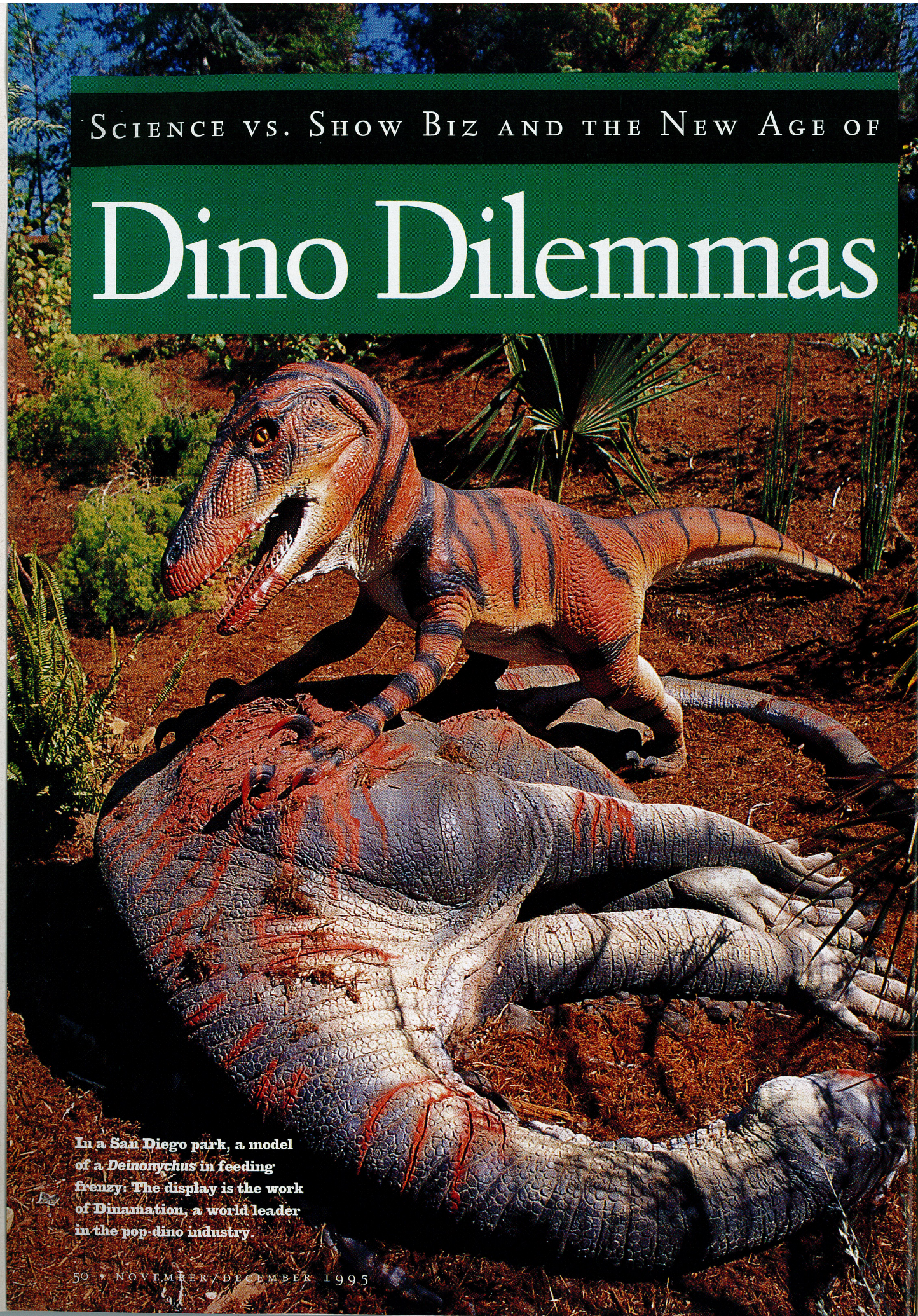


SCIENCE VS. SHOW BIZ AND THE NEW AGE OF

Dino Dilemmas



In a San Diego park, a model of a *Deinonychus* in feeding frenzy: The display is the work of *Dinamation*, a world leader in the pop-dino industry.

Science: Part II

Sexy scenarios of dinosaur behaviour draw huge museum crowds. Is learning served—or is palaeontology making a spectacle of itself?

Article by HEATHER PRINGLE

TWELVE METRES OF HONED MUSCLE, seven tonnes of murderous instinct, the sleek male cocks its head. With cold eyes scanning above a gunmetal-grey snout, the *Tyrannosaurus* steps out of the shadows. In the distance,

along the river's bend, tall ferns rustle, heralding some unseen presence. The *Tyrannosaurus* stares intently, then explodes into speed. It sweeps down the riverbank like a charging racehorse, churning up a hail of muddy clots.

Stealing swiftly across a broad forest clearing, a lone *Dilophosaurus* senses danger. Freezing in its tracks, the graceful, six-metre-long predator scours the deep green world beyond. A light wind tugs at the branches as a summer storm approaches. Out of the corner of its eye, the young *Dilophosaurus* catches a blur of tawny colour. It wheels sharply in alarm, baring its front teeth to spit lethal venom at its attacker.

In the soft dawn light, a trio of *Velociraptors* dispatch their next victim, a young herbivore. Leaping into the air like kick-boxers, they slash its flanks with sickle-shaped claws, striking with calculated precision. The herbivore stumbles in pain, flailing its head blindly from side to side. And then the pack leader lunges upon its defeated prey, tearing off a great strip of muscle and tossing it back in one gulp.

Such Mesozoic mayhem exerts a powerful hold on our imaginations: we are hopeless suckers for any glimpse of dinosaurs and

their vanished world. But were these "terrible lizards"—as 19th-century British anatomist Richard Owen dubbed them—really such gifted killers? Was *Tyrannosaurus* more fleet of foot than many living mammals? Did *Dilophosaurus* spit poison? Did *Velociraptor* hunt in packs as wolves do today?

According to various scenarios in the hit Hollywood movie *Jurassic Park*, the answer is yes. Yet according to palaeontologists who spend their days peering at the petrified remains of real dinosaurs, the true life of these creatures did not measure up to the action-packed movie. *Tyrannosaurus* could never have set such speed records, says Hans-Dieter Sues, associate curator-in-charge of the vertebrate palaeontology department at the Royal Ontario Museum in Toronto. He explains that the enormous beast's foot bones would have disintegrated from the stresses. Furthermore, *Dilophosaurus* possessed perfectly ordinary dinosaur teeth—devoid of the holes that would have been needed to spray venom. As for *Velociraptor*, well, no one really knows just how this creature hunted.

Considering what we do know about Hollywood's hunt for box-office hits, it's no surprise that *Jurassic Park* embroidered so lavishly on scientific fact to win over impressionable young minds. What is more interesting is the knotty scientific conundrum raised by the movie's success. While *Jurassic Park* may have distorted science for profit, it did feed a genuine public appetite for knowledge. After all, adults and chil-

dren across North America are fascinated by the real lives of dinosaurs. "Behavioural questions are extremely popular," says Paul Sereno, a palaeontologist at the University of Chicago, "because that's how people experience animals in the living world." The problem is, the fossil record may offer abundant clues to dinosaur evolution and anatomy, but is miserly on such issues as skin colour, social orders, and defences. So how do scientists satisfy the public desire to know?

On this question, palaeontologists are radically divided. In recent years many researchers have begun embellishing accepted fact with educated guesswork and inference. Teaming up with illustrators, writers, and animators, they've produced a flood of popular and profitable dinosaur films, books, and museum shows. Some supporters endorse such glossy infotainments as just the thing to hook public interest. "I think there is a validity to anything in science that grabs people's imagination," says Sid Katz, executive director of Science World British Columbia, an interactive science centre in Vancouver. "Then you can go the next step."

In the more sober chambers of leading research institutions, however, palaeontologists are less sanguine. They say that dinosaur infotainment diverts public attention from the real business of their science—piecing together the intricate evolutionary relationships among dinosaurs. With its slick images and seductive packaging, the new dinosaur media present a nearly

seamless blend of fact and fiction to a huge audience that cannot distinguish between the two. "It's a frustrating thing because you want to get accurate and reliable scientific information out there," says Sues, "but you are constantly up against the glitzy presentation of bogus facts."

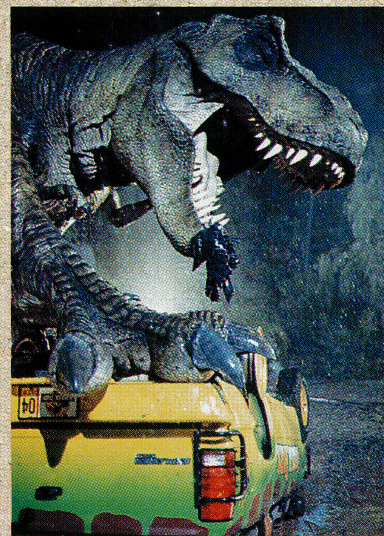
Glitz has certainly played a major role in the success of firms such as Dinamation International Corp. of Irvine, California. Founded in the early 1980s by former airline pilot Chris Mays, the firm has grown from its roots in his garage to become one of the world's leading manufacturers of robotic dinosaurs for museum and science centre displays. It employs sculptors, designers, robotics engineers, computer programmers, and palaeontologists who have teamed up to manufacture more than 750 moving, beckoning, often life-sized creatures. Dinamation robots are displayed in institutions as diverse as the Utah Museum of Natural History in Salt Lake City and Science North, a science centre in Sudbury, Ontario, and the firm typically takes a cut of the gate receipts. Business is booming: in 1993 alone, Dinamation creations were featured in more than 125 exhibits around the world, attracting more than 12 million visitors.

Retaining the services of such prominent but highly controversial American palaeontologists as Robert Bakker (author of *The Dinosaur Heresies*), Dinamation regularly bills its creatures as "scientifically accurate" and "realistic." As one company official concedes, however, guesswork and speculation play a major part in the work. George Callison, vice president in charge of science and education at the firm and a palaeontologist with expert knowledge of small dinosaurs, explains that the public demands more than science can offer. "And try to get somebody to come up with a statement of what dinosaurs really did look like," he remarks.

In researching a robotic creature, says Callison, the company's scientific

Boffo Beasts: Dinos as Screen Demons

While Steven Spielberg's *Jurassic Park*, right, has made dinos popular in the 1990s, they've been screen stars as far back as 1933's *King Kong*, below, in which director Willis O'Brien built a *Tyrannosaurus* from clay on a wire-and-wooden skeleton. Hall Train, a Toronto dino animator and O'Brien fan, admits that animators imprint themselves on their creations. "O'Brien's wife used to say King Kong was Willis O'Brien," he says. "The way he gestured and behaved was just like O'Brien after having a few drinks."

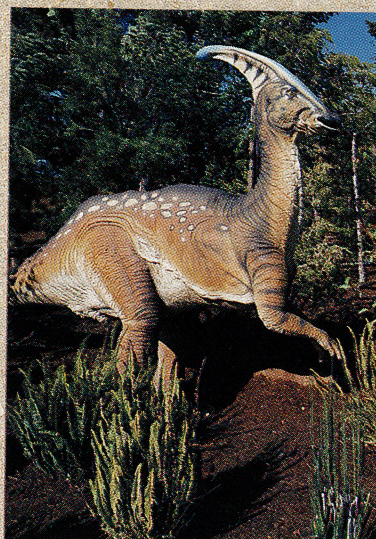
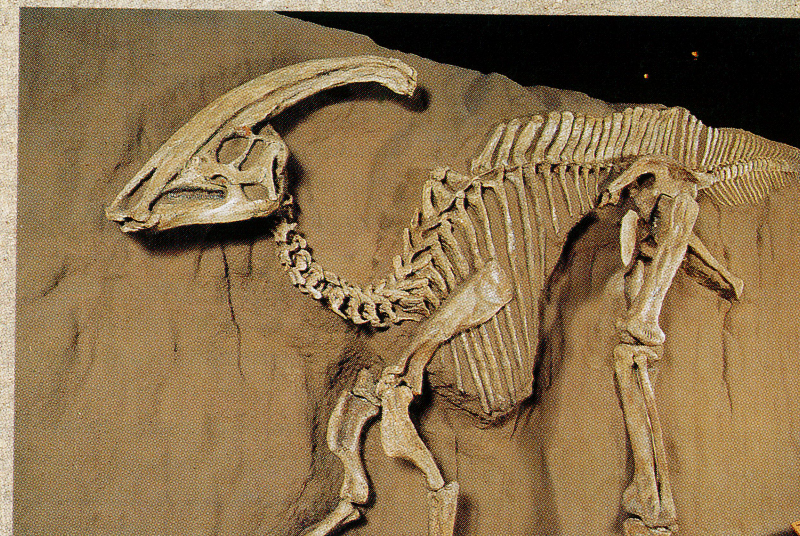


staff canvas museums for the appropriate fossil skeletons. The bones supply concrete evidence about the shape, size, and overall features of the animal. Casts of the area that the brain once occupied offer information on the size of certain cranial nerves, which in turn provide clues to the animals' sensory apparatus and behaviour; and teeth and jaws supply clues to the animal's eating habits. Skin impressions can shed light on skin texture. After extracting this scant information from the fossil record, however, Callison and his team—like all palaeontologists—are pretty much on their own. Making assumptions on how muscles were attached, gleaned general ideas about

skin colouration from living animals, and speculating on everything from the animal's habitat to the sounds it may have made, the Dinamation staffers create robots that seem to owe as much to imagination as to fact.

The final results (see facing page) may suffice for displays in arcades or shopping malls, but they seem rather fanciful for exhibits in museums and science centres. Many museum directors, however, see these rubberized dinosaurs as a way of luring audiences inside, where lectures and other exhibitry can serve up more serious science. Faced with diminishing government funding, many North American museums certainly need the attendance boosts that a sexy

Fossils Made Flesh: Facts or Fictions?



A fossil skeleton of a *Parasaurolophus*, above, is the kind of basic reference used in creating a fleshed-out model, left, by California's Dinamation International Corp. How are all of the colourful details of appearance and behaviour filled in? Though they bill their models as "scientifically accurate," the creature's creators admit to heavy speculation. "We're pretty confident we have size and shape down," says company vice president George Callison. "And we have posture down, but beyond that, it's really stretching it."

Dinamation display can provide.

The robot builders are not the only ones playing loose with scientific fact. As the ROM's Hans-Dieter Sues points out, speculation, distortion, and outright exaggeration run rampant in the popular press. An animated, articulate man with a doctorate in biology and a quick sense of humour, Sues is no dour stick-in-the-mud. But on this early summer morning in Toronto, he is clearly frustrated with recent news coverage of the discovery in Alberta of a new *Struthiomimus* skeleton. Slender of leg and streamlined in appearance, *Struthiomimus* bears many hallmarks of a nimble speedster. Palaeontologists have painstakingly calculated its av-

erage running speed as 30 to 50 kilometres per hour, explains Sues, using evidence of dinosaur footprints. In recent popular press coverage, however, one writer inflated this modest speed to a grand 100 kilometres per hour. Sues complains: "So, suddenly these animals run a lot faster than the actual evidence suggests."

While some of these inaccuracies may be simple errors, he adds, others clearly reflect serious divisions between conservative and radical palaeontologists. "Journalists like people who are controversial," says the palaeontologist. "If one professor says, 'We found this dinosaur

and it's 15 metres long and that's about it,' and there's another guy who says, 'Oh, no, I know this dinosaur did this complicated mating dance,' who's going to get the media coverage?"

As Sues points out, the origins of these two armed camps go back to the beginnings of the debate on warm-blooded dinosaurs. For decades until the 1960s, most researchers conceived of the giant reptiles as overgrown, lethargic lizards that spent their days lolling in primeval swamps. The public took little real interest. Then in 1964, a major discovery sent palaeontologists back to the drawing board. While excavating in Montana, Yale University researcher John Ostrom discovered a strange birdlike dinosaur known today as *Deinonychus*. Lithe and powerful in build, with long slender leg bones made for leaping and fierce sickle-shaped claws for slashing, *Deinonychus* could not be considered a standard swamp-bound monster. "It was clearly an active, highly sophisticated predator," says Sues. Greatly impressed, one of Ostrom's students, Robert Bakker, began studying posture, locomotion, and bone structures in dinosaurs, comparing them to modern mammals and birds. Dinosaurs, he concluded, could not have been cold-blooded and sluggish like reptiles: they were warm-blooded athletes akin to birds and mammals.

Conservative researchers were appalled. Certain that Bakker was wrong, they began embarking on new studies of modern animals. In his research, Bakker had relied on prevailing views of body-temperature control in mammals and reptiles. "But it turned out that these ideas were oversimplified," says Sues. Some mammals, for example, were not warm-blooded at all in the textbook sense: they weren't always able to raise their core body temperatures above ambient temperatures. And some reptiles were not strictly cold-blooded. "Sea turtles can raise their body temperature significantly," says Sues, "and yet in most other respects, sea turtles are good reptiles." Today, sci-

entific understanding of body-temperature control in animals is more complex than Bakker originally thought. And many researchers suggest we may never reach a clear understanding of this facet of dinosaur biology.

But Bakker remains unapologetic. He tours the continent, airing new controversies in popular books such as *The Dinosaur Heresies* and advising companies such as Dinamation. Other young researchers have jumped in to find jobs in the burgeoning pop-dino industry. "Only about one out of three people who have a degree in palaeontology today get a job in a research institution," says Eugene Gaffney, curator in the department of vertebrate palaeontology at the American Museum of Natural History in New York. "So there are people now who get jobs by lecturing and having a popular presence. As a result, a sort of pop palaeontology... has developed that is certainly a grey-area science."

Free to speculate, many young researchers have begun hunting for clues to some of the more popular riddles of dinosaur behaviour and appearance. While poring over fragmentary skeletal remains of *Stegosaurus*, American sculptor and researcher Stephen Czerkas began studying the arrangement of triangular plates along the animal's back. Perhaps they served as solar panels to collect the sun's heat on wintry days and dispel it on hot summer days, he speculated. The public was fascinated. Back in the lab, conservative researchers shook their heads. Intriguing ideas, but they could never be tested scientifically: the animals themselves were long extinct. At palaeontology conferences, researchers from other disciplines began joking about dinosaur research; young students began steering clear of a subject with a growing reputation for flakiness. "It's like if you're an astrophysicist," says Gaffney, "and went to a really good university and had a lot of fellowships. Would you suddenly announce that you're going to start studying UFOs?"



Today, frustrated conservative researchers are beginning to toss their own salvos. At the American Museum of Natural History, for example, Gaffney and his colleagues have recently redesigned their world-renowned dinosaur halls. To incorporate up-to-date scientific knowledge, they have remounted several key fossil specimens, including the famed *Tyrannosaurus*. The great predator was previously displayed with its tail dragging feebly on the ground, but recent studies show that such posture would result in spinal dislocation. In the revised display, *Tyrannosaurus* poses with its tail brandished high in the air. What is particularly intriguing about the halls, however, is an unconventional new labelling strategy. As visitors wander rooms filled with more than 100 fossil specimens, they view display cases with labels that meticulously distinguish between fact and speculation on subjects such as parenting behaviour and sexual competition among dinosaurs.

For Gaffney the refurbished halls are an honest effort to communicate current scientific knowledge about dinosaurs. And museum colleagues elsewhere applaud these efforts. At the Royal Tyrrell Museum of Palaeontology in Alberta, for example, renowned Canadian palaeontologist Philip Currie welcomes labelling as a way of combating common public misconceptions. "I think too often in museums and in books on dinosaurs and so on, people get the perception that everything there is to be known about dinosaurs is already known and that it's not an interesting field to go into because it's pretty straightforward."

Still, some diehard dinosaur fans find the galleries too austere, too academic, too dry. And those in the business of conjuring up dinosaurs for public consumption say that fidelity to the fragmentary fossil record is an unnecessary straitjacket. Informed speculation can inject life into long-extinct animals and

excitement into a film or exhibit. "I think part of the fascination with dinosaurs is that we want to see them whole, and there's no way that science can give us that," says Don Lessem, an American science journalist who founded The Dinosaur Society, a non-profit organization designed to further dinosaur research and education.

In his office in Oakville, Ontario, Peter May clearly agrees. Turning over the problem, the founder of Research Casting International Ltd. (see story on page 42), a leading Canadian dinosaur-casting firm, proposes that *Jurassic Park* succeeded wildly because it gave us the illusion of living, breathing dinosaurs—creating a fervent public fascination for palaeontology at a time when cash-strapped scientists needed it the most. "You know, I think it's a great thing for the science to be so popular," says May. While he clearly sympathizes with researchers who want to protect the integrity of the scientific record, he sees little harm in some extrapolation for the public. "If the palaeontologists never moved away from the characters [key features] on the bones," he says, "it would be an awfully boring science."

And in the end, it is clear that no one really owns dinosaurs, no one has the right to control how they are portrayed. "They are an enigma," says Toronto artist Hall Train, who has collaborated closely with May and whose animated videos of *Albertosaurus*, *Stegosaurus*, and their kin now form part of the dinosaur exhibits at the American Museum of Natural History. "We'll never really know exactly what they looked like. We'll never really know how they moved. It's constantly a mystery. A lot of people don't like that. A lot of scientists really do believe they have the last word, but they don't. There are so many incredibly big questions about what these things were like."

Heather Pringle is a long-time EQUINOX field correspondent who lives in Vancouver.

The Real Deal on Dinos

Five popular notions about prehistory's "terrible lizards"—and what cautious science can truly tell us.

All dinosaurs were giants.

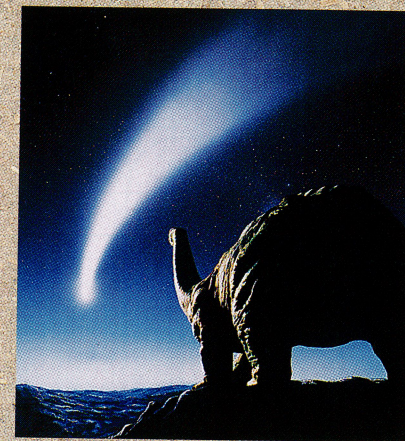
About 350 species of dinosaurs have been excavated over the last 150 years. The reigning titans were the sauropods—"truckloads of flesh arrayed around girders of bone," as palaeontologist Michael Benton wrote in a recent book. *Brachiosaurus*, for example, was nearly three times as tall as a modern giraffe. And *Ultrasaurus* and *Seismosaurus* may have stretched as much as 40 metres from head to tail. As researchers have also discovered, however, midget dinosaurs roamed the Mesozoic Era too. *Compsognathus longipes*, for one, measured little taller than a chicken and likely weighed less than four kilograms.

Dinosaurs parented as birds do today.

Palaeontologists have gleefully uncovered dinosaur eggs and nests in many sites, but they are still uncertain about the nature of dinosaur par-



enting. At one Montana site, famed palaeontologist John Horner and colleague Robert Makela have found fossil eggs, hatchlings, juveniles, and adults of the duckbilled dinosaur *Maiasaura* (or "good mother lizard"). To these men, the site looks like a dinosaur nesting colony, where adults fed, nurtured, and even defended their young. But other researchers remain skeptical. They point out that the combination of eggs, hatchlings, and adults also occurs in the breeding sites of turtles—which provide no care at all for their young.



Dinosaurs went extinct after a catastrophe some 65 million years ago.

A large asteroid or comet did pound into Mexico about 65 million years ago, and on the other side of the globe, great volcanic activity seared much of southwestern India. The precise impact of these catastrophes on Earth is unclear, however—and there's no clear proof they directly triggered the dinosaurs' demise. The current margin of error in dating these events ranges between 30,000 and 100,000 years—too great to link them to what we know of dinosaur extinction. Worse still, scientific knowledge of dinosaur extinction is fragmentary. Researchers know when the fabled creatures went extinct in western North America but know virtually nothing about their demise in South America, Europe, Asia, or Africa.

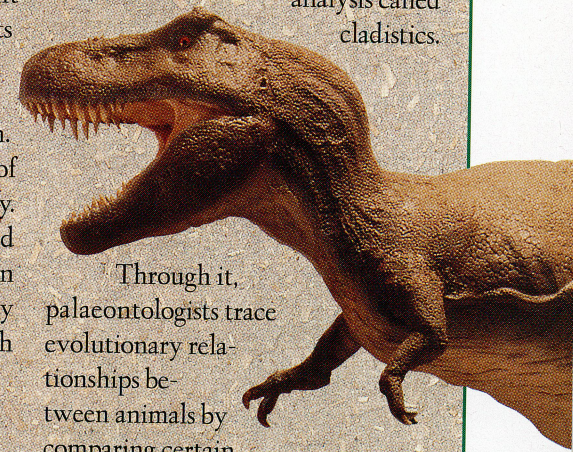
Dinosaurs were solitary animals.

This is almost certainly false, for both the sauropods and the duckbilled dinosaurs ambled across North America in impressive herds. Scientists have detected traces of this ancient sociability in several fossil trackways—areas where dinosaur footprints have been naturally preserved in muds and sands that later hardened to stone. For example, researcher Martin Lockley, a professor of geology at the University

of Colorado—Denver, has analyzed the imprints, found at the Davenport Ranch in Texas, made by a small herd of 23 sauropods as they swung from right to left across the soft ground. And, doing research in a New Mexico trackway site, he mapped the companionable movements of 55 young duckbilled dinosaurs, all loping north across the site. According to palaeontologist Greg Paul, such trackways offer a unique glimpse into dinosaur behaviour—a kind of motion picture of these long-extinct animals.

No dinosaurs survive today.

Palaeontologists have news for you—the turkey that roasts in the oven on Christmas Day is a dinosaur. And so is the robin that yanks out worms from your lawn in spring. Birds, in other words, are living dinosaurs. So says a relatively new method of scientific analysis called cladistics.



Through it, palaeontologists trace evolutionary relationships between animals by comparing certain key anatomical features. Animals that share many of these key features are close kin; animals that don't are more distantly related. Birds and dinosaurs, for example, possess more than 125 of these shared derived characters, including a unique kind of ankle joint and upright or erect limbs—which has convinced even conservative dinosaur researchers that the two groups are intimately related. —H.P.