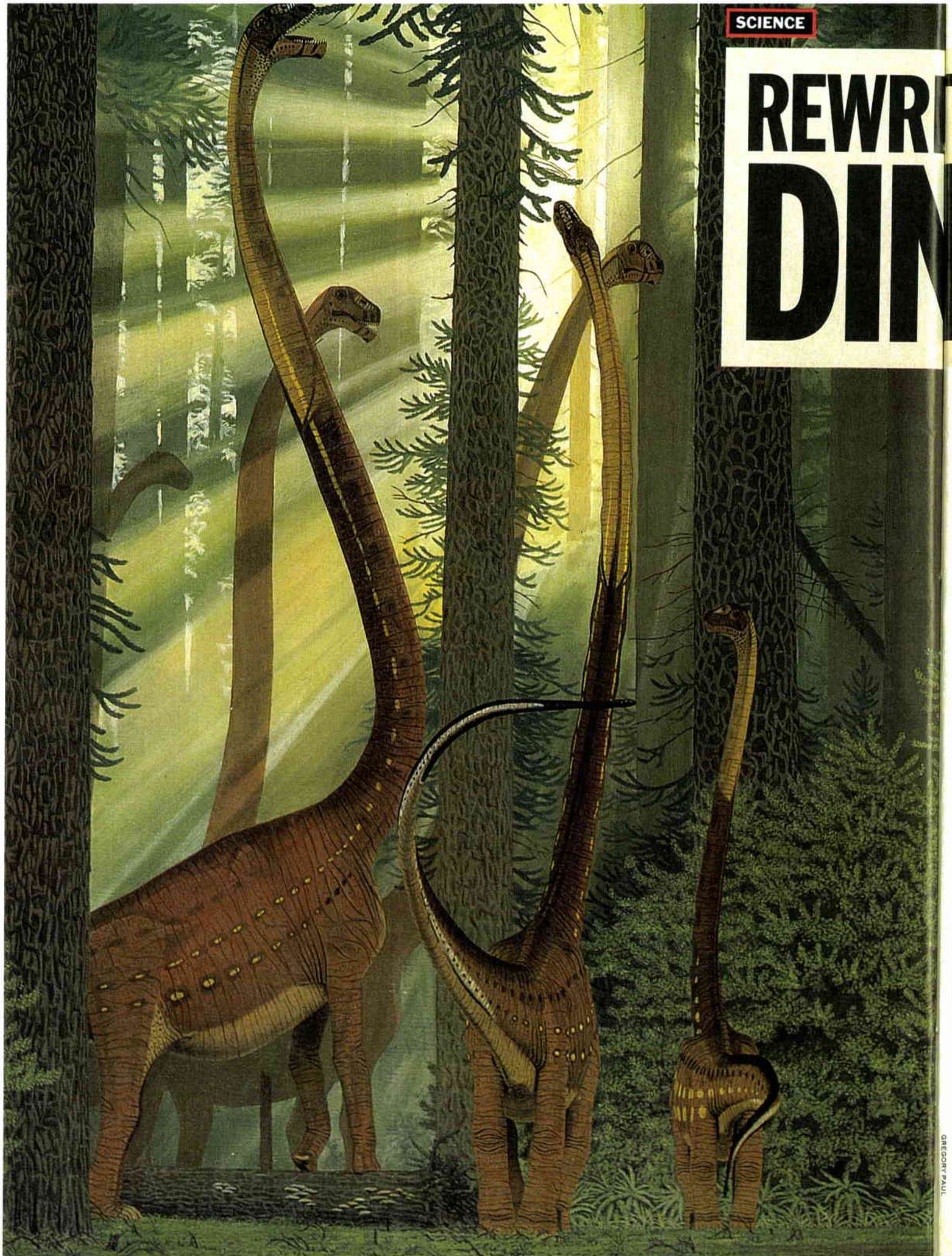


SCIENCE

REWRITING DINOSAUR



TING THE BOOK ON DINOSAURS

Forget what you knew: they weren't necessarily cold-blooded or pea-brained, and may not really be extinct

By MICHAEL D. LEMONICK

A COOL AND MISTY DAWN, CIRCA 78 million B.C. A lone triceratops interrupts a leisurely meal of ferns and twigs to glance around uneasily. Though the 11-ton creature is an intellectual lightweight, it senses the danger lurking in the surrounding forest. Suddenly, out from behind a tree lumbers one of the largest and fiercest carnivores that have ever lived: *Tyrannosaurus rex*. Although this beast is a mere adolescent, it is 15 ft. tall and armed with dagger-sharp teeth. The triceratops attempts a retreat, but the cold-blooded creature can only move slowly. It is too soon after sunrise, and the dinosaur hasn't had time to absorb the heat it needs to rouse its sluggish metabolism. While *T. rex* has the same problem, its longer legs enable it to quickly overtake the docile herbivore. And then...

Wait! Time out! There is something wrong with this picture. Nearly everything, in fact. Two decades ago, paleontologists might have signed off on such a scenario, but not today. An avalanche of new evidence—from fossilized bones, dinosaur nests, eggs and even footprints, analyzed with such high-tech equipment as CAT scans and computers—has completely transformed scientific thinking about dinosaurs. *Triceratops* and other herbivores were not necessarily dull-witted, nor did they wander around alone; they probably traveled in vast herds and went on annual migrations. They may have cared for their young, and perhaps cooperated with one another to protect them from predators. Predators too were social. All but the oldest and biggest tyranno-

EVOLUTIONARY STRETCH: China's long-necked *Omeisaurus*, left, is cousin, hundreds of times removed, to the European *Plateosaurus*, right

saurus traveled in packs and attacked like prowling wolves, as did most of the smaller and nastier predators. (Despite popular belief, *Tyrannosaurus* was not necessarily the most vicious.)

Dinosaurs probably weren't cold-blooded either. They could move along briskly, even in cool weather; some lived above the Arctic Circle, where the sun never rises in winter. Rather than a uniform dull green, they could easily have been striped, spotted and brilliantly colored. Even the idea that all the dinosaurs died out 65 million years ago is now passé. Many experts believe that one resilient line is still flourishing today. The common name for these modern dinosaurs: birds. Observes Mark Norell, a paleontologist at the American Museum of Natural History in New York City: "Birds are more closely related to *Tyrannosaurus rex* than *Tyrannosaurus* is to almost any dinosaur you've ever heard of."



This rewriting of conventional wisdom has accelerated in the past 10 years. New fossil beds have been found and old ones re-discovered in the Gobi Desert, along the ancient Silk Road in the mountains of China, on the margin of the Argentine Andes and in the jungles of Laos and Thailand. Despite the remarkably small number of scientists working in the field—only about 100 worldwide, splitting a meager \$1 million in research funds—a new dinosaur species is found on average every seven weeks.

Surprises crop up constantly. The latest: a new species from Mongolia, announced last week by Norell and several U.S. and Mongolian scientists. Known as *Mononychus* (meaning one claw), the turkey-size animal looked like a modern, flightless bird, complete with feathers, but had bone structures characteristic of both birds and dinosaurs. Its discovery cements the bird-dinosaur link even more firmly.

Thanks largely to the explosion of information, dinosaurs are more popular than ever—if that's possible. In light of the new insights, museums around the world are revamping musty exhibits or installing new ones. They are rearranging the old stilted skeletons on display into new dynamic poses and adding such modern attractions as robotic dinos and interactive computer games. Dinosaur theme parks are booming, while toy stores overflow with stuffed stegosauruses, dinosaur puzzles and models, not to mention the omnipresent videosaurus Barney. And early in June, dino-mania will reach fever pitch with the premiere of Steven Spielberg's long-awaited movie version of the Michael Crichton thriller *Jurassic Park*. (See following story.)

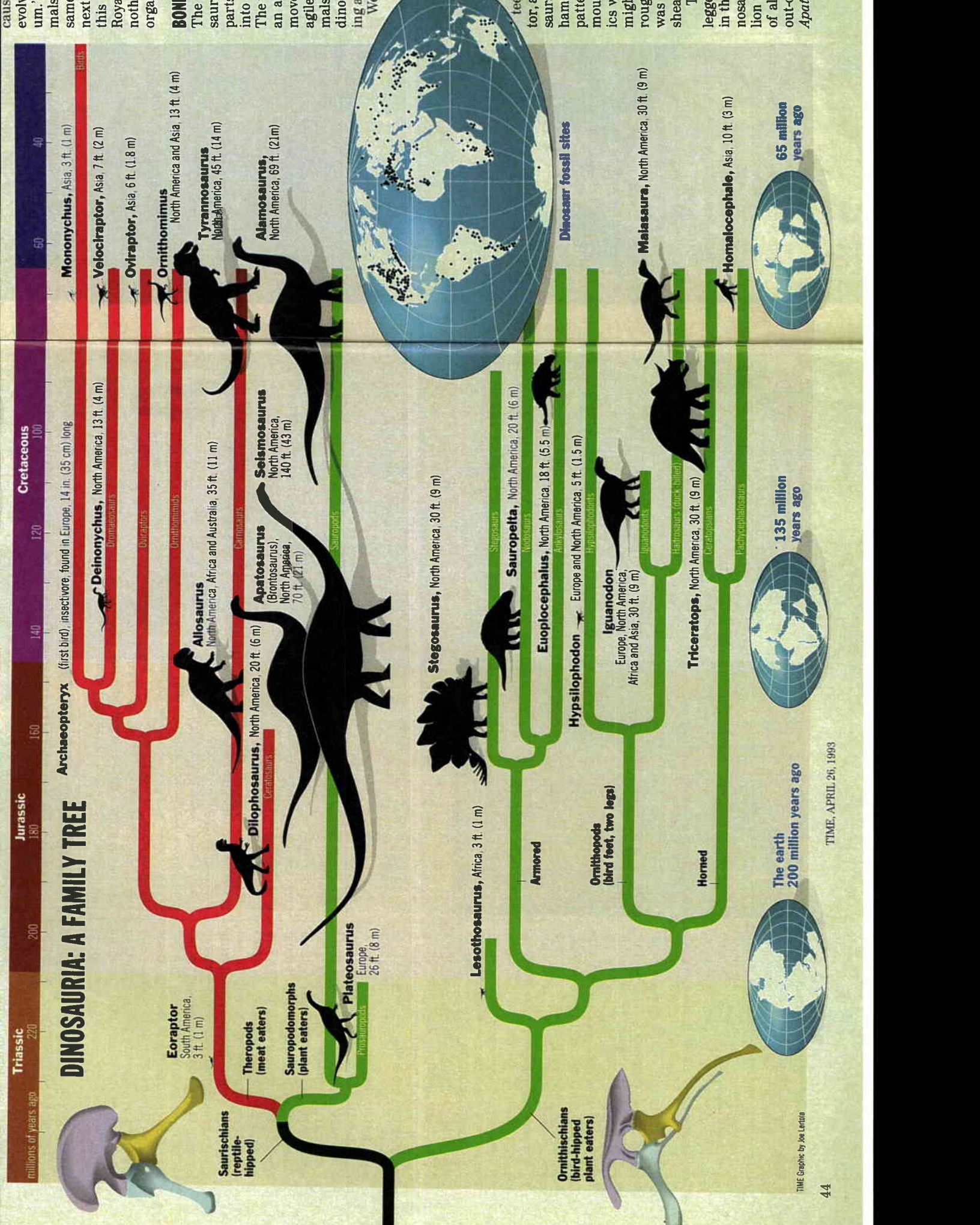
The rage for dinosaurs is hardly new. The British anatomist Richard Owen first coined the term dinosaur (from the ancient Greek *deinos*, "terrible," and *sauros*, "lizard") in 1841 to characterize gigantic fossilized bones found several decades earlier. Dinosaur bones and footprints had actually been known for centuries, but were ascribed to dragons or extinct lizards or even giant ravens. Owen realized that these enormous bones belonged to a previously unknown and long-extinct group of animals related to but different from lizards. Dinosaurs became an immediate rage in London. An 1854 exhibition at Hyde Park's Crystal Palace featured a number of life-size dinosaur models that drew throngs of admirers.

The early dinosaur experts were hampered, however, by a shortage of fossils, and they made egregious mistakes about what the creatures looked like. Owen believed, for example, that *Iguanodon*, a grazing beast some 30 ft. in length, was built something like a hippopotamus, with a small, sharp horn on its nose. Half a centu-

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DINOSAURIA: A FAMILY TREE

Archaeopteryx (first bird), insectivore, found in Europe, 14 in. (35 cm) long.

Eoraptor
South America,
3 ft. (1 m)

Theropods
(meat eaters)

Sauropodomorphs
(plant eaters)

Plateosaurus
Europe,
26 ft. (8 m)

Allosaurus
North America, Africa and Australia, 35 ft. (11 m)

Dilophosaurus, North America, 20 ft. (6 m)

Apatosaurus
(Brontosaurus),
North America,
70 ft. (21 m)

Seismosaurus
North America,
140 ft. (43 m)

Ornithomimus
North America and Asia, 13 ft. (4 m)

Tyrannosaurus
North America, 45 ft. (14 m)

Alamosaurus,
North America, 69 ft. (21m)

Stegosaurus, North America, 30 ft. (9 m)

Lesothosaurus, Africa, 3 ft. (1 m)

Armored

Ornithopods
(bird feet, two legs)

Horned

The earth
200 million years ago

TIME, APRIL 26, 1993

Mononychus, Asia, 3 ft. (1 m)

Velociraptor, Asia, 7 ft. (2 m)

Oviraptor, Asia, 6 ft. (1.8 m)

Sauropelta, North America, 20 ft. (6 m)

Sauropelta, North America, 20 ft. (6 m)

Euoplocephalus, North America, 18 ft. (5.5 m)

Hypsilophodon Europe and North America, 5 ft. (1.5 m)

Iguanodon
Europe, North America,
Africa and Asia, 30 ft. (9 m)

Triceratops, North America, 30 ft. (9 m)

135 million
years ago

Maiaasaura, North America, 30 ft. (9 m)

Homalocephale, Asia, 10 ft. (3 m)

65 million
years ago

ry later, scientists decided the creature was shaped more like a kangaroo and the horn was really a misplaced claw that belonged on its forefoot. Now they think it was probably four-footed after all.

Despite all the fossils unearthed since then, scientists are still working with spotty information. "We probably don't even know 1% of all the species," admits Jack Horner, curator of paleontology at the Museum of the Rockies in Bozeman, Montana. Yet they have made tremendous progress in understanding how dinosaurs evolved, how they came to dominate the world for an incomprehensibly long 165 million years (humans, by contrast, have been around fewer than 4 million), how they lived and behaved, and how they finally passed into history.

THE RISE OF DINOSAURS

During the Triassic period—say, 225 million years ago—it would have seemed absurd to suggest that dinosaurs would soon inherit the earth. At the time, they were inconsequential creatures, perhaps the size of dogs, living among far more imposing giant crocodiles and other reptiles. During Triassic times, the continents were stuck together in a single mass that scientists call Pangaea. The planet was warmer and rainier than it is today—ideal conditions for the growth of vast forests along coastlines and adjacent to rivers. Conifers, horsetails, tree ferns and ginkgos were the dominant vegetation. Giant 3-ft. dragonflies whirred through the air, and 18-in. cockroaches scuttled along the forest floor. The seas teemed with mol-

lusks, algae and large marine reptiles.

No one knows what the very first true dinosaur looked like, but a young paleontologist named Paul Sereno of the University of Chicago has come closer than anyone else to finding out. In 1991, working with Argentine scientists in Ischigualasto Provincial Park at the edge of the Andes, he unearthed one of the oldest dinosaur fossils ever found. The animal, now known as *Eoraptor*, was a carnivore that dates from 230 million years ago. Like the much later *Tyrannosaurus*, the *Eoraptor* belonged to the saurischian, or lizard-hipped, category of dinosaurs. (The name refers to the arrangement of its pelvic bones; the other category of dinosaurs, which includes *Stegosaurus* and other herbivores, is labeled ornithischian, or bird-

