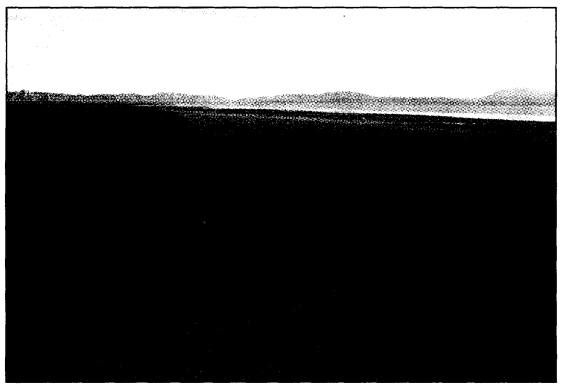


Molecular herbarium. Specific plant-leaf molecules preserved in the bottom muds of this Mexican lake recorded a shift toward grasses since the last ice age.

predominance of C_3 plants, according to the carbon isotopic analysis of leaf wax hydrocarbons. But after the end of the last ice age, weather patterns shifted, the lake level fell—reflecting a drying of the region—and C_4 plants such as grasses came to predominate.

More than 2000 kilometers to the southeast, under the same declining CO_2 levels, the postglacial weather shift tended to make the region around Lake Quexil in Guatemala wetter rather than drier. As the region moistened, the C_3 plants that had held a slight edge over C_4 grasses rose to an "overwhelming predominance," according to Huang and his colleagues. The two sites experienced the same change in CO_2 levels, but the C_4 pathway that gives an advantage to grasses under low CO_2 levels can also give them an edge in a drier climate, which turned out to be decisive at the drying Alta Babícora.

Huang extrapolates from the important role of climate 20,000 years ago to explain what might have happened in the Miocene 5 million to 20 million years ago. Although C_4 photosynthesis no doubt evolved in response to the long-term CO_2 decline during the past 100 million years, argues Huang, "to say CO_2 is the only driver [in the Miocene] for C_4 expansion is probably not correct. Low CO_2 [levels were] not enough. Aridity probably was also very important."

Geochemist Jay Quade of the University of Arizona in Tucson agrees that "CO_2 is not the only explanation" for the Miocene shift to C_4 grasses. Quade was one of the authors of the 1997 *Nature* paper by geochemist Thure Cerling of the University of Utah in Salt Lake City and colleagues that proposed the CO_2 decline as the proximate cause of the global expansion of C_4 grasses. The postglacial shifts found by Huang and colleagues are "pretty robust," Quade says, and they stress "the complexity of the control" of C_3 or C_4 dominance. Whether climate or CO_2 is foremost "is a matter of emphasis," he says.

The complexity of other aspects of the grasslands story has increased lately as well. Paleoceanographer Mark Pagani of Colorado State University in Fort Collins points out that recent analyses of records of Miocene CO_2—his own study of marine organic matter as well as research on sedimentary boron and the abundance of fossil leaf pores—suggest that CO_2 levels were already low by the time of the Miocene and did not decline markedly during that epoch. And paleontologist Christine Janis of Brown says that her recent work with colleagues on the fossil record of mammals that browsed on C_3 vegetation versus those that grazed on C_4 grasses isn't consistent with the theory that the shift to C_4 grasses triggered a burst of mammal evolution, at least not in North America. Their analysis of the fossil record shows that the major shift from mostly browsers to mostly grazers had already occurred there by 10 million years ago, well before the sudden expansion of grasslands 8 million years ago.

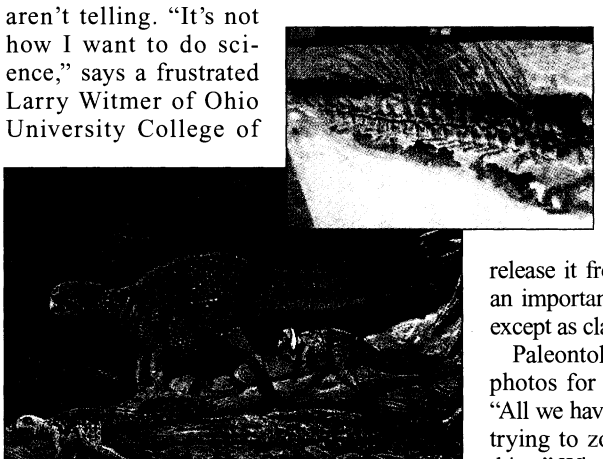
With atmospheric CO_2 levels now on the rise, such complexities could make it harder for scientists to predict which regions will have the greener pastures in the centuries to come. **–RICHARD A. KERR**

CREDIT: (TOP) S. METCALFE/UNIVERSITY OF EDINBURGH

SCIENCE ON THE INTERNET

Mysterious E-Photos Vex Paleontologists

A dinosaur with a strange, bristly tail set paleontologists abuzz last week after grainy photographs of the fossilized creature began crisscrossing the Internet. Scientists yearn to know more about the fossil—which may have been smuggled out of China—and examine the specimen firsthand. But the tantalizing e-mail attachment said nothing about its whereabouts, and the few who know aren't telling. "It's not how I want to do science," says a frustrated Larry Witmer of Ohio University College of Osteopathic Medicine in Athens.



Sneak preview. Unauthorized photos of mystery fossil (*top*) inspired illustrations of bristle-tailed psittacosaurs in a new book.

The beast in question is a psittacosaur, a primitive horned dinosaur that grew to between 1 and 2 meters long. What makes this specimen unique is a tuft of what look like long, hairlike filaments on the end of its muscular tail. The significance of the filaments is not clear, but at their most profound they might represent an ancestral characteristic of all dinosaurs. "If it's real it would be very unusual and interesting," says Luis Chiappe of the Natural History Museum of Los Angeles County.

Speculation began around 20 August, when Michael Schmidt, a fossil dealer in Edmonton, Alberta, forwarded color photos of the specimen to some members of the DINOSAUR Internet mailing list. Schmidt says he obtained the pictures from a partner in France who knows both the buyer and seller and who wants to remain anonymous.

Paleontologists are viewing the fossil cautiously in light of doctored specimens that have been illegally exported from China in the past, such as *Archaeoraptor* (*Science*, 22 December 2000, p. 2221). The psittacosaur appears to have come from western Liaoning Province in China, an area with a wealth of feathered dinosaurs and other exquisitely preserved fossils about 125 million years old (*Science*, 12 January, p. 232). Paleontologist Zhou Zhonghe of the Institute of Vertebrate Paleontology and Paleoanthropology in Beijing believes that the psittacosaur was smuggled out of China a few years ago. Apparently, the specimen was prepared in an Italian museum, but negotiations to return it to China broke down, Zhou says. It's now rumored to be in a German museum.

Probably because of its shadowy history, no researcher has formally described, or even announced, the specimen at a conference or in the literature. Photographs surfaced a few years ago at a meeting of the Society of Vertebrate Paleontology but were only shown discreetly to a few people in the hallways. One of the viewers, paleoartist Luis Rey of London, included the hairy tail in his illustrations of psittacosaurs in *Extreme Dinosaurs*, a book published this month. "I'm trying to call attention to this specimen, to see if we can release it from its jail," Rey says. "It's such an important specimen, and we can't see it except as clandestine material."

Paleontologists who are now seeing the photos for the first time are exasperated. "All we have are pixely JPEGs that we're all trying to zoom in on and not seeing anything," Witmer says. But until the mysterious fossil comes to light, he says, all he and his colleagues can do is try not to think about it.

–ERIK STOKSTAD