MEETING SOCIETY OF VERTEBRATE PALEONTOLOGY

Fossils Come to Life in Mexico

MEXICO CITY—New insights into ancient life came by land and sea at the 60th annual meeting of the Society of Vertebrate Paleontology, held here from 25 to 28 October. Stunningly preserved fossils from Mongolia continued to impress; biomechanical models were also big, including one that clocks the swimming speed of cruising ichthyosaurs.

More Family Life for Dinos

As a sandstorm howled about them, 15 *Protoceratops* hatchlings huddled in a nest. Suddenly, an onslaught of sand, perhaps from a collapsing dune, buried them alive. Uncovered more than 65 million years later at a dig in Mongolia, their tiny bones have given paleontologists the first evidence that this common herbivore cared for its young. Meanwhile, other Mongolian fossils suggest that a predatory dinosaur cited as a model parent may not have been so nurturing after all. Taken together, the new finds point to "radically different strategies" of dino parenting, says Hans-Dieter Sues, a paleontologist at the Royal Ontario Museum in Toronto.

The care of dinosaur young has fascinated scientists since the 1980s, when well-preserved nests discovered in Montana showed that duck-billed *Maiasaura* padded their nests with plants and carefully arranged the eggs to prevent them from rolling. The new report of the first known *Protoceratops* nest comes from a 1994 discovery by Narman Dakh of the Mongolian Paleontological Center in Ulaan Baatar, which David Weishampel, a paleontologist at the Johns Hopkins University School of Medicine in Baltimore, described for the first time at the meeting. The 15 skeletons, each just 16 centimeters long, lay belly down on one side of the nest. All had their heads facing away from the prevailing wind, as indicated by patterns in nearby fossil dunes. Weishampel believes that the young dinosaurs were siblings and were probably being cared for by an adult. "There certainly is a family life here," says Peter Dodson, a paleontologist at the University of Pennsylvania in Philadelphia.

Carnivores can be caregivers, too. In the past decade, paleontologists have found two striking examples: a pair of nests on which predatory *Oviraptor* mothers apparently died while brooding their eggs. At the meeting, Weishampel described hints that closely related dinosaurs, the oviraptorosaurs, may have become self-sufficient shortly after hatching. Three fossilized eggs from a Mongolian nesting site—also about 65 million years old—contain partial, articulated bones, he said. They are much more developed than bones from other oviraptorosaur embryos, and the type of tissue deposition indicates rapid growth. These facts suggest to Weishampel that when the dinosaurs hatched, they were relatively fully developed and may have been itching to leave the nest.

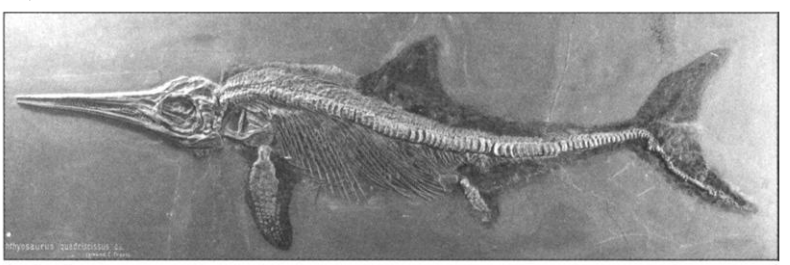
How Fast in the Water?

While dinosaurs roamed the Mesozoic land, equally exotic reptiles—ranging from long-necked plesiosaurs to huge, powerful lizards—swam the oceans. Their teeth and skeletons offer many clues to how they lived, but watertight estimates of their typical swimming speeds have been few and far between. At the meeting, paleontologist Ryosuke Motani of the Royal Ontario Museum in Toronto described a new method for calculating both the speed of sleek marine reptiles called ichthyosaurs and how energetic they must have been to achieve it. "The neat thing about this study is that it is the first opportunity to have an empirical estimate of potentially raised metabolism in this group," says Glenn Storrs of the Cincinnati Museum Center and the University of Cincinnati.

Motani became interested in the speed of ichthyosaurs last year while trying to figure out how deep the animals could dive. He thought they could stay submerged for about 20 minutes, judging from a correlation between body size and dive duration in modern swimmers. To know how deep they could go, though, he needed their typical speed. Clocking speed can be tricky for extinct land animals, because they could have walked in many different ways. For swimming creatures, however, the laws of hydrodynamics dictate that an animal's speed depends strongly on its shape. Because ichthyosaurs were shaped much like modern tuna, Motani conservatively estimated that they swam at tuna speed, about 1 meter per second. Thus, he calculated, they probably could have dived at least 500 meters.

To check his results, Motani developed a mathematical model that estimates the most efficient swimming speed from features of a fossil, such as the length of the animal and the shape and size of its tail fin. Then he tested the model on 12 species of whales, fishes, and other living marine swimmers. It correctly predicted their typical swimming speeds. Motani then plugged in the dimensions of an Early Jurassic ichthyosaur called *Stenopterygius*, one of a few fossils preserved with its tail fin intact. The model indicated that the roughly 2-meter-long ichthyosaurs would have swum most efficiently at speeds between 1.3 and 1.8 meters per second. That's on a par with tuna of the same size but slightly slower than whales, which have a different body plan.

Next, Motani compared his results with those of a model designed in 1988 by Judy Massare of the State University of New York, Brockport. Massare's model calculated the relative speeds of swimming animals from their size, shape, and metabolic rate—the last an unknown in the case of ichthyosaurs, of course. Motani fine-tuned the model and tried it with three different metabolic rates: an average of rates of modern marine mammals; an average for terrestrial reptiles; and an intermediate rate, like that of leatherback turtles and some tunas. The cruising speed for the turtle-and-tuna group matched the range of the ichthyosaurs, suggesting that the creatures had similar metabolisms.



Swift swimmer. Streamlined ichthyosaurs such as 2-meter-long *Stenopterygius* may have been as fast and powerful as modern tuna.

Ichthyosaurs needed a fast metabolism to propel their sleek, streamlined bodies to full speed, Storrs says. And compared with their modern land-dwelling cousins, adds David Norman of the University of Cambridge, United Kingdom, reptiles that spent their lives immersed in cold water would have required extra energy just to stay warm.

–ERIK STOKSTAD

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