PALEONTOLOGY

Earliest Animals Old Once More?

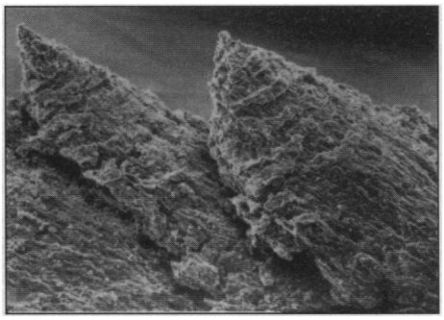
TORONTO—In the past month, the apparent age of the first known animals nearly doubled to a startling 1.1 billion years, then swung back to the conventional figure of 600 million years. And last week at the annual meeting here of the Geological Society of America, the pendulum swung one more time, back toward the extraordinarily early dates claimed a month ago. Paleontologists may have to reckon after all with signs of animals 500 million years earlier than the first known animal fossils.

The first dramatic claim came in the 2 October issue of *Science* (pp. 19 and 80), when researchers said they had found tracks of multicellular animals in 1.1-billion-year-old Indian rocks. Then, paleontologist Rafat Jamal Azmi of the Wadia Institute of Himalayan Geology in Dehra Dun, India, claimed in the *Journal of the Geological Society of India* that he had found tiny fossils, known to be from about 540 million years ago, in rocks just above the purported trace fossils. If so, the tracks might actually be only about 600 million years old (*Science*, 23 October, p. 627). Paleontologist Anshu K. Sinha, director of the Birbal Sahni Institute of Paleobotany in Lucknow, noted that Azmi's finds might be confused with certain kinds of sedimentary structure and that his work had not been replicated. But Sinha and other paleontologists who read Azmi's paper and studied scanning electron microscope (SEM) images of the finds concurred that they were indeed small, shelly fossils (*Science*, 23 October, p. 601).

In a question-and-answer session at the meeting, however, paleontologist Nicholas Butterfield of the University of Cambridge reported that after Azmi visited and gave him a look at actual samples, he believes they are not fossils at all but artifacts. "They're very convincing in black-and-white" SEM images, says Butterfield, "but they're absolutely not biogenic when seen in Technicolor" under a light microscope. Once he could view the objects from any angle and under varied lighting, Butterfield concluded that their ribbed structure was simply a reflection of fine layers in the rock itself. The texture of the rock plus the acid treatment Azmi used to extract any fossils apparently created the oddly shaped bits, Butterfield says.

Others also have doubts. Two other Cambridge experts in Cambrian fossils, Simon Conway Morris and Soren Jensen, studied the samples with Butterfield when Azmi visited Cambridge 2 weeks ago, and they agree that the bits are not fossils. Even one-time supporters, such as paleontologist Martin Brasier of the University of Oxford, who found the photographs persuasive but hasn't seen the samples themselves, now agrees that, based on the Cambridge experts' views, "it looks doubtful that they are convincing."

Azmi, however, stands by his find, saying that Conway Morris studied unpublished fossils rather than the examples cited in his recent paper. He says that Butterfield's "generalized statement" is "very confusing," because it does not address the issue "specimen by specimen." Azmi concludes: "There cannot be any doubt that these are fossils, for they are not artifacts."



In the eye of the beholder. Some say the regular pattern on bits of rock like these make them look like fossils, but others say they are only artifacts.

Even if this particular challenge to the claim of billion-year-old animal tracks may be fading, paleontologists at the meeting weren't quite ready to embrace such a startlingly ancient origin of animals. Some critics still aren't sure the tracks are those of living creatures. Confirming the age of the rocks may require new radiometric dates, which will take a few years to complete. The age of the first animals is—still—a question mark. —**RICHARD A. KERR**

With reporting from Pallava Bagla in India.

CATALYSIS

Chemical Accessories Give DNA New Talents

Cells have a strict division of labor: DNA conveys genetic information, while proteins run the chemistry of life. Teams of chemists and biologists are now working to bridge that division by creating hybrid molecules that tack the chemically active functional groups of proteins onto DNA's coiled backbone. The goal is to create molecules that are both chemically adept, like proteins, and easy to copy and vary, like DNA—properties that might enable researchers to "evolve" valuable new catalysts. But this elegant scheme faced a serious hurdle: The enzyme that copies DNA, called DNA polymerase, refused to play along, balking when it encountered a modified DNA building block.

Now two groups have managed to outwit the finicky enzymes, opening the door to a new family of DNA-based catalysts and raising questions of whether such molecular hybrids could have played a role in the evolution of life. In last week's *Angewandte Chemie, International Edition in English*, molecular biologists Kandasamy Sakthivel and Carlos Barbas III of The Scripps Research Institute in La Jolla, California, reported that adding a rigid chemical arm to the side of a DNA building block, or nucleotide, allowed them to tack on a wide variety of functional groups to the molecule. DNA chains containing the altered building block could still be copied by DNA polymerase. And at the American Chemical Society meeting in August, another team led by Steven Benner at the University of Florida, Gainesville, reported going one step further. They too found that specialized DNA polymerases could copy synthetic nucleotides adorned with functional groups. But they also showed that the DNA hybrids could take a first step toward doing chemistry, by binding avidly to a molecular target.

Although neither of the new experiments actually shows that hybrid DNA-protein molecules can catalyze chemical reactions, "they are getting very close," says Michael Famulok, a biochemist at Ludwig Maximilians University in Munich, Germany. And that's exciting, he adds, because it's far easier to generate enormous families of DNA chains, each one slightly different from the others, than it is to create libraries of related proteins. Such libraries are hunting grounds for new catalysts, says Bruce Eaton, a molecular evolution specialist at NeXstar Pharmaceuticals in Boulder, Colorado. "There's a chance to evolve new chemistries no one has ever seen before."

Researchers have long been generating large families of RNA and DNA chains to see if they could isolate individual ones that performed interesting chemistry. But DNA and RNA by themselves are "rather poor catalysts," says Barbas, because their nucleic acid backbones don't contain the diverse chemical groups needed to carry out a wide variety of reactions. Last year, Eaton and his colleagues improved RNA's catalytic abilities by, for example, modifying RNA bases to carry groups known as pyridines, which are well known for binding to catalytically active metals.

Barbas and Sakthivel wanted to see if they could do the same kind of thing with DNA, because it's more stable than RNA and even easier to replicate. But they had to get around the problem that DNA polymerases are far more finicky about copying modified bases than RNA polymerases are. The chemists thought that if they were careful to make each change away from the business end of each nucleotide—the part that faces its nucleotide counterpart on the com-

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