Abstractions

LAST AUTHOR

Tamás Vicsek began his career as a statistical physicist, studying the collective behaviour of atoms. Later, Vicsek, now a professor at the Eötvös Loránd University in Budapest, Hungary, became intrigued by living systems such as colonies of bacteria. Analogous patterns, he notes, are present in the collective behaviour of many different kinds of systems, as long as the units within a given system are basically similar. Vicsek has extended this idea to people, modelling group panic and crowd dynamics. A few years ago, one of Vicsek's former graduate students, László Barabási, suggested they look at networks. On page 664, the pair, together with Gergely Palla, analyses a network that represents collaborations among 30,000 scientist authors over 12 years, and another network that represents mobile-phone calls among 4 million users over 2 years.

What spurred you to use phone records to study networks?

Mobile-phone calls reflected the level of individual communication in an unbiased way compared with information gained from questionnaires. The extremely large scale of the data collection opens a road to deeper understanding of everyday social processes. The data are completely anonymous and coded — and even the coded data can be provided only to researchers who sign an agreement to use it appropriately.

Why use collaborations between scientists to study networks?

Scientists document their co-authorships quite well and the data are easy to collect. Also, we figured that readers of *Nature* would be interested in these types of networks.

How did the networks evolve over time?

We looked at a 2-year time period for phone calls, and a 12-year period for scientist co-authors. Large groups within both types of network persisted longer if a portion of the membership constantly changed. But small groups were more stable when membership remained unchanged.

How do you hope to follow up on this work?

Our best hope is that other researchers will use our method and apply it to other data sets. We'd be happy to provide the software free of charge. Also, at this point, the nodes are studied only by their connection — the nodes themselves don't have any specific descriptive features. We'd like to complement the study with more information. For example, we could look at whether the social network groups among scientists in certain fields last longer than those in other fields. ■

MAKING THE PAPER

Ning Zheng

How an e-mail got a structural biologist hooked on plants.

Four years after becoming head of a lab at the University of Washington in Seattle, Ning Zheng received an e-mail that opened up a whole new area of research. Up to that point, Zheng had been studying the structure and function of mammalian ubiquitin ligases, a family of enzymes. Now he is immersed in the world of plants.

The message was from plant biologist Mark Estelle at Indiana University in Bloomington. In 2005, Estelle identified the cell receptor in plants for the important hormone auxin. This hormone regulates growth in response to various environmental cues, although the mechanism behind its action has proved elusive.

The receptor identified by Estelle, called TIR1, was similar to the ubiquitin ligases that Zheng had been studying. "Right away we wanted to work on this new enzyme," says Zheng. "But even before I wrote a message to Mark, I got an e-mail from him asking me to collaborate. I sent a response back within one minute: 'We are on board'."

The scientists wanted to find out how auxin binding to TIR1 activated the cascade of chemical responses in plants. Usually enzymes such as ubiquitin ligases bind proteins that have been tagged with some kind of molecular modification. But auxin is a relatively small molecule — how could it mediate this? To complicate matters further, there are many naturally occurring and synthetic auxins, and despite being chemically different, they all elicit the same response.

Zheng's group began by trying to work out the crystal structure of TIR1. But the team was surprised to find an electron-dense region in the centre of the protein. Puzzled, Zheng telephoned his father, a retired biochemistry professor in China, to ask for advice. His father suggested that an inositol phosphate molecule might explain the structure and act as a co-factor for the enzyme's activity. Zheng confirmed the hunch using mass spectrometry, performed by researchers at the University of Cambridge, UK, earning his father a place in the list of authors on the paper on page 640 of this issue.

With this puzzle solved, the researchers went on to obtain the first glimpse of TIR1 bound to auxin. They found that TIR1 has a cavity on its surface and that by filling the cavity, auxin acts like a 'molecular glue' for TIR1 to bind tightly to its substrates.

Zheng's group went on to determine the structure of TIR1 bound to a number of different auxin analogues. In each case, the small molecules fit snugly into TIR1's pocket. "That explains why different molecules have the same effect," says Zheng. "Anything that you can fit into that cavity between receptor and substrate will work to enhance their affinity."

The finding has implications for drug discovery. Traditionally, scientists have tried to synthesize small molecules that inhibit interactions among proteins as a way of treating disease. But such approaches have had limited success. "It may be more feasible to use small molecules to promote interactions," says Zheng, who now plans to test this idea. He also hopes to determine the structure of another plant hormone bound to its receptor. "I am totally into plants now," he says. "I had ignored plant biology during graduate school and my postdoc, but now I am surrounded by plant-biology textbooks and papers." ■

KEY INSIGHT

As a graduate student in Germany, Ulrich Wortmann collected rock samples in the Bavarian Alps. Little did he know that these rocks would one day help him solve a geochemical mystery.

Now based at the University of Toronto in Canada, Wortmann has studied the marine system that converts organic matter and sulphur, burying them as sediments in the sea floor.

In today's oceans, the burial rates of organic matter and sulphur are interrelated. But 120 million years ago, in the Early Cretaceous period, data suggest that this was not the case — a phenomenon that had never been satisfactorily explained.

Analysing his alpine rock samples, which in the Early Cretaceous would have been part of the sea floor, Wortmann saw that there was a time when the amount of sulphur buried in the sea bed fell to almost zero.

This, he argues on page 654, coincided with the emergence of the South Atlantic ocean basin. The massive gypsum deposits that formed on the new shores of Africa and South America removed sulphur from the oceans — leaving little to be buried and so apparently disrupting the carbon–sulphur relationship. "I was only able to do this work because I have a background in seemingly unrelated fields such as plate tectonics, Cretaceous carbon cycling and biosphere research," says Wortmann. ■