Abstractions

SECOND AUTHOR
Understanding the nature and origin of asteroids that pass by — and occasionally hit — Earth may help us to identify future impact threats. Richard Binzel, a planetary scientist at Massachusetts Institute of Technology (MIT) in Cambridge, and his colleagues match meteorites (objects that fall to Earth from space) to their asteroid origin on the basis of their mineral compositions. Surprisingly, the authors find that near-Earth asteroids are most similar to a rare class of meteorites (see page 858). Binzel tells *Nature* more.

How did your approach evolve?
Three years ago, my co-authors and I started a joint programme between MIT and the University of Hawaii using NASA's InfraRed Telescope Facility to observe near-Earth asteroids one or two nights per month. Measurement of each object's near-infrared spectra gave clues to its mineralogy, but we needed a way to quantify the underlying mineral chemistry. Pierre Vernazza developed a model to determine the percentages of common minerals, such as olivine and pyroxene, in meteorites for his PhD dissertation. We challenged his model to decode the chemistry of known meteorites. It did so well that we adopted it for decoding asteroid fingerprints.

How did you explain your results?
Using this telescope, we can check the composition of bigger asteroids — those about 1 kilometre in size. Meteorite samples are typically only about 1 metre in size. Despite this difference, we expected the mineral composition of near-Earth asteroids to match the bulk of meteorites. But we found they best matched a class that represents only 8% of meteorites, which probably originate from the inner edge of the asteroid belt. So how do small meteorites from elsewhere in the asteroid belt reach Earth? The Yarkovsky effect — a gentle force that results when an asteroid radiates the Sun's heat — can alter a small object's orbit over time, so could slowly nudge smaller asteroids from throughout the belt towards Earth. The effect is minor for large asteroids, so only those at the belt's inner edge have a good chance of reaching Earth.

Could this help us respond to potential problem asteroids?
We analysed the entire asteroid population, and also assessed potentially threatening objects, such as Apophis — a 300-metre-diameter asteroid that will first come close to Earth on 13 April 2029. By determining its meteorite class, we were able to establish its size, likely mass and energy in just a couple of days. These parameters help us estimate whether an object will reach Earth — the first step for any possible course of action. ■

MAKING THE PAPER

Carl Petersen

Neighbouring neuron recordings reflect behavioural changes.

It is more than 80 years since German psychiatrist Hans Berger first measured human brain activity using an early electroencephalograph that took electrode readings at the skull's surface. Since then, it has become possible to insert electrodes into the brain — and even, in animals, inside individual cells. But to establish the roles of single neurons in specific brain activities, such as sensory processing and behaviour, we need to be able to take concurrent readings from within neighbouring neurons in awake animals. Now, for the first time, two researchers in Switzerland have achieved just that.

Carl Petersen, a neurobiologist at the Swiss Federal Institute of Technology (EPFL) in Lausanne, set out to understand how information is processed by individual neurons, and how these cells communicate with one another. Using electrophysiological techniques that capture high-speed 'snapshots' of the electrical activity in single brain cells, Petersen and postdoc James Poulet succeeded in simultaneously recording the electrical activity inside pairs of neighbouring neurons in awake mice (see page 881).

By recording changes in the electrical potential difference that exists across each cell's membrane, the two were able to study the electrical correlations between neighbouring neurons when an animal changes its behaviour. They focused on the barrel cortex, a brain area responsible for processing tactile sensory information from the whiskers, during two different brain 'states': quiet and active. The active state was distinguished by 'whisking' — rapid, rhythmic waving of the whiskers back and forth — a feature of mouse exploratory behaviour. Whisking is akin to the way that humans visually scan or physically touch their environments, says Peterson, and experimental work has shown mouse whiskers to be as sensitive to touch and texture as human fingertips. Whisking ceases in mice that are in a quiet, relaxed state.

In mice in the quiet state, the membrane potentials recorded from neighbouring cell pairs swung dramatically in a slow, almost perfectly synchronized pattern. When the mice became active, the cells desynchronized and their electrical potentials fluctuated at higher frequencies. Petersen believes these results are analogous to electrical oscillations reported by Berger in 1929. He noted that humans relaxing with their eyes closed yielded patterns of slow, large-amplitude electrical waves, which disappeared upon eye opening.

Obtaining simultaneous recordings from two specific neurons in awake animals was technically challenging. A glass electrode had to be held perfectly still in cells just 10 micrometres wide. Petersen estimates that he and Poulet managed the feat about 5% of the time. To get the big picture of how every cell in the brain is involved in particular processes, Petersen says, "we somehow need to be able to measure from thousands or millions of cells at any given time, and that is going to be a big challenge."

But the ability to record from neighbouring cells is an important step, he says, because it will allow further enquiry into how cells respond in relation to one another as sensory information comes in. Petersen hopes that by piecing together information one small region at a time, he and his colleagues will turn up important clues about brain function. "In my lifetime, I don't think we'll understand how the whole thing works, but we may be able to understand very small, isolated circuits." ■

FROM THE BLOGOSPHERE

At the Seven Stones blog (http://tinyurl.com/5apjbw), Thomas Lemberger, an editor on *Molecular Systems Biology*, discusses work by James Evans of the University of Chicago in Illinois (*Science* **321,** 395–399; 2008) that shows how electronic publication has shifted citation patterns. Scientists now cite fewer papers overall, and tend to largely limit their citations to recently published work. This concentration on a smaller number of articles is hastening scientific consensus, with the implication that, as Evans writes, "Findings and ideas that do not become consensus quickly will be forgotten quickly."

Lemberger notes that Evans's study highlights two complementary strategies in information retrieval: finding relevant papers by targeted Internet searches versus staying informed on a broad range of topics by systematic browsing. He asks whether scientists are overlooking the importance of "good, old-fashioned table-of-content-skimming to stimulate cross-disciplinary thinking". The increasing efficiency of search engines, RSS feeds and aggregators is useful, but so is continuous exposure to diversity. ■

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