PARADOXES OF THE PLATYPUS

Is this web-footed, duckbilled, egg-laying, venomous Australian mammal nature's joke or last laugh?

By Eric Hoffman
Photographs by D. Parer and E. Parer-Cook

In 1798, scientists at the British Museum received a specimen from Australia unlike anything they had ever seen. About half the size of a house cat, it had a furry pelt, webbed feet, a flat tail like a beaver's, a long bill like a duck's and various other anatomical curiosities. Their reaction was immediate disbelief: the creature had to be a fake, the clever ruse of irreverent Australian colonials.

Today that specimen is still in the museum's research collection, complete with scalpel marks where skeptics tried to locate the stitchery that attached the bill to the body. The animal, it turned out, was no hoax, but a real egg-laying mammal now commonly known as the duckbilled platypus.

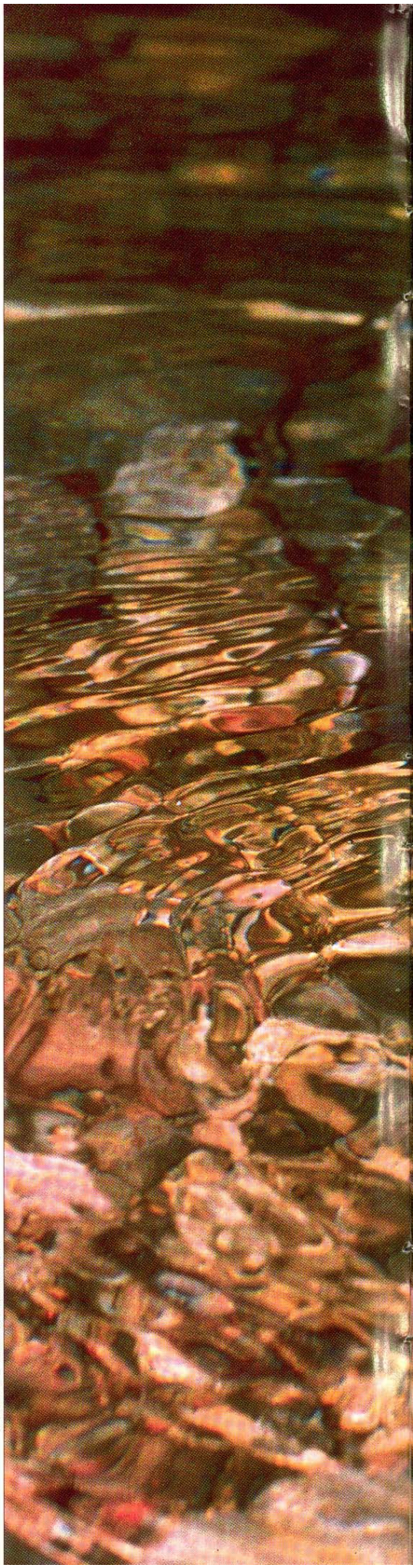
Difficult to study, the platypus was generally ignored by science—other than its anatomy—until the middle of this century. Only now are investigators beginning to solve the mysteries of how the creature survives and where it came from. The picture they are assembling is of an animal far more bizarre and sophisticated than anything the scientists at the British Museum could have imagined.

The species' unique snout, for example, is no mere duck bill for collecting food underwater. In 1986, researchers were astonished to discover that it can receive electrical signals, giving the mammal a sixth sense that helps it "see" underwater. Equally amazing is a recent finding that a platypuslike creature lived long before the Age of Mammals. When paleontologist Alex Ritchie of the Australian Museum in Sydney recognized the telltale fossil six years ago, "The hair literally stood up on my back," he says.

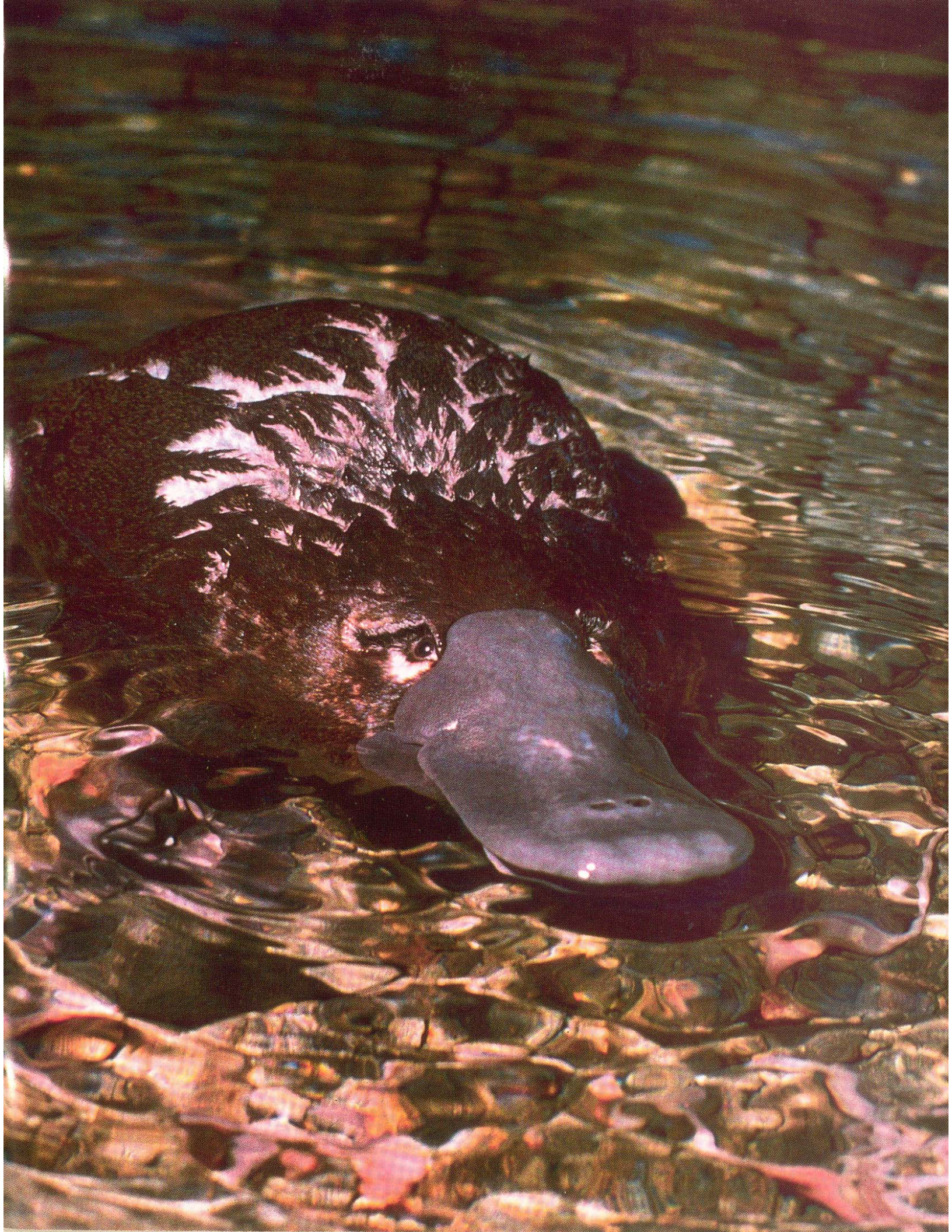
Only the most dedicated observers have ever seen platypuses in the wild, although substantial numbers paddle about watercourses along Australia's eastern edge, including the island of Tasmania. Not only is the animal wary, it feeds underwater at night, spends much of its time hidden in underground burrows and is easily stressed to death in captivity. Just one captive egg has been successfully hatched.

Platypus-watchers are most likely to succeed at the crack of dawn near a glass-smooth pool formed by a secluded stream. Their subject is smaller than they might expect; adult males weigh 4 pounds at most and rarely measure longer than 19 inches. Except for the bill and feet, the animal's entire body is covered with a

Perhaps the strangest living mammal, the platypus does not use its eyes or ears underwater, where it feeds, as special grooves close tightly over them. Instead it relies on a sixth sense in its unique bill.



D. PARER & E. PARER-COOK (AUSCAPE) (3)



thick, dark fur that is often the same color as the murky rivers it frequents.

Usually the first sign of an approaching platypus is a small wake. Then the observer might see the animal's eyes, nostrils and upper back above the surface. If it dives, a mass of air bubbles might give it away. Around the turn of the century such bubbles prompted the popular belief that the animals breathe through their backs. Naturalists have since realized that what they are seeing is nothing more than trapped air escaping from the fur—a coat so dense it insulates better than that of polar bears.

Among scientists it was once commonly believed that platypuses, like reptiles, could not regulate their body temperatures in water. But in 1972, Tom Grant, then a New South Wales University doctoral student, found with telemetry equipment that platypuses thermoregulate as well as any aquatic mammal. Their metabolic rate increases in the cold, allowing them to maintain a constant body temperature, even submerged in near-freezing water. The feeding platypus stays underwater for a minute or so, gathering prey into cheek pouches.

The platypus is the only known creature with separate aquatic and terrestrial sensory systems. Underwater, a furry groove closes to cover the eyes and ears, and the nostrils—located in the bill—close tight. Scientists have known for more than a century that the bill is extremely sensitive. The mystery was how touch could compensate so well for not being able to see, hear or smell. "What guided them underwater was the question everyone has been asking for years," says Grant.

The answer came in 1986 from Henning Scheich, an electric eel expert at the Technical University of Darmstadt in West Germany, and colleagues in Australia. Using 1.5-volt batteries, the researchers sent electrical signals similar to those created by the platypus's favorite food: freshwater shrimp, other crustaceans, worms and insect larvae. Sure enough, their study subjects were attracted to the batteries, even when the electric field was only as strong as that created by a shrimp flicking its tail.

In 1988, a team at Melbourne's Monash University found pores on the bill's side with nerve endings responsive only to electric currents, along with lubricating glands to keep the receptors from drying out. As the hungry platypus dives or paddles along, it scans back and forth with its bill to get a fix on prey and obstacles like submerged boulders and logs. "They're very good at pinpointing a source of low-voltage emissions," says Australian mammalogist Chris Tideman, "even if it's in a hollow brick."

Pliable and leathery, the finely tuned bill has approximately 850,000 tactile and electrical receptors, a system more sophisticated than that of sharks and other fish.

Unlike aquatic mammals that swim with hind legs and tails, the platypus uses its large webbed front feet; its tail serves as rudder. On land, with webbing tucked back, the same feet walk and dig.

Researchers believe it is an independent adaptation. Only one other mammal, the echidna, has electroreceptors.

The platypus's swimming technique is also its own. Unlike other aquatic mammals, such as the beaver, which push through water with hind legs and tail, the platypus strokes with its extensively webbed, oversized front feet. A strong swimmer, it churns along at twice the speed of the ducks or geese that sometimes share its pools.

Its broad, flat tail has often been compared to the beaver's. But the beaver's tail is hairless and muscular and it propels the animal through the water. In contrast, the platypus's fur-covered tail is a fat-filled appendage used not for propulsion but as a rudder. It also serves as a reserve energy source and even as a portable blanket. When platypuses curl up to sleep or incubate their eggs in their riverbank burrows, they wrap their tails around the front half of their bodies.

When the platypus surfaces from a dive, it transfers its catch from cheek pouches to the mouth and grinds its food between horny pads in its upper and lower jaws, radiating ripples and faint splashing from its busy bill. It might interrupt its eating to groom, court other platypuses, settle territorial squabbles or play. But at the slightest movement on the bank or in the water, the show is over.

During the 1800s, persistent hunters developed a way to capture the creatures. When the hunter found an animal relaxed on the surface, he shot just below it, stunning the platypus long enough for a dog to retrieve it. (Shooting a hole in the platypus defeated the purpose of collecting its pelt.)

The coat was prized for small apparel such as furry slippers and hats. It was even used for rugs and bedspreads made of as many as 40 skins. But it never caught on as a commercial export, or even as a domestic moneymaker—probably because the animals are so difficult to locate and have such small, tough-skinned pelts.

Hunters and dogs alike found that even a stunned or dying platypus could trade tit for tat. Males have sharp spurs on their hind legs that dispense a strong venom. A platypus could kill a dog by clamping its legs around the dog's muzzle, driving in its spurs and releasing poison. Occasionally the animals spurred hunters, who experienced severe pain, swelling and weeks of partial paralysis. Platypuses usually use the spurs against other males, possibly in fights over females.

Scientists have never seen wild platypuses mate, though they do know that the animals breed almost until the end of their 12-year lives. Much of how the creature cares for its young is still a mystery. During nesting in spring and summer, females seal themselves in burrows for days. Gestation is thought to take about a month. The young hatch—naked, blind, the size of a quarter—in 10 to 14 days and require three months of vigilant care before their

mother takes them for their first swim.

The young spend their first months in a plugged hole; the mother leaves occasionally to feed. Researchers theorize the tactic could be a strategy against predators. But the holes are sealed so tightly that oxygen should run short.

In the early 1980s, Grant and veterinarian Richard Whittington found yet another rare adaptation. The creatures have an inordinate number of red blood cells, similar to that of prairie dogs, unrelated animals which also survive with little air.

The female's mammary glands are proportionately very large. In the middle of this century, scientific literature reported that the young feed by licking fatty discharge from the fur. Then scientists thought they established that the glands produce true milk and that nipples have evolved to accommodate the young's bills. But recently a worker at Queensland's Fleay's Fauna Centre reared a young orphan by feeding it a milk mixture sprayed on brush bristles, giving new credibility to the first notion.

Aborigine legend has it that the first platypus egg was laid by a duck raped by a water rat. It was a notion nineteenth-century taxonomists might have welcomed when they grappled with classifying the animal. Some thought it was a primitive mammal, a possible bridge to reptiles.

That early confusion still generates scientific debate. For every bit of proof the platypus is a mammal, there seems to be another signaling a reptilian link. Although it lays eggs, the female platypus's hormonal changes are remarkably similar to those of other mammals. Males produce structurally simple sperm like that of reptiles, but with mammallike cell parts. The animal's pectoral girdle is reptilian. But, asks Frank Carrick of the University of Queensland, who has studied the platypus for 20 years, why not call it molelike? "After all, both mammals dig tunnels. Their skeletal structure is as apt to be a response to function as it is anything else." And what about the male platypus's spurs? "All reptiles with venomous systems have modified salivary glands," Carrick says. "How do you explain the platypus's venomous system placed on the hind legs?"

Almost two centuries ago, a British scientist came up with the Latin name *Platypus anatinus* for the "duck mole," as many colonials knew it. But this scientific name was scrubbed for *Ornithorhynchus anatinus* when it was discovered that a group of beetles was already known as Platypus. Probably because the correct name is such a mouthful, it is used only by scientists, and "platypus" has survived for popular usage.

The creature belongs to the lonely mammalian order of Monotremata, which means "one hole" for excreting waste and reproduction. Only the echidnas—two species of spiny anteater in Australia and New Guinea, also egg-layers—share the order. The classification places platypuses beneath both placental mammals such as otters and marsupials in evolutionary development—a position scientists increasingly question.

As it dives, bubbles escaping from its thick fur, a platypus scans back and forth with its bill to detect electric signals created by small invertebrates —freshwater shrimp and insect larvae.

Theories of the platypus's origins were further confounded in 1984, when paleontologist Alex Ritchie visited the Lightning Ridge opal fields in New South Wales to look over some fossils. His trained eye riveted on a fragment: the opalized jawbone and three teeth of a cat-sized mammal, fossils that would date back 100 million years in a country where till then the oldest known mammal was 24 million years old.

Ritchie phoned Michael Archer of the University of New South Wales, who oversees Australia's famous Riversleigh dig, which has yielded the fossil remains of more than 100 unknown species. The next day, in a dingy Sydney hotel room, Archer recognized the jaw as belonging to a platypuslike creature—an animal that lived when dinosaurs roamed the Earth. He called the discovery "heraldic." News of the fragment—named *galmani* in honor of opal miners Dave and Alan Galman, who found the jaw—ricocheted throughout the scientific community.

The fossilized adult jaw has teeth. But today's platypus has only degenerative teeth replaced with horny pads before maturity. That change has kicked off much debate about the future of the animal. "Today's platypus is more specialized than his extinct cousin," says Archer. "Without teeth it has limited dietary options, which makes adaptation to dietary changes more difficult."

Overspecialized or not, the platypus seems to fare well enough if it is left alone. Besides its wide distribution and broad-spectrum diet, its combination of extreme wariness and tunnel life has made it nearly predator-proof (though a crocodile may gulp one down in the tropics, or an eagle or dingo might snatch one traveling across land).

Grant has found evidence that platypuses can withstand severe habitat upheaval. He monitored populations before and after a flood that changed a river from a series of deep pools to a raging mass of brown water. "Amazingly, many of the animals I tagged before flooding were in the same pools when the river subsided," he says. "How they accomplished that, nobody knows."

Ultimately, the animal that once seemed to be nature's joke could, with its extraordinary mix of specialized adaptations, prove to be nature's last laugh. "The platypus has 100 million years under its highly sophisticated mammalian bill," says Carrick of the University of Queensland. "That's success." ▣

Eric Hoffman is the author of Adventuring in Australia, *a natural history guide to the Outback (Sierra Club Books, in press). Australian filmmakers David Parer and Elizabeth Parer-Cook specialize in natural history subjects and documentaries.*