Brewing microscopic skeletons in a beaker

Zoom in on a drop of pond water and you'll see an extraordinary array of tiny, odd-shaped swimmers encased in intricately patterned outer skeletons. Scientists marvel at those forms, yet stumble in attempts to mimic them.

Now, Geoffrey A. Ozin and Scott Oliver, chemists at the University of Toronto, and their colleagues have found a way to synthesize tiny forms that resemble natural skeletons. They describe the process in the Nov. 2 NATURE.

Microorganisms such as diatoms and radiolaria grow the decorative, mineralized outer shells to protect their innards. These exoskeletons display features from 1 micrometer to more than 1 millimeter in size. Ozin's team has managed to synthesize "crystalline, lamellar aluminophosphate structures" on the same scale and with the same subtlety as those seen in nature.

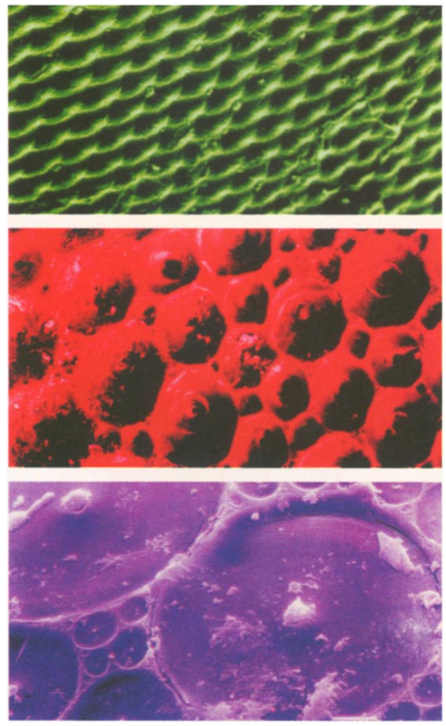
The approach uses both organic and inorganic compounds, which organize themselves into modular patterns on a plain surface. Tiny globules adhering to the growing form, Ozin says, help bowl-shaped textures to emerge. This process helps to minimize free energy on the structure's surface and fosters the accumulation of mineralized honeycomb patterns.

In explaining how the artificial biomineral patterns form, the scientists invoke principles used to describe the formation of natural mineral skeletons. In the case of radiolaria, one model of skeletal formation posits that organisms secrete silica into a network of "bubblelike alveoli." Ozin's group holds that its synthetic structures involve a similar mode of material deposition.

"This work is exciting on two fronts," says Charles T. Kresge, a chemist at the Mobil Strategic Research Center in Princeton, N.J. "There are the materials themselves and the method of synthesizing them." The technique suggests ways to make new catalysts and porous filtration materials, he adds.

Ozin says he found something missing from previous synthetic chemical approaches: "a fourth constructional stage of biomineralization, which controls shape on different scales."

In the 19th century, naturalists marveled at the diversity of nature's skeletal patterns, Ozin says. "Even then, they knew that closely packed cells, minimizing free energy, must create these patterns. The trouble is that no one could replicate this process in a laboratory.



Ozin and Oliver/NATURE

Synthetic forms resembling tiny skeletons display opaline (green), honeycomb (red), and bowl (purple) patterns.

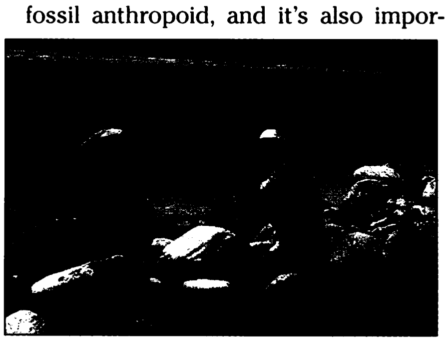
"But these results show that we can almost match nature in the process of turning living materials into stone," he adds, "like Medusa." — *R. Lipkin*

Asian fossils reveal primate evolution

Paleontologists would always like more time in the field, but K. Christopher Beard is really racing against the clock. In 2 years, a new dam will flood his field site along China's Yellow River, a location harboring secrets of the early evolution of anthropoids, the group of higher primates that includes monkeys, apes, and humans.

While working in central China's Yuanqu basin last May, Beard and his colleagues unearthed important new fossils of a small mammal called *Eosimias*. The finds demonstrate that *Eosimias* was an anthropoid and not a hedgehog, as some critics had once argued, Beard reported last week at the annual meeting of the Society of Vertebrate Paleontology in Pittsburgh.

"*Eosimias* is the earliest well-known fossil anthropoid, and it's also important because it is so primitive that it really is the only good evidence we have of what early anthropoids would have looked like," says Beard, a researcher at the Carnegie Museum of Natural History in Pittsburgh.



Beard

Sieving for fossils in the Yellow River.

Carnegie scientists and Chinese coworkers first identified *Eosimias* last year from two partial jaws and four teeth, all found in 45-million-year-old rocks in eastern China (SN: 4/16/94, p.245). This year, in the slightly younger rocks of the Yuanqu basin, they unearthed a complete lower jaw, with all its teeth in place, belonging to another species within the *Eosimias* genus.

Tiny in comparison to living simians, the mouse-size Chinese animal displayed several anthropoid characteristics. Like modern South American monkeys, *Eosimias* had small incisors and large canines. The back corner of its lower jaw was rounded along the bottom, as is the jaw of humans and other higher primates. *Eosimias* also had distinctive premolars and molars, Beard notes.

The Carnegie finds challenge current ideas about the evolution of higher primates. Elwyn L. Simons of Duke University in Durham, N.C., reported earlier this year that the oldest well-documented anthropoids come from 36-million-year-old rocks in Egypt, suggesting that such creatures arose in Africa not long before then (SN: 7/1/95, p.6).

But if higher primates were wandering around Chinese jungles 45 million years ago, anthropoids must have evolved much earlier, possibly in Asia, says Beard. The *Eosimias* fossils also suggest that early anthropoids developed from animals related to modern tarsiers and an extinct group called omomyids, he adds.

Other paleontologists hail the new Chinese fossils but question Beard's interpretation. "It certainly looks a lot more like a primate than what he had before. Whether it's an anthropoid ancestor or not, I'm not sure," says Gregg F. Gunnell of the University of Michigan in Ann Arbor. "What's missing is we still don't have a skull. Without a skull it's going to be hard to say."

Gunnell also disputes the idea that higher primates are closely related to omomyids. Instead, he finds evidence that anthropoids share closer bonds with lemurlike creatures called adapids.

Although Beard's ideas remain controversial, the new finds underscore the great potential of future finds in China and nearby countries, says Duke's Richard F. Kay. "There is a whole evolutionary history of primates that's virtually undocumented in Asia." — *R. Monastersky*