Eccentric Echidna

Australia's Other Egg-Laying Mammal

The short-beaked echidna (Tachyglossus aculeatus) *forages with its nose to the ground. The narrow, sensitive snout contains electrochemical receptors that help an echidna find food and detect danger. The echidna lacks a hinged jaw, but an opening at the end of its snout permits its six-inch-long tongue to probe for ants, termites, and grubs. Echidnas also use their powerful claws to dig for food.*

by Eric Hoffman

Nineteen hundred and ninety-two, two hundred years after this strange animal was first presented to the Royal Zoological Society in London, has been declared The Year of the Echidna. It is about time this shy anteater was given some attention. Over the years it has caught the eye of very few scholars, especially in Australia. The latest researcher to be captivated by this little known monotreme is a German-educated American.

Operating on a shoestring budget, Peggy Rismiller has dedicated the last four years to field studies of the short-beaked echidna (*Tachyglossus aculeatus*). Her labo-

ratory is the seventy-mile-long Kangaroo Island, much of it naturally vegetated in heath, fern gullies, and low-growing varieties of eucalyptus, called mallee scrub. It rates as among the best echidna (pronounced "ee-kid-na") habitat anywhere. Free from the scourges of most feral predators, Kangaroo Island is generally known as one of the last bastions for Australian wildlife. Yet it is located only a few miles offshore from South Australia's capital city of Adelaide.

Arrival at Pelican Lagoon, where Peggy Rismiller lives with naturalist Mike McKelvey, is a step back in time of one hundred years, or it could be a visit to a different planet. None of the vegetation looks familiar, nor does a nearby mob of Tammar wallabies sunning themselves near the front porch.

Our hosts are headed towards the sea to collect supper. In about 30 minutes they gather a bucketful of shellfish, pick a salad from the garden, and locate a bottle of wine for the occasion of two visiting scientists and a journalist. We eat outside at a table next to an open fire. Just beyond is a moving tableau of non-human guests hopping and strolling across the late-afternoon sky. Brush-tailed possums, tiny Tammar wallabies (nearly extinct on the mainland), and three-foot-long goannas—a kind of monitor lizard—come within a few yards of the table, each casting a solicitous eye our way.

At sunset Rismiller releases a venomous tiger snake she has captured the day before. Then she demonstrates how to catch the deadly reptile, should the desire ever well up in any of us someday. Before turning in we stroll under a full moon to the Indian Ocean and watch fairy penguins come ashore and scamper to their nests in the miniature limestone catacombs along the shore. Night in the tiny guest house, with its gravity-fed bucket shower, isn't as tranquil as I assumed it would be. For hours possums work at resolving a territorial dispute on the corrugated metal roof over my head. Occasionally, chattering, loud squeaks, and heavy footsteps are interrupted with a resounding thump as a possum is either shoved or falls from the roof—only to climb up again and return to the fray.

M. McKELVEY/P. RISMILLER

When threatened, an echidna curls into a ball, with only its spines showing—an effective defense against most predators. Foxes and dingos, however, have learned to flip the echidna over to expose its unprotected underside. Instead of scurrying out of the way, echidnas often adopt their defensive posture in the face of oncoming vehicles.

Before dawn Rismiller and McKelvey rouse us so we can stagger after them through the dimly lit mallee scrub to a termite mound frequented by echidnas. Rismiller's enthusiasm for these creatures is infectious. "How often do you get to be the first person to record unknowns about the ecology of such a unique species?" she asks of her three guests. "For a scientist," McKelvey continues "this is a chance of a lifetime."

"The fact that the echidna is such a pleasant little creature just adds to the enjoyment," says Rismiller, who grins broadly while pointing towards a single echidna rooting through a termite mound in front of us. The echidna senses our approach. It digs straight down churning away with its sharp claws and powerful forelimbs until it is no longer visible. Later, we discover another one that dem-

onstrates the more common echidna defense. It sits perfectly still hoping to go unnoticed. When it sees there is no escape it rolls into a tight little ball, hiding its face and limbs. We handle it gingerly. The echidna is nearly a symmetrical orb, with spines erect in all directions.

Rismiller explains, "They are very sensitive to noise, vibration, or even a shadow passing over them. They are discriminating, too. They know which creatures pose a real danger. We've seen kangaroos hop up to a foraging echidna and sniff it. Usually the echidna ignores the kangaroo and continues rooting through a termite mound unperturbed. On the other hand, when a person walks near they usually take immediate defensive action."

Just how clever and elusive an echidna can be was made clear to Rismiller during her first year of research. She tracked a male that was wearing a transmitter needing new batteries to his burrow under a termite mound. "Knowing that echidnas are sensitive to vibrations I waited motionless 30 feet from the burrow's only entrance. After three hours the echidna cautiously poked his head out and sniffed the air. A nose in the air was new behavior to me. Normally echidnas travel with their noses to the ground. This echidna slowly came out, pointed his nose in my direction then retreated rapidly back into his burrow. After waiting hours more for him to reappear I walked to the termite mound and found that he had dug out the back of the mound in the only place out of my field of vision."

Because they lay eggs, echidnas are often portrayed as some kind of primitive mammalian link between reptiles and placental mammals. Adherents to this philosophy place echidnas at the bottom of the mammalian evolutionary ladder. Rismiller disagrees. "Evolution isn't necessarily a lineal progression. There are scientists who try to explain mammalian evolution with the egg-layers at the bottom, followed by the marsupials, like kangaroos and wombats, and at the top they place placental mammals as the evolutionarily most advanced. Sometimes accompanying this view is the belief that the creatures at the lower end of the ladder are less intelligent and responsive to predators and other dangers, thus making it more vulnerable and less likely to survive. It just isn't that simple."

THE RECLUSIVE echidnas Rismiller is studying are found throughout Australia and on the large offshore islands of Tasmania and Kangaroo Island. Nobody knows in what densities they occur or in what regions human activities adversely affect them. There is some discussion as to the number of subspecies, four, five, or six, but each is distinguished from the others by differences in a grooming claw found on their hind legs, and by the density of their hair and spines.

To an untrained eye an echidna from anywhere in Australia looks about the same. Adults weigh between five and ten pounds and rarely measure more than 12 inches in length. At first glance an echidna looks like a cross between a European hedgehog and a North American porcupine, but it is related to neither, except, of course, that all three are mammals.

On closer inspection an echidna is even more anatomically baffling. The echidna has tiny eyes set close to the base of its snout (or beak). Instead of a hinged jaw it has a naked, slender snout with a small orifice near the end for its six-inch tongue to slip through, plus two tiny nostrils at the tip of the snout. The ribbon-like tongue can extend far into a termite mound or ant colony and can retrieve dozens of insects with a single flick. The

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Seventy-mile-long Kangaroo Island lies a few miles offshore from the southern Australian city of Adelaide. The island retains much of its natural vegetation as in this view of Flinders Chase National Park. A haven for wildlife, the island has its own subspecies of echidna.

ERIC HOFFMAN

American biologist Peggy Rismiller has spent the past four years studying echidna behavior. Using radiotransmitters, she has tracked up to 15 echidnas for 24 hours a day. Long-term monitoring of the echidna in the wild has helped Rismiller unravel some of the mysteries surrounding this monotreme.

tongue has evolved unique grooves allowing it to hold onto several insects at once. "They can eat things much bigger than was once thought. We call witchety grubs, a two-inch larva and a well known Aboriginal staple, 'echidna milkshakes,'" explains Rismiller. "When an echidna finds one it pokes a hole in it and slurps out the contents."

Echidnas are busy foragers. The long snout is quite tough and is used as a trenching device and mini pry bar. Evidence of their whereabouts is seen in soil where they've cut shallow furrows through the earth looking for insects. A churned-up section of earth usually means an echidna has found nesting insects, often termites, and dug them out.

Even the fecal matter of an echidna is unique. Excrement comes in a thin semi-transparent membrane that looks like cellophane. It's thought that the membrane evolved to protect the lower intestinal tract of the echidna from sand and debris ingested along with food that is passed through the animal.

The claws of their hind feet befuddle people. They point backwards, and many a wildlife artist insists on reversing them to create an appearance similar to other animals. But the echidna has far stranger oddities. For instance, instead of two openings the echidna has one, called the cloaca (Latin for "sewer") for both reproduction and passing waste. The female echidna lays a leathery egg which is transferred to her pouch where it hatches. The baby then suckles its mother's milk like other mammals. Well, almost like other mammals. The echidna doesn't have teats, the milk is secreted from pores at the base of specialized mammary hairs located on either side of the anterior end of the pouch.

Just what an echidna is related to has been debated from the time the first pick-

During the breeding season "trains" of male echidnas may follow a single female for weeks. The males dig a rut around the female and have a shoving match until only one remains. Here, a male courts the female (wearing a transmitter) by prodding her with his snout. If she is receptive, the male will stroke her spines until they flatten, and then he will lie on his side in the rut to mate.

led echidna arrived, to considerable confusion, at London's Royal Zoological Society. Its coat possessed both hair and spines and for a time the skin was thought to belong to a new species of porcupine. But, instead of a jaw with incisors used for gnawing, this new creature had an elongated snout and flexible tongue. George Shaw wrote the first scientific description of the echidna and concluded it was related to the South American giant anteater (*Myrmecophaga tridactyla*).

In 1802 Sir Everard Home, a British anatomist, discovered the similarities between the echidna and the duck-billed platypus (*Ornithorhynchus anatinus*), which also lives in Australia. As the two animals were the only mammals with a cloaca they were assigned to the lonely mammalian order of Monotremata which means "one hole."

Later, a third monotreme was discovered in the wilds of New Guinea. This is the long-beaked echidna (*Zaglossus bruijni*) that survives on a diet of earthworms. The Australian species with its narrow three-inch snout is known as the short-beaked echidna (*Tachyglossus aculeatus*), or to most Australians, the spiny anteater.

AFTER CLASSIFYING the echidna as a relative to the platypus, it took nearly 80 more years for scientists to figure out that these two creatures shared another secret. In 1881 Wilhelm Haacke, the director of the South Australian Museum in Adelaide, discovered in an echidna's pouch an egg which promptly ruptured. Haacke recorded that the female had a well developed pouch that appeared large enough to carry young much larger than the one-inch-round egg he had discovered.

That same month a Scottish naturalist, William H. Caldwell, found an egg in the pouch of an echidna brought to him by an aborigine. An earlier account of eggs found near a caged platypus had been discounted as aborted births. Caldwell also discovered that both the echidna and the platypus had pouches and laid eggs. When Caldwell made his discovery he sent off a telegram to the Royal Society in Montreal where top biologists were meeting. The telegram, heralded as one of the great revelations in biological science, read: "Monotremes oviparous, ovum meroblastic." In common language Caldwell's message meant that monotremes lay eggs similar to birds and reptiles.

As this news ricocheted through the European scientific community it prompted new ideas and theories about the evolutionary connection among amniotes—reptiles, birds, and mammals. Two popular theories emerged. One argued that monotremes and marsupials are linked through a common ancestor sometime in the distant past. Though the echidna lays an egg it also has a small pouch somewhat like a marsupial. The other theory put monotremes on their own evolutionary limb evolving separately over 150 million years ago, and splitting off from the evolutionary tree even closer to the common ancestor of all mammals. The earliest fossilized monotremes discovered in Australia, dating back 100 million years to the time of the great dinosaurs, have teeth. So monotremes lost features that other mammals kept, and kept many features that other mammals lost.

Theories aside, here was a mammal that laid eggs and suckled its hatchling on mammary glands: it presented a paradox that defied commonly held notions about mammals. The fact that the echidna was a highly specialized forager relying on its snout and whip-like tongue to extract insects from hard to reach places for millions of years seemed to contradict another popular notion. It was thought that a highly specialized species possessing only a narrow ability to procure its food was less apt to survive severe climatic, and subsequent dietary changes. Yet, here was the echidna, highly specialized and a survivor from the time of the dinosaurs.

Caldwell's telegram led to worldwide scientific interest in monotreme reproduction. The German biologist Richard Semon arrived in Australia in 1891 hot on the trail of echidnas. But he quickly learned that just finding the naturally secretive echidnas was his most formidable challenge. By enlisting aborigines as collectors and by listening carefully as they explained their knowledge, Semon was able to learn a great deal and produced a series of remarkable multi-dimensional drawings of embryonic development of the echidna that have yet to be surpassed.

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An aboriginal rock painting from the Cape York Peninsula depicts a short-beaked echidna. Echidnas provided meals both for aborigines and early English settlers.

Unfortunately, Semon's illustrations and journals were lost to researchers for most of this century until renowned monotreme expert Mervyn Griffiths referred to them in his 1978 book *Biology of the Monotremes*. Griffiths, who had become interested in the echidna during the late 1950s, was largely responsible for rekindling interest in the monotreme and began unlocking many of its mysteries. More recently, under the direction and encouragement of Rismiller and colleagues, other scientists, locals, and Earthwatch volunteers have contributed thousands of hours yearly monitoring echidna ecology. Some basic biological questions posed over 125 years ago are finally being answered.

The embryonic echidna uses an egg tooth to help it hatch from its leathery, grape-size egg. A newly hatched echidna weighs less than half a gram and is only half an inch long. It clings with tiny claws to mammary hairs in the mother's pouch where milk secretes. The discovery in 1881 that the echidna, like the platypus, lays eggs, created a scientific sensation.

M. McKELVEY/P. RISMILLER

THE NEW research has proved "common knowledge" about echidnas to be something less than accurate. The first myth Rismiller uncovered was that groups of echidnas often seen traveling together were not, as the folklore had it, family groups. These groups are called "trains" because they are made up of animals traveling in close proximity to one another and often in single file. According to Rismiller, echidna "trains" turn out to be males courting a single female. "The female, which is often the largest, leads with males following close behind. The smallest animal at the rear is usually a young male tagging along, more in a student-voyeur role than an actual participant," explains Rismiller. "The distribution of size with the largest animal going first and the smallest bringing up the rear gives the appearance of a family grouping, which it is not."

The males may follow closely behind a female for weeks until she is receptive. Rismiller's team has documented the end of the "train" behavior when the amorous activities of the male and receptivity of the female result in copulation. She spurns the early advances of the male prodding with his beak by curling into a pincushion. When she is receptive she remains flat on the ground often with her head and front feet dug in, to gain purchase. Courting males dig around the female forming a rut five to ten inches deep. When the rut is sufficiently deep, the males have a shoving match, until one remains.

When mating with a pincushion, "foreplay" becomes important. The male often strokes the female's quills with his front foot prior to copulation. This appears to help relax the female whose quills undulate and then lie flat. The male lies on his side in the rut exposing his furry belly to hers. He sports a seven-centimeter penis, which is one-fourth the length of his body. It also has four openings which create an ornate-looking head somewhat resembling a miniature cauliflower. "With this degree of exposure, it's no wonder the male echidna positions himself so carefully and strokes the female to relax her quills before attempting penetration," notes Rismiller. When the female appears relaxed and the male is snuggled into position, copulation begins and may last up to two hours.

How the males find the females is still a mystery, though Rismiller feels she is close to solving it. The scent of the female during her receptive period seems to be the key. In two different experiments Rismiller placed the female, picked up in a train, in a cloth bag. In one instance she placed the bag with the female inside some distance from the males. In other instances Rismiller placed a bag that a female had been in on the ground. In both cases, within a few hours, males arrived and began prodding and scratching at both the empty bag and the one with a receptive female inside. A male echidna removed from a train was able to negotiate a four-kilometer obstacle course of rough country to return to the spot he had last been with the train. Semon noted that both females and males give off a musk odor that may help them locate one another. Rismiller says when close to the ground near a "train" she also whiffs this odor.

During hours of field work, Rismiller has uncovered other discrepancies with the common wisdom. Echidnas are not always nocturnal. She has found echidnas readily mate and forage during both day and night, even when it's raining. But, like the rest of us, they seem to be less active on hot, sunny days. Carrying an egg doesn't seem to affect female behavior.

It still baffles science how the echidna lays its eggs into its pouch. Semon guessed perhaps the egg is shoved along the ground by the echidna and somehow rolled into its pouch. Griffiths speculates that an echidna in sitting position can, with a nudge from her snout directly pass an egg from her cloaca to the posterior section of her longitudinal pouch. If this is how it is done, the egg never touches the ground. Griffiths' explanation makes good sense because echidnas have often been observed sitting upright while grooming their stomachs with their snouts, demonstrating the dexterity needed to transfer the egg.

Forty days after hatching, the baby echidna, called a puggle, is bare and shrivelled but quickly puts on weight with its rich milk diet. The puggle turns gray as its hair and spines start to grow, prompting the mother to transfer her offspring from the pouch into a burrow, where she continues to nurse it every five days for several months.

The egg is round to oval in shape with the diameter of a ten-cent piece. It is covered with a leathery shell and weighs about one and a half grams. Mervyn Griffiths has determined that once the egg moves to the pouch it incubates for about ten days before hatching.

Rismiller and McKelvey are among a very select group that has actually seen an egg hatch. The tiny, translucent young pushes free of the shell with an egg tooth (a horny projection rather than a true tooth) common in reptiles and birds. The hatchling is only about a half inch in length but full of energy and capable of gripping stomach hairs as it struggles to the nursing areas. The echidna doesn't have nipples for disgorging milk. Instead she has two milk patches, or areolas, where over a hundred pores allow milk to pass through the mother's skin, along hairs. It was thought the tiny young nursed by licking the milk-coated hair but it has since been found that the hatchling must suck in the areola to stimulate milk production. As the baby imbibes milk its body swells and the milk is clearly visible inside the growing youngster.

The milk is very rich. Pouch young can grow from a half gram at the time of hatching to over four hundred grams in two months. To produce enough milk for their gluttonous offspring, Rismiller found, a mother may travel as much as three kilometers a day foraging under rocks and in termite mounds and ant colonies as she makes her rounds. The growing baby, the puggle, remains naked, with wrinkly grayish skin, blind, and sports pronounced ear slits. In appearance a puggle looks vaguely like the sci-fi movie character, E.T. At about 50 days in the pouch the puggle begins to grow quills which literally prickle the mother into off-loading it into a burrow. The mother goes on suckling the burrow young for another five to six months but on a less rigorous schedule. In the burrow phenomenal growth continues. A single feeding can increase a young's body weight 20 percent.

A GREAT DEAL of new information has been collected by the Kangaroo Island researchers, but many unknowns persist. The researchers discovered that predators such as large goannas can and do kill burrow young. It is also known that dingos, a relatively new (10,000 years) predator on mainland Australia can successfully penetrate an echidna's curled pin-cushion defense by rolling an echidna on its back and waiting patiently for it to uncurl and expose its vulnerable stomach area to attack. Feral predators, particularly cats and foxes, also take their toll, but to what degree they threaten populations isn't known.

Aborigines have probably eaten echidnas for most of the 40,000 years they've occupied the island continent. Early accounts from English convict colonies that settled Australia also listed echidnas as among the edible creatures the country had to offer. However, as time passed and livestock became established the European palate returned to traditional European foods.

In today's Australia it's not dietary habit that has scientists wondering about what lies ahead for the echidna. Roads criss-crossing the landscape prove to be the undoing of many a spiny anteater. Unfortunately, echidnas often curl into a ball when sensing an approaching vehicle rather than scurry out of harm's way. Still another unknown is the changes to the countryside since European occupation. Much of Australia's arable land has been converted to vast tracts of grain crops. This conversion often rids the landscape of decomposing woody material, the food of termites and other insects. And the use of insecticides undoubtedly impacts the echidna's food sources.

For millennia the echidna has shuffled through the underbrush lapping up insects and digging itself out of sight to avoid trouble. Nobody has the slightest idea how many echidnas live in Australia, or even where they are. "Most maps showing Australian mammals indicate echidnas are distributed over the entire continent. This is guess work," explains Rismiller. "There have been no studies."

Rismiller and other scientists have recently undertaken an ambitious project, "Echidna Watch," which is a nationwide effort organized through the Gould League, to assess just where the echidnas are or aren't. Named after the famous naturalist Jay Gould, the Gould League is largely made up of students and bushwalkers who involve themselves in wildlife preservation. "For the first time hundreds of people are wondering about the whereabouts and welfare of the echidna. Regardless of the outcome of this census," smiles Rismiller, "a great number of young Australians are learning to appreciate echidnas." □

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