Abstractions

FUTURES AUTHOR
Greg Bear has been fascinated by both science and science fiction since he was a child. He pursued a scientific career, but left the bench after flunking advanced calculus as an undergraduate. Despite this, he has never stopped thinking about what the future may hold and what impact science might have on society. His books range from *Blood Music*, which discusses the effects of nanotechnology, to *Darwin's Radio*, which explores evolution and genetic engineering. In this week's Futures (see page 1050), Bear ponders the downsides of artificial intelligence courtesy of a robot book reviewer. *Nature* caught up with him to find out more.

What would happen if robots took over peer review?
I like the idea: your equipment looks over your scientific results. But if the robot in my short story did your review, you'd be in a lot of trouble. He'd be as mean and as nasty as the worst human reviewer — probably nastier, as he's so naive.

Many of your protagonists are scientists — and a disproportionately high number of your heroes are women. Why?
There hasn't been a surfeit of well-rendered scientists in any form of fiction. And I have a lot of sympathy for female scientists. They have a tough role. It's always been an old boy network. They get cut out, but they are so humble about it. They don't complain.

You cover topics from planetary science to biology. Why the wide range?
I love all aspects of science. A lot of my friends are scientists. I hang out with them and talk to them.

How does your own scientific background affect your choice of topics?
I'm kind of a philosopher scientist. I can't do the lab work and I certainly can't do the math!

How does your role of philosopher scientist play out in your work?
Science fiction lets scientists dream without being responsible. It also models how the public might react to science. It lets you figure out where your ideas stand in the culture.

How have scientists reacted to your work?
Many of the ideas and proposals in *Darwin's Radio* have been met with real interest. Getting that far — in a tough crowd — pleases me immensely.

What's next?
I'm in the early stages of writing about thermodynamics and information — writ cosmologically, 100 trillion years in the future. The beginning will be: "Everything you know is wrong..." ■

MAKING THE PAPER

Cheng-Ming Chuong

The inside track on how feathers are regenerated.

Cheng-Ming Chuong's fascination with feathers began some 20 years ago. Performing a neurological experiment in chickens, he saw that cells associated with feathers might have multiple roles. "It was a defining moment," says Chuong, a developmental biologist at the University of Southern California in Los Angeles. He has since assembled an interdisciplinary team to investigate the evolutionary origin, molecular signalling, complex patterning and tissue engineering of feathers.

With interest in stem cells increasing in recent years, Chuong became curious about how feathers are regenerated in adult birds. He decided to try to track down the location of stem cells in feathers. Together with graduate student Zhicao Yue, he began the search. The pair thought that their task should be successful because the location of stem cells in hair — the mammalian equivalent of feathers — had already been identified. But hair stem cells were found in a bulging region in the upper wall of the follicle and there is no such structure in a feather.

The search began in chicken feathers and used typical techniques for labelling and identifying potential stem cells. But the researchers soon realized that they had to adjust their approach because "feathers and hairs have totally different cell dynamics", Chuong explains.

Once they had found suitable candidates, the researchers had to work out how to prove that they were indeed stem cells and able to generate multiple cell types. In mammals, this is usually done by transplanting transgenically marked cells into mice and tracking their fate. The team came up with a similar trick, eventually transplanting transgenic quail stem cells into chickens. This helped the group to track and map the location of the feather stem cells.

On page 1026 of this issue, Chuong and his team reveal the results of their hunt. They conclude that feather stem cells appear in a ring on the internal wall of the vase-like follicle. As new cells are generated, they move upwards away from the feather's tip. When birds moult, the stem-cell ring remains in the follicle to produce future generations of feathers. This process also helps to explain why the ends of quills taper.

But there was still one outstanding question: how do the stem cells give rise to different feather shapes? There are two basic types of symmetry in feathers. Flight feathers are bilaterally symmetrical,with the central quill dividing two mirror images, whereas downy feathers are radially symmetrical — looking a bit like dandelion seeds. "How these two kinds of symmetry are constructed and evolved is a mystery," Chuong says. "One wonders about the enormous molecular codes required for these diverse designs."

To their surprise, Chuong and his team discovered that in flight feathers, the ring of stem cells 'tilts' towards the side where the quill arises, but in radially symmetrical feathers the ring is horizontal. It seems that adjusting the angle of the ring's tilt gives rise to different types of feather. "Nature has a simple solution for making complex feather forms," Chuong says.

Chuong plans to continue his characterization of feather stem cells. He thinks that some of the tricks used in feather regeneration could be used to help regrow human tissues. ■

QUANTIFIED **SINGAPORE**

A numerical perspective on *Nature* authors.
Karuna Sampath describes her lab as informal and boisterous. Based at the Temasek Life Sciences Laboratory (TLL) in Singapore, Sampath heads a team of seven investigating vertebrate development. Fortunately for Sampath, she has few administrative responsibilities and does not have to apply for grants formally. This means that she has more time to work at the bench with her team — something she enjoys immensely.

Choosing the right people to work with is one of the keys to successful research, says Sampath. On page 1030 of this issue, Sampath and her team reveal the fruits of a collaboration with Eric Weinberg's group at the University of Pennsylvania, Philadelphia, which resulted in the early identification of dorsal cells in embryonic zebrafish.

54 submissions to *Nature* in 2005 came from Singapore (total global submissions = more than 13,000).

12 authors working in Singapore contributed to papers published in *Nature* during 2005 (total number of authors = more than 5,500).

92% of all authors in Singapore who contributed to *Nature* this year work in the biological sciences.

67% of authors in Singapore published in *Nature* this year are based at the TLL.