Abstractions

REVIEW AUTHOR
While pondering how erosion shapes landscapes, William Dietrich and his graduate student Taylor Perron realized that many models used by Earth scientists to explain the phenomenon are missing something: life. The models tend to be mechanistic and don't take into account biological factors. This led Dietrich, a professor of Earth and planetary science at the University of California, Berkeley, to wonder what Earth would have looked like if all life were removed. His subsequent search for the 'topographic signatures' of life generated results that have implications not only for Earth's landforms but also for whether Mars or Titan show signs of past life (see page 411). *Nature* caught up with Dietrich to find out more.

What was the premise that kicked this review off?
Are mountains higher or lower because of the presence of life? If so, how so, and what's the signature of that?

What was the mental exercise that started you thinking beyond purely physical erosion?
If you could examine the high-resolution topography of Earth, could you tell there was life here? I assumed we would find some distinct features reflecting biotic influences.

What did you conclude?
One of the strongest effects we found is that height, width and symmetry of mountains is influenced by life. 'Influenced' is the key word here — despite the pervasiveness of life on Earth, there seems not to be a unique topographic signature for it.

Couldn't the absence of a unique signature be a scaling issue?
Yes, that may be where the signature is, at the finer scale. But at the coarser scale, we can't make any conclusions.

How did the recent Mars rover images influence your work?
They rattled my cage. These images got us thinking: can we use Mars as a way to see the absence of life? But it was a shock to me as an Earthbound scientist to see how familiar Mars is. There are hill slopes on Mars that are rounded and smooth, there are valley networks with apparent regular spacing. It's the shock of the familiar.

Where do we go from here?
We'd better get our act together and bring biotic effects into geomorphic processes. Geobiology is often thought of as being microbiology. But I think this can be applied as macrobiology — how do we bring life into our purely physical equations for landscape evolution? ■

MAKING THE PAPER

Jessica Flack

How dominant macaques police their group to prevent conflicts.

Jessica Flack's time as a graduate student at Emory University has given her a platform from which to contemplate evolutionary biology — quite literally. She spent 5 months doing 12-hour shifts watching pigtailed macaques from a vantage point 8 metres off the ground.

Her aim was to learn how the macaques resolve conflicts within their group, but the task was not straightforward. First Flack needed to be able to identify all 84 macaques in the group by sight. Then she had to learn the signs that showed a dispute was brewing — and wait for the conflicts to arise. "It takes a lot of patience," Flack says, "because most of the time the animals aren't doing anything."

> "It's remarkable, all the dominant males have to do is approach the conflict and it breaks up."

Flack undertook this sometimes "gruelling" enterprise because she wanted to explain how fairly complex social interactions emerge among the macaques. She learned, for example, that over time a few monkeys gain dominant status through fighting.

"One of the most interesting behaviours is the policing function performed by some of these very powerful males," Flack says. "It's remarkable, because when a conflict erupts, all they have to do is approach the conflict and it breaks up; they usually don't have to show any aggression." Although this policing function manifests simply, it takes many complex interactions to build up.

Flack was especially fascinated by the way the animals created a social system with a set of rules that can be modelled. "These behaviours are learned by individuals," Flack says. "And social structures persist when these individuals are gone."

To find out how, Flack concentrated on aspects such as displays of aggression and signals of submission that seemed to build into a social network. For example, she saw that individuals who have lost a fight to another member will silently bare their teeth when approached by the past victor, in effect indicating 'I recognize that I am subordinate'. She also saw that active policing by a third party happened in only about 15% of conflicts — but that its potential had broad implications for social organization, including how individuals build their social networks.

Flack enjoyed observing the social interactions, despite the long hours. But the challenge was to go beyond observation into theory. To do so, she borrowed the idea of knocking out a gene from developmental genetics and instead disabled a behaviour, in this case, policing. She needed to turn a complicated set of interventions, status signalling and conflict-related behaviours into data that could be coded systematically and would be amenable to social-network analysis.

Once she had completed her observations, Flack moved to the Sante Fe Institute in New Mexico, where she focused asking what she calls "the robustness question" — in other words, how do these social behaviours persist over time?

"At first it wasn't clear what these data meant and what statistics were appropriate for this network," she says. But part of the satisfaction was cracking this problem and finding a set of mathematically sound rules that have implications for evolutionary biology.

Next, Flack plans to look at other rules of social organization in macaques in the hope of modelling interactions between larger groups. ■

QUANTIFIED **LOS ALAMOS**

A numerical perspective on *Nature* authors.
As part of the plasma physics group at Los Alamos National Laboratory in New Mexico, Manuel Hegelich looks after a research programme that uses a short-pulse laser. The working environment is fairly free-form, he says, and team members are encouraged to "follow their nose". But every three or four months, this freedom is curtailed as the team goes on an experimental run.

For up to six weeks, Hegelich and his group can use the main laser facility, and they work as many hours as they can. They spend all day with the technicians running experiments, and then stay behind to analyse the data after the technicians go home. On page 441, the group reports on the production of laser-driven high-energy ion beams with vastly reduced energy spreads compared with previous experiments.

29 submissions were made to *Nature* in the past six months came from Los Alamos National Laboratory.

45 scientists working at Los Alamos National Laboratory have reported original research in *Nature* in the past year.

$2.2 billion is the approximate annual budget for Los Alamos National Laboratory.

39.5 square miles is the area covered by Los Alamos National Laboratory.