PALEONTOLOGY

Argentine Dinos Vie for Heavyweight Titles

PLAZA HUINCUL, ARGENTINA—"I work with the biggest dinosaurs in the smallest museum," paleontologist Rodolfo Coria likes to say. Coria may be exaggerating slightly about the size of the municipal museum in this little town in northern Patagonia, but he isn't kidding about the bones that crowd the halls there: They're the size of small refrigerators. These seven vertebrae belonged to *Argentinosaurus*, a long-necked vegetarian dinosaur, or sauropod, that may have outweighed other giants by 40 metric tons. Move over, *Seismosaurus*, *Supersaurus*, and *Ultrasaurus*, contenders from the American West. *Argentinosaurus*, which lived 100 million years ago in the middle of the Cretaceous period, could be the new dinosaur heavyweight champion.

"*Argentinosaurus* is unquestionably the largest sauropod for which we have good material," says paleontologist Thomas Holtz of the U.S. Geological Survey in Reston, Virginia, who discussed it with Coria at the October meeting of the Society of Vertebrate Paleontology in Seattle. Not everyone is ready to grant this new contender the crown, though; David Gillette of the Utah Geological Survey thinks it was probably no heavier than the American ground-shakers. And sauropod specialist John McIntosh of Wesleyan University in Middletown, Connecticut, points out that estimating size and weight from incomplete skeletons always involves "lots of if's, and's, and but's."

But there's no doubt, McIntosh allows, "that [*Argentinosaurus*] is a very, very large animal." Along with the bones of another giant that are crammed into Coria's hallways—an unnamed meat-eater, or theropod, that may be big enough to dethrone *Tyrannosaurus rex* as king of the carnivores—it raises a lot of questions about dinosaur size. Paleontologists wonder how such huge creatures found enough to eat, cooled their bodies, and coped with the force of gravity.

Argentinosaurus, which has been excavated since the late 1980s by Coria and José Bonaparte of the Museum of Natural History in Buenos Aires, was a titanosaurian, a type of sauropod that flourished in South America during the Cretaceous period. By comparing the dimensions of the fossils with those of the matching bones in more complete titanosaurian skeletons, Bonaparte and Coria estimate that the creature had a hind limb 4.5 meters long and measured 7 meters from shoulder to hip. Add a tail and neck of the usual (titanosaurian) proportions, and *Argentinosaurus* would have been some 30 meters long.

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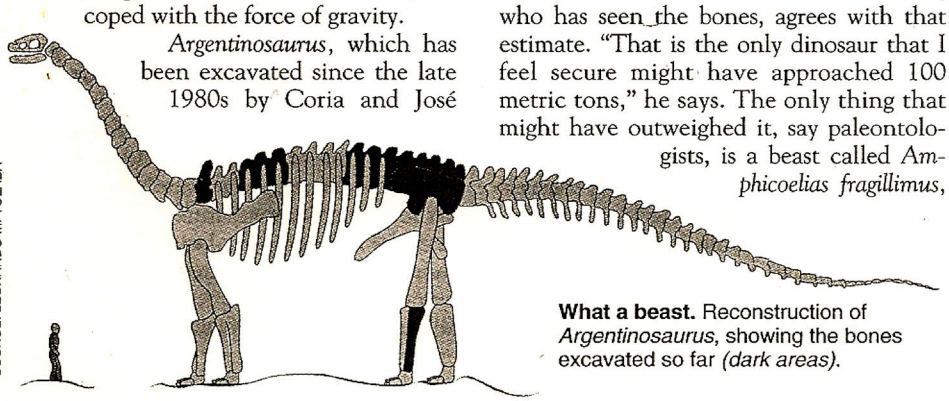
Showing some spine. Vertebrae of *Argentinosaurus*, the largest a meter and a half high.

There are longer dinosaurs, but perhaps no heavier ones. One sauropod from New Mexico, called *Seismosaurus*, may have measured 40 meters or more from tip to tail. But it was long and lean—as dinosaurs go. Gillette, its discoverer, estimates that *Seismosaurus* probably weighed between 40 and 80 tons. *Argentinosaurus*, shorter but stockier, probably matched *Seismosaurus* in weight, he says.

But Gregory Paul, a respected dinosaur illustrator in Baltimore who has made systematic estimates of the largest dinosaurs' size and weight, thinks the difference in build tips the scales decisively in favor of *Argentinosaurus*. He puts its weight at between 80 and 100 tons—heavier than two fully loaded semi trucks. Paleontologist Dale Russell of the Canadian Museum of Nature in Ottawa, who has seen the bones, agrees with that estimate. "That is the only dinosaur that I feel secure might have approached 100 metric tons," he says. The only thing that might have outweighed it, say paleontologists, is a beast called *Amphicoelias fragillimus*, known only from a single titanic vertebra discovered more than 100 years ago in Colorado (and now lost).



SOURCE: LEONARDO M. TOLABA

What a beast. Reconstruction of *Argentinosaurus*, showing the bones excavated so far *(dark areas)*.

The other new Patagonian monster is also a claimant for a heavyweight title, in this case going up against "Sue," a giant *T. rex* from South Dakota, for the carnivore title. Sue probably measured 15 meters and weighed seven tons. The bones of the new theropod, excavated last year from a 110-million-year-old deposit by Coria and Leonardo Salgado of the University of Comahue in the nearby city of Neuquén, include a thigh bone and an upper jaw that are a few centimeters longer than matching bones of the South Dakota behemoth. But because this theropod belonged to a different lineage than Sue and had a heavier build, says Holtz, a theropod specialist, "I would expect this animal may have been several tons heavier than Sue."

But whether the animal is truly the biggest or merely very big, its dimensions raise sizable questions. One is about the metabolism that could have sustained such a giant. For two decades, researchers have been wrangling over whether dinosaurs were warm- or cold-blooded. The warm-blooded, or endothermic, view gained support 2 years ago, when an analysis of oxygen isotopes in the bones of several dinosaurs, including a tyrannosaur, implied that these creatures kept their extremities nearly as warm as their body cores—a hallmark of warm-bloodedness.

But James Farlow of Indiana University–Purdue argues that a warm-blooded giant would have needed an implausible amount of food. If giant theropods had food requirements resembling those of large mammalian predators, he says, the total population would have been so small that chance events could easily have wiped it out. "I don't see how they could have attained these large body sizes and been endothermic," he says. Peter Dodson of the University of Pennsylvania has reached a similar conclusion for the giant sauropods, although his reasoning is different. Larger animals have a harder time shedding internal heat, he explains, and an animal the size of a giant sauropod that had a mammalian metabolism would have baked itself from the inside out.

Whatever metabolic style these dinosaurs had, it will not explain the evolutionary pressures that drove them to get so big. Nor will it explain how they solved the bioengineering problems posed by enormous size. How did a creature as big as *Argentinosaurus* pump blood up to its lofty head, for example? "When you get to the really giant ones," Dodson says, "you can only scratch your head in wonderment." Coria's South American contenders are not just pushing the limits of his hallway space—they're also testing the limits of scientific explanation.

–Tim Appenzeller