Abstractions

FIRST AUTHOR

"It would be so nice if something made sense for a change," said the title character in *Alice in Wonderland*. This sentiment held true for Ellen Decaestecker of the Catholic University of Leuven in Belgium. She and her colleagues dug mud cores from a pond in Heverlee, and isolated different generations of the water flea *Daphnia magna* and its microbial parasite, *Pasteuria ramosa*, from different depths. The team grew these in the lab and monitored how flea–parasite pairs from different generations interacted. They found that parasitic virulence increased over time, but that the water flea's evolution kept pace, so infection rates remained steady (see page 870). Decaestecker discusses this 'Red Queen' effect — named after another Lewis Carroll character who said, "It takes all the running you can do, to keep in the same place."

What is the Red Queen effect?

The Red Queen hypothesis says that because the host and parasite are fighting each other all the time, no one wins. Red Queen dynamics are rare, and those that occur result from the maintenance of sexual reproduction. As the parasite adapts to the host, the host changes, so the parasite has to adapt all the time. If the host can create a lot of variation through sexual reproduction, it can fight off the parasites.

How did you find this particularly parasite-prone pond?

By coincidence. I started my PhD work on the parasites of *Daphnia*, and the pond is near the university. When infected, *Daphnia* change colour depending on the parasite. This pond is a parasite treasure trove, because it is quite shallow and nutrient-rich.

Was it hard to recreate the pond conditions in the lab?

The only tricky thing was getting enough spores from the parasites and growing them — we lost a lot of lines. We also had to choose among hundreds of possible flea-parasite combinations. We wanted to do every one, but we had to make choices of samples from several depths and strains representing the past, present and future.

What do your findings tell us about the arms race?

In terms of infectivity, there's a stalemate. But if you look at spore loads, then you do see a strong increase in parasite numbers. In terms of spore production, you could say the host loses the battle, because it doesn't seem to find a quick response. However, the effect of increased spores may not be strong enough to warrant counterbalancing by the host. ■

MAKING THE PAPER

Steven Miller

Modelling the changes in a giant planet as it approaches the Sun.

The value of scientific progress risks being limited if researchers cannot clearly explain their findings and the attendant implications to other people. Thanks to a varied career spanning science and journalism, Steven Miller is now helping young scientists to meet this challenge.

Miller, a planetary scientist at University College London (UCL), started his career with a PhD in physical chemistry, which he received from Southampton University in 1975. He followed this up with a couple of postdoc jobs, but found full-time academic positions to be in short supply, so, in the early 1980s, he opted to change direction.

He helped Ken Livingstone, now the mayor of London, start up a left-wing newspaper to take on the conservative policies of then Prime Minister Margaret Thatcher. When he returned to science with a job at UCL a few years later, he realized that "many people couldn't communicate effectively to their colleagues, let alone to non-experts". So he began teaching science communication to young scientists, knowing it would improve their work if they could "express more clearly why they thought what they thought".

Although there is an obvious benefit to biomedical research being understood by the public, because it relates to human health, Miller argues that public engagement in astronomy is just as important. Pointing to the immense popularity of the Cassini-Huygens probe that landed on Titan, one of Saturn's moons, he notes, "astronomy lifts us above the daily grind".

His research focuses on the atmospheres of exoplanets — those found outside our Solar system. One type that astronomers have identified is the Jupiter-like gas giant. These planets are huge, and some, such as HD209458b, which Miller and his co-workers chose to study, orbit incredibly close to their stars — at about 0.05 astronomical units (AU). One AU is the distance between Earth and the Sun.

Although Jupiter has a relatively thin atmosphere — equivalent in depth to about 10% of the planet's radius — the atmosphere of HD209458b measures between 200% and 300% of its radius. If Jupiter were moved in towards the Sun, Miller's group wondered, at what point might it begin to look like HD209458b?

The team created a three-dimensional model of this process and found that the change from a stable, Jupiter-like atmosphere to an expanded atmosphere with hydrogen gas escaping in a bulk outflow of 'planetary wind' occurs over a very short orbital distance. At 0.16 AU the atmosphere is stable, but at 0.14 AU the hydrogen breaks down, with catastrophic results.

Such a drastic and abrupt transition had never been modelled before and was rather unexpected. The group's three-dimensional model included a key aspect — the stabilizing effects on the planet of wind circulation, which distributes and dissipates heat (see page 845).

The finding provides insight into the evolution of gas-giant planets, which typically migrate in towards their stars during their lives. "Most form further out — such as where Jupiter is — and drift in over time. They probably cross a point where they go through this catastrophic breakdown," says Miller. The giants in our Solar System are stable and are not moving towards the Sun, although we do not know why. But, as Miller says, "this is lucky for us, because these giants have a tendency to kick the little planets out of the way as they drift". ■

FROM THE BLOGOSPHERE

The Sceptical Chymist (http://blogs.nature.com/thescepticalchymist/), the Nature journals' chemical community blog, has been tracking the career advancement of several guest bloggers.

Prospective Professor writes: "after eleven years of being entrenched in higher education, I am finally making a break for it. Yes, I am looking for my first job." He describes conflicting advice on writing cover letters (http://tinyurl.com/2ju9cd). Whom to believe? "The one that told me, 'The cover letter is critical. It's your one chance to get someone's attention.' Or the other that said, 'In our department, they ripped off the cover letter and threw it away.' Sigh..."

Rookie Rocky, on the other hand, is coming to terms with new professorship status (http://tinyurl.com/2kfh5q). He notes that professors enjoy preferred seating in the front of the seminar auditorium. "To actually sit in a 'business-class' seat as a brand new assistant professor along with my colleagues brought ... a thrill of excitement, needless to say, and a lot of pressure: now, even a boring seminar won't be a good chance to doze off!" ■

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