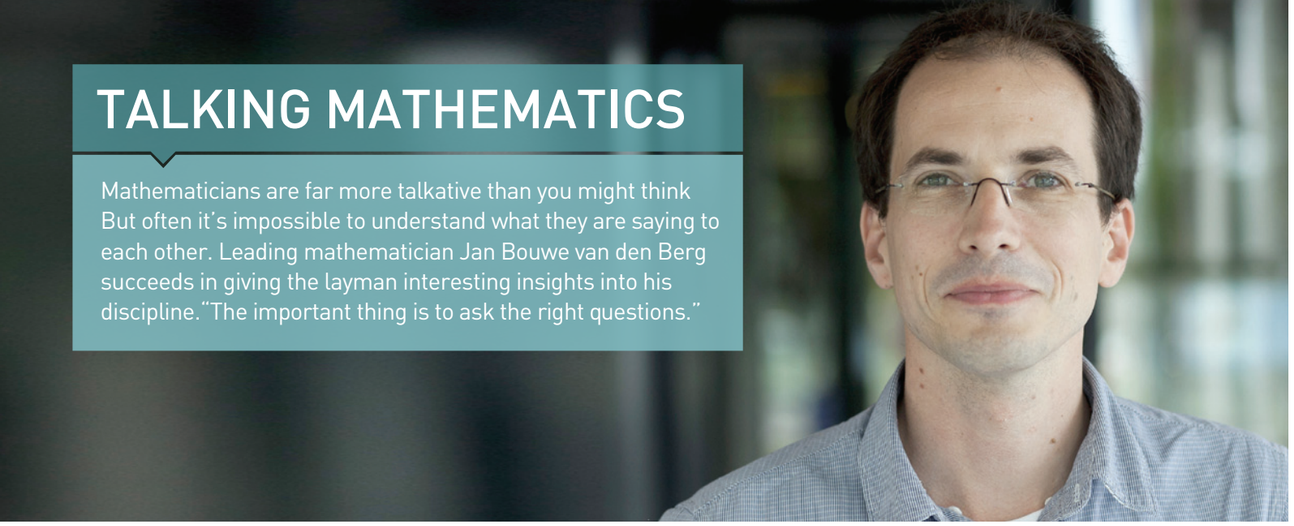


TALKING MATHEMATICS

Mathematicians are far more talkative than you might think But often it's impossible to understand what they are saying to each other. Leading mathematician Jan Bouwe van den Berg succeeds in giving the layman interesting insights into his discipline. "The important thing is to ask the right questions."

By Rianne Lindhout

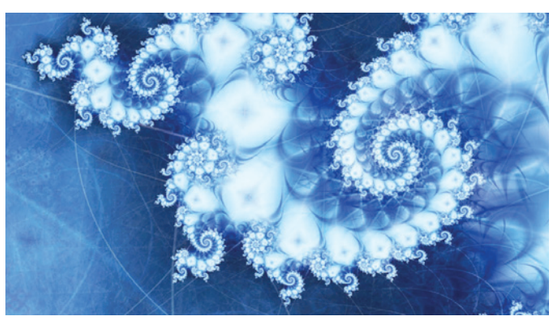
Shortly before our interview, mathematician Jan Bouwe van den Berg received a week-long visit from a postdoc from the US. They discussed equations they were unable to solve by themselves, then continued to work on them individually, incorporating the new input from their discussions. No high-tech equipment, just good old pen and paper. When one of them had an idea, he tried it out on the blackboard in Van den Berg's office. The other offered contributions along the way and using this method, they were able to make some progress.

Van den Berg explains: "We only used the computer if there was too much ... How can I put this clearly? ... If we had to verify whether a large number of things were true. If we had to solve a great many equations along the lines of: is the outcome negative or not?"

There you have it: maths is hard to explain. Thanks to the work of Jan Bouwe van den Berg, Professor of Differential Equations and Applications at VU University Amsterdam, aircraft will hopefully be able to run on less fuel in the future. If his line of research does not turn out to be a dead end, in five to ten years' time his calculations will improve our understanding of gas and liquid flows.

Understanding how air flows around aircraft, for example, can help aerospace designers develop wings with greater lift. "The complex air flow at the edge of an aircraft's wing has a particularly strong influence on the lift," Van den Berg reveals. That's the kind of flow he is trying to fathom using mathematics.

Yet Van den Berg never thinks in terms of airflow when he arrives for work at the university in the morning. Like all mathematicians, he has a deep appreciation of the beauty of mathematics.



Appreciating the beauty of mathematics

> "It's a real kick to go from not being able to understand a problem at first and, by thinking and talking about it, to finally reach the point where you do understand"

Jan Bouwe van den Berg: "It's a real kick to go from not being able to understand a problem at first and, by thinking and talking about it, to finally reach the point where you do understand."] After graduating from high school, he opted to study mathematics and physics. "In the sciences, things fall into place. It's not the same with languages. There are never exceptions to the rules." Now mathematics is his full-time job. "It's a real kick to go from not being able to understand a problem at first and, by thinking and talking about it, to finally reach the point where you do understand."

SMART PEOPLE ONLY

He is exceptionally good at his job. Five years ago, at the tender age of 34, he became a professor. This year, he was awarded 1.5 million euros by the Netherlands Organization for Scientific Research (NWO) to recruit talented people for his research programme. This grant is a remarkable achievement, as nowadays the funding set aside for the exact sciences is usually snapped up by the computer scientists and astronomers.

So what exactly is it that makes Van den Berg so good? He laughs: "In maths there are very smart people only! That's the basis on which they are selected." Then, after some thought: "The important thing is to ask the right questions. You can ask questions that are too obvious and therefore not interesting, but it's also very easy to ask questions that are far too tough. Questions you'll never be able to answer. Apparently asking the right questions is something I know how to do."

To have a career in science, those in a position of power have to see you as a suitable candidate to occupy a certain position. You have to be able to organize things and supervise other researchers. "People from the exact sciences tend to be less talented in these areas than those from the more social disciplines," acknowledges Van den Berg. From their earliest beginnings right up to the early stages of their PhD research, mathematicians are hardly ever selected on communication skills. After that stage you start teaching, passing on your knowledge. In other words, being able to deal with other people suddenly becomes important. For Van den Berg that's not an issue: "It's wonderful to observe how a student who doesn't understand something at first suddenly realizes how it all fits together." He also regards supervising PhD students as one of the most rewarding aspects of his work. "I talk to them on a weekly basis and we discuss what they have done, what they have understood."

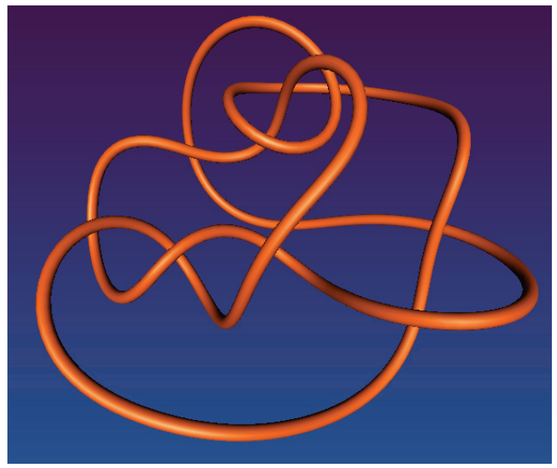
GOOD LUCK

As Van den Berg sees it, you won't go far in mathematics simply by thinking 'I'm very smart, so I'm bound to make it'. "There are an awful lot of very smart people around. For most it's a matter of working very hard in order to go far." This applies to him too, but he has also had his share of good luck. "I've ended up in a field where there are opportunities for growth, because of the possible applications. As a PhD student, it's difficult to see where the prospects lie. It helps if the right people cross your path."

In addition, Van den Berg wisely pursued a different branch of mathematics after obtaining his doctorate, so that he would not be limited to a single area later on. "That's an approach I'd recommend to every mathematician. It's tricky though: as a postdoc you are supposed to start publishing your work quickly and that's hard when you still have to get up to speed in a new area of mathematics."

BUILDING BLOCK

One of the discoveries that the VU's Professor of Differential Equations made involves bringing a pan of liquid to the boil. "We had a certain type of equation to describe fluids. If you heat fluids from below, it gives rise to rotating flows called convection rolls. You can summarize these in a differential equation. Working with a colleague, I have found a new way to look at this equation, namely by looking at the solutions as knotted solutions."



Hmm ... "That means that these convection rolls can occur in so many different ways that you can never predict exactly how they will move or how many there will be. In a nutshell, the question was: is the occurrence of such rolls chaotic or not? The answer is yes." You could also have demonstrated this empirically, Van den Berg adds. But his discovery marked a new way of looking at the differential equation, a viewpoint that can generate yet more innovations. "It's like contributing a building block to the edifice of mathematics. And larger sections of that edifice can be applied in the world of technology."

> "It's like contributing a building block to the edifice of mathematics"

THE LANGUAGE OF MATHEMATICS

The purpose of the mathematics on which Van den Berg usually works – differential equations – is not to solve equations. He tries to determine whether the solution is very large or very small. Or even whether it runs in circles. The equations on which he works concern things that change over time, for example liquids that flow, that go from quiet to turbulent, and vice versa. "I'm looking for ways to describe these transitions." In mathematical terms, a gas is also a liquid. The way in which air swirls around an aircraft therefore falls under the same branch of mathematics used to describe the above-mentioned flows in a liquid that is heating up or how a hazardous substance spreads as it leaks into water. "The language you can use to describe these phenomena is mathematics."

DOUBT

Talking to Professor Van den Berg, you come to understand – to some extent at least – those satisfying eureka experiences you can have as a mathematician. But they don't tell the whole story. Van den Berg believes that mathematicians may well be more prone to serious doubts than many scientists. "As a student, you attend lectures by people who understand everything. You think, this seems logical, but how do you come up with it in the first place?" As a PhD student, things only get more challenging. "You have to design your own research, working among people with at least ten years' experience. You only have yourself to rely on. For every one year in which you feel you're getting somewhere, three years can go by in which nothing happens. At conferences, people present years of research in fifteen minutes. That's a humbling experience. Eventually you learn to put these things into perspective, but still. This isn't something PhD students share with each other. They tend only to talk about their successes. I encourage them to share the ups and the downs."

> "For every one year in which you feel you're getting somewhere, three years can go by in which nothing happens"

Van den Berg also encounters such feelings of insignificance himself. He discusses them with his colleagues and creates a bit of breathing space by tackling another mathematical problem every now and then. During the annual mathematics study group with industry, for example, when about fifty mathematicians, including many PhD students, work together in small groups for a week to tackle problems presented by companies. Last February, Van den Berg worked on a question asked by Philips about how to make LED light softer and less white. "I know a lot about various bits of mathematics. The trick is to know which bit you should use to address a particular question. Philips can now build on the good ideas we came up with."