Abstractions

FIRST AUTHOR

Microbial infections are often likened to warfare — either the microbe or the host prevails. But persistent infections represent an equilibrium between host and microbe. On page 843, Martin Blaser, an infectious-disease specialist at New York University School of Medicine, presents a dynamic, multi-scale model of cooperation to explain how an equilibrium can be sustained between a microbe and its host. He tells *Nature* that this model could help determine microbial responses to modernization.

How, as a physician, did you come to model persistent-infection dynamics?

At a 1990 conference, a hot topic was how *Helicobacter pylori*, a microbe that persists in the human stomach, increases the host's inflammation response. I postulated that, for it to persist for a lifetime, *H. pylori* must trigger an equal and opposite cellular response to avoid excessive inflammation that could ultimately destroy its niche. My co-author, Denise Kirschner, and I showed that only a negative feedback of co-evolved signals — whereby bacterial-induced inflammation prompts the host to alter the environment such that the bacteria signal less — could allow the cycle to persist.

Your work reconciles evolutionary theory with game theory. How does this work?

In classical evolutionary theory, everything is based on competition because it's assumed that, in a cooperative situation, 'cheaters' would usurp resources and the system would fail. But cooperation exists, so I wanted to determine how it fits into the model. About six months ago, I came across game theory's Nash equilibrium concept, which can be summed up as 'if you cheat, you lose'. I realized that persistence relies on creating a system that would be disadvantageous to either a bacterial or host cheater.

How has the rise of civilization affected pathogen success?

Population size has been very important. Evolutionarily, small host-population size selects for microbes that are symbiotic or cause disease only late in life. Bigger populations can tolerate greater virulence, as is evidenced by the HIV pandemic.

What effect has modernization had?

H. pylori causes ulcers and stomach cancer later in life, but also protects against reflux and oesophageal diseases early in life. Owing to increased antibiotic use, however, organisms such as *H. pylori* are disappearing. We're thus more exposed to virulent organisms at a time when our microbiological defences, evolved over millions of years, are possibly being depleted. ■

MAKING THE PAPER

Curtis Marean

Cave findings reveal modern man's earliest seafood diet.

For Curtis Marean, finding a site that might yield evidence of how early modern humans survived a glacial maximum that made much of Africa uninhabitable was neither straightforward nor without incident. The work, which culminated in the discovery of the earliest known instance of modern humans incorporating shellfish into their diets, began with climbing cliffs and dodging falling rocks.

Since 1991, Marean, an archaeologist at Arizona State University in Tempe, has studied early modern humans in South Africa. On the basis of palaeoclimatic records, he says, only a handful of places on the African continent could have supported human populations during the glacial maximum that occured between 195,000 and 130,000 years ago. One potential refuge was along the southern coast of South Africa, where ocean currents would have kept temperatures warmer and provided conditions in which food would have been plentiful on land and at sea.

What Marean sought was a cave that would have been near enough to the low sea at that time for early man to have had sufficient food and warmth, but high enough that its contents would not have been washed out by the elevated sea levels that followed soon afterwards, some 123,000 years ago.

Peter Nilssen, a friend and collaborator of Marean's from the Iziko-South African Museum in Cape Town, had a few photographs of caves in cliff faces at Pinnacle Point, which overlooks the Indian Ocean, that looked promising. The two carried out reconnaissance work in 1999, climbing down some 60 metres of sheer cliff face to the rocky beach and then scrambling back up another 15 metres to the mouth of a cave dubbed PP13B. On one trip, Marean recalls, "Peter was ahead, and he dislodged a rock on the way up. It just missed my head, and it gave me quite a fright." At the top, they both came to a realization — they may have found the perfect location for their work, but they could never run a project there, for fear of losing graduate students to the danger.

A solution came in the form of Ricky van Rensberg, a nearby ostrich farmer with a knack for building innovative structures. By 2000, the team was excavating, thanks to a 200-step wooden stairway leading from the cliff top down to the beach. In 2003, a bridge and a walkway up to the cave were added. But occupational hazards still exist — the cave opening is so narrow and the water so close that it's like being at sea. "Sitting in the cave, all you see is ocean — two students actually got seasick," Marean says.

But the difficulties faced in getting to and working at the cave turned out to be worthwhile when excavations got underway. The team found remains of molluscs in sediments on the cave floor that dated to around 164,000 years ago. This was much earlier than previous reports of shellfish consumption by humans — the earliest documented evidence before this dated to about 125,000 years ago (see page 905).

How people first came to sample seafood, however, remains a mystery. They may simply have been curious, inspired by the sight of birds feasting on mussels and crabs exposed at low tide. Or perhaps desperation led some brave early human to take a gamble. Far from being just a tasty snack, Marean says, seafood may have contributed to the survival of our species. ■

FROM THE BLOGOSPHERE

In the 'Post-docs and Graduate Students of the World' forum on Nature Network (http://tinyurl.com/2z2oq9), Craig Rowell, a research associate at Duke University in Durham, North Carolina, is looking beyond the postdoc to the next step. He asks whether group members or their friends have successfully moved on from a postdoctoral position to the next stage in academic research, or to another career. Members of the group share their experiences of a range of careers in or related to scientific research, including quite a few tips and comments from Nature journal editors in response to questions about careers in publishing.

In another thread on this Network group, Anthony Power, a graduate student at the Ottawa Health Research Institute in Canada, invites other members to share their postdoc experiences: tips on how to find the right lab, approach potential supervisors and secure funding, as well as how to make the transition to being an independent scientist.

The postdoctoral and graduate student group, one of many groups, forums and blogs on Nature Network, is open for anyone to join. ■

Visit Nautilus for regular news relevant to *Nature* authors ▸ http://blogs.nature.com/nautilus and see Peer-to-Peer for news for peer-reviewers and about peer review ▸ http://blogs.nature.com/peer-to-peer.