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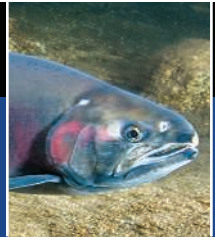

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PALEONTOLOGY

Bird-Dinosaur Link Firmed Up, And in Brilliant Technicolor

BEIJING—Which came first, the chicken or the dinosaur egg? That one's a cinch. Less obvious is the riddle of kinship. Most scientists think birds evolved from dinosaurs about 150 million years ago. But a sparse fossil record has provided ammunition to those who insist that birds arose independently. A stunning new fossil makes that idea virtually untenable. And a second paper this week brings dinosaur feathers vividly to life, offering new clues to why this instrument of flight first evolved in flightless creatures.

On page 571, fossil-hunter extraordinaire Xu Xing of the Institute of Vertebrate Paleontology and Paleoanthropology (IVPP) here and colleagues unveil *Haplocheirus sollers*, a new genus of alvarezsauroid—a group of dinosaurs once thought to be flightless birds. The nearly complete skeleton, unearthed from 160-million-year-old mudstone deposits in northwestern China's Junggar Basin, extends the fossil record of alvarezsauroids back in time by a whopping 63 million years—making it about 15 million years older than the earliest known bird, *Archaeopteryx*.

In 2006, specimens from another theropod group—tyrannosauroids—challenged the so-called temporal paradox: the fact that irrefutable birdlike dinosaurs appear millions of years after *Archaeopteryx* in the fossil record. (Among other birdlike features, tyrannosauroids sport three-toed feet, hollow bones, and even wishbones.) Along with those and other recent finds, *Haplocheirus* "establishes once and for all that there is no temporal paradox," asserts Hans-Dieter Sues, curator of vertebrate paleontology at the National Museum of Natural History in Washington, D.C.

The newest, oldest alvarezsauroid dispels some of the group's mystique. "Alvarezsauroids were collected for the first time in the 1920s but were so enigmatic that they were never recognized and described until the 1990s," says Philip Currie, a paleontologist at the University of Alberta in Edmonton, Canada. As specimens turned up in Asia, Europe, and North America, debate raged over whether they represented dinosaurs or flightless birds. *Haplocheirus* "definitely settles this dispute," Sues says. The exquisitely preserved specimen "is so primitive," says IVPP's Zhou Zhonghe, that it lacks some birdlike features seen in later alvarezsauroids such as fused wrist bones, a backward-facing pubis, or a crest near the top of the shinbone.

Birds of a feather. A new avianlike alvarezsauroid (*below*) predates the first bird, *Archaeopteryx*—powerful evidence that birds arose from dinosaurs. Fossilized pigment organelles reveal the true colors of *Sinosauropteryx* (*left*).

The controversy highlights how hard it can be to distinguish birds from dinosaurs. "Deep in evolutionary history, it's extremely difficult to draw the line," Xu says. The discovery of feathered dinosaurs in the late 1990s turned classification upside down.

Why feathers evolved in dinosaurs is a puzzle. One idea is that feathers provided insulation. Another is that they evolved as camouflage or to attract a mate. But evidence such as distinctive colors or patterns had eluded researchers—until now. This week in *Nature*, paleontologist Mike Benton of the University of Bristol in the United Kingdom and colleagues offer the first report of organelles bearing the pigment melanin in dinosaurs. They found melanosomes in the theropods *Sinornithosaurus* and *Sinosauropteryx* and in a bird, *Confuciusornis*, that lived roughly 125 million years ago.

Although many scientists expected dinosaur feathers to contain melanosomes, finding them wasn't easy. In Benton's lab in Bristol, IVPP's Zhang Fucheng says he "spent day and night for more than a year" studying scanning electron microscope images of scores of fossil specimens. Zhang's diligence paid off—he uncovered melanosomes containing the two most common kinds of the pigment: eumelanin, which gives a gray or black tinge, and pheomelanin, which gives a chestnut to reddish-brown color. The find could settle a debate over whether bristles studding *Sinosauropteryx* were primitive feathers or collagen fibers. "Melanosomes prove that those structures are indeed feathers," Benton asserts.

The discovery also reveals the true colors of dinosaurs. *Sinosauropteryx*'s protofeathers ran in alternating orange and white rings down its tail like a barbershop pole. To Benton, the vibrant pattern suggests that "feathers first arose as agents for color display and only later in their evolutionary history did they become useful for flight and insulation." Others are not so sure. Zhou, a co-author of the *Nature* paper, still thinks feathers evolved for insulation.

To Xu, the mystery has deepened. "Now we are realizing that feather evolution is more complex than we thought," he says.

–RICHARD STONE

Published by AAAS