Abstractions

CONTRIBUTING AUTHOR

When Franziska Michor heard about Martin Nowak's plans to apply mathematical modelling techniques to cancer, her interest was piqued.

Michor had done undergraduate work in both molecular biology and maths, and originally planned to pursue experimental work in cancer genetics. But Nowak, who runs Harvard University's recently established Program for Evolutionary Dynamics, suggested she do a PhD with him. At his lab, she was able to pursue her interests in maths and biology, and to combine theory with experiment. Most recently, Michor was elected to be a Harvard junior fellow.

Nowak and Michor gathered a team together and modelled the resistance of cells to chemotherapy in leukaemia. They showed that a small subset of leukaemia cells — cancerous stem cells — determine the dynamics of treatment (*Nature* **435**, 1267–1270; 2005). Here, Michor talks about how she got involved with the research and about the challenges of the field.

How difficult was it to make the decision to pursue mathematical biology?

When Martin suggested I do a PhD at Harvard, my undergraduate adviser at the Research Institute of Molecular Pathology in Vienna — Kim Nasmyth — said the time wasn't ripe for maths in biology. Since then, he's invited me back to talk about my work.

How did you and Nowak collect your collaborators?

Lots of connections and lots of luck. When I met Martin, he was working with Bert Vogelstein at Johns Hopkins University in Baltimore; Bert told Martin to work with a particular type of leukaemia. Then he referred us to Charles Sawyers at the University of California, Los Angeles, an expert in this kind of cancer. Charles got us in contact with Tim Hughes in Australia, who had access to clinical samples.

What is it like to be a molecular biologist working with both mathematicians and clinicians?

It's not easy, because they use completely different kinds of language.

Would you encourage other young scientists to do mathematical biology?

Yes, definitely. It's the best field to be in. People expect you to be brilliant in maths and brilliant in biology — and that's not possible. But with the simulations, experiments and data analysis, it's very much a team effort.

What do you do to relax?

I ride Icelandic horses. It's always good to go into the forest and hope to be inspired.

MAKING THE PAPER

Bruno Andreotti

A riddle of the sands is revealed to this painstaking physicist.

Dune roaming: Bruno Andreotti in the Sahara.

A trio of scientists fascinated by the dynamics of small grains chased their curiosity into the desert. Their three years of observations show that barchans — dunes formed by wind from a single direction — are inherently unstable objects (see page 720).

Bruno Andreotti of the PMMH, a physics laboratory at the University of Paris VII, and his group decided to study barchans because they are model dunes, rather in the way that fruitflies are model organisms. However, there are very few places with the conditions needed to produce them; the closest is a region of the Sahara desert in southern Morocco. Hicham Elbelrhiti, a Moroccan grad student who spent half of his three-year PhD in the field, was accustomed to the sometimes harsh conditions, but Andreotti and Philippe Claudin took longer to adapt.

"After a few missions under canvas, we decided to rent a fisherman's house close to the sea," says Andreotti. There they had the comfort of water and electricity, although no relief from the sand they were studying. The ubiquitous grains made life difficult for the cameras, computers and other instruments. "But the natural beauty of the landscape made us forget all difficulties," says Andreotti.

That beauty slowly revealed itself over repeat viewing, in a process that Andreotti likens to the film *Blow Up*, in which repeat scrutiny of an enlarged negative gradually reveals clues. "As time goes by, your eye becomes sensitive to more and more details," says Andreotti. "You can recognize the dunes in a familiar area, and their almost invisible changes."

The truly subtle changes — in the undulations on the flanks of the dunes — became obvious from some observations that ran counter to previous models. Lab simulations based on these models indicated that barchans reproduce their shapes using scaling laws. "This was not the case in reality," says Andreotti. The group's observations revealed other factors at work: the models didn't account for slight fluctuations in wind directions and the effects of storms on barchan formation.

Andreotti would like to use his observations to build models that take into account the effects of these instabilities. "We hope that such a model will be able to reproduce the structure of the dune field and will help us to understand what selects the size of dunes at a given place," he says.

Andreotti and his group plan to extend their study to subaqueous ripples and dunes in rivers. "Are they different or do they result from the same instability mechanism?" asks Andreotti. The goal is to show that, when properly rescaled, dunes have the same physics in denser environments, such as water, and lighter ones, such as Mars.

The group is also collaborating with some Algerian physicists to understand how multidirectional winds create more complex shapes, such as 'star' dunes. The physical origin of these large dunes is still not understood and Andreotti says that nobody has succeeded in reproducing them in small-scale experiments or in simulations. Perhaps more trips to the desert will help sift through those sands. ■

QUANTIFIED **ST ANDREWS**

A numerical perspective on *Nature* authors.

St Andrews, on the eastern tip of Fife in Scotland, may seem remote. But Andrew Whiten says that, in today's electronic age, working in the town of 16,000 means having a good quality of life outside work. Keeping up with colleagues and research does not require much travel, he says. Local and electronic networks are his keys to scientific communication.

A bigger problem for Whiten, whose research concentrates on social learning and cognitive evolution, is that Britain has no national centre for studying primate behaviour. So Whiten's joint research programme with Frans de Waal at the Yerkes Center of Emory University in Atlanta, Georgia, is particularly important. Together with a postdoc, Victoria Horner, Whiten and de Waal have used controlled experiments to track 'cultures' — such as the use of certain tools — across whole groups of chimpanzees (see page 737).

18 submissions have been made to *Nature* from St Andrews since January 2005 (total submissions = 10,142).

204 citations have been made of Whiten *et al.*'s earlier *Nature* paper on cultures in wild chimpanzees (*Nature* **399**, 682–685; 1999).

2,081 page views of Whiten *et al.*'s paper were made in the first three weeks after online publication on 21 August 2005.

7,777 people in Fife visited *Nature* online during August 2005.