Brushing Up On Dinosaurs

When art and science combine, the result can be a remarkably vivid and accurate glimpse into prehistoric life

By STEFI WEISBURD

Robert Bakker met his first dinosaurs in the spring of 1955 in his grandfather's sun room, and he fell in love. There on the coffee table, a terrifying *Tyrannosaurus rex* glowered at a long-necked *Apatosaurus* supping in a swamp – both surrounded by a menagerie of wonderfully exotic creatures that roamed the prehistoric landscape hundreds of millions of years ago. Ten-year-old Bakker had discovered Rudolph Zallinger's Pulitizer-prize-winning mural, reproduced that week on the cover of LIFE.

"As soon as I saw it I decided I was going to spend the rest of my life studying dinosaurs," says Bakker, who went on to do just that, becoming a renowned paleontologist and artist in his own right. "That was the first really great color dinosaur mural. It launched an awful lot of careers, including mine."

While many, like C. P. Snow in *The Two Cultures,* have lamented the growing abyss between science and the arts, the two are inexorably merged in paleontology, particularly in the reconstruction of dinosaurs and their habitats and behavior. This union of art and science is what makes ancient bones of long-extinct animals come alive. Paintings and sculptures not only spark the public imagination and inspire new ranks of paleontologists, but for scientists they also are an effective means of communicating ideas and exploring new theories.

"Paleontology is a very visual inquiry," notes Bakker. "All paleontologists scribble on napkins at coffee breaks, making sketches to explain their thinking." If they are not artists themselves, most dinosaur paleontologists work closely with artists, some of whom have published scientific work of their own.

To celebrate a century of these collaborations, the Natural History Museum of Los Angeles County this year unveiled "Dinosaurs Past and Present," a traveling exhibit of dinosaur art. Organized by artist and curator Sylvia Czerkas, the exhibit traces dinosaur reconstruction from its beginnings in the 1800s to the most recent paintings and sculptures. It has just moved to the Denver Museum of Natural History. The show is also scheduled to tour natural history museums in Philadelphia, Washington, D.C., New York City, Albuquerque, Drumheller (Alberta) and Toronto, after which it may be sent to Japan and China.

Courtesy of the American Museum of Natural History

Many artists consider Charles Knight the granddaddy of accurate dinosaur illustrations. In portraying dinosaurs as lively, agile creatures, this 1897 painting of a pair of Dryptosaurus *fighting was considerably ahead of its time.*

One purpose of the exhibit is to show how thinking about dinosaurs has evolved since they were first discovered early last century. Dinosaurs in many of the earliest works on display are portrayed as violent, clumsy and slovenly beasts, dressed in drab greys, browns and dark greens and standing by themselves. The newest paintings and sculptures in Czerkas's exhibit project quite a different image of sleeker, more varied and lively animals that lived in socially complex communities and had adapted to almost every ecological niche now oc-

Yale Peabody Museum of Natural History

This is a scale version of Rudolph Zallinger's 110-foot-long mural, finished in 1947 for Yale's Peabody Museum. The painting, which won a Pulitzer Prize and was on the cover of LIFE in 1955, depicts the age of reptiles, 70 million to 320 million years ago.

cupied by modern mammals and birds. Dinosaurs were "a totally unique form of life that this planet has never seen since," says artist and paleontologist Stephen Czerkas, whose works, along with those of Sylvia Czerkas and many other artists, are featured in the exhibit.

Museum of the Rockies

This 1983 painting of a Maiasaura *herd by Douglas Henderson was based largely on the discovery by paleontologist John Horner of massive bone beds in Choteau, Mont. Horner found a layer of volcanic ash with the bones, suggesting that the herd was killed* en masse *by a volcanic explosion about 100 million years ago.*

One of the most important changes that has taken place in the portrayal of dinosaurs is in their posture. Until fairly recently, the convention was to draw many large dinosaurs with their front legs splayed out and bent at the elbows, like lizards. But in pictures today, the elbows are straight and the front legs have been pulled under the body, closer to the animal's center of gravity.

The physical appearance of many dinosaurs has changed in other ways as well. Recent studies by Stephen Czerkas, for example, have shown that the *Stegosaurus,* which had been portrayed with two rows of bony plates down its back for 100 years, really had just one row (SN:8/2/86,p.69). And contemporary illustrators have started to use more vivid colors: mauve, pink, metallic blues and reds. While there is no direct physical evidence to show that dinosaurs were indeed colorful creatures, "this makes a lot of sense," says Bakker, "because dinosaurs are closely related to birds. Colors were undoubtedly used, especially in the mating season."

The reconstruction of dinosaurs has become as sophisticated as forensic science. For his sculptures, Stephen Czerkas often begins with resin casts of a real skeleton. From muscle scars on bones, which indicate where a muscle or major tendon would attach, and from a knowledge of the anatomy of living animals, Czerkas then "fleshes out" the dinosaur, building up the muscles layer by layer in clay. Sometimes a mummified dinosaur is found with the skin preserved, enabling the artist to sculpt a realistically patterned skin to cover the sculpture. Then the entire piece is cast in a durable material, such as steel-reinforced fiberglass and resin.

Included in the dinosaur exhibit is the first restoration of an animal called *Carnotaurus,* or "meat-eating bull," because of its unusual bull-like horns. The model, sculpted this year by Stephen Czerkas, was based on the skeleton and skin impression recently discovered by paleontologist Jose Bonaparte at the Museo Argentino de Ciencias Naturales in Buenos Aires, Argentina. This was the first find of skin belonging to a meat-eating dinosaur. Before it was discovered, fossil skin from other types of animals had been used as a reference, says Czerkas. "But that would be like putting the skin of a horse on a lion," he says.

By studying the mass and distribution of muscles, the mechanics of limbs,

Joseph Garlington

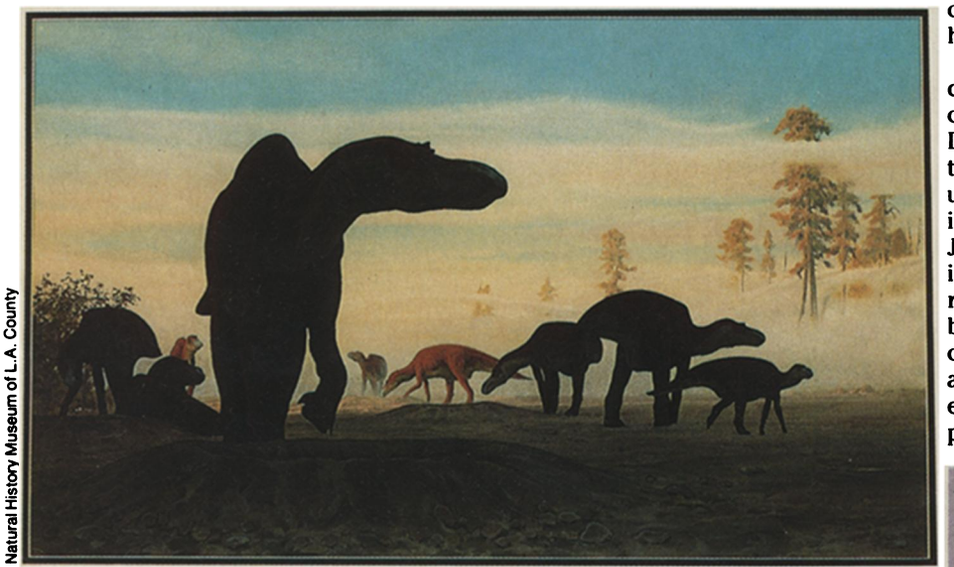
Finished in 1984, this 22-foot-long carnivorous Allosaurus *by Stephen Czerkas is the state of the art in dinosaur reconstruction. The model was sculpted directly over a cast of the skull and other skeletal parts. It is the first life-sized sculpture whose skin patterns are based on actual skin impressions of a meat-eating dinosaur.* Allosaurus, *like other meat-eaters, had prominent crests above its eyes.*

fossilized footprints and the newly characterized posture of the dinosaurs, some scientists have concluded that the animals could move at greater speeds than once thought. Bakker, in particular, has championed the idea that dinosaurs were much nimbler than earlier paleontologists believed. His 1969 drawing of a running *Deinonychus* (or "terrible claw," for the lethal, sickle-shaped claws on its feet) shows a "very sleek, fast-moving animal," says Sylvia Czerkas. "It started people thinking in a whole different way about dinosaurs. It's probably one of the most viewed and reproduced modern drawings."

At a symposium held in Los Angeles last February in conjunction with the exhibit, Bakker presented evidence, based on the stride and leg lengths of some dinosaurs, that their walking speed averaged about 3 miles per hour — about four times as fast as that of present-day lizards and turtles, and comparable to the speeds of moose, deer, bulls and other warm-blooded animals. Because the average cruising speed reflects an animal's metabolism, Bakker argues that many dinosaurs were warm-blooded.

Natural History Museum of L.A. County

Gregory Paul's 1985 "Ambush at Como Creek" shows that the herbivorous Diplodocus *(of the sauropod family) was not the passive victim of attacking* Allosaurus fragilis *packs. Its thick tail could be a lethal weapon. Trackways show that both predatory dinosaurs and sauropods moved in groups.*



Natural History Museum of L.A. County

Paleontologist John Horner's discovery of a Maiasaura *nesting ground, complete with the remains of 15 partially grown animals, suggests that these dinosaurs nurtured their young until they were old enough to fend for themselves. His find inspired this recent painting of a* Maiasaura *nesting ground by Douglas Henderson.*

"When I went to school [in the 1960s] it was indeed a heresy to think of dinosaurs as warm-blooded and light-footed," he says. "And in 1979, the last time there was a major dinosaur symposium, a lot of people still viewed these ideas as heresy. But at the L.A. meeting one could definitely see movement toward quick-footedness."

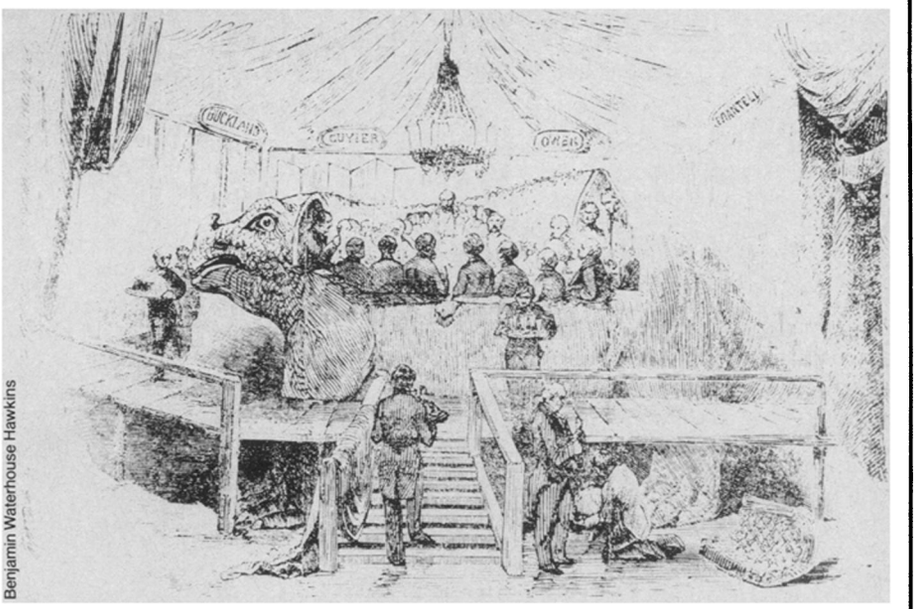
Another perception that has evolved dramatically is that of the social behavior of dinosaurs, which paleontologists have inferred from various kinds of physical evidence. These clues — such as bone beds, created when a group of animals was killed *en masse* by a flood, volcano or other catastrophe, and fossilized trackways — suggest that both predators and prey traveled in packs or herds. One painting in the exhibit, by Baltimore artist Gregory Paul, illustrates that the prey were by no means defenseless: A herbivorous *Diplodocus* is rearing up like an elephant to protect the rest of its herd against a carnivorous *Allosaurus,* and is swinging a thick, very lethal, whip-like tail. Trackways also show that some dinosaurs walked side by side as they traveled. Other tracks indicate that meat-eating dinosaurs could swim, leaving the herbivores little chance of escaping in the water, as some scientists had once believed they could.

There is also growing evidence that dinosaurs, like present-day crocodiles, cared for their young after they hatched. Dinosaur eggs were first discovered in the 1920s in the Gobi deset, but it wasn't until a few years ago that communal nesting grounds were found. Paleontologist John Horner of the Museum of the Rockies in Bozeman, Mont., discovered a series of nests in Choteau, Mont., that had belonged to duckbilled *Maiasaura.* Because young *Maiasaura* of different ages and sizes were found in nests, some scientists have concluded that parents were protecting and feeding their young until

National Museum of Natural Sciences, Ottawa

If dinosaurs had not become extinct and had continued to evolve, they might have developed into the "dinosauroid" on the left. That is how artist Ron Séguin and paleontologist Dale Russell envision the descendants of a small, meat-eating dinosaur called Stenonychosaurus *(on the right).*

A Retrospective of Dinosaur Resurrectionists



Benjamin Waterhouse Hawkins

Dinner in a dinosaur: To celebrate New Year's Eve, 1853, and the construction of the first life-sized Iguanodon *restoration, 21 scientists dined on a seven-course meal inside the beast's belly. Artist Benjamin Waterhouse Hawkins made the model with the help of paleontologist Richard Owen, who sat within the* Iguanodon's *skull. The scientists heartily joined in on a song, composed specially for the occasion, with the rousing chorus: "The jolly old beast/ Is not deceased/ There's life in him again." The* Iguanodon *sculpture, along with restorations of other prehistoric creatures, was constructed for the grounds of the Crystal Palace in England, where they can be found today. Waterhouse Hawkins was commissioned to make similar sculptures for what was to be a museum in New York City's Central Park. The project, however, was scrapped by park commissioners, and the sculptures were buried in the park, where they are thought to remain to this day.*

The story of the discovery of the dinosaurs began in 1822. Before that time, large bones that were probably dinosaurian had been found, but scientists, some of whom believed the bones were the remains of giant humans, had not guessed the fossils' origin. In the spring of 1822, Mary Ann Woodhouse Mantell changed all that when she accompanied her husband Gideon, a country doctor and amateur paleontologist, on a house call. While walking outside, she came upon a large fossil tooth. The tooth fascinated Gideon because it, like other teeth and bones found shortly thereafter, was embedded in rocks thought to be too old to contain relics of mammals. Because the teeth resembled those of the living iguana, he named the animal *Iguanodon* and suggested in an 1825 paper that the teeth were the remains of a giant lizard. With the discovery of other fossils, the scientific community came to agree with Gideon's interpretation, and to recognize that reptile-like creatures inhabited the earth long before mammals.

The first life-sized reconstructions of dinosaurs, including the *Iguanodon,* were made in the 1850s by British artist and anatomist Benjamin Waterhouse Hawkins, who worked with Richard Owen, the British paleontologist who coined the word dinosaur (taken from the Greek and meaning terrible lizard). The sculptures, built of concrete, stone and iron, were constructed on the grounds of the Crystal Palace at Sydenham, England, where they got their first major public debut. Even though the Crystal Palace burned down in 1936, the sculptures can still be seen at Sydenham today.

Waterhouse Hawkins's work set the stage for dinosaur reconstructions as both popular enticements and scientific pursuits. But because he and other early dinosaur artists had to struggle to rebuild animals from only fragmentary bits of fossil skeletons, early reconstructions were not terribly accurate. A horn put on the snout of *Iguanodon* in its earliest reconstructions, for example, was later shown to be a spike-like thumb bone — prompting paleontologist George Gaylord Simpson to write in 1983 that "... the animal thus thumbed its nose at its first reconstructor."

Starting in the late 1870s, however, in places like Como Bluff, Wyo., scientists discovered tons of dinosaur bones — some preserved as articulated skeletons, with the bones arranged in the proper order. The search for bones was fueled by a rivalry that had developed between two paleontologists, Edward Drinker Cope of Philadelphia and Yale University's Othniel Charles Marsh, as they raced to find the most and best fossils. The great quantity and quality of the bones collected provided the raw materials for some of the first full-scale mounted skeletons for museum displays and gave scientists and artists a much clearer and more diverse picture of what dinosaurs looked like.

It was during this first wave of intense dinosaur research that artist and anatomist Charles Knight began his work. Knight, who worked closely with paleontologist Henry Fairfield Osborn (then director of the American Museum of Natural History in New York City), is widely regarded as the grandfather of prehistoric life illustrations. "Waterhouse Hawkins's works were beautiful," says dinosaur-exhibit curator Sylvia Czerkas, but because of the times Knight lived in, "[his] are beautiful and *accurate.* His image was imprinted on the public's imagination as well as on the scientific community's for a very long time."

Knight was the primary source for many later artists who created popular books and movies. According to Stephen Czerkas, an artist and paleontologist, "some artists would literally trace his work and then maybe flop the image to make it original and start to bastardize the interpretation. They'd elaborate on it, stick horns on things that don't have horns, for example. They'd do all kinds of weird things that maybe made it look artistically more attractive, but the content and scientific value were increasingly diminished."

Since Knight, there has been a geometric increase of fossil discoveries and scientific illustrators, says Sylvia Czerkas. However, Robert Bakker, a paleontologist and artist at the University of Colorado Museum in Boulder, thinks dinosaur paleontology suffered for a while after 1910 because "the best minds in paleontology just didn't go into dinosaur research. As a result, a lot of silly notions crept in and solidified as an orthodox view." Moreover, he says, artists in the 1930s, '40s and '50s didn't work as closely with scientists as Knight did.

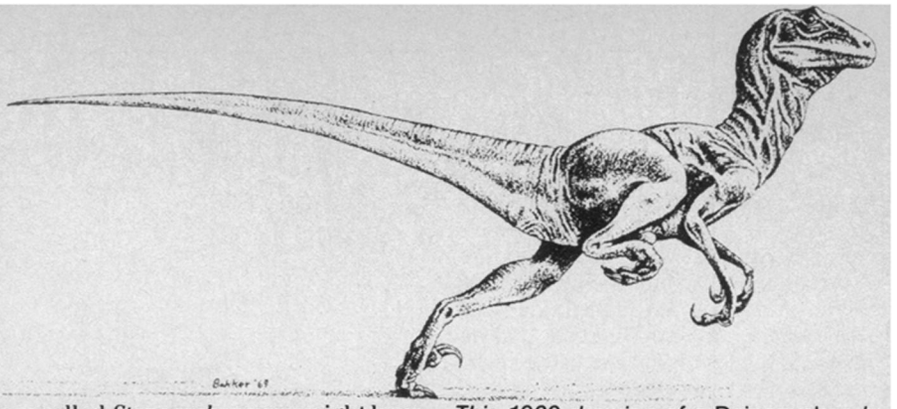
Today, he says, there's a real renaissance among artists: "If they want to paint dinosaurs, they have to learn anatomy and go the route of da Vinci by being both a scientist and an artist."

— S. Weisburd

they were large enough to fend for themselves.

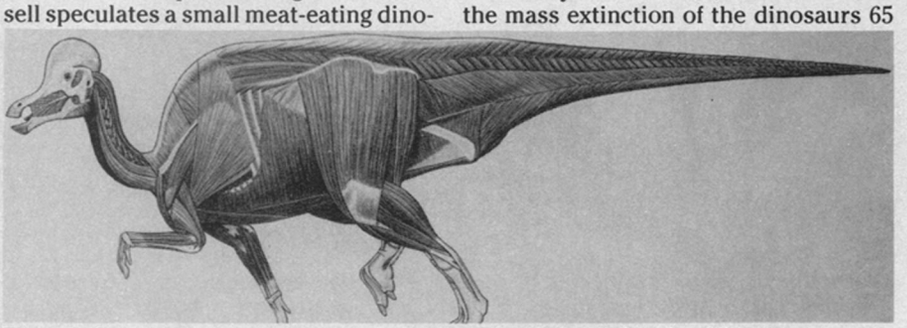
"These aren't the stereotypic dinosaurs, portrayed in the movies as always killing each other," says Sylvia Czerkas. "There were a lot of tender and gentle moments."

Dinosaur reconstructions enable scientists to envision not only how life used to be, but also what it might have become. Perhaps the most intriguing piece in the exhibit is a somewhat eerie sculpture by Canadian artist Ron Séguin of a very human-like "dinosauroid." This creature is what paleontologist Dale Russell speculates a small meat-eating dinosaur called *Stenonychosaurus* might have eventually evolved into, had it survived the mass extinction of the dinosaurs 65 million years ago. Russell, who works with Séguin at the National Museum of Natural Sciences in Ottawa, chose the two-legged *Stenonychosaurus* as an ancestor of the dinosauroid because it had a relatively large brain (comparable to that of a large modern bird), opposable fingers and big stereoscopic eyes.



Bakker/Yale Peabody Museum of Natural History

This 1969 drawing of a Deinonychus *by paleontologist and artist Robert Bakker has become a logo for the view that dinosaurs were lively and warm-blooded.*



Natural History Museum of L.A. County

The art of reconstructing dinosaurs is a science unto itself. In this 1984 muscle study, artist Gregory Paul draws on both fossil remains and his knowledge of the anatomy of living animals to flesh out, layer by layer, a Hypacrosaurus *(meaning "very high-ridged lizard). The complete restoration is thought to be exceptionally accurate because it is based on well-preserved dinosaur mummies that show almost every detail of the skin surface, including many wrinkles. The articulated, or connected, skeletons indicate that the animal's tail was held straight and stiff behind and that its knees were flexed like those of birds.*

The dinosauroid is a clear favorite among the younger visitors at the exhibit. Watching a few delighted children ogle this magical world, Stephen Czerkas asks, "Who knows how many paleontologists we're stimulating [with this exhibit]?" Adds Sylvia Czerkas, pointing across the room at a child, "That could be a baby Bob Bakker right over there." □

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Annual Review of Pharmacology and Toxicology, Vol. 26 — Robert George, Ronald Okun and Arthur K. Cho, Eds. This volume begins with W.D.M. Paton's autobiographical account of becoming and being a pharmacologist and ends with a review of reviews by E. Leong Way. Annual Reviews, 1986, 604 p., illus., $31.

Getting Started in Bird Watching — Edward W. Cronin Jr. Explains for the beginning birdwatcher how one makes bird identifications. Focuses on the techniques of birding, giving the "tricks of the trade." Outlines a systematic approach that is intended to enable readers, with the aid of a field guide, to identify birds locally and throughout the world. HM, 1986, 224 p., paper, $5.95.

Meditations at 10,000 Feet: A Scientist in the Mountains — James Trefil. The mountains are used as a springboard to introduce natural phenomena found there and to present to the general reader in fascinating essays the scientific theories involved. Scribner, 1986, 236 p., illus., $16.95.

Turtles, Tortoises and Terrapins — Fritz Jürgen Obst, translated from the German by Sylvia Furness. Turtles are one of the most seriously endangered groups of animals in the world today because of a very low reproductive rate, a slow succession of generations and an inability to adapt easily to a changing environment, according to the author. This beautifully illustrated book provides a broad survey of species, from sea turtles to the giant Galápagos land tortoises to the North American snapping turtle. Discusses the work being done to preserve the last habitats of many turtle species and zoo breeding programs designed to conserve some threatened species of turtles. St Martin, 1986, 231 p., color/b&w illus., $19.95.

The Whale and the Reactor: A Search for Limits in an Age of High Technology — Langdon Winner. Explores the meaning of technology in order to develop a political philosophy of technology. Examines modern social movements that have chosen "one technology or another as a focus of their hopes or fears." Delves into the politics of language. "How can we limit modern technology to match our best sense of who we are and the kind of world we would like to build?" This is the question that is posed throughout the book. U of Chicago Pr, 1986, 200 p., $17.50.