainly influenced me. It was never certain that I’d eventually come to work here in Holland. I spent most of my teenage years in the United States. I then studied physics at Yale, and later went to Harvard for my PhD. When I arrived in Delft, my English was easily better than my Dutch.”

It seems that has changed.

“Yes, I managed to get my Dutch back. My American background still makes it easier for me to come into contact with American researchers. I come across as totally American.”

Who is Nynke Dekker?

As a young professor of single-molecule nanoscale biophysics, Nynke Dekker (Amsterdam, 1971) says she doesn’t suffer the pressure of great expectations. On the other hand, she does regret the fact that these days she often finds so little time to read articles, have discussions, sit and think, and thus generate the good ideas that fuel any leading research group.

Dekker studied physics at Yale. As a nuclear physicist, her PhD research at Harvard involved using magnetic fields to control the paths of caesium atoms, although she later made the switch to studying living matter. In 2003, TU Delft enticed her to return to the Netherlands. Two years later, her research group published a cover article in Nature, on DNA. In April 2009, she delivered her inaugural address as a professor at TU Delft.

Physicist Nynke Dekker is conducting research on single molecules.

Her research has already led to a cover article in Nature. “A cell is such a large and complex system!”

Joost Panhuysen

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Why is that?

“I speak English with an American accent, and share many of the same points of reference. Consequently, invitations to conferences are more forthcoming, things like that. So, my background is a great help to me.”

Were you always certain about wanting to study physics?

“I did hesitate for a while. I knew it had to be one of the sciences, though. In my final year at school we were living in Holland, and so I did take a look around Twente University and TU Delft, but I decided that the courses they offered were terribly dull. The curriculum was completely set, with no option for making your own choices. And things were also rather formal. At Yale you didn’t immediately have to decide on a specialist subject. Biophysics and biochemistry both appealed to me, but because the physics classes proved to be so inspirational, I ultimately opted for physics - and I’ve never regretted that choice. Physics gives you a proper foundation for pursuing other things later. I finally ended up in molecular biophysics. So I’ve come full circle.” (Laughs)

In your inaugural address as professor at TU Delft, you described yourself as a physicist with an interest in biological systems, and said, “There is also a trend in biology to look at increasingly smaller details of biological systems.”

“Yes, but you’ll never hear me claim to be a biologist. We use physical methods and technologies to try to understand how biological molecules work. Even so, I did get some extra training.

Biology is steadily moving towards the molecular level, which is a development that started in the 1950s. Biologists are always finding better ways of isolating certain molecules, of getting more to grips with the smallest matter. Physicists on the other hand are good at making minute structures and getting very accurate measurements. We can now see the two coming together.”

Are there also biologists in your research group?

“Yes, there are, and that’s a good thing too, because if we had to make do with just physicists who received some extra training... (laughs). This can work up to a certain level, but to properly work with cells and molecules, you also need biologists. Their broader view of biology is especially useful, as this leads to other perspectives.”

Over the past couple of years, your group managed to unravel the ‘dance’ between the topoisomerase IB enzyme and DNA, with an existing cancer growth inhibitor providing interference in the background. While being copied, the double helix of the DNA molecule tends to get tangled up. Topoisomerase IB acts as a molecular motor that stretches the loops and knots back into shape, allowing the DNA copying process to continue. You have been looking at how the cancer growth inhibitor disrupts the process by slowing down the enzyme, an effect that might retard the division of cancer cells. Is your current research along the same lines?

“We are now in a slightly different phase. I’ve been working as a researcher at TU Delft for six years, and when we started, we built two test set-ups in which we conducted many interesting measurements during the first four years. We looked at how the topoisomerase proteins rotate with the DNA, and how cancer growth inhibitors can affect the process. For such measurements we developed magnetic nano tweezers. Eighteen months ago we started improving and testing those tweezers with a view toward conducting new measurements. I expect our new nano tweezers to be finished this year. We are in a slightly different phase now.”

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summer. I hope we can start the measuring phase as soon as possible, so that we can stay ahead of the competition.”

Is it a race?
“Certainly, even though researchers in the United States started this kind of research a decade earlier than we did in Europe. The research groups breathing down our necks – or the other way round – are at universities like Berkeley and Stanford. Fortunately, there are people in our group who have brilliant ideas and deliver excellent work.”

What will you do with those nano tweezers?
“We’re already quite good at measuring the length of DNA, and the number of twists we induce in the DNA. Some parameters keep eluding us though, such as the rotational rigidity and the rotational density that determine the torsion in the DNA molecule as it gets itself tangled up during the copying process. Until now, to get a rough idea about the torsion, we had to use figures measured by other researchers to fill models that didn’t really do justice to the complexity of the process. With the new nano tweezers, we hope to be able to measure the stress and the torsion ourselves.”

Are you conducting fundamental research, or is the purpose of the research to improve cancer growth inhibitors?
“This is fundamental research. People sometimes feel the need to stick a label on research to appeal to the masses, and then suddenly it’s being said that we’re going to solve the problem of cancer and discover new drugs, which of course is nonsense. Because we can study a single molecule very accurately, we may be better able to understand how a cancer growth inhibitor can be improved at the molecular level, with the consequence being a reduction in side-effects, for example. But that is something altogether different from developing new drugs.

Of course there is the hope – which I share – that one day we will have ‘specific’ drugs, but to my knowledge there isn’t a single example yet of a drug developed on the basis of molecular principles and then actually prescribed. The current cancer growth inhibitors were discovered in the 1960s by means of massive screening methods, with researchers adding tens of thousands of different substances to cells, just to see if they
Hundreds of thousands of researchers are all acting against cancer. It may sound old-fashioned now, but it was certainly effective.”

Could your research have indirect benefits for the development of new or improved cancer growth inhibitors?

“Absolutely. Our research group could perhaps contribute by finding out how a certain molecule works at a very detailed level. An improved cancer growth inhibitor will of course have to be tested for any new side-effects – and that would cost millions.”

You discovered an interaction between an enzyme and a DNA molecule, in which the cancer growth inhibitor slows down the action of the enzyme. Is this effect of the cancer growth inhibitor also what causes a cancer cell to ultimately die?

“That is indeed our hypothesis. We shall have to conduct further research in order to prove it, though. But if we’re right, it could be an important starting point for the design of new cancer growth inhibitors.”

Does your research improve your insight into the basics of life itself?

“Well, life… I have trouble defining what ‘life’ is exactly. We want to discover how the cell works. And just one cell is already such a large and complex system! Granted, the object itself is minute, but so many things are occurring inside it.”

You intend to get to the bottom of the cell’s complexity?

“Hundreds of thousands of researchers are all trying to get to grips with various processes inside the cell. Our research cannot shed light on all the cell’s processes, but the molecular motors we’re studying are very important. If they stop working, the cell usually dies. We don’t want to just describe the interaction between molecules, we want to understand the underlying physical principles. The greater the number of different things you can measure, the more precisely you can characterise a molecular motor. Only then will we really understand how these molecular interactions work. And, eventually, we will help other researchers find out how they can control these molecular interactions with specific drugs.”

Nanotechnology is a controversial subject. Some expectations are exaggerated, with visions of hunger and disease becoming things of the past. Apocalyptic visions are also conjured up, with whole armies of nanobots, viruses that escape from laboratories…

“We don’t use nanoparticles, we just observe things on a nanometre scale. Even so, I approve of the discussion. When genetically modified crops were first introduced, we saw how the general public opposed the new technology simply because they had been poorly informed. That is something we should try and avoid this time. The nanobots story is hard to take seriously. I don’t foresee a future in which nanoparticles will wipe out the human race! And it goes without saying that researchers must take steps to prevent viruses escaping from laboratories. It’s also reassuring that nanoparticles are subjected to toxicological tests to ensure they don’t jeopardise our health.”

Can you say that the risks of nanotechnology are small?

“I think the risks are easy to control.”

Is nanotechnology being demonised?

“I get the impression that the media sometimes greatly exaggerates the risks. Everything is still contained in the research laboratories, with no risk at all to the general public. I often think we would do better to solve some of our more pressing problems first. We have known for years that soot particles emitted by diesel-engines end up inside our lungs and can shorten our lives by several years, but soot filters still haven’t been made compulsory for all heavy diesel vehicles. Why would we be more afraid of nanotechnology than of things that ruin our health, and that we’ve known about for years without doing much about it? I fail to see the logic in that.”

You are a member of ‘The Young Academy’ of the Royal Netherlands Academy of Arts and Sciences. You sit on a committee that has reported on recommendations for improving the career policy for young researchers. Are young researchers being denied opportunities?

“It varies considerably between universities and faculties. You sometimes find systems that make it impossible for anyone but a certain person to get a professorship. This way you not only block the way for young talent, but also for new ideas – although I’d be the last person to suggest that young researchers are the only ones who can come up with new ideas.

If Dutch researchers have been abroad and gained experience in types of research that haven’t yet been started in the Netherlands, make sure they get the opportunity to start a similar line of research in this country, rather than fitting them into existing structures. Young scientists should also be given more freedom to select their own fields of research; that’s how science advances. At the moment, they often have to conduct research dictated by the professor who holds the departmental chair.”

Speaking of career policy, in your inaugural speech you said that universities should ensure that female researchers don’t become disillusioned and quit.

“One way of doing so would be to approach people who aren’t on the shortlist when you go looking for someone to take up a new professorship. At TU Delft, the great majority of professors are males, so when they start making their shortlists, they automatically tend to think of other males. I’m not saying they’re doing it on purpose, but I do think this is how it works. At ‘The Young Academy’, for example, members could only nominate a single new member. When the rule was relaxed to allow two nominees, it resulted in a disproportionate rise in the percentage of female nominees. But nobody is going to admit that they will only nominate a women if they can name two candidates.”

Was the cover article in Nature in 2005 the high point of your career – at least, so far?

“Each new paper is fun, it’s always another piece of research completed. And of course, if we think we’ve got a winner, we try to get it published in Science or Nature, simply because we know it’s the best way to get everybody’s attention. But that’s not to say that I think publications in other journals are less interesting, far from it.”

So there are no Hollywood-style highs in your career?

“That’s not how it works. It’s more of a gradual process. It’s still relatively easy to come up with new ideas, but realising them has become a much harder and slower process.”

So it takes patience?

“Yes, this type of research requires patience.”

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Stuur Outlook