SPECIAL ISSUE: The Year in Science

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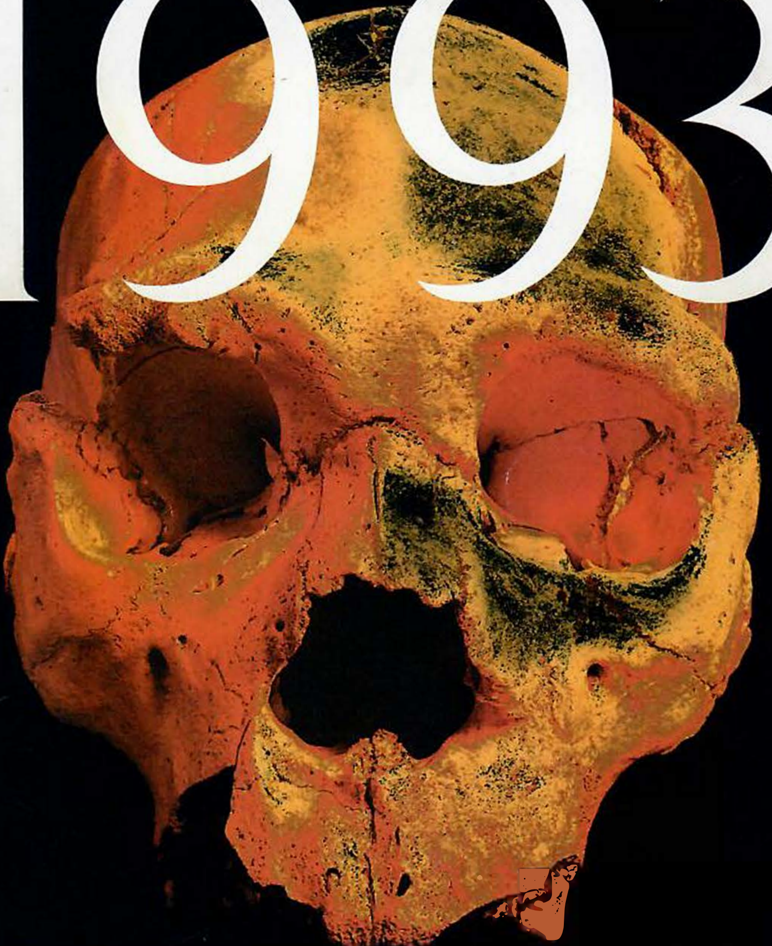
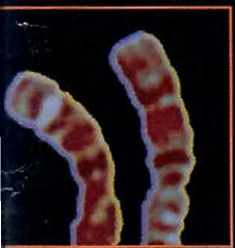


THE TOP 50 SCIENCE STORIES

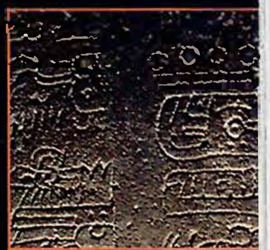
Supernova Missing Link



The Year in Genes

The First Reusable Rocket

Revenge of the Red Planet



Pre-Mayan Writing

Healing Power of Sharks

YEAR OF THE NEANDERTHALS
Did they really die out? Were they cannibals?

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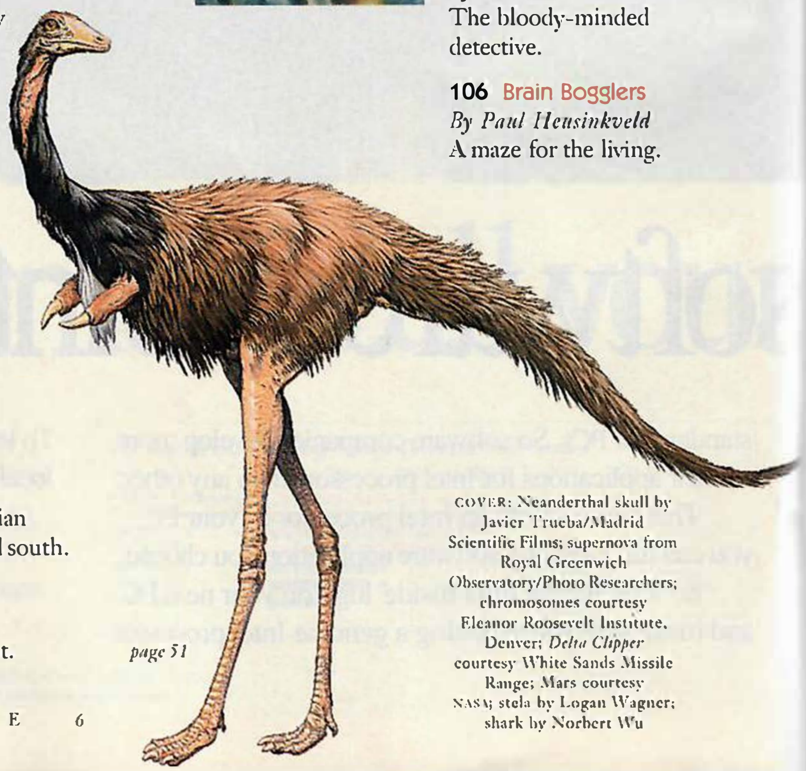
DEPARTMENTS



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COVER: Neanderthal skull by Javier Trueba/Madrid Scientific Films; supernova from Royal Greenwich Observatory/Photo Researchers; chromosomes courtesy Eleanor Roosevelt Institute, Denver; *Delta Clipper* courtesy White Sands Missile Range; Mars courtesy NASA; stela by Logan Wagner; shark by Norbert Wu

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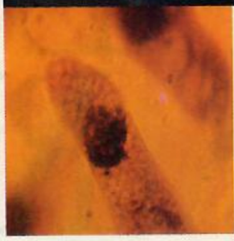
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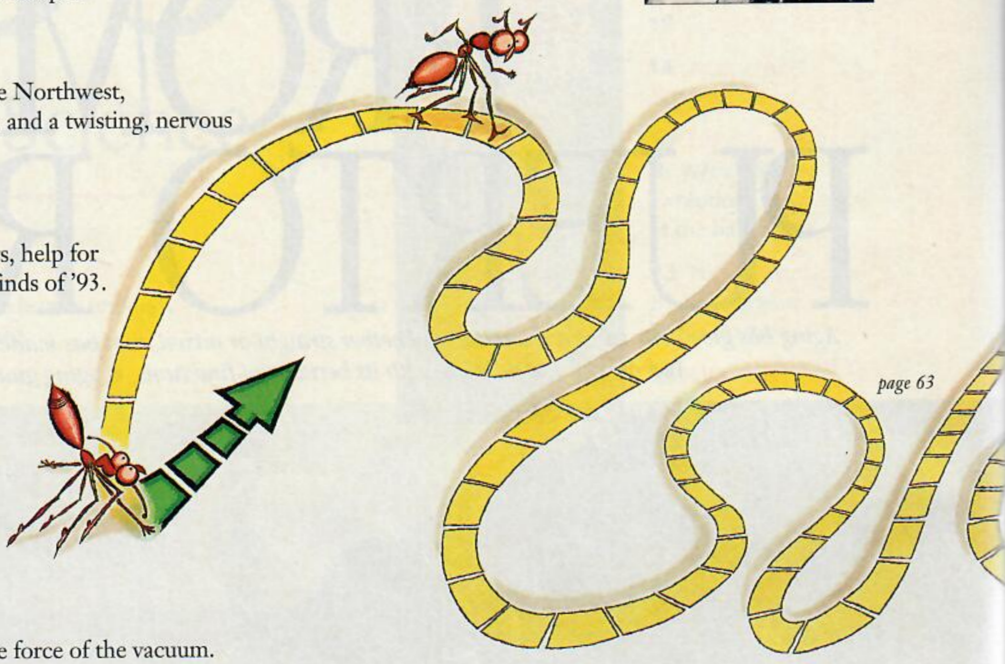
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The Year in Science

Ants and Their Antecedents

THE LEGENDARY PHYSICIST RICHARD FEYNMAN ONCE SPENT AN ENTIRE AFTERNOON WATCHING ANTS CRAWL AROUND HIS BATHTUB. HOW, HE WONDERED, COULD SUCH TINY CREATURES, who can see only a few inches ahead of themselves, march in such a straight line? To find an answer, young Feynman placed a clump of sugar at one end of the bathtub and waited for an ant to find it. As this pioneer ant returned home with news of the feast, Feynman used a colored pencil to follow its wiggly path. He then traced the path of each successive ant to follow the trail. The successive ants, he found, didn't stick exactly to the trail; they did better, cutting corners until the trail became a straight line. "It's something like sketching," Feynman observed in his autobiography, *"Surely You're Joking, Mr. Feynman!"* "You draw a lousy line at first; then you go over it a few times and it makes a nice line after a while."

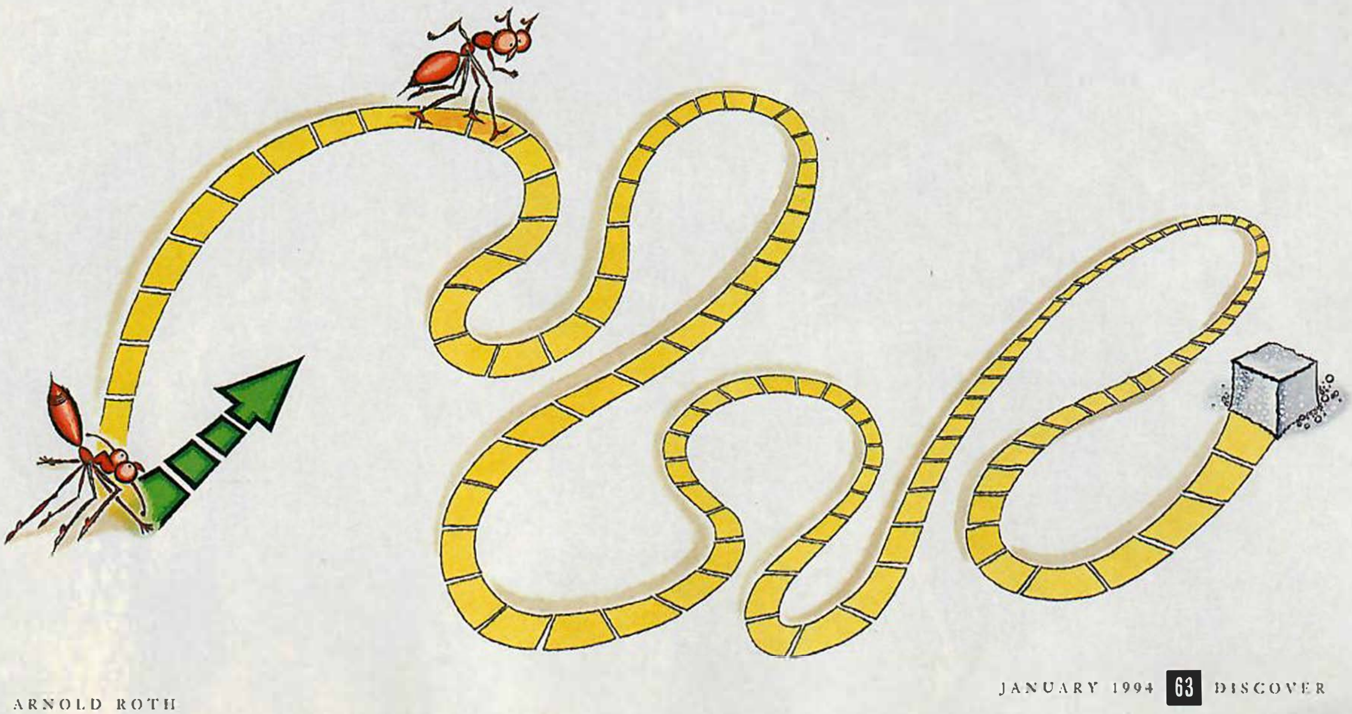
But these musings stayed just that until last spring, when Israeli computer scientist Alfred Bruckstein of the Technion in Haifa—inspired by Feynman—proved mathematically that successive followers really do make a wiggly line straight. Bruckstein considered an infinite number of idealized ants following one another toward a common goal (a clump of sugar, for instance). Each ant, he stipulated, heads directly toward its predecessor, no matter how winding the predecessor's path.

Since each ant makes a beeline toward its leader, Bruckstein reasoned, the distance between successive ants either stays the same or decreases. If the pioneer ant travels a straight path, its successor will follow the same straight line and—assuming all ants travel at the same speed—will remain a constant distance away. Any turns by the lead ant, however, allow its successor to cut a corner and narrow its following distance. Therefore, as successive ants follow each other, a winding path from point A to point B can only decrease in length. After a certain number of ants, the path length shrinks to some minimum value: to the shortest possible distance between two points—namely, a straight line.

"It's something like sketching. You draw a lousy line at first; then you go over it a few times and it makes a nice line after a while."

How do the real insects do it? "Well, they have these mathematician ants . . . just joking," says Carl Rettenmeyer, director of the Connecticut State Museum of Natural History and an ant expert. "They put down chemical trails. The first ant is very hesitant because it's following nothing—it's an explorer. So it puts down a wiggly trail. But the next ant coming along finds that trail, and it doesn't have to track it for the entire length. It will put down a chemical trail that is straighter than the initial one," and so on. In other words, Feynman and Bruckstein are right. But ant biologists have known that for a while, and the mathematical proof that what ants do really works will be of no great import to them.

It may be more useful in robotics; teaching a robot to navigate the shortest path around obstacles is a difficult and important problem. Instead of equipping a single robot with a complex navigation system, Bruckstein says, researchers may do better to build a swarm of simple robots that could forage for the best route and communicate their findings to one another. Bruckstein has even found biblical justification for seeing ants as robot role models, in Proverbs 6:6: "Go to the ant, thou sluggard; consider her ways, and be wise." —*Scott Faber*



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