Evolutionists Wing It With a New Fossil Bird

Sparrow-sized bird skeletons from an Early Cretaceous lake bed in China provide clues to the evolution of flight

MOST OF WHAT SCIENTISTS KNOW ABOUT THE origin of birds comes from *Archaeopteryx*, the 150-million-year-old fossil with its odd mix of reptilian and bird-like traits. But while *Archaeopteryx* provides a starting point, many subsequent steps in the evolution of birds have remained a mystery, because of the dearth of fossils from the following 50 million years.

A fossil find reported in this issue of *Science* (p. 845) sheds new light on those evolutionary steps, which transformed birds into strong, specialized flyers. Paul Sereno of the University of Chicago and his colleague Rao Chenggang of the Beijing Natural History Museum describe the fossilized skeletons of several sparrow-sized birds from a 135-million-year-old lake bed in China. The birds, dubbed *Sinornis*, for "Chinese bird," have many of the traits of modern birds while retaining certain primitive characteristics of *Archaeopteryx*, making them a missing link in bird evolution. "It's really fantastic," says Jacques Gauthier, an evolutionary biologist at the California Academy of Sciences in San Francisco who studies the origins of birds. "We are learning what happened between *Archaeopteryx* and modern birds."

Until recently, scientists trying to piece together the later steps in bird evolution had to rely on 100-million-year-old fossils of water-dwelling, flightless birds, a task Gauthier likens to "trying to figure out the origins of mammals when all you have is a bat and a whale." Besides leaving a gap of about 50 million years in the fossil record, Gauthier adds, those birds now appear to lie off the main ancestral line that led to modern birds.

Sinornis is not the first fossil bird to fill in the gap, but compared to the two other finds—in Spain and Mongolia—it is the most complete. "There is no question that this paper is the best character analysis of any of those early birds," says Joel Cracraft, an avian systematist at the University of Illinois, Chicago.

One thing *Sinornis* provides that the other birds do not is an early glimpse of a critical change in flight evolution: the transition from the primitive wing of *Archaeopteryx* to a specialized wing more like that possessed by modern birds. *Sinornis* is the only fossil bird of its period with intact hand bones, and they show that this transition was well under way just 15 million years after *Archaeopteryx* lived.

Sinornis had a modified wrist bone like that of modern birds, with a groove that let the wrist bend sharply back, so the wing could be tightly tucked in during flight or rest. And while *Archaeopteryx* had three long, claw-tipped fingers that apparently did double duty in flying and grasping prey, *Sinornis* had greatly reduced claws, and small hands with a sturdy middle finger, which served as the anchor for important flight feathers. *Sinornis'* fingerbones were separate, rather than fused together as they are in modern birds, but they were nevertheless well adapted for flight. "It's clear the forelimb is no longer playing any role in securing prey," says Gauthier, who has examined the fossil. "Flight has taken over."

Along with its new hands, *Sinornis* showed other body changes, not seen in *Archaeopteryx*, that adapted it for fully powered flight. These—which *Sinornis* shares with the Spanish and Mongolian birds—include a shortened body and tail, which would make flying easier; feet with an opposable toe in the ideal position for perching; and a breastbone and shoulder structure that provided both room and support for the bulky muscles and pulley-like tendon system that give modern birds their powerful wing strokes.

But as befits its transitional status, *Sinornis* also had some very primitive characteristics not seen in any fossil bird besides *Archaeopteryx*, including a dinosaur-like pubic bone and a full set of abdominal ribs that also hark back to its flightless ancestors. "This bird is very primitive," Sereno says, but "everything critical to the modern flying machine is there. The animal had moved from the ground-dwelling, dinosaur-like design of *Archaeopteryx*...to an animal that is predominantly arboreal and designed for powered flight. Meanwhile, everything else that was extra baggage hadn't had time to change."

As with most other aspects of bird evolution, however, the importance of the *Sinornis* find is controversial. Several paleontologists told *Science* that even though it is more complete than the Spanish and Mongolian birds, it doesn't add anything significant to what had already been learned from those early finds—namely that birds were strong flyers and tree-dwellers by the Early Cretaceous, 145 to 100 million years ago. But Sereno differs with that view, pointing to the wealth of information *Sinornis* provides about the intermediate steps in wing evolution. And Illinois' Cracraft concurs: "That's critical information," he says. "Slowly but surely we build up our understanding of early avian evolution with finds like this." ■ MARCIA BARINAGA

Missing link. Sinornis *anatomy suggests birds were well on their way to a modern lifestyle 135 million years ago, just 15 million years after* Archaeopteryx.

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