



# NATIONAL GEOGRAPHIC

---



BOTH BY NATIONAL GEOGRAPHIC PHOTOGRAPHER WILLIAM ALBERT ALLARD

## From the Editor

"FOLK MUSIC?" remarked legendary bluesman Big Bill Broonzy. "I don't know no other kind but folk music. Did you ever hear a horse sing it?"

Of course he had it right. Music is about people, about culture, about history. It is as natural a subject for NATIONAL GEOGRAPHIC as Egyptology or dinosaurs. But you can paint a cutaway of a pyramid and assemble a T-rex skeleton. How do you evoke in words and pictures something as ethereal, and yet as essential, as music?

Author Charles E. Cobb, Jr., searched to find the right approach for an article about African-American music. First he considered jazz, then a biography of Louis Armstrong. Finally Cobb settled on the blues, the crucible of African-American music, and how it evolved as blacks migrated north from the Mississippi Delta.

"The songs themselves are stories," says Cobb. "They draw you to the people and their history."

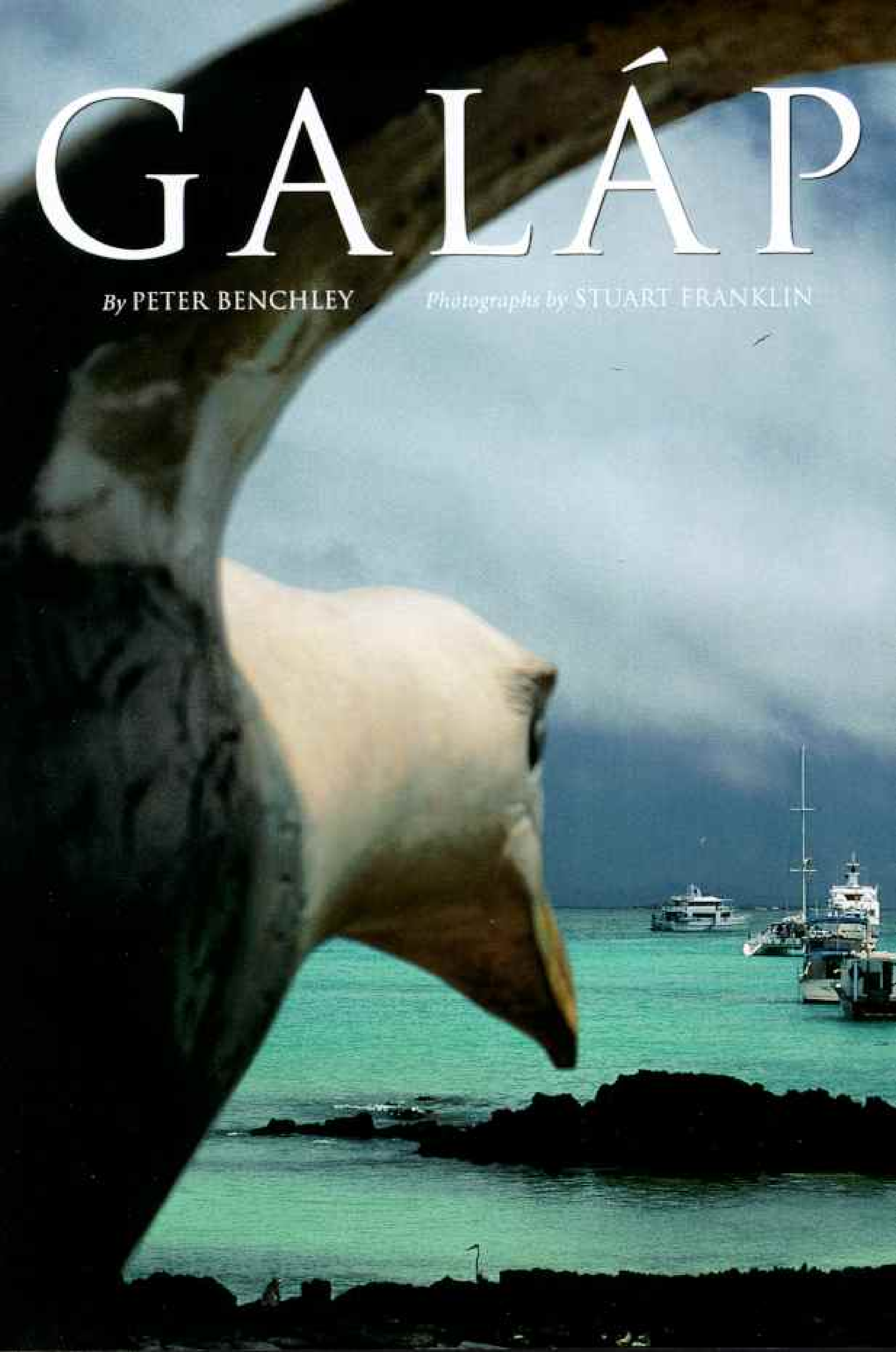
His heartfelt ode to the bluesman—and William Albert Allard's soulful photographs ranging from the glitter of Beale Street in Memphis to blues master B. B. King playing in Pickens, Mississippi (above)—conveys the sorrow, the triumph, and the beauty that are the blues.

*Bill Allen*

# GALÁP

By PETER BENCHLEY

Photographs by STUART FRANKLIN



# AGGOS

## *Paradise in Peril*

*IMAGINE PUERTO AYORA without fishing and tourist boats and that concrete albatross, and you get a picture of the pristine South American islands Charles Darwin visited in 1835. But the picture has since been developed.*





*JUNKYARD SURVIVOR: Marine iguanas have thrived in the Galápagos, but the detritus of human development threatens many of the islands' 1,900 endemic species. "Garbage. Muck. Plastic bags," says one long-time resident. "It's going downhill."*



*"THEY APPEARED MOST OLD-FASHIONED antediluvian animals or rather inhabitants of some other planet," Charles Darwin noted about Galápagos tortoises. Once as many as 250,000 of them roamed the islands; today some 15,000 remain.*



**O**N A SANDY BOTTOM in a sheltered cove of a volcanic island 600 miles west of the shoulder of South America, there lives a fish.

No bigger than a pistol, it has ruby red lips perpetually curled downward (think of Carol Channing in a pout), topped by dark eyes and a fetching hornlike, noselike protuberance studded with tiny spines. It supports itself on fins that resemble gnarled limbs, and when it moves, it sort of hops, sort of lunges. It makes its living by grubbing around in the sand eating mollusks and other hapless miniatures and by "fishing" with the hornlike, noselike thing, which has sensory organs that help it detect prey.

In its realm it is as noble a piece of work, as finely tuned to its environment, and as precisely evolved as you and I. We call it *Ogcocephalus darwini* or the red-lipped batfish.

An equally intriguing bird lives on another island up north in the same archipelago.

Slightly larger than a tennis ball, it lands upon the backs of bigger birds and pecks at them until they bleed, and then it drinks their blood. And when times are tough and things are slow, it rolls other birds' eggs down hills to break them open to get at the savory contents. It is a finch, a finch you do not want to cross. Scientists call it *Geospiza difficilis*. I prefer its nickname, for never, not even in my most disturbed dreams, had I imagined that there exists in the world such a thing: the "vampire finch."

The reptiles of these islands are remarkable too, and I was able to swim in company with a superlizard.

No bigger than most house cats, it is possessed of such formidable armor and malevolent mien that when the makers of the latest *Godzilla* epic went looking for a prototype, they selected this lizard (tarted up to look a lot bigger and meaner) as a model for the star. Technically, the lizard is an iguana, the world's only marine iguana, *Amblyrhynchus cristatus*. What makes it super in the kingdom of lizards

---

PETER BENCHLEY has been contributing to NATIONAL GEOGRAPHIC magazine for almost three decades; his most recent assignment took him to French Polynesia (June 1997). During his 13 weeks in the Galápagos, photographer STUART FRANKLIN visited more islands than Charles Darwin did but is amazed by how much the great naturalist observed in only five weeks.

*A PATH to a better future? Some say this paved road will improve the quality of life both for Santa Cruz's residents and for the immigrants drawn by the booming tourism industry. But others bemoan such black scars because they speed up the development spiral by luring more workers and their families, who require more schools and services, which demand more revenues—and more tourists. Once you start down that road, say critics, it's tough to put on the brakes.*



is that it is amphibious: It takes most meals underwater. It eats the algal fuzz off rocks.

These three splendid characters have one important thing in common: They are all indigenous to the Galápagos Islands, a handful of young volcanoes—some still active—that form the westernmost province of Ecuador.

As a landmass the Galápagos archipelago is insignificant. Its 13 large islands, 6 small islands, 42 islets, and innumerable rocks, humps, bumps, and pinnacles make up 3,000 square miles of land on a 50,000-square-mile patch of Pacific Ocean.

As an ecosystem and a natural laboratory, however, it is high on the list of the most important on the planet. Over the past 150 years it has contributed incalculably to our understanding of our origins, our existence, and our destiny.



Despite a scarcity of fresh water during all but a few months of each year, hundreds of terrestrial plant and animal species have developed and flourished in the Galápagos, and because of the islands' isolation from not only the mainland but also the traditional lanes of maritime commerce, these species have been able to adapt and evolve in pristine nature. Nearly half the birds, 32 percent of the plants, 90 percent of the reptiles, and 46 percent of the insects in the Galápagos exist nowhere else. And of the original roster of species in the archipelago, the vast majority still exist, remarkable considering that human beings have known of the islands for at least 450 years.

The Galápagos are without peer as a marine ecosystem too. Located at the juncture of several major Pacific currents, the undersea mountains help generate a massive cold-water

upwelling that feeds the entire chain of sea life, from the tiniest planktonic creatures to the greatest of the whales.

I've visited the Galápagos three times over the past dozen years, always with my dive gear, and every time I've strapped on a scuba tank and stepped off the stern of a boat, I've been jazzed. Not only is the diving tough and taxing—open-ocean currents that swirl around underwater mountaintops can be strong and utterly unpredictable—but it usually serves up a full menu of surprises.

I have begun days watching orcas and dolphins frolicking in the early light, then swum with sharks and rays and curtains of shimmering jacks, seen sea lions toy underwater with the long-suffering but imperturbable iguanas, and exulted as the sun set behind an entire pod of sperm whales gathered socially

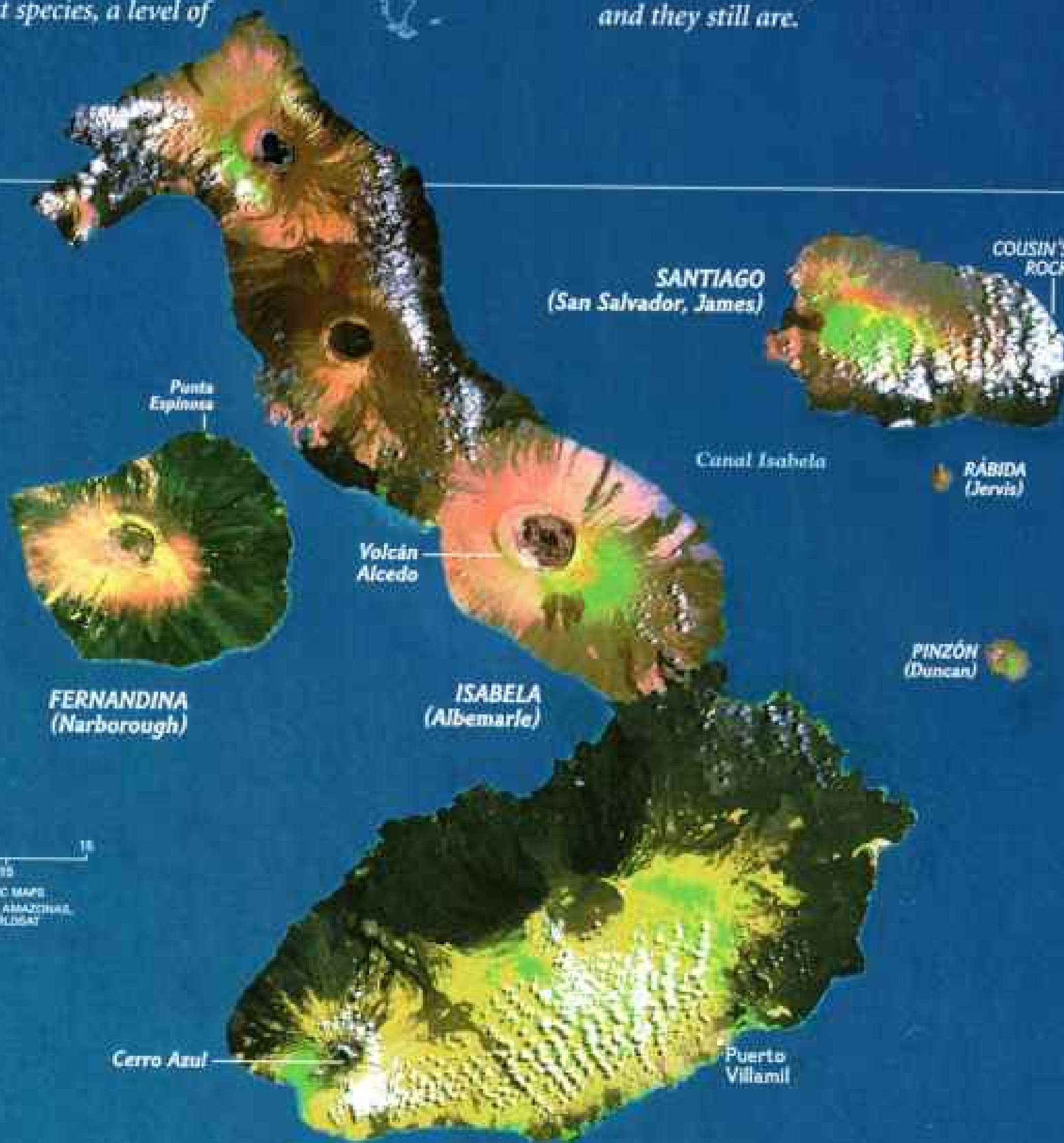


# THE GALÁPAGOS ISLANDS

IN SPECTACULAR SECLUSION some 600 miles off the coast of Ecuador, this volcanic archipelago poked above the Pacific Ocean less than five million years ago—just a heartbeat in geologic time. Today the Galápagos are home to more than 5,000 different species, a level of



biodiversity nourished by a wide variety of habitats. "I never dreamed," wrote Darwin, "that islands . . . most of them in sight of each other, formed of precisely the same rocks . . . would have been differently tenanted." But they were, and they still are.



0 mi  
0 km  
10  
10  
NATIONAL GEOGRAPHIC MAPS  
MADE BY FUNDACIÓN AMAZONIA,  
QUITO, ECUADOR, WORLDGAT  
INTERNACIONAL INC.

THE ISLANDS OF DARWIN AND WOLF ARE LOCATED ABOUT 110 AND 90 MILES NORTHWEST OF ISABELA, RESPECTIVELY.

THIS LANDSAT SATELLITE MOSAIC COMBINES 13 FALSE-COLOR IMAGES TO FORM A VIRTUALLY CLOUDLESS VIEW OF THE MAIN GALÁPAGOS ARCHIPELAGO. DENSE VEGETATION APPEARS AS GREEN, SPARSER VEGETATION AS PINK, AND ARID SOILS AS BROWN. THE OCEAN SURFACE WAS ARTISTICALLY ENHANCED.

SECONDARY NAMES OF ISLANDS, MANY STILL IN USE, APPEAR IN PARENTHESES.

Pacific Ocean

Canal de Marchena

GENOVESA  
(Tower)



EQUATOR



ONE SPECIES BRANCHING out to become many—biologists call the process *adaptive radiation*, and it was among Darwin's most revolutionary insights. He based his theory in part on observations of the islands' 13 species of finch, each with a different beak suited to a different food. The large ground finch, for example, uses its stout beak to crack and eat hard seeds; the cactus finch probes cactus flowers with

its long pointed beak.

What would Darwin have made of the rare Galápagos hybrid above—probably part mangrove finch, part ground finch—which represents a step in the opposite direction from speciation? Biologists are just starting to study the role of such hybrids in evolutionary change.

SAN CRISTÓBAL  
(Chatham)

Puerto Baquerizo Moreno



SANTA FE  
(Barrington)

Puerto Velasco Ibarra

FLOREANA  
(Santa María, Charles)



ESPAÑOLA  
(Hood)





*CAMERA AFFIXED* like a high-tech appendage, a tourist starts shooting as he hits the runway on Baltra. A 700 percent increase in tourism in 20 years has generated much-needed revenue, but it has also spurred conservationists to seek restrictions on tourism to minimize environmental damage. While interactions with wildlife are carefully controlled, close encounters such as snorkeling with sea lions are unavoidable.



on the surface to bask in the warm evening. For fecundity, diversity, and sheer fascination I have seen no place like it on the globe.

The Galápagos have been designated a World Heritage site by UNESCO; the islands are a national park, and the sea around them is a marine reserve. But somewhat like an old soldier rich in medals but poor in pension, this precious natural treasure is suffering and in danger.

Stressed by the combined pressures of politics, overcrowding, economics, and, most recently, catastrophic weather, the World Heritage site has come close to being declared officially endangered. To help combat these pressures, the government of Ecuador passed the Special Law for the Galápagos in 1998. It puts restrictions on immigration, increases the percentage of tourist revenue going to the national park, expands the limits of the marine reserve around the islands, and regulates the transport of introduced species. Still, the populations of several species are diminishing with alarming speed—fished out in many cases, gobbled up in others.

On the island of Santiago, for example, feral pigs—introduced in the 19th century by mariners so that they could have pork chops—have grown in number and appetite, and they now eat many of the eggs and hatchlings of the resident green sea turtles. On some islands the turtles' survival rate has declined dramatically.

Sharks, which I recall as almost frighteningly abundant on my first visit in 1987, are now scarce throughout the islands, affected by El Niño and humans alike. Gone are the clouds of hammerheads that would block the sun from a diver looking up from the bottom; gone too are the schools of robust and inquisitive Galápagos sharks that pursued my white-bladed swim fins to the surface and propelled me into a Zodiac in the forbidding shadow of Roca Redonda. Some sharks have fallen victim to long-liners, modern fishing machines that set heavy lines with many hooks across as much as 80 miles of open ocean, killing indiscriminately anything suckered into taking a bait. Others have been, quite literally, finned to death—caught by fishermen who slice off their fins for the soup markets of Asia and toss the living animals back into the sea to die.

Sea cucumbers—lumpy, sluglike animals—graze the sea bottom, processing and aerating its sediments. In 1992, one prize species was "discovered" in the Galápagos by Asian entrepreneurs, who offered a rich price per animal. A fishing frenzy ensued. Fishermen flocked from the mainland, illegally camping and curing sea cucumbers in national parklands on uninhabited islands. Government limits succeeded only in provoking violence. Conservationists were threatened. In 1997 a Galápagos park warden was shot by poachers. And in retaliation against restrictions, vigilante fishermen butchered several score of the magnificent tortoises on Isabela Island, some of which had been crawling in the high meadows since well back into the reign of Queen Victoria.

ANY OF THOSE TORTOISES might conceivably have been the one on whose back Charles Darwin rode when he visited the Galápagos in 1835. Darwin spent five weeks in the islands, observing and collecting, and then embarked on the last year of his five-year voyage aboard the *Beagle*.

Although 24 years would pass before Darwin published *On the Origin of Species by Means of Natural Selection*, the material he gathered from the Galápagos was critical to his treatise. As he noted earlier in *The Voyage of the Beagle*, "both in space and time we seem to be brought somewhat near to that great fact—that mystery of mysteries—the first appearance of new beings on this earth."

Darwin was certainly not the first European to visit the archipelago, and Europeans were not the first humans. Archaeologists have found possible evidence of visits 600 years ago by pre-Columbian voyagers. The first recorded visit was accidental, brief, and not at all encouraging. In 1535 Tomás de Berlanga, Bishop of Panama, was on his way to Peru when he was blown far westward. On sighting the islands he wrote: "It looked as though God had caused it to rain stones." Not exactly a ringing endorsement for the tourist brochures. Later Spanish voyagers would dub these islands *galápagos*, an old Spanish word for a particular kind of saddle that the tortoises were said to resemble.

In the first decades of the 20th century a few daring businessmen launched ventures



*A WORLD AWAY FROM THEIR COUSINS in Antarctica, Galápagos penguins are the only penguins to live and breed as far north as the Equator. The cold waters around Fernandina Island supply the fish these penguins need to survive.*



that failed in the hot and hostile terrain, and a few Europeans moved to the settlement of Puerto Ayora on Santa Cruz Island. Some, like the Angermeyer family from Germany, combined a distaste for the Nazis with a desire for a Robinson Crusoe kind of life.

Then, in the late 1960s, Galápagos tourism was born, and with it came the modern world, with all its promise and all its problems. Money flowed in, but so did pollution, corruption, resentment, and crime.

"We never used to lock our doors," a man selling T-shirts advertised as "endemic souvenirs" told me one day. "Now we buy guard dogs and string up barbed wire."

Even organized prostitution has arrived. A merchant in Puerto Ayora, evidently amused by my wretched Spanish, directed me not to the hotel I sought but to a brothel a few miles out of town.

**T**HERE IS ONLY ONE WAY to see the Galápagos—by licensed boat with licensed guide, for though the law acknowledges small settlements on four islands, 97 percent of the land area is restricted park.

In all, about 80 boats are licensed to carry tourists. A few take half a dozen scuba divers; a few carry a maximum of a hundred hikers, birders, and snorkelers.

In 1997, some 63,000 tourists paid the park entry fee (as much as 80 American dollars). Even though a greater percentage of these entry fees now stays in the Galápagos, figures can be misleading.

"Some owners sit in Quito and let their boats earn cash for them," I was told by Fiddi Angermeyer, the tall, slim, angular owner of the vessel I chartered on my last trip. "They don't live here, educate their kids here, or get sick here. If they did, you can bet we'd have better schools and better health care than we do."

Still, conditions overall are far better in Galápagos Province than anywhere else in Ecuador—there is less unemployment and higher per capita income—which has lent credibility to what is called the "golden aura" of the Galápagos. Over the past few years the image of the archipelago in the eyes of mainlanders has reversed: From being seen as a place not fit to live, it has been transformed

into a string of fantasy islands where no one is poor and jobs grow on trees. The consequence of the altered perception has been massive migration from the mainland.

In 1960 the population of the province was 2,000; by 1996 it had risen to at least 14,000, half of whom live in and around Puerto Ayora. More people, of course, have pushed the demand for everything from food and water to municipal services to, and often beyond, the breaking point. During one blinding, deafening frog-strangler of a rainstorm I sat in an open-air restaurant on San Cristóbal and watched as the streets ran like rivers and the sewers overflowed, clouding the harbor with raw waste. When the rain stopped, the lava rocks along the shore were caparisoned with garbage and coated with foul-smelling slime.

The two strongest magnets for immigration are the tourist and fishing industries. At one end of the spectrum are young men like Fernando Ortiz—educated, articulate, concerned, and active. A native of the Guayaquil region on the mainland, Fernando has been a certified guide and dive master in the Galápagos for nine years, and he has witnessed a precipitous decline in several animal species.

He is careful, however, to be fair in assigning blame.

"In my country we are quick to make scapegoats of the Japanese," he said. "Remember, it's Ecuadorian fishermen who are working with Japanese fishing companies. They catch the fish illegally and run them offshore to where the Japanese factory ships are waiting.

"On the other hand, we are a developing country. Many of our people can put no food on their table, no roof over their head. And the world has the gall to ask them to sacrifice more because some bureaucrats declare Galápagos to be a World Heritage site? Please. . . ."

At the polar opposite from Fernando is the traditional fisherman I met one rainy afternoon in a hardware store in Puerto Ayora. He had come from the mainland coastal fishing town of Manta, lured by the "golden aura." Elderly, uneducated, and poor, he had quickly been disillusioned by reality.

Because of uncontrolled poaching his catch was down; because of unrestricted competition the price he was getting for his catch was down. Yet the prices he was paying here in the hardware store were up—up 100 percent, in

## DRAMATIC EFFECTS OF EL NIÑO ON THE GALÁPAGOS

*CHANGE THE TEMPERATURE of the sea by a few degrees and watch an ecosystem change. That's been a recurring lesson of El Niño—a periodic reversal in the direction of wind and water currents that leads to abnormally high water temperatures in the central and eastern Pacific Ocean—which clobbered Galápagos wildlife in 1997 and '98. The casualties included marine birds as well as sea lions (below), whose population dropped 50 percent. Biologists remain uncertain whether most marine birds and sea*



*lions starved or just migrated to better feeding grounds.*

*On the plus side of the El Niño ledger, heavy rains fed a riotous growth of plant and insect life, which meant more food for reptiles and insectivores like the vermilion*

*flycatcher (above). For some prospective visitors, though, El Niño's negatives overwhelmed its positives, leading them to reschedule their tours. Even so, those that made the trip witnessed nature in its purest form.*





*GETTING THEIR GOAT: Hunters hired by the park service aim to rid Isabela and Santiago Islands of nearly 200,000 feral goats with the help of trained dogs. First introduced to the Galápagos by settlers more than a century ago, goats have destroyed the habitats of tortoises and other endemic species.*





fact, in the previous nine months. He did not know how long he would be able to stick it out. He missed his family, but he could not bring them out to the Galápagos; his wife and daughter earned more as chambermaids on the mainland than he did as a fisherman.

I felt that *he* felt the times were out of joint; he had become flotsam in the wake of what people called progress.

**I**T WAS BY CHANCE that my second visit to the Galápagos coincided with the peak of the terrible 1997-98 El Niño; it was by design that I timed my last visit to coincide with El Niño's end.

The differences between what I saw in December 1997 and May-June 1998 were striking, poignant, and sad.

Gerard Wellington, a biologist and corals specialist from the University of Houston, told me why El Niños are particularly worrisome in the Galápagos. "Organisms accustomed to living in cool-water environments are extremely vulnerable to temperature swings," he said. "A difference of ten degrees Fahrenheit in water temperature can be cataclysmic. Most fish live in a very narrow range, and when the water warms up, they leave. Usually they go so deep in search of cooler water that the animals that feed on them can't reach them. Sea lions and boobies dive, sure, but there's a limit. If you burn up more calories looking for food than you consume eating it, you starve, simple as that."

The archipelago straddles the Equator, so there are no vast seasonal changes. But the meandering currents do produce cool- and warm-water seasons, and there are rainy months that follow dry, especially in an El Niño year.

December is often a dry month, but in December 1997 some Galápagos islands received 12 inches of rain—much of an entire normal year's rainfall. Several islands looked unusually verdant, and there was talk that the 13 endemic species of finch were already breeding with extraordinary zeal. Still, there was no hard evidence of impending doom.

When Jerry Wellington and I visited the small, arid rock called Baltra, for instance, we were greeted by a gaudy display of nature in full and nonchalant flower.

On one of the island's two docks, Ecuadorian

soldiers awaiting transport to their base or to the nearby airport sat at tables shaded from the fierce midday sun. Sharing their shade, like friends come to bid them adieu, were groups of sea lions. Adults lolled on the concrete, occasionally emitting a lazy bark or a languid moan; pups waddled beneath the tables, sniffing trousers and yapping at lizards.

In the water a profusion of pelicans preened and scratched and shook and probed the shallows for edible tidbits.

Boobies and frigatebirds wheeled in the sky above, cawing raucously, their silhouettes reminding us of their ancestry among the dinosaurs.

All seemed right with the world.

Jerry and I returned six months later, at the end of May 1998. We anchored in the harbor, as before, and rode to shore in the boat's *panga*, the Ecuadorian catchall for dinghies, dories, Zodiacs, and punts. I wondered how big the sea lion pups would be.

Moments before we landed, I knew something was wrong. No flights of birds sliced the cerulean sky. No pelicans bobbed in the wash of passing motorboats; one single sentry cruised above our wake, as if hoping our propeller would cough up a canapé.

And when we reached the dock, there were no sea lions sleeping in the shade or basking in the sun. None. Not anywhere.

All that remained of the tableau from last December was the soldiers.

I was appalled; Jerry had seen it before, in the 1982-83 El Niño. "During severe El Niños sea lions and boobies don't have the resources to feed both themselves and their young," he said. "Reports are coming in to the station that some populations are down by 50 percent."

The "station" is the Charles Darwin Research Station, an underfinanced group of dedicated scientists from many nations who work at the only research institution in the archipelago. Its few unprepossessing buildings sit on some brambly acres near the offices of the national park service on Santa Cruz, the big island across a small channel from Baltra.

For \$22 Jerry and I chartered a bus to haul us, our team, and our gear for the hour's trip across the highlands to the station. I grew up in New York City and know nothing about things that grow in the ground, but even I could discern the

(Continued on page 25)



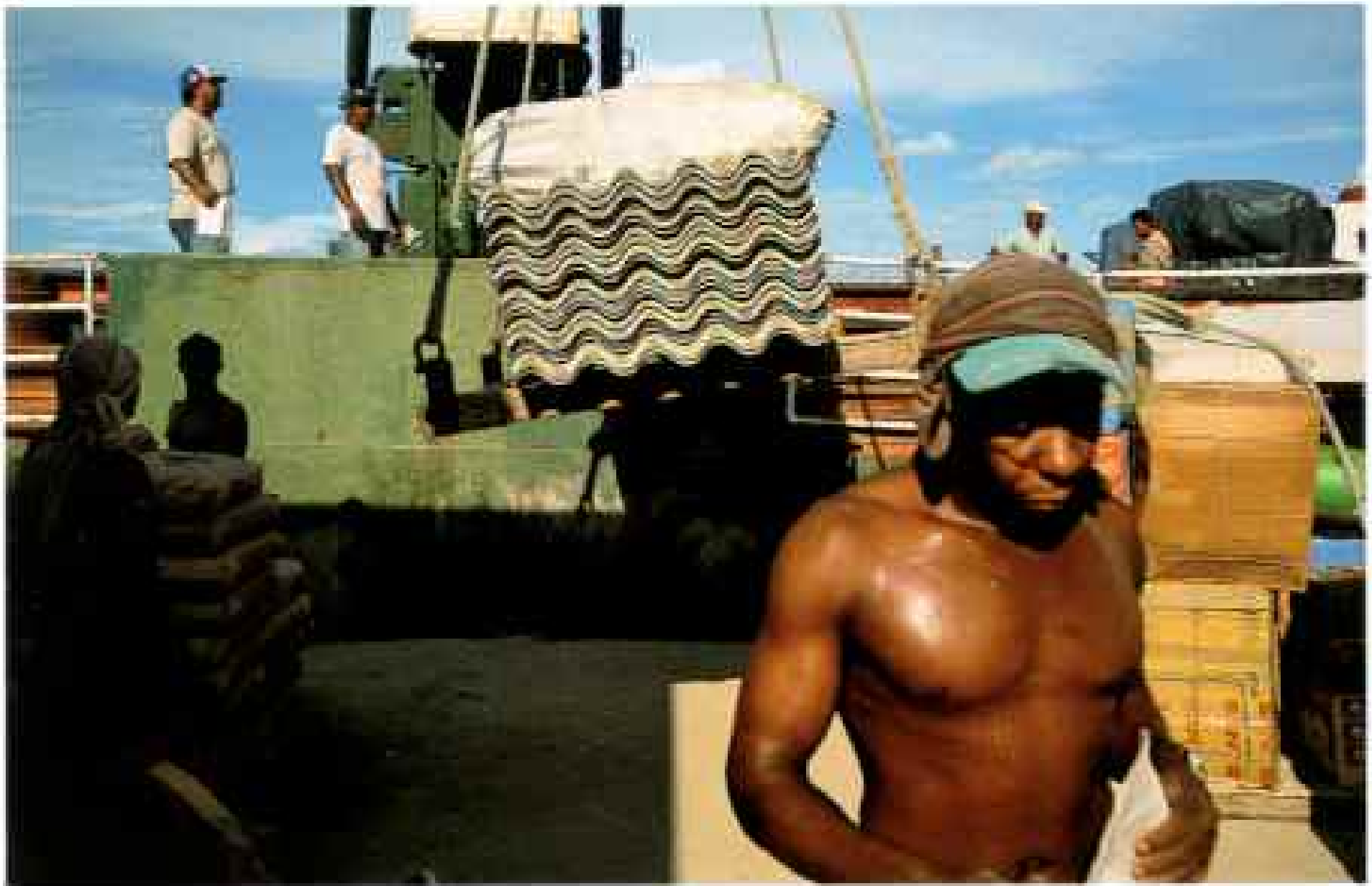
*FENCED IN FOR THEIR OWN PROTECTION, tree ferns on Isabela Island are wilting and dying. Scientists are not certain if goats or subtle environmental changes caused by the goats are to blame. This chain-linked laboratory, they hope, will provide answers. Land iguanas, which Darwin saw in great profusion, have also dwindled in number. A captive breeding program (below) seeks to reverse the decline.*







*TAKING THE HEAT* on the coast of Caamaño Island, marine iguanas—the only seagoing iguanas in the world—rely on the sun to help regulate their body temperature. At night they rely on one another by clumping together to stay warm.



*To sense the growth spurt in the Galápagos, consider the cargo ships in Guayaquil, on the Ecuadorian mainland. Each week, loaded with roofing and construction supplies, they head for the islands, where thousands have moved for jobs and housing. In Santa Rosa (below), also on the mainland, merchants troll for deals on fins from sharks caught in Galápagos waters, a high-priced delicacy popular in Asia.*



effect of the teeming El Niño rains. The normally rust brown hillsides were glutted—clotted, practically suffocated—by prodigious plants with gargantuan green leaves. Jerry pointed to what looked to me like big trees and said they were humble plants run riot.

That evening we arrived in Puerto Ayora, and Jerry took me to meet two old friends, Gayle Davis-Merlen, the hardy librarian of the station, and her husband, Godfrey Merlen, a British-born cetologist who is a licensed guide in the islands and who looks like how I imagine Charles Darwin might be depicted by Gary Larson—a gamin face with elfin eyes, all surrounded by a corona of untamed hair.

Gayle and Godfrey live at the end of a tunnel of jungle off the main road between the town and the Darwin station. The house had been booby-proofed—floors and furniture covered with newspapers—for a houseguest: a female blue-footed booby named Boobling, which Godfrey and Gayle were nursing back to health from the brink of starvation.

Boobling was a handsome bird of steely eye and, according to Gayle, rigorous standards. “She demands her food at mealtimes,” Gayle said, “and she condescends to show us affection now and again.” As if on cue, the sedate booby rubbed her beak against Gayle’s hand.

I asked if they thought Boobling would survive when the time came to put her back in the wild. “We do,” said Godfrey. “Now that El Niño is ending, as cold water returns the fish will come back. She’ll be able to find food.”

But was El Niño ending? Jerry had heard recently that water temperatures of 86° F were still being recorded. I remembered seeing more than 50 dead marine iguanas on one beach, all starved to death.

The warm water, Jerry explained, stunts the growth of the algae the iguanas feed on. They consume other algae and have even been known to eat lawn grass, “but their digestive system doesn’t have the enzymes to deal with them. Sometimes they’re bloated as they starve.”

Godfrey agreed. “Someone said to me the other day that the iguanas looked good. I said, ‘You’re seeing the survivors.’ These are the ones with that extra little bit of genetic what-not that has allowed them to survive.”

It occurred to me that what Godfrey was describing, what we were seeing every day, was

the crucial core of Darwin’s premise: natural selection.

The next morning Jerry and I boarded Fiddi Angermeyer’s *Samba*, a comfortable 78-foot motor sailer. As the crew readied the boat for our journey to the western islands, we leaned on the stern railing and gazed idly back at Puerto Ayora.

Suddenly and simultaneously we saw an astonishing vision: Swimming with grim determination directly toward our boat, crossing two or three hundred yards of open water, completely exposed and vulnerable to sharks or other big predators, propelling its green-black body onward with thrusts of its mighty tail, was a marine iguana.

When it reached the stern of the boat, the iguana disappeared beneath the surface. After perhaps 30 seconds it reappeared, snatched a couple of breaths, and went below again. Another minute passed, and then it popped out from under the boat, used its sharp claws to climb onto the Zodiac tied alongside, and sprawled on the hot fabric.

“Do you realize what we’re seeing?” Jerry said. His face radiated the excitement of epiphany. “Pure El Niño behavior. That iguana swam all the way out here to eat the algae or whatever the vegetation is that’s growing on the boat’s bottom. This is yet another example of ‘survival of the fittest.’ The strongest of these animals will survive because of their tenacity.”

**F**ROM SANTA CRUZ we sailed overnight to a spot I remembered fondly: Punta Espinosa on Fernandina Island, which is said to be the only sizable Pacific Ocean island that has remained almost entirely free of introduced species. This state of purity is jeopardized whenever anything floats ashore or anyone sets foot on land.

Before we disembarked, our guide, Jonathan Green, a British expat trained in geology, had us wash our shoes to rid them of any alien seed or other communicable material.

When I was here in 1987, Punta Espinosa struck me as a natural theme park dedicated to the glories of the Galápagos. Everything was here, and in numbers too thick to count: sea lions, boobies, iguanas, and, most memorable, little Galápagos penguins, the most northern penguins in the world, which zipped





*A YOUNG FISHERMAN on Pelican Bay near Puerto Ayora leaves a tiny ecological footprint compared with the foreign trawlers that operate nearby. Ecuador recently expanded the islands' commercial no-fishing zone from 15 nautical miles to 40.*



around us underwater with speed, grace, and pinpoint precision.

Now, as we followed the path across the lava rocks, I noticed that everything was still here but with a difference: Everything was dead.

Carcasses were everywhere—sea lions, iguanas, birds—rotting where they fell. Punta Espinosa's resident population of sea lions had been reduced from several score to . . . well, it was impossible to be certain, but in two hours ashore we saw ten, all adults.

Only the little lava lizards, perched triumphantly atop sea lion corpses, and the brilliant red Sally Lightfoot crabs seemed to be thriving.

"And the hawks," Jonathan added. "Galápagos hawks are scavengers, and some of them are so fat they can hardly fly."

Underwater the effects of El Niño were more subtle but still visible to a trained eye. "A lot of the filter feeders are gone," Jerry said. "The tube worms, the barnacles, the clams. All the tiny plankton they feed on die off in the warm water. And you'll see patches of bleached coral, where the coral animals have been killed by the hot water and increased ultraviolet sunlight. But I think they'll come back; I can already see some colonization taking place."

I knew that the sea lions would probably bounce back quickly too, though not by any leap of adaptation. They were simply lucky. Their primary predators, sharks, had been hunted in large numbers.

**L**EGALLY, FISHING ANYWHERE in the Galápagos is restricted to the islands' roughly 600 *artesanal* fishermen—that is, fishermen who fish the old-fashioned way. But Rodrigo Bustamante, the bearded young man who heads the marine program at the Charles Darwin Research Station, said the laws and restrictions are of little use when there is no money to enforce them. There was evidence, he said, that Costa Rican boats were active well within the boundaries of the marine reserve.

"Still," he said, "things are better. At least the conservationists and the fishermen are talking. When I came here in '94, the fishermen chased us with machetes and took us hostage."

On Sunday, May 31, I witnessed a healthy demonstration of the ongoing dialogue. Our boat and others returned to port so the crew

could vote in national elections. Voting is mandatory in Ecuador, and a citizen who neglects to vote risks losing legal privileges, like the ability to open a bank account or borrow money.

Election day was a fiesta in Puerto Ayora. Placards and banners flew from buildings and light poles; food vendors hawked spareribs and sherbet and fried plantains; children threw darts at balloons in hopes of winning toys. And, of course, cynics prowled the streets. A man known to one and all only as Empanada (the word means a kind of meat-filled turnover; an equivalent American nickname would be Hot Dog) confided in me that "the lesser man will win because he is playing to people's ignorance. He offers empty dreams, but he is giving every voter a bag of rice, and they all want to believe him."

Addressing a different level of belief, a local dive master, Mathias Espinosa, surveyed the crowd and remarked, "There are different religions here, and among them there is not a single soul who believes in evolution or natural selection or any of the things that make the Galápagos famous."

The issues at stake in the election that day were important to Galápagos Province—fishing rights, fishing limits, allocation of revenues—but among voters generally there was a sense of ennui because of what is known as a *secreto a voces* (an open secret): pervasive, epidemic, and intractable official corruption.

I had heard from several sources—park guides, hoteliers, and boat captains, all of whom feared retribution if their names were mentioned—that some of the same military officers charged with upholding the laws were backroom partners in illegal fishing operations.

"Boats fish everywhere," one guide told me. "They pay no attention to boundaries. They take everything, legal or not. We see them, we denounce them, we even videotape them. And what happens? We are called criminals for . . . I'm serious . . . defaming them! If the videotape is ever shown in court, whoops!—so sorry—it's blank."

I called Rebecca Winchester, an official of the United States Information Agency based in Quito, to ask how serious she thought the corruption was. "It exists," she said, "but it's not as important as the two basic issues—



*PLEDGING TO PROTECT THE EARTH, a troop of scouts on San Cristóbal Island devote themselves to all sorts of environmental projects, including coastal cleanups and the eradication of alien species. Carrying on a New Year's Eve tradition, revelers in Puerto Ayora burn effigies (below) to send messages, political or otherwise. One year locals burned a papier-mâché parrot, a colorful but non-native bird.*



tourism and fishing. Tourism is much more important to the economy as a whole, but fishing provides almost as many jobs. Another important issue is introduced species."

An educated estimate by scientists at the Darwin station and the park service is that almost 800 species of plants and animals have been introduced to the islands. And they're taken very seriously.

As of the mid-1990s, more than 100,000 wild goats roamed the area of Volcán Alcedo on Isabela Island, consuming the food and destroying the habitats of dozens of endemic species. Wild dogs have killed countless iguanas and young tortoises there.

All through the islands rats and feral cats are eating the eggs and hatchlings of birds, sea turtles, and tortoises. On Pinzón Island, for example, black rats have killed every tortoise hatched in the wild in the past hundred years. However, a successful program has been established by the Darwin station and the park service to collect, rear, and reintroduce these tortoises.

Wasps, fire ants, and other insects are appearing on islands that have never known them and have no indigenous way of coping with them.

According to one scientist, the modern villain of the piece is none other than the golden goose himself, the tourist.

"Tourism is a curse in disguise," he told me. "Look at what it does just in terms of introduced species. Those hundred-passenger ships leave all their kitschy lights on all night, attracting every insect for miles around. They all come and nest, and when the ship hauls anchor and moves on to the next island, they go too.

"If I had a choice of getting rid of fishermen or tourists, it would be no contest: Tourists would go." He laughed at the thought of the decree. "Of course, I'd have to run for my life because the whole population would be after my scalp."

**A**S TERRY AND I traveled on from island to island, we searched hopefully for conclusive signs that the catastrophic El Niño had, at last, pooped out. There was no good news at all—the water remained warm—until one day, near the end of our journey, we noticed a

*THE WORLD'S only gull species that hunts at night, the swallow-tailed gull has filled a niche that allows it to avoid daytime fights over food with frigate-birds and other diurnal competitors.*

*Biologists point to adaptations like the gull's eyes (very large) and its chicks' white down (which makes them easier to see and protect in the dark).*

*Finding a sustainable niche and avoiding conflict while keeping an eye on the welfare of the next generation: Gulls have done it, but can the people of the Galápagos?*



change and decided to stop for a dive. All of a sudden there was a shimmer to the water that suggested turmoil, a mixing of temperatures and consistencies.

The first bulletin we received was chilling. Literally. The sea, as I dropped into it, took my breath away. Till now I had encountered some water as warm as 86° F, and none below 80. This water was 67 at the surface and 59 on the bottom, 60 feet down.

Underwater, the animals seemed suddenly energized by the bracing infusion of cold water. Creatures great and small swarmed around us as they had not done since the day we arrived.

A Port Jackson shark, blunt headed, perfectly camouflaged, and perhaps 18 inches long, rose off the bottom and blundered into Jonathan Green, apparently mistaking him for



a cleaning station where it could be rid of pesky parasites.

A big school of whitetip reef sharks patrolled the lava plain in formation, like marchers in a parade.

Grunts and jacks and snappers glided by en masse; moray eels, which had not shown themselves at all, poked their heads from crannies in the rocks and, once or twice, slid into the open water and snaked their way among us.

From the edge of vision, swooping down upon us like a ghost bomber, came an eagle ray, easily seven feet across from wing tip to wing tip and perfectly white, an albino without spot or blemish.

When I surfaced, I saw that the riot of life and propagation was going on ashore as well. Male frigatebirds puffed up for their females,

inflating their splendid pouches like gaudy red balloons. Boobies flirted with one another, exchanging sticks and stones. Flightless cormorants wound their necks together in a ballet of courtship.

Of course, the animals of the Galápagos neither knew nor cared that a major upheaval in nature's rhythms was coming to an end. They had survived El Niños before and would endure them again.

Now, as they had always done, they were responding to ancient imperatives whose end was as magnificently simple as Charles Darwin perceived and articulated it 140 years ago: "The vigorous, the healthy, and the happy survive and multiply."

It was a prescription, I thought, that would fit nicely in virtually all of humankind's testaments of faith. □

*Article and photographs by DAVID DOUBILET*

# GALÁPAGOS

*Underwater*

*SPIRALING PAST, a sea lion regards me with a weightless gaze in a sea so warm that it has become nearly barren. In the throes of a powerful El Niño, the once teeming waters surrounding the Galápagos Islands are in distress.*







**A** veil has been lifted. The dark, cold, rich waters of the Galápagos have become brilliantly clear and almost 10°F warmer than when marine biologist Gerard Wellington and I explored and photographed here 20 years ago. In December 1997 the Galápagos are in the grip of a massive El Niño. “The cold Peru and Cromwell Currents are forced deep. The surface water heats up, which kills the plankton and disrupts the food chain. It’s beautiful—it’s deadly,” says Jerry. Times are desperate for Galápagos penguins,

---

DAVID DOUBILET’S last assignment for the GEOGRAPHIC took him to Papua New Guinea, where he photographed and wrote about coral reefs for the January issue.

*which fly under the surface scouting for fish (left); much of their prey has been driven to deeper, cooler waters. The local dragon, a marine iguana (below), grazes on green algae. But in warm water the plants become stunted and overgrown by brown algae, which the iguanas cannot digest. Many will die, their stomachs bloated like children of famine. The hunt goes on as a young sea lion (following pages) chases a school of salema near Cousin's Rock. The fish circle defensively, creating a carousel of confusion for the hungry animal.*









*Pacific swells push against Darwin Island, where white snappers and black triggerfish (above) feed beneath breaking waves. Here 20 years ago Jerry and I were intimidated by huge squadrons of sharks—hammerhead and the more aggressive Galápagos sharks. Now I see just one hammerhead nearby. The sharks too have been driven into deeper waters in search of prey, and when I'm down to 150 feet I see hundreds of them far beneath my fins, disappearing into a twilight sea. Just off Wolf Island bigeye jacks (right) swim together, and the*

*male turns black in a courtship display, as if the shadow of the female. Upon mating they release sperm and eggs into the open sea. Near the Plazas Islands juvenile sea lions (following pages) scare up inch-long shrimps by furrowing the sandy bottom with their lower jaws. Before El Niño ends, many sea lions will starve, unable to follow their principal prey, lantern fish and squid, as they move down into colder waters. But now in 1999 the warm, clear nightmare is over, and the sea has turned again from fallow to full.*









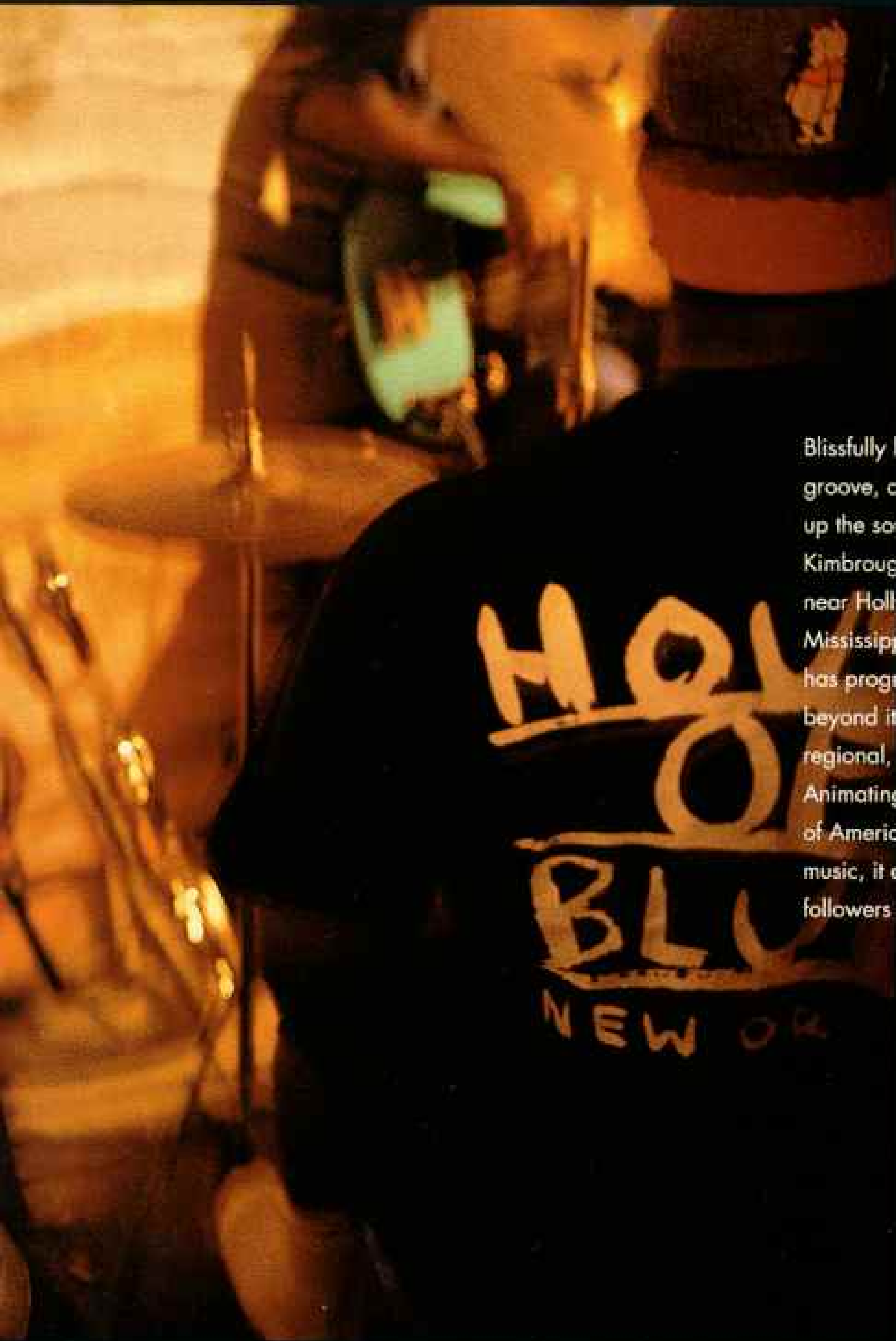
# Traveling the Blues Highway



Rooted in the Mississippi Delta, the blues sprang from spiritual music and field hollers,

By CHARLES E. COBB, JR.

Photographs by WILLIAM ALBERT ALLARD  
NATIONAL GEOGRAPHIC PHOTOGRAPHER



Blissfully lost in the groove, a crowd soaks up the sounds at Junior Kimbrough's juke joint near Holly Springs, Mississippi. The blues has progressed far beyond its origins as a regional, rural song form. Animating the very soul of American popular music, it attracts devoted followers the world over.

spinning a cultural thread that followed the great black migration from South to North.



The Blues

BVA



Blistering guitar licks distinguished the late Luther Allison, who quit high school to jam with the top bluesmen of Chicago's West Side. "That," he said, "was my school."

**S**AMUEL REUBEN KENDRICK, my great-grandfather, was born a slave in Alabama. In 1888 he founded a farming community called New Africa on 160 acres he bought from the railroad near Duncan, Mississippi. Among the tribulations he faced—floods, boll weevil infestations, bank loans due—one incident finally persuaded him to leave Mississippi. When a sharecropper on a nearby plantation asked to live and work on some of his land, Sam Kendrick sent over a wagon for the man's family and belongings. A mob of whites led by the plantation owner trapped my great-grandfather and pounded him to the ground with ax handles, cursing him for taking one of their workers. Stealing from a white man, they called it.

Soon after the incident, on a cold January day in 1909, he was repairing the little wooden bridge over the lake on the edge of his farm. His mind may have wandered—perhaps to his plans for starting anew in Texas—and he dropped his hammer. He waded into the water to get it and continued hammering. That night he felt chilled. A few days later, at the age of 56, Samuel Kendrick was dead of pneumonia.

Lights are low and the beat is slow as dancers sway to a jukebox ballad at Po' Monkey's lounge in Merigold, Mississippi. Born as a lamentation for physical hardship, the blues evolved to address the heart's every yearning.



## "No matter where they're playing . . .

*Well, the blues am a achin' old heart disease,  
Well, the blues am a low down achin'  
heart disease,  
Like consumption, killin' me by degrees.*

—ROBERT JOHNSON

The phrase "having the blues" goes back to 18th-century England, where the "blue devils" was slang for melancholia. But it was sorrows like Sam Kendrick's, common among blacks after the Civil War, that led to a raw new

music—the blues—depicting work, love, poverty, and the hardships freedmen faced in a world barely removed from slavery.

If he had lived, my great-grandfather would have been part of one of the largest peacetime internal movements of people in history. Between 1915 and 1970 more than five million African Americans left from every field and corner of the South, most going to the nation's booming cities. Sam Kendrick's eldest child, Swan, my grandfather, settled in Washington, D.C., where both my mother and I were born. Others in the family followed the heavily traveled path out of Mississippi to Memphis, where the blues spurred the rise of rock-and-roll. This "blues highway" led on to Chicago—

CHARLES E. COBB, JR., a former staff writer, is now freelancing. He serves on the board of Africa News Service and is currently spending more time in Mississippi researching a book about Bob Moses, the legendary civil rights activist.



## blues is music to move to.”

—WORTH LONG, HISTORIAN

the mecca for bluesmen and other migrants.

One who landed in Chicago in 1936, Willie Dixon, called the blues “the facts of life.” Dixon was a blues songwriter, poet, and philosopher who campaigned for more than 50 years for recognition of the blues as the root of all American music. “Everything that’s under the sun, that crawls, flies, or swims likes music. But blues is the greatest, because blues is the only one that, along with the rhythm and the music, brings wisdom.”

All routes from the South were paved with a people’s blues, but no place is more closely associated with the music than the Mississippi Delta. This broad, rich floodplain—anchored by the Mississippi and washed over

by the Yazoo, Tallahatchie, and Big Sunflower Rivers—spreads 200 miles from Memphis, Tennessee, to Vicksburg, Mississippi. The black Delta soil steams in the broiling summer heat as I turn off Highway 61 onto a narrow paved road that was a wagon track in my great-grandfather’s time. Robert Johnson’s “Me and the Devil Blues” is playing loud on my tape, his brooding voice and intense guitar seeming to conjure up Delta spirits. I stand on a steel bridge—successor to the one Sam Kendrick had worked on—and stare into the murky water. Here in the place where his life ended, I’m beginning a journey through memory and into the blues.

Around midnight on a sweltering Saturday



## The North . . . was the talk in

in August, Mama Rene slides onto the barstool next to me at the Do Drop Inn, just off Highway 61 in Shelby, Mississippi. "No, honey, blues aren't just about us being sad. That's why I opened this place. It's a way to remember. The blues talk about black folk, how we lived, the way we were treated. And we're still going on."

Irene Walker—Mama Rene—is a handsome woman of 63 who grew up a sharecropper's daughter. For 33 years she's been a nursing assistant with the Delta Community Home Health Agency, based in Clarksdale. Lately she's been trying to attend to the blues with the same care she shows for her patients. "Blues is fading away with young black folks," she says, shaking her head. "They think it's for old

folks. They've let the rap take their culture away from them, and young whites are moving into our culture."

Next to the bar is a brightly lit area with a pool table and electronic game machines. Beyond is a small stage and dance floor, dark but for the glow of blue and green Christmas lights strung along the ceiling.

On stage a hard-driving blues band with two guitars, drum, and electric piano is connecting with the sparse crowd. The lead singer, sweating heavily, eyes shut, moans, "Have you ever seen a one-eyed woman cry?" His mournful words elicit emphatic shouts of release from the dancers. "Yess, Lawd!" "Talk to me now!" With waving arms and swaying bodies they



A spring shower soaks a field in the Mississippi Delta, a fertile place for cotton—and the blues. The land produced a who's who of musical greats (map). Many joined the migration of blacks from the South to northern cities along what came to be known as the "blues highway" connecting New Orleans and Chicago. Between 1915 and 1970 the nation witnessed a relocation of more than five million African Americans.



## cotton fields.

seem to be pushing through a doorway, if not to a better life, to a better moment.

The scene is a reminder of what Worth Long, a historian of the blues, told me. "No matter where they're playing, juke or in a yard, blues is music to move to." Before the blues, songs were sung to pace work—pounding railroad ties or chopping cotton with hoes. Then, said Long, "the work song moves to the dance, which was once held in front and back yards. Then dancing moves from the yard to the juke—commercial places."

A year passes before I return to Mama Rene's to find a radio DJ playing CDs. He's telling everyone tuned in that he's broadcasting live from the Do Drop Inn in Shelby. The crowd



Music was the ministry when the Spiritual Kings visited Zion Travelers Baptist Church near Jackson, Mississippi. Gospel influenced Grammy award winner Keb' Mo' (right), whose mother sang in a Baptist choir. His repertoire includes his own songs and those of blues icon Robert Johnson.



is younger, larger. "I've got to make money," Mama Rene sighs. "I'm trying to think how to bring my blues night back the way it was. I'll find a way."

**Y**OUNG BLACK PEOPLE still go to places like the Do Drop to dance, but the blues doesn't mean much to them anymore, although it animates rap and other music they listen to. Blues music sprang from poverty and restriction, and for many black Americans it has been something to disavow. The often earthy lyrics didn't help either. Indeed lines like Sonny Boy Williamson's "Every time she starts to loving, she brings eyesight to the blind" had some calling the blues "devil music." A straitlaced, nonsmoking, nondrinking, hymn-singing churchman like my great-grandfather Samuel Kendrick would even have been offended by words like James Cotton's "raising a good-cotton crop's just like a lucky man shooting dice."

Mississippi Delta blues has been called "deep" blues. Musicians from the cotton

fields—men and women like Muddy Waters, Willie Foster, David "Honeyboy" Edwards, Memphis Minnie, and Son House—played and sang with extraordinary power. The land itself seems to demand it. In summer the Delta is a place of sullen heat and sudden angry thunderstorms, when heaven seems to short-circuit and puts humans in their place. Long rows of cotton offer no relief from the disorienting flatness. You always feel exposed and want to run for cover, into a juke joint with a bottle of whiskey or into a church. Both places maybe. Depends whether it's Saturday night or Sunday morning.

My friend Sterling Plump from Mississippi, a poet, university professor, and sage on black music, reminded me that the spiritual music of the church and the worldly music of the juke joint are not that far apart. "The first time I heard blues was in my grandfather's prayers," he said. "'Take care of Seal, the work-horse that's sick. Drive the bo'weevils away. Put some softness in white folks' hearts so they won't cheat so badly this time.'"





Recalling the seminal years of the blues, convicts pick cotton at the Louisiana State Penitentiary in Angola. The cadence of singing field-workers shaped the blues' musical structure





Comforts of home: A "juke house" residence in Bentonia, Mississippi (left), sells drinks and plays recorded blues. It was old home week for Mary Shorter of Chicago (below, at center), visiting friends at an Indianola, Mississippi, club before a performance by native son B. B. King.



In Yazoo City, the Reverend Arnold "Gate-mouth" Moore, 87, confirmed the tie between blues and church. I asked him about making the shift from popular blues singer to preacher. "When I came to Christ, I changed the lyrics. I got the same voice, same key, but the words are different. Same music, same everything."

So while I can't imagine Sam Kendrick singing, "If the blues was whiskey, I'd stay drunk all the time," I can hear him singing, "O Lord, O my Lord, O my good Lord, keep me from sinking down."

As an educated black landowner, my great-grandfather was in a tiny minority. But the freedman's blues he suffered linked him with the most uneducated black sharecropper. Across the South in the late 1800s Jim Crow laws tightened racial segregation, curtailing freedoms gained as a result of the Civil War. Curfews banned blacks from streets after sunset. Mississippi's 1890 state constitution effectively stripped blacks of voting rights. Years later Sam Kendrick's youngest daughter, my great-aunt Hattie, said she couldn't look

at the TV movie *Roots* because it reminded her of those bitter Mississippi days. "I find my throat dry, and stuff kind of boils up in me," she said.

**S**INCE I LAST TRAVELED the Delta a quarter century ago, it has changed almost beyond recognition. You don't see people working in the fields anymore. The sharecropper shacks, once ubiquitous, are gone, replaced by a few neat bungalows and trailer homes for the families of the men who operate the tractors, mechanical cotton pickers, and other implements that have replaced human labor. Metal irrigation sprinklers crawl across the land like giant millipedes. Bright yellow crop dusters fly overhead, spraying chemicals to hold back insects and weeds.

Folks in drowsy towns like Tutwiler who remember the old days don't regret their passing. "You picked the white man's cotton. He takes it from you and do what he want with it," is how Judge Davis Irving, 69, describes sharecropping. "Judge" is Irving's real name,



Sheer joy of performing radiates from Big Jack Johnson and family members in Clarksdale, Mississippi. His guitar wails with the amplified notes of Chicago-style blues.





Sashaying before an appreciative crowd, Lynn White belts it out at the two-day Medgar Evers Homecoming Festival near Pickens, Mississippi, where the tang of barbecued ribs is music to the nose. From the beginning the blues and southern cooking have nurtured each other: Performers



but everyone calls him J. D. (When white people addressed you by your first name no matter what your age, having "Judge" as a first name was one way to protest the insult.) Until he was 18, J. D. lived and worked with his father on Prairie Plantation just outside Tutwiler. "It had maybe 200 houses on it and 50 mules, not counting us."

Sharecropping usually meant a cycle of endless debt. Half of what the sharecropper grew belonged to the owner outright. To purchase supplies or rent a "shotgun" shack (so named because a blast fired through the front door went straight out the back door), the sharecropper borrowed from the plantation owner in the spring. This loan was called "furnish." Repayment was due at "settle" when the fall crop came in. Any money the sharecropper made came from what was left over. Often he got nothing or owed money. The plantation owner, "he got the books and keeps the figures," J. D. said, frowning. "If you disagree, you move; you go to another plantation."

The blues sank its earliest and deepest roots

in fields worked by sharecroppers. Willie Foster, still performing at 77, is one of a dwindling number of bluesmen with the memory of laboring to a song. "A man be way down in the field plowing with a mule, singing, 'Oh, my baby gone. I'll soon be gone myself.' That was because he couldn't move off the plantation when he gets ready. He would ask the man, 'Can I move?' And if he say, 'Naw you can't move,' he'd run off and he would sing, 'I'm gonna leave you, baby, and I won't be back no more.' It wasn't his wife he was singing about."

We're talking in Willie's small home in Greenville. He is missing a leg and is legally blind, but that doesn't stop him from singing in local jukes and touring overseas.

"I was born with the blues," Willie says, describing how his mother gave birth to him on a cotton sack in a Delta field because the plantation boss refused to give her time off. With no brothers and sisters for company, Foster taught himself to play the harmonica. ("It was 25 cents at the Rexall in Leland.") He imitated birds, trains, and train whistles.

traveled the "chitlin' circuit" of nightclubs that served up hot music with chicken and chitterlings on the side. Since World War II the blues has gained a wide following among audiences of all colors and has extended its reach even farther through its high-spirited offspring: rock-and-roll.



"When I turned 17, I said, 'Mama, I'm grown now. I done learnt everything about the Delta, but I heard so much about Chicago.'" Willie left home on foot "without a dime in my pocket," and by taking various jobs along the way, he eventually made it to Chicago.

**N**OT ONLY does every bluesman have a getting away from the plantation story, they all have an apprentice story related to that experience. In 1931 David "Honeyboy" Edwards, now 84, hopped a Memphis-bound freight train with a guitar borrowed from his brother-in-law. "Working for a dollar a day all day was not for me," he said, remembering his life on a plantation near Greenwood, Mississippi.

But he drifted back home a few months later. "The music hadn't learned me like," he said, referring to his lack of artistry. One night he met Big Joe Williams, a well-known bluesman, who asked Edwards if he could play the guitar he was holding. "I played a few strums on it, and he said, 'I can learn you how to

play.'" Edwards left with Williams, "and I never did come back."

After traveling with Big Joe for a time, Honeyboy found his own path one day in Bay St. Louis, Mississippi. "I was on a bridge. They was catchin' crab on it—had the nets down with meat in 'em. Somebody say, 'There's a boy with a guitar. Can you play that guitar, boy?' I started to play on that bridge, and people started stoppin' catchin' crabs and listenin' to me. Gave me nickels and dimes. I say, 'I don't think I need Joe Williams.'"

Honeyboy Edwards is still a blues master. Having listened to a recording he made in 1941, I'm astounded, hearing him in 1998, that the power of his voice and playing has not diminished. In the blues, as he shows, the singer's vocal timbre drives the emotional impact of the song as much as the lyrics. Like Willie Foster, Honeyboy is a living history of the blues, with personal knowledge of every major blues figure from Charley Patton and Robert Johnson to Muddy Waters and Little Walter. When asked about Robert Johnson, he

smiles for a moment, mind flashing back. "He definitely liked the women and his whiskey."

*Now there's got to be some change made  
around here, people;  
I'm not jiving, that's a natural fact. . . .  
I'm gonna jump up on one of these old poor  
mules and start riding and I don't care  
where we stop at.*

—MERCY DEE WALTON

**T**HE CRUCIAL DIFFERENCE between slavery and sharecropping, best reflected by bluesmen like Honeyboy Edwards, was the relative freedom to move: from field to field, from field to factory. Moving on is a frequent theme in the blues, a refrain that is really a code for freedom and opportunity.

By the turn of the century tens of thousands of African Americans had already left the South, some joining land rushes to Kansas and Oklahoma, others going to northern cities, where opportunities seemed greater and oppression less. But with the advent of World War I and the accompanying demand for increased production in the industrial North, the real exodus from the Delta—and the entire South—began.

Honeyboy Edwards was not quite two years old in 1917 when black America's most widely read newspaper, the *Chicago Defender*, ran this ad: "The Defender invites all to come north. Plenty of room for the good, sober, industrious men. Plenty of work. For those who will not work, the jails will take care of you. When you have served your 30 days at hard labor you will then have learned how to work. Anywhere in God's country is far better than the southland. . . . Don't let the crackers fool you. Come join the ranks of the free."

Eighty percent of America's ten million blacks lived in the South in 1917, when the nation entered World War I. Chicago's busy brickyards, meatpacking houses, and steel mills had long attracted European immigrants, but the war halted this flow. Meanwhile white factory workers in the U.S. were going to Europe to fight, leaving a vacuum just as industrial demand was soaring. Southern black labor was a solution. Once under way, the movement out of the South ebbed only during the 1930s Depression, with the numbers between 1940 and 1970 exceeding a million people a decade.



Backyards flit by in a blur seen from a train highballing it to Chicago. The Illinois Central was a steel highway for those seeking to leave the hardscrabble life exemplified by a store in Clarksdale, Mississippi.

You might think that in a region rife with racial tension, where blacks often outnumbered whites, the exodus was welcomed. Not so. "Where shall we get labor to take their places?" asked Alabama's *Montgomery Advertiser*. In Mississippi laws imposed fines or jail on agents—usually blacks—who encouraged laborers to leave the state. Charles Johnson, a sociologist who traveled in Mississippi in 1917, noted that an agent "would walk briskly down the street through a group of Negroes, and without turning his head would







Tuned up and turned out, Jessie Tolbert entertains at Lee's Unleaded Blues in Chicago, a city celebrated in early songs as the last great stop along the blues highway.

Upstaging his age, 80-year-old Rufus Thomas works the Chicago Blues Festival. Singer, dancer, and comedian, he promoted the blues in the 1950s as a disc jockey on WDIA in Memphis, the first radio station dedicated to black music. His own biggest hit was the novelty song "Walking the Dog."



say in a low tone: 'Anybody want to go to Chicago, see me.'

In 1918 a ticket to Chicago from New Orleans cost about \$20—nearly a month's pay on some plantations. Many people sold their belongings—often at a loss—and gradually moved north, working and saving enough money in one town to move to the next. Sometimes families split up. One man with a family of five wrote to the Chicago Urban League, a black social service organization, for train tickets: "If you cant sen for all send 2 one for me and my brother he live with me he is 18 yers old then i can arang for the rest after i get out there."

The *Chicago Defender's* militant drumbeat contrasted lynching and racial oppression in the South with glowing descriptions of a free and prosperous life in Chicago. "Copies were passed around until worn out," said one reader. People coming back home for a visit brought gifts, flashed money, and were full of all the news about living large in the big city. The North, the "promised land," was the talk in cotton fields, on street corners, in churches,

barber shops, and juke joints. As one Chicago letter writer noted, there was more to it than the search for jobs: "My children are going to the same school with the whites and I don't have to umble to no one. There isn't any 'yes sir' and 'no sir.'"

**F**OR THOSE LEAVING the Delta, the port city of Memphis on the Mississippi was the first major stop. Trains from the South converged on Memphis, where passengers boarded the Illinois Central Railroad for Chicago. If you walk a few blocks northeast of the old railroad station, now being renovated, through a crumbling neighborhood with cracked, weed-sprouting sidewalks, you come to Beale Street, once the heart of black Memphis.

"I found Beale Street to be a city unto itself," writes B. B. "Blues Boy" King in his recently published autobiography. At 73, B. B. King still travels with his old guitar, Lucille, the two of them performing up to 300 days a year. To King, who was born on a plantation

near Itta Bena, Mississippi, and first went to Memphis in 1945, Beale Street looked "like heaven. . . . There were three movie palaces, cafés, hotels, pawnshops—I'd never seen a pawnshop before—variety stores, and musicians everywhere. All my confidence from all those Saturdays playing all those little Delta towns vanished—just like that."

A musician could play on the street for tips or, with luck, in a theater or club. Both blues and jazz blew into Memphis, reinforcing each other. In the 1950s B. B. King helped pioneer the use of spiritual and jazz elements in the blues. "As folks moved up and down the river, they brought what they saw at each end into song," says Worth Long, the blues historian.

In Memphis in 1909 W. C. Handy, who had traveled the South with his own bands since the 1890s, wrote what is said to be the first blues song ever published. It was inspired, he said years later, by a melody he heard in 1903 while waiting for a train in Tutwiler, Mississippi. Handy was awakened by a man "plunking a guitar beside me. He pressed a knife on the strings of the guitar. The effect was unforgettable." The song Handy wrote, "Mr. Crump," was a campaign song for Edward H. "Boss" Crump, the powerful mayor of Memphis.

These days on Beale Street tourists choke the blues clubs. Fast-food carryouts and souvenir shops are inescapable, and the Monarch Saloon, one of Handy's hangouts, is vacant. The elegant Palace Theater, which gave B. B. King and other musicians an important boost, has been demolished.

A. J. Burnett, 71, was just 13 when she began dancing at the Palace in the 1940s as one of the "Vampin' Babies." A tall woman, she's still given to lithe, quick movements. "What they are doing in Las Vegas now, we were doing 50 years ago," she says, taking my hand as we walk down Beale. In her day it was a street of jazz and blues, men in suits, women dressed to kill or die for. Everywhere music floated above motion. "Decent people didn't go to juke joints," she says, expressing disdain for today's commercial hustle.

Like it or not, Beale Street tourism swells city coffers. But A. J. dislikes the way blues instead of jazz has become the street's main flavor. As we pass Handy Park, where a blues singer is passing a box around to tourists for coins and bills, she snaps, "The street is nothing now."

**F**ROM MEMPHIS it's on to Cairo, Illinois, the halfway point to Chicago. As Judge Irving had told me in Tutwiler, Cairo was where the North began. "They had a black curtain on the bus—white folks in front, us in back. They took it down in Cairo."

Hattie Kendrick, the youngest of my great-grandfather's five children, moved to Cairo in 1927 at the urging of a cousin who'd come up from Mississippi. In this "oasis," as Aunt Hattie called Cairo, she settled into a boarding house and began teaching in a one-room school.

I hadn't been to Cairo since I was a small boy. Then, I didn't know enough to ask my aunt the questions I wished to ask her now. She died in 1989 at age 94, but I'm grateful that during the last ten years of her life she put her recollections on cassette tapes.

Like many African Americans taking their first steps in the promised land, Aunt Hattie found that life in it wasn't all that had been promised. She was angered that black teachers earned less than whites and in 1941 sued the Board of Education to equalize teachers' salaries. Thurgood Marshall, who was then chief counsel of the NAACP and would in 1967 become the first African-American justice on the Supreme Court, took the case.

"Let me tell you a good story," Aunt Hattie liked to begin, when recalling the day her case came to court. "Thurgood and this other attorney were being called 'boys' by the defense attorney. He went on about how only a 'brilliant attorney' like the one who'd won a case like this in Tennessee could win this one. After he finished, Thurgood got up and bowed to him and thanked him, saying: 'I am that qualified, brilliant attorney who handled that case.' The whole courtroom burst into laughter." The case was won.

In 1973 Hattie Kendrick charged that Cairo's at-large system for electing the mayor and four councilmen discriminated against the city's black population. Seven years later her complaint paid off—a consent decree resulted in the creation of five wards, two with a black majority population.

Aunt Hattie, like her father Samuel Kendrick, sang no blues, though many of her tapes are punctuated by songs she remembered from childhood and church. Yet her life is a blues story, not for any hurt that came her way but because of her determination to move on to



The strain of life on the road bears down on Texan Johnny Clyde Copeland, backstage at the Memphis in May Festival in 1997. Four months earlier he had undergone a heart transplant but insisted on continuing to tour. He died that July after a follow-up operation.



something better. Like the great blues singers, Hattie Kendrick was set on making her mark.

*Well, I rode number seventy-four, boys, and  
the rain was falling down.*

*Well, I rode number seventy-four, boys, and  
the rain was falling down.*

*Well, you know I got awful cold and chilly,  
boys, but I was Chicago bound.*

—WILLIE LOVE

FOR ALL THE IMPACT of people like Hattie Kendrick, Cairo remained a backwater, stunted by the decline of lumbering in the region and the growth of Chicago as a railhead and port. Even Aunt Hattie spent summers in Chicago, working as a maid, enthralled by the city's size and pace. "You could just stand there at State and Madison Streets and see things you never dreamed of."

I like Chicago's energy too. But the day I arrived, newspapers were reporting the collapse of a truce between two gangs. Another day, walking down 47th Street, I saw two

young men make a lightning-quick exchange—a small packet of white powder for money.

A tough, sometimes grim, but less self-destructive black Chicago greeted Elnora Jones when she stepped off the train from Mississippi in 1945. A trim woman of 79 who laughs easily, she'd just moved into a new apartment near Lake Michigan when I visited her. "Look at me now!" she exclaimed. "A sharecropper's daughter, and I got an air conditioner, a view of the lake, and a reporter in the house. Don't tell me you can keep a good woman down."

Her mother had come to Chicago first. Elnora followed a few weeks later with her three children and her youngest brother, Eddie Campbell. Eddie, once the band director for the blues legend Jimmy Reed, is now a highly regarded bluesman himself. They boarded the Illinois Central in the Delta hamlet of Coahoma. "We didn't take much. We all had little suitcases, sort of cardboard you know, the kind you have to tie together or they would pop loose. And shoe boxes of fried chicken and biscuits."

On the outskirts of the great city they passed

End of an era was marked by the January 1998 death of blues elder statesman Junior Wells, an ace harmonica player whose stage presence matched his flamboyant playing style. His 1965 album *Hoodoo Man Blues* is considered one of the greatest blues recordings of all time.



the fire-belching smokestacks of steel plants. Pulling in at night at the 12th Street station, they were greeted by noisy throngs, huge buildings, and bright lights. "It was the biggest place I ever saw."

Elnora still shivers with excitement as she describes the trolley ride from the station, when she discovered that the rules of racial etiquette so rigidly applied in Mississippi didn't apply in Chicago. "It was crowded, and I'm standing there holding the rod when a white man got on, and his hand touched mine. I let my hand go, then I put it back. Wow!"

Not that there weren't occasions for second thoughts. Chicago was crowded. There was a sharp color line in housing, and conditions were rough. "Roaches," she shudders, talking about her first apartment, which she shared with three other families. "I'd seen rattlesnakes in Mississippi but not those things."

Between 1910 and 1930 Chicago's black population grew fivefold, to nearly a quarter of a million. Working-class neighborhoods—the "black belt"—stretched south from downtown

along Lake Michigan. They were home to steelworkers, packinghouse workers, janitors, porters, and maids like Elnora, who draws herself up proudly when telling me that even though she has a third-grade education, her three children have college degrees.

It was working people with extra money to spend who made possible the musical success of men like McKinley Morganfield, better known as Muddy Waters. (As a child he liked playing in the mud.) He had jumped off a train from Mississippi in 1943 with his guitar and a single change of clothes. Although he found a job paying \$45 a week on the loading dock of a paper factory, he was soon playing at rent parties and in loud clubs like the Chicken Shack on Chicago's West Side.

As musicians came to Chicago, exchanging ideas and influence, the city pioneered the transition from the folk, acoustic sound of the plantation South to a more sophisticated urban, amplified sound. Maxwell Street, on the West Side where the poorest of the poor settled, became a mile-long teeming bazaar on

A warm Memphis reception pleases Clarence "Gatemouth" Brown, who spices his sets with Cajun, jazz, and bluegrass, illustrating the affinity between other American music and the blues.

weekends. Musicians sang or played on corners, and electric cords stretched from sidewalk amplifiers to sockets in apartment walls. Muddy Waters played Maxwell Street occasionally, but he told an interviewer, "I didn't like to have to play outside in all the weathers, and I didn't like to pass the hat around."

**P**ARALLELING the growth of music in Chicago was the growth of enterprise in communities like Bronzeville, a sprawling, energetic South Side neighborhood that ran from 26th Street south for some 40 blocks. Today the blues hangs over much of the area, but not much music is heard. It's late afternoon, and I'm sitting with Gerri Oliver at the bar of the Palm Tavern on 47th. "My family's dream was for me to be a funeral director," says Gerri, another Mississippian who moved to Chicago in the 1940s. "I just wanted to put my son through school." She didn't pursue her family's wish but worked variously as a check cashier, hairdresser, and manicurist. Then in 1956 she and her husband bought the Palm.

With its gloved waiters and starched white tablecloths the Palm was soon *the* place for local and visiting musicians to come for food and drink. Gerri ticks off a long list that includes Dizzy Gillespie, Count Basie, and the Temptations. "To think I knew all of these people who are now famous," she says. "I took them for granted."

As we talk, one or two regulars drift in for a drink. Most of the clubs and theaters that made Bronzeville so vibrant have closed, and the Palm doesn't offer dinner anymore. "Those drug dealers told me if I don't let them sell from here, I wasn't going to get any business. I don't sell crack, and I sure ain't making money off martinis in here," Gerri sighs. But this is the life she knows, and so she's holding on.

From the Palm it's a short walk to the Checkerboard Lounge on 43rd, where I meet Sterling Plumpp, the poet and professor from Mississippi. Sitting with him at a Formica table, I glance around the room. Posters advertising



## The blues is

beer, some with a woman cuddling up to a can, decorate the walls. A street sign hanging from the ceiling reads "East Muddy Waters Drive."

The Checkerboard is one of a handful of places on the South Side where you can still hear live blues. Although black Chicago powered the blues, live music has largely moved to posh clubs on the North Side, where for musicians the pay is better, and for the mainly white patrons the walk safer.

"If you're not living here, the neighborhood seems dangerous," says the bartender when I comment on the empty streets. "Actually, it is sometimes."

Part of today's problem is the flight of middle-class blacks to the suburbs. As de facto



## simply how life feels as it goes on.

segregation north of the Mason-Dixon Line crumbled in the 1970s, blacks fled inner cities, much as an earlier generation in the South had fled plantations. The facts of life, Willie Dixon called the blues. The facts change; the blues is simply how life feels as it goes on. "There's more continuity in blues as an expression of everyday life than anything on this globe," Sterling says. That's what connects Samuel and Hattie Kendrick to Honeyboy Edwards, Willie Foster, Elnora Jones, and others I met along the blues highway.

The continuity lets me recognize myself in the blues. Not unlike teenagers today, my generation had dismissed the blues as too old and too passive. We couldn't hear. And for many of

us, our southern roots were distant. But now in Chicago, at this journey's end, I look back down the blues highway and give thanks to those who traveled it before me. Their music and their struggles smoothed my way.

I settle into the music. On stage at the Checkerboard is John Primer, at 52 a bluesman of a younger generation than men like Honeyboy Edwards, Willie Foster, and Gatemouth Moore. Primer's voice has a rough edge; his harmonica produces torrents of sound. It is as if he is trying to force life back into the bleak streets outside. "Sweet Home Chicago," he sings, not with irony but fervent belief. □

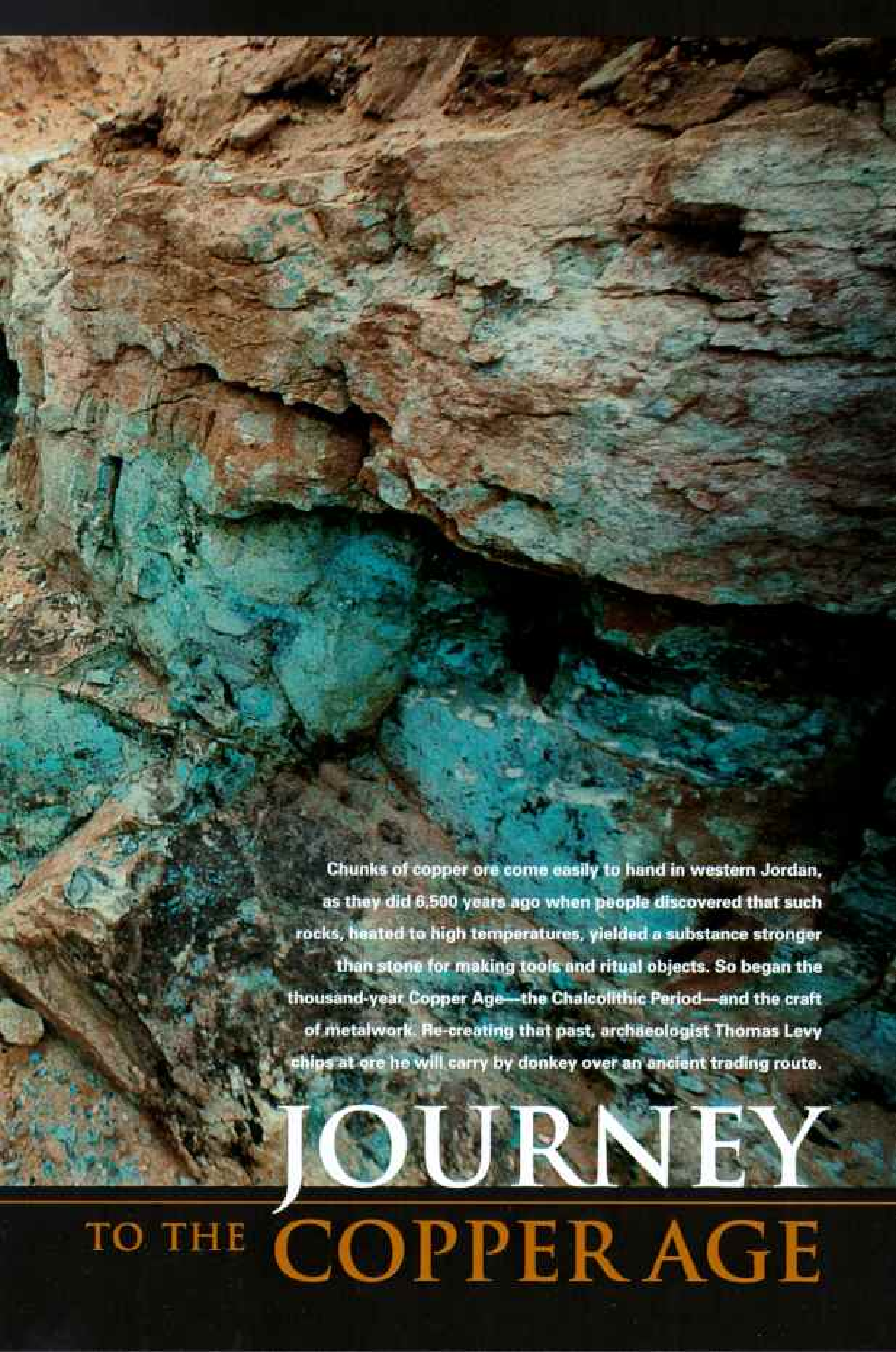
Got a feeling for the blues? A family story to share? Log on to [www.nationalgeographic.com/ngm/9904](http://www.nationalgeographic.com/ngm/9904).



By KATHERINE OZMENT Photographs by KENNETH GARRETT

Art by CHRISTOPHER A. KLEIN

NATIONAL GEOGRAPHIC ARTIST



Chunks of copper ore come easily to hand in western Jordan, as they did 6,500 years ago when people discovered that such rocks, heated to high temperatures, yielded a substance stronger than stone for making tools and ritual objects. So began the thousand-year Copper Age—the Chalcolithic Period—and the craft of metalwork. Re-creating that past, archaeologist Thomas Levy chips at ore he will carry by donkey over an ancient trading route.

# JOURNEY TO THE COPPER AGE

“**T**his is pure copper ore,” Andreas Hauptmann, a mineralogist from the German Mining Museum, tells us as he holds a piece of blue rock in his outstretched hand. We gaze at it as if transfixed. It is the reason we are here in western Jordan, standing in a dried-up streambed in the Wadi Faynan region. We have come to search for copper ore and to listen for a sound—of hammer stones pounding rock—that echoed through this valley so very long ago.

Three thousand years before Moses walked the Holy Land, peoples scattered from the Balkans to the tip of the Sinai Peninsula began to mine copper ore and make something of it. They crafted axes, adzes, awls, and chisels, which eased their way through daily chores, as well as objects used purely





for ritual—mace heads, ornate standards, and crowns. Wadi Faynan was one source of copper for this newfound metal industry; the ore mined here found its way to the smelting furnaces of settlements in what is now southern Israel.

Who were the people who learned to mine the ore, move it to faraway villages, and make metal objects from it? How did they live? That is what Tom Levy, an archaeologist from the University of California at San Diego, and a group of other scientists—Israeli, Jordanian, and German—are trying to learn firsthand in the field. I travel with them as they retrace the steps of ancient copper traders from the mountains of Jordan to Israel's Beersheba valley, where fertile alluvial soil along streambeds supported rapidly increasing populations.

#### RESEARCH PROJECT

Supported in part by your Society

We travel as people did then. Donkeys take us through winding, rock-strewn valleys and over stretches of windswept desert. And when we reach our destination, we will try to do what those who came before us did with such skill: turn chunks of blue rock into a shiny, malleable metal.

From the village of Dana (left) our team of archaeologists, Bedouin, and journalists descended into the valley to start the re-creation of a Copper Age journey (map,

above). On foot and by donkey we crossed the desert sands of Wadi Arabah, the rocky slopes of the Negev desert, and entered the once fertile Beersheba valley,





## CRAFTS FOR RITUAL AND TRADE

**C**opper, ivory, stone, and gold: These and more were worked by people of the Copper Age. Avi Gopher, an archaeologist at Tel Aviv University, explains that eight gold circles from Nahal Qanah (above) were "too small to be bracelets and too big to be rings. They were probably ingots,

worn on a string for easy transport, and they may have come from Egypt." If so, they are further evidence that trade routes were well established in the Copper Age.

Two foot-high ivory figurines from the Beersheba valley (below, foreground) were carved from hippopotamus and elephant tusk.



They were likely used in rituals, the enlarged noses and breasts perhaps symbols of fertility. Violin-shaped figurines (facing page) from Gilat, made from schist, granite, and limestone, may represent goddesses of a fertility cult.

Yet no find surpasses one made in a cave high up a canyon called Nahal Mishmar on the west side of the Dead Sea, where a team led by archaeologist



Pessah Bar-Adon discovered 429 objects wrapped in a reed mat.

The 5,500-year-old cache (above) of ivory pieces, copper vessels, crowns, scepters, and mace heads yielded work of unexpected artistry. Casting such objects required technical finesse and the use of copper ore rich in arsenic or antimony—elements not found in nature within 800 miles of the Holy Land.





## CAVE OF THE WARRIOR

**T**omb of an unknown soldier, a cave near Jericho (above, at bottom) yielded a spectacular find when it was discovered in 1993 by archaeologists searching for Dead

Sea scrolls. Instead they found a treasure of a different kind: the complete skeleton of a man thought to have been a Copper Age warrior. Placed on a plaited reed mat, the skeleton was





accompanied by a wooden bowl, leather sandals, and a long flint blade (above). A broken bow, its tips shaped like rams' horns, and a walking stick (below)—the left leg bone of the skeleton showed a healed fracture—

were also recovered.

At the Israel Antiquities Authority in Jerusalem, curator Tamar Schick (bottom, at right) and conservator Olga Negnevitsky took on the painstaking tasks of opening, preserving, and

mounting the 23-foot-long linen shroud in which the warrior's body was wrapped.

"Some of the linen was stained with red ocher, which was used in rituals during the Copper Age," Schick tells me. Ocher, an impure iron oxide used as a dye, made the fabric brittle. "Parts of the cloth disintegrated into fine powder at our very touch," says Negnevitsky, who spent a year unfurling the heap of cloth.

"The exquisitely crafted shroud, probably woven by several people on a ground loom, suggests that the deceased was a high-ranking individual," concludes Schick.





## A COPPER AGE VILLAGE

**B**y 4200 B.C. the village of Shiqmim (painting above) was probably home to a thousand people," says Tom Levy, who was stunned when he came upon the site in the late 1970s. During excavations Levy and his team uncovered a network of underground rooms, the most extensive Copper Age cemetery in Israel, remnants of copper smelting, and several tons of pottery sherds and worked flint.

Shiqmim's settlers built their first dwellings into hill-sides (detail, above right) and

used the subterranean rooms to store grain. As sediment filled a nearby streambed, villagers expanded their settlement into the floodplain, erecting mud-brick houses on stone foundations and what Levy calls "corporate buildings"—larger structures where religious, economic, or social activities were held.

Among many pits were

three used for copper smelting and casting. In them Levy found clay crucibles, slag, and pellets. A standard, awl, and ax (facing page, top) were found in other areas.

Ten days after leaving Wadi Faynan, our group arrives in Shiqmim and sets out to make its own copper ax. The trick is to keep the fire at least at 1981°F (1083°C) so that

Storage area



pure copper held in the ore will be reduced. Ayner Goren, Andreas Hauptmann, and Tom Levy (below, from left) blow on the coals simultaneously through bamboo stalks.

After half an hour Hauptmann pulls the crucible from the fire and pokes the contents with a stick. "Nothing," he says, and they begin blowing again, keeping a steady stream on the coals by taking turns. Another half hour passes. Hauptmann empties the crucible's contents into a pan and pours water over the debris. Swirling the pan, he lets most of the water and the ash spill over the sides. This time, success: Several pellets the size of small BBs remain—pure copper.

We cannot stay the extra weeks we now realize will be needed to make a shiny



metal ax. "You can see why we found 250 stone axes for every copper one at Shiqmim," Levy says.

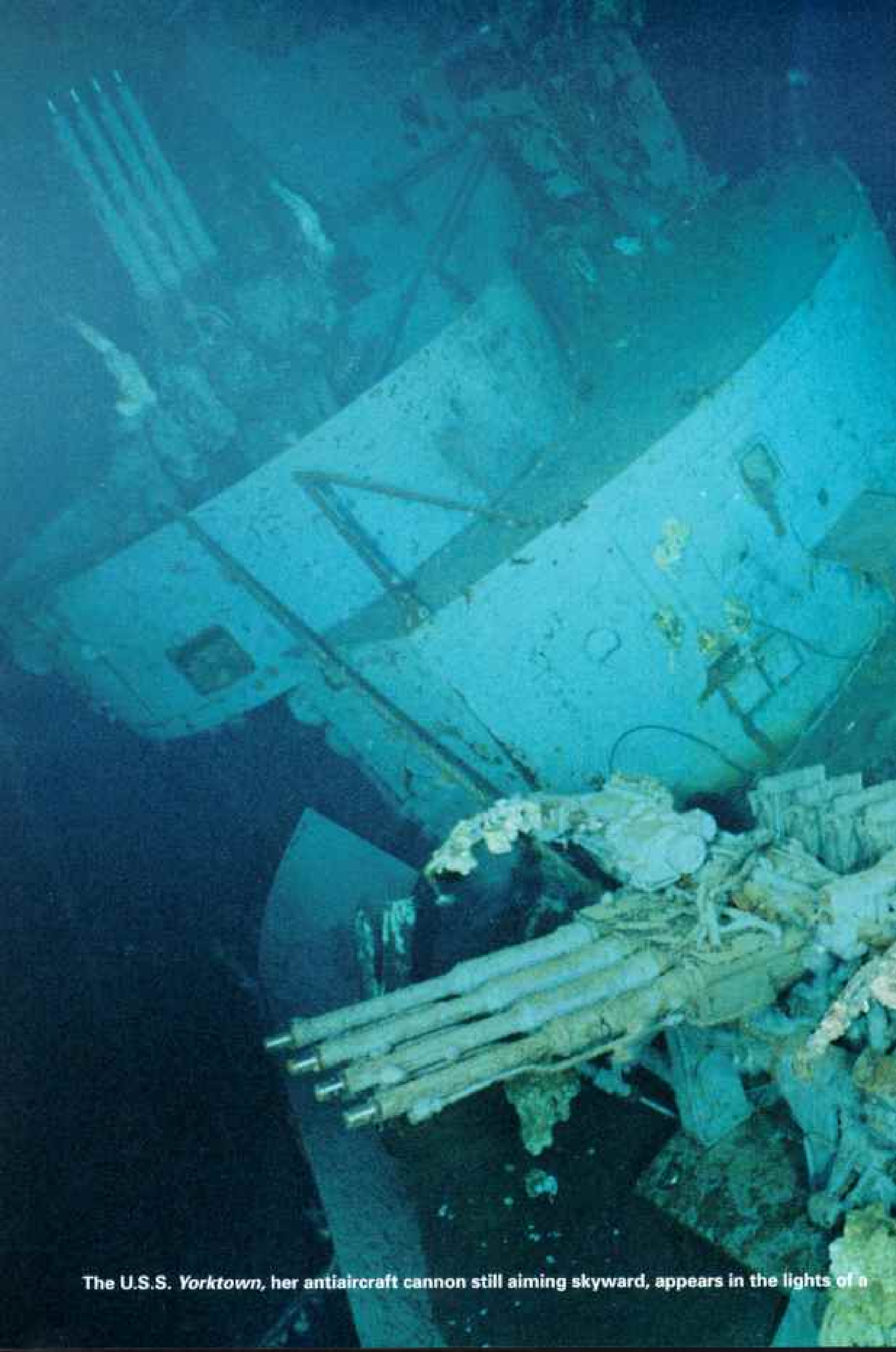
Still, we are satisfied. We sense what it was like for traders and smelters living 6,500 years ago to haul ore and make metal tools. And

we can truly understand the metalworking pioneers who first took fire to stone—and changed the world. □

---

KATHERINE OZMENT is a former member of the editorial staff. She lives in California. KENNETH GARRETT is a frequent contributor, specializing in ancient cultures.





The U.S.S. *Yorktown*, her anti-aircraft cannon still aiming skyward, appears in the lights of a

# GHOSTS AND SURVIVORS

RETURN TO THE BATTLE OF

# MIDWAY

For the warriors who survived it, the Battle of Midway lives on, etched in their memories as searing moments that carried death but gave them life. The epic World War II duel between aircraft carriers of the United States and Japan ended with five of those carriers sunk. They lie over three miles deep in the Pacific, gone but still remembered by the men who stood on slanting decks as their ships began to die.

BY THOMAS B. ALLEN

PHOTOGRAPHS BY DAVID DOUBILET

U.S. Navy robot submersible, culminating a search led by undersea explorer Robert D. Ballard.

DAVID DOUBILET WITH KEITH A. MOOREHEAD, NGS STAFF





**BACK ON PATROL**



Vintage Navy warplanes—from top, Dauntless dive-bomber, Avenger torpedo bomber, and Wildcat fighter—salute the U.S.S. *Constellation*. In the Battle of Midway brethren of these aircraft flew from carriers such as the *Yorktown* (right), whose crew doused a fire to keep her in the fight.

AIRCRAFT FROM PLANES OF FAME, OHIO, CALIF., AND PALM SPRINGS (CALIF.) AIR MUSEUM; NATIONAL ARCHIVES, WASHINGTON, D.C. (RIGHT)





**O**N JUNE 4, 1942, 18-year-old Bill Surgi crouched on a catwalk on the port side of the *Yorktown*, feeding .30-caliber bullets to a machine gun lashed to a rail. Surgi saw three torpedoes drop from Japanese bombers that were skimming the sea through a hail of gunfire. He looked up and saw a Japanese airman in a white scarf waving or shaking his fist. He watched one torpedo, "bright and shiny," speeding toward him. Then came two blasts, hurling Surgi to the deck of the catwalk.

Fifty-six years later Surgi and three other war veterans—one American, two Japanese—sailed with Robert D. Ballard, the underwater explorer who found the *Titanic*, as he searched for the lost ships of Midway. I was also aboard, learning about Midway from these old foes turned latter-day shipmates. Their remembered moments led me to other survivors, to other moments that formed a mosaic of memory, a remembrance of battle from the men who were there.

Aboard Ballard's search ship, every time the U.S. Navy robot submersible went down to seek his ship, Bill Surgi took up his watch station at a monitor showing images transmitted from far below us. Bill wore a white Navy hat, dungarees, and a blue shirt with a petty officer 1st-class insignia on the sleeve. In his lap he held the helmet—"my tin hat"—that he had clutched when, with his left arm broken, he had tried to stay afloat in the oily waters near the abandoned *Yorktown*. An officer had



NATIONAL GEOGRAPHIC MAPS (TOP), NATIONAL ARCHIVES

**Burning oil tanks blacken Midway's sky during the raid by Japanese bombers, a prelude to a planned invasion. Midway, a U.S. base named for its mid-Pacific location, guarded Hawaii. Today turquoise waters and squadrons of clouds surround the atoll's wartime targets: Sand Island and smaller Eastern Island. Albatrosses still occupy Midway, a wildlife refuge since 1988.**



ordered him to let go of the helmet, but he had stubbornly held on. While he watched the monitor, he held the helmet, vowing not to put it on until he saw his ship again.

Then came the day when the image of the *Yorktown* appeared on the monitor, green and ghostly. Lights played across the hull. And there, black against the camera's spotlights, was the hole made by the Japanese aerial torpedoes.

"She looks good for the shape she's in," Bill said softly. And he put on his helmet.

Taisuke Maruyama, a 19-year-old flying from the carrier *Hiryu*, commanded the plane Bill Surgi had seen torpedoing the *Yorktown*. As Maruyama's plane began its torpedo run, bullets ripped into it, wounding the gunner. "Gas was coming out like a vapor," Maruyama tells me as we sip tea alongside a Japanese garden. "It was like being in a spiderweb of bullets. I thought, I don't want to die before dropping my torpedo." He ordered his pilot to release it. The *Yorktown* loomed before them. The pilot

zoomed across the carrier, the propeller almost touching the flight deck. Maruyama, seated between the pilot and the gunner, slid back the canopy and swung a camera around to photograph the torpedo's explosion.

Three of the four survivors sailing on Ballard's search ship had also fought in the air. Harry Ferrier had flown as a radioman-gunner in a torpedo plane defending Midway. It was the first time the 17-year-old had seen combat.

Yuji Akamatsu and Haruo Yoshino had flown from the aircraft carrier *Kaga*. Both men were veterans of battle. On December 7, 1941, in the Japanese attack on Pearl Harbor, Yoshino had torpedoed the battleship *Oklahoma*, and Akamatsu had attacked the battleship *Arizona*. Now, six months later, they were part of a Japanese invasion armada heading for the U.S. naval base on Midway, two small islands that form a coral atoll in the north Pacific about 1,300 miles northwest of Hawaii.

That armada was the main prong of a

colossal offensive aimed at destroying American power in the Pacific. Japanese strike forces, spread across 2,000 miles of ocean, were to invade Midway and two islands in the Aleutians, the bleak archipelago curving westward from the Alaska mainland. Japanese strategists expected to draw the U.S. Pacific Fleet from Pearl Harbor and into a decisive battle. Adm. Isoroku Yamamoto, commander in chief of the Japanese Combined Fleet and architect of the Pearl Harbor attack, believed that his plan would smash the enemy fleet, forcing the Americans to a negotiated peace.

Spearheading the Japanese operation were four aircraft carriers: the *Akagi*, *Kaga*, *Hiryu*, and *Soryu*. Surrounding them was a screen of 11 destroyers, two battleships, and three cruisers. The other forces included transports for the 5,000 troops who would invade Midway. Secret documents recently made available show that U.S. commanders had reason to believe the Japanese were contemplating poison gas for the invasion. This would have been a fateful decision, for the United States would have retaliated, and a horrible new weapon would have entered the war.

As the Japanese fleet steamed toward Midway on June 2, Yamamoto hoped the advantage of surprise was still on his side. But in fact three U.S. carriers—the *Yorktown*, *Hornet*, and *Enterprise*—with their destroyers and cruisers, were waiting to pounce on an enemy they knew was coming because of the incredible performance of U.S. code breakers.

**S**INCE LONG BEFORE the Pearl Harbor attack, U.S. cryptanalysts had been chipping away at the Imperial Navy's most secret communications. The frontline code breakers worked in a basement room at the naval district headquarters building in Pearl Harbor, a dank, dark place known as "the dungeon." It is still there, empty and forgotten.

Ruling the room in 1942 was a genius of code breaking, Comdr. Joseph J. Rochefort. Rarely sleeping or eating, he paced the windowless room in his shabby red smoking jacket and carpet slippers, downing cups of coffee and coming up with answers to riddles. "He never took anything for granted," remembers Gilven M. Slonim, one of the cryptanalysts. "Only if it could be proven was it intelligence."

## REPORT TO THE U.S.S. *ENTERPRISE*: "ENEMY FLEET UNITS



At age 88 Richard Best recalls the day he commanded Bombing 6, a squadron of Dauntless dive-bombers like the one behind him. He spotted the Japanese carrier *Akagi* and aimed at the flight deck's red rising sun. His bomb hit home. Other Dauntlesses set a cruiser afire (left). A faulty oxygen system seared Best's lungs, and after Midway he never flew again. But, he says, "I quit at the top."



In the spring of 1942 the code breakers cracked intercepted Japanese messages referring to an attack on AF, a place that Rochefort deduced to be Midway. When superiors in Washington would not accept his theory, Rochefort employed a ruse. He told Midway to transmit to Pearl Harbor radio messages about a water problem, both in clear text and in a low-level code that he knew the Japanese could read. On May 22 Japanese naval intelligence, in a message heard by U.S. interceptors, reported a water problem on AF. So AF was Midway.

Reporting to Adm. Chester W. Nimitz, commander in chief of the Pacific Fleet, Rochefort predicted that the Japanese would attack the Aleutians on June 3 and Midway the next day. Although members of his staff and jittery officers in Washington warned Nimitz that the code breakers were falling for a Japanese deception operation, Nimitz used Rochefort's report as the linchpin for U.S. strategy.

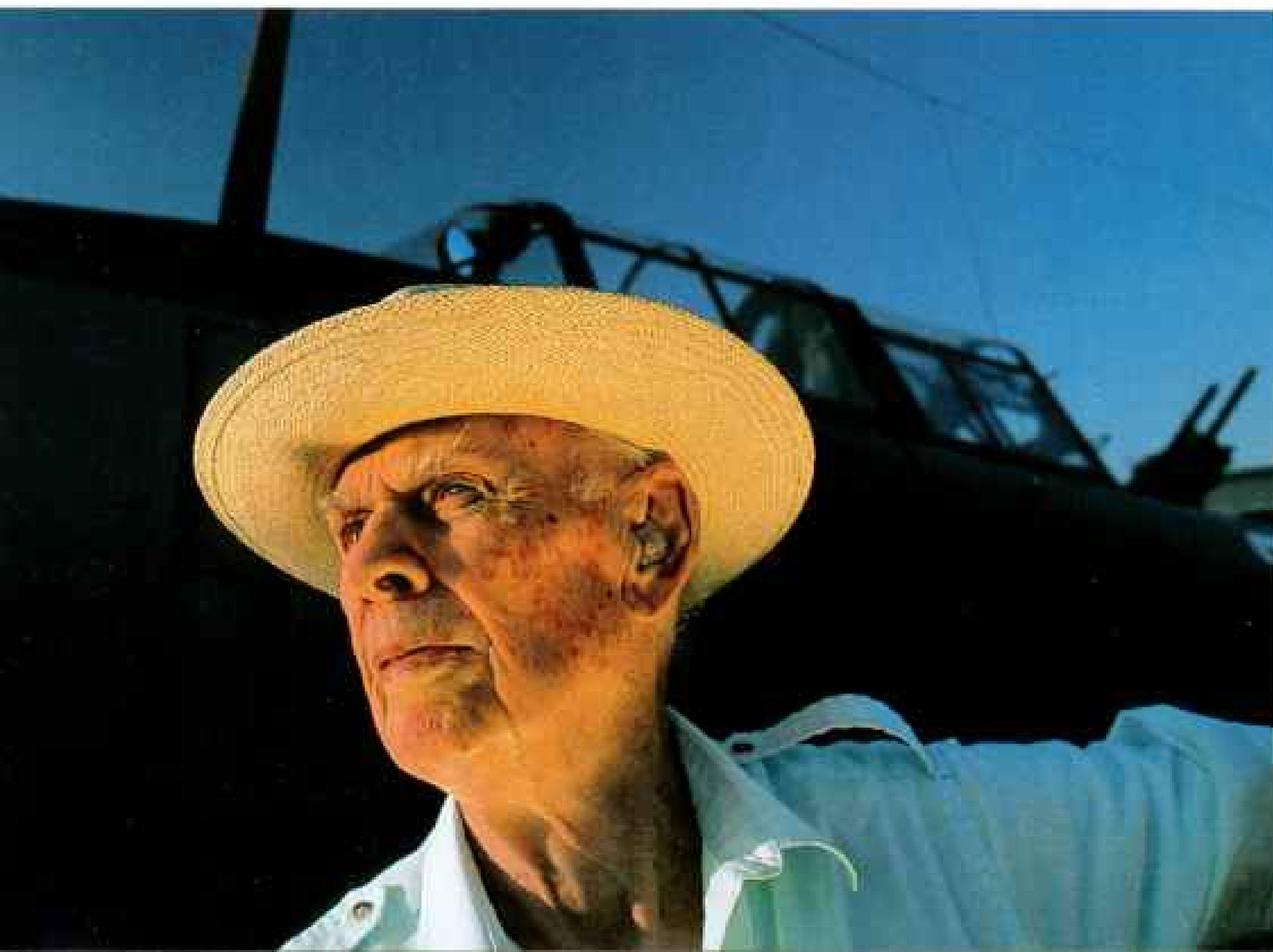
To fight the four Japanese carriers and their fleet, Nimitz had two seaworthy carriers—the *Enterprise* and the *Hornet*—and the battered *Yorktown*. She had arrived in Pearl Harbor on May 27, a stream of leaking oil spreading for

miles behind her. A bomb had struck her in the Battle of the Coral Sea on May 8, holing her flight deck and exploding deep within the ship. Crewmen like Bill Surgi expected that she would be sent to the U.S. West Coast for repairs. But Nimitz ordered her readied for battle in three days. Some 1,500 yard workers clambered aboard, patched her flight deck, welded steel plates on her hull, and shored up her collapsed bulkheads with timber.

The *Enterprise* and the *Hornet* left Pearl Harbor on May 28. Two days later came the *Yorktown*. Arrayed with their support ships in two task forces, the carriers rendezvoused on June 2 at a spot about 390 miles northeast of Midway designated "Point Luck." The name was fitting, for the outnumbered American forces would need large measures of luck to win the day. Their chances of success would be much higher if they could find the Japanese before the Japanese found them.

As it happened, June 3 was their lucky day. That morning Ens. Jack Reid, piloting a PBV Catalina flying boat, was flying a search fan out of Midway. At 9 o'clock, 30 miles beyond his 700-mile search range, Reid saw what first

## ON A COURSE FOR MIDWAY. LAUNCH BOMBING 6."





ON WINGS OF MEMORY



Once they dueled to the death—emblazoned with the Japanese rising sun and the U.S. star. Now they fly as rare relics of war: the last Zero fighter and one of two Dauntless dive-bombers still able to rise into the wild blue yonder. At Midway Dauntlesses sank the cruiser *Mikuma* (right).

AIRCRAFT FROM PLANES OF FAME; NATIONAL ARCHIVES (RIGHT)





# THE BATTLE



## Japanese Forces

To destroy the U.S. Pacific Fleet, crippled by the 1941 attack on Pearl Harbor, Japan plots an occupation of two Aleutian islands and an invasion of Midway. Strategists believe that the twin actions will lure U.S. carriers to their doom. Two Japanese carriers and 58 other ships sail for the Aleutians. For Midway, Japan commits 4 large carriers, 2 light carriers, 280 planes, 7 battleships, 14 cruisers, 15 submarines, 42 destroyers, and more than 30 supporting ships. These include transports carrying 5,000 troops to take Midway.



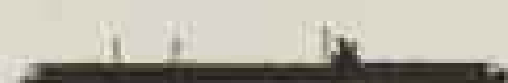
Akagi: sunk



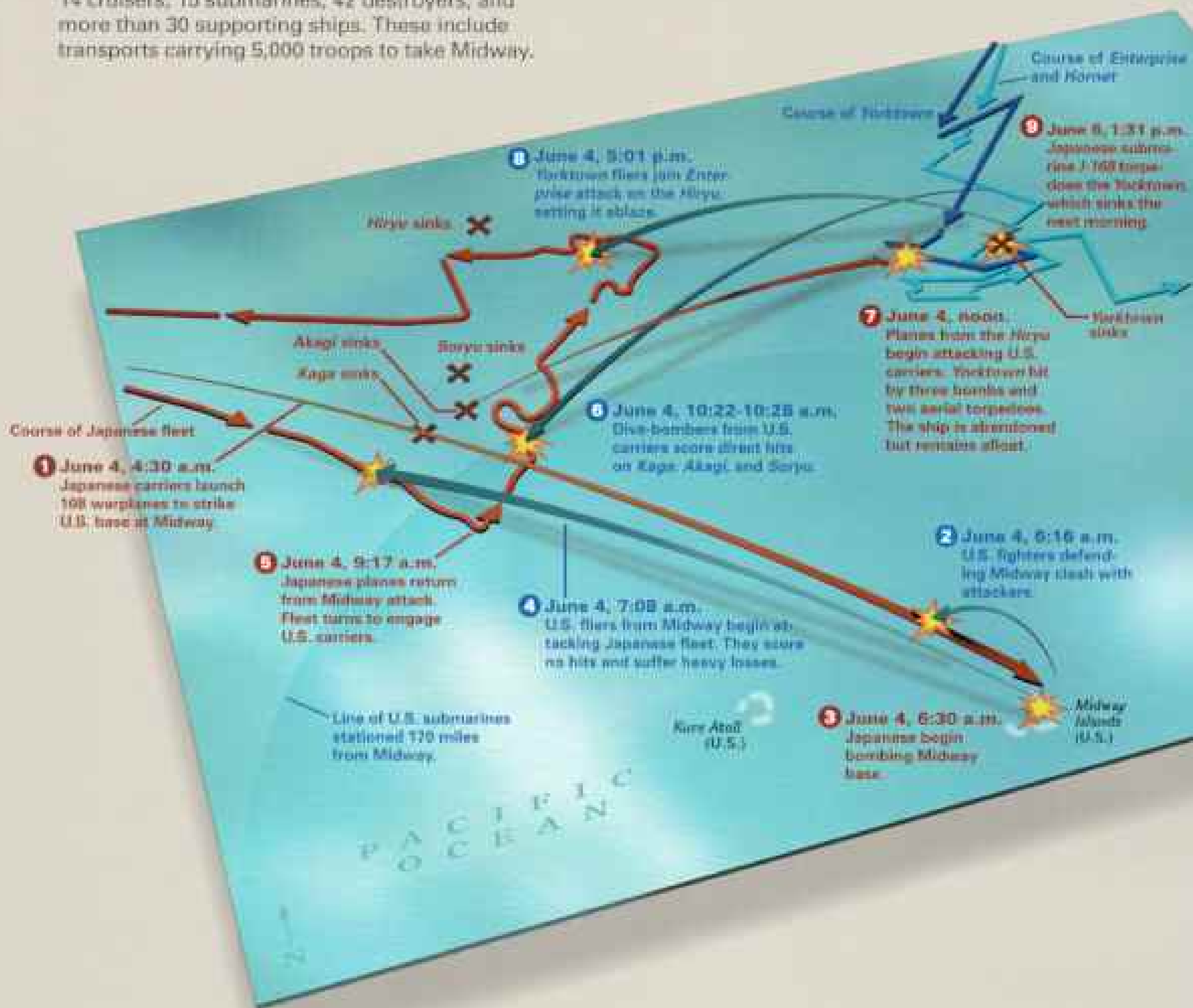
Hiryu: sunk



Kaga: sunk



Soryu: sunk



## U.S. Forces

No battleships guard U.S. carriers sent to Midway to engage the enemy fleet. Into combat go 3 carriers, including battle-damaged Yorktown. Protecting them are 8 cruisers and 16 destroyers. The U.S. has a total of 360 aircraft, including 234 carrier-based fighters and small bombers. Based on Midway are 28 fighters, 46 small bombers, 31 PBV Catalina scout planes, 4 Marauder medium bombers, and 17 Flying Fortresses. Most pilots on Midway have never flown in combat.



Yorktown: sunk



TBF Avenger: 6 / 5 lost



Hornet



F4F Wildcat: 88 / 26 lost



Enterprise



F2A Buffalo: 21 / 13 lost



A6M Zero: 106 / 94 lost



D3N Kate: 93 / 81 lost



D3A Val: 72 / 72 lost



U.S. Dauntless  
dive-bomber



SBD Dauntless: 128 / 48 lost



PBY Catalina: 31 / 1 lost



SB2U Vindicator: 21 / 6 lost



B-26 Marauder: 4 / 2 lost



TBD Devastator: 44 / 40 lost



B-17 Flying Fortress: 17 / 2 lost

looked like “dirty spots on the windshield.” After a second look he shouted, “I believe we have hit the jackpot!” Reid dived, putting the PBY just above the wave tops, and began counting enemy ships and sending coded messages. Hours later, as he landed in the Midway lagoon, one sputtering engine quit; as he moored at a buoy, the other engine also ran out of gas.

That same day two Japanese carriers in Alaska waters launched planes that bombed Dutch Harbor in the Aleutians, just as Rochefort had predicted. His other forecast came true at dawn on June 4 when the Japanese strike force launched 108 aircraft to bomb Midway.

The planes that attacked Midway ran into heavy antiaircraft fire and fought fierce dog-fights against slow, outclassed U.S. fighters. Swarms of fast, agile Japanese Zeros massacred the Americans. Of the 25 Marine fighters that rose to defend Midway, only 8 survived, and only 2 of those would ever fly again. Fourteen of the pilots were killed and four wounded.

Fifty-one other Midway planes, among them six TBF Avenger torpedo bombers, set out to attack the Japanese fleet. Each Avenger was manned by a pilot and two gunners. As the planes neared their target, more than 20 Zeros jumped them. Within seconds a Zero’s cannon shells and machine-gun bullets tore into one of the planes, killing turret gunner Jay Manning. The pilot, Ens. Bert Earnest, did not immediately know that Manning was dead. But Harry Ferrier, in the tunnel-like lower gun station, did. He felt something dripping and looked up and forward to see, through a red haze, a sight he would always hate to remember.

Other shells knocked out the hydraulic system and elevator wires. The tail wheel dropped, slowing down the already slow-moving bomber. A shell fragment hit Earnest’s right cheek. A bullet grazed Ferrier’s scalp, knocking him out. As the plane dived toward the sea, Earnest saw a cruiser and dropped his torpedo. The plane lurched upward, and Earnest managed to get control. “There was blood all over the plane,” he recalls. “I thought I was long gone.” He had no compass, but eventually he saw the big black smoke rising from Midway and headed for that, his bomb bay doors hanging open and 70-odd holes in his plane.

He skidded in for a landing. “I waited for the other people to come back,” Earnest says. “But no one came back.” Every other Avenger was



## TAISUKE MARUYAMA: "THE *YORKTOWN* LOOMED UP

shot down, and all the other men were killed.

On Bob Ballard's ship *Ferrier* showed the baseball cap he had worn to his first battle. The cap had a hole in it. "If I were an inch taller," he says, "I would be dead."

One day *Ferrier* realized that our ship was on the exact reverse heading of the course his torpedo bomber group had taken from Midway. He stood alone at the bow rail, looking down at the water where the *Avengers'* men had died.

The fierce opposition from Midway blunted the Japanese attack, so the leader of the raid,

---

THOMAS B. ALLEN is the co-author of *Spy Book: The Encyclopedia of Espionage*. He and photographer DAVID DOUBILET last teamed up for an article on Pearl Harbor (*NATIONAL GEOGRAPHIC*, December 1991).

Lt. Joichi Tomonaga of the *Hiryu*, radioed his commander: "There is need for a second attack wave." But Japanese ordnance men were already loading aircraft with torpedoes and armor-piercing bombs for the next phase of the operation: a strike on the U.S. carriers Yamamoto hoped to lure to their deaths. Another attack on Midway meant rearming planes with ground-attack bombs, so the men were ordered to exchange the torpedoes and armor-piercing bombs for ground-attack bombs.

At almost the same moment the *Hornet* and the *Enterprise* began to launch their aircraft for a strike on the Japanese carriers. The *Yorktown* planes followed soon after. The mission would take many of the warplanes to the edge of their range. Fliers knew the risk facing them; they

might not have enough fuel for a round-trip.

Twenty-three minutes after Tomonaga's call for a second attack on Midway, a Japanese scout plane reported seeing "what appears to be ten enemy surface ships." At that moment, on the *Enterprise*, code breaker Slonim translated "teki, teki, teki—enemy, enemy, enemy" from the intercepted message and instantly deduced that the U.S. carriers had been spotted. "My heart sank," he remembers. "This meant that they were going to do to us what we wanted to do to them."

**At Japan's Zero Park Museum in Shirahama, Taisuke Maruyama recalls flying at Midway in a Kate torpedo bomber. From his seat between the pilot and the gunner, he spotted the *Yorktown* and told his pilot to drop down to 60 feet. Leaking fuel and flying through fierce antiaircraft fire, they released a torpedo—one of two that hit the carrier (right) on June 4. A white geyser marks the instant of impact.**



## BEFORE US. I SHOUTED TO THE PILOT, 'FIRE A TORPEDO!' "

On the Japanese carriers, officers ordered another switch—back to torpedoes and armor-piercing bombs. The carriers' decks were crowded with rearming, refueling planes when 15 TBD Devastator torpedo bombers from the *Hornet's* Torpedo Squadron 8 appeared. But before the Americans could attack the vulnerable carriers, an inferno of gunfire wiped out the squadron. The only survivor of 30 men was Ens. George H. Gay. His riddled plane cartwheeled into the water with the radioman-gunner dying and Gay wounded. He crawled out and clung to a seat cushion, reluctant to inflate his highly visible yellow life raft.

Iyozo Fujita, flying a Zero from the *Soryu*, saw a torpedo heading toward his carrier. "I wagged my wings to signal the ship," he

remembers. "They didn't pay any attention. Fortunately it did not hit."

Fujita kept attacking the torpedo planes until *Soryu* gunfire hit his plane. Pinned down by the g force on his flaming Zero, he flipped out backward. "I went out like a tumbler," he says. His chute did not open. He shook the parachute bag, and it opened. "I had about a half second before I hit the sea." Like Gay, Fujita would bob in the ocean throughout the battle, one man watching a victory, the other a defeat.

Devastator torpedo bombers kept coming—

14 from the *Enterprise*, another 12 from the *Yorktown*. Enemy fighters shot them to pieces. Some airmen who ditched would survive. Two were rescued after 17 days in a life raft. Three picked up by Japanese destroyers were interrogated and executed, two by being thrown overboard with weights tied to their feet.

Of the 41 Devastators that had flown unescorted by fighters against the Japanese carriers, only 4 survived. No torpedo hit an enemy ship.

But the Devastators had not gone down in vain. Lumbering in at low levels, they kept the Zeros and antiaircraft crews busy while, far overhead, dive-bombers arrived, unnoticed and unopposed.

Lt. Comdr. Clarence Wade McClusky, air group commander of (Continued on page 100)

BY ROBERT D. BALLARD

**F**OR FOUR DAYS we have been searching the Pacific for the lost ships of Midway, a battle that was a turning point of World War II. In these waters and in these skies men fought and died in the battle that sent five aircraft carriers to the bottom. I wanted to find these gallant ships, which rest over three miles down. We had sailed out of Midway, headed for the likely site of the U.S. aircraft carrier *Yorktown*. Now it looks as if we have found her.

The good news comes from a web of lines appearing on a computer-generated grid of the seafloor about 17,000 feet below us. Karen Sender, a sonar technician in the University of Hawaii's Mapping Research Group, did some quick calculations about a blob in the web. That blob could be the grave of the *Yorktown*.

The Hawaiian ocean mappers operate the MR-1, a torpedo-shaped device that we tow behind our search ship, the *Laney Chouest*. The MR-1 transmits sonar signals to the ocean floor and records them as they bounce back. Computers convert the pings into video displays or printouts that show us the ocean floor. Somewhere down there are the *Yorktown* and the four Japanese carriers sunk in June 1942.

On May 2, 1998, our ship began towing the MR-1 in an up-one-row-down-the-other pattern designed to cover every foot of a 22-mile-by-10-mile search box. This is almost as big as the combined search boxes for the *Titanic* and the *Bismarck*.\*

By May 5 our map of the search box was covered by a web of lines produced by a computer and my own hand. Using the computer printout as an overlay on a chart of the area, I draw a crisscross of lines showing the progress of the search. Matching these lines with the sonar data, Karen had detected an object some 800 feet long and 43 feet high. The object could be a ridge jutting from the seafloor. But the blob was just about the length of the *Yorktown*, and the height seemed about right if the carrier had ended her dive jammed upright in the silt.

I decided to recover MR-1 and launch the U.S. Navy's advanced tethered vehicle (ATV).



The 15,000-pound unmanned submersible can plunge as deep as 20,000 feet on a tether containing control cables. A pilot and copilot in a van on the deck of the *Laney Chouest* "fly" the ATV by using joysticks to operate thrusters that send it in any direction. They also control video and still cameras mounted on the ATV.

On its maiden dive for the *Yorktown*, the ATV failed. At about 5,000 feet the tether cracked and water shorted an electric line, blacking out lights and cameras. The damaged section of cable had to be removed and the spliced ends resealed with epoxy, which would take 24 hours to harden. So we waited.

When the wait ended, I put on my *Yorktown* baseball cap and went into the control van. On the fantail a dozen U.S. Navy men got ready to launch the ATV again. This time it reached 15,600 feet, about a thousand feet above the seafloor and the blob. Then, blackout.

Two large glass instrument packages had imploded with such force that shock waves ripped through the ATV, battering cameras, damaging computer boards, and knocking out the sonar. As the Navy crew worked around the clock to repair the ATV, we headed for a new area about 180 miles northwest of Midway, where three of the Japanese aircraft carriers—the *Akagi*, *Kaga*, and *Soryu*—had gone down. (The fourth, the *Hiryu*, was about 70 miles north of the others.)

After a survey with the MR-1 located two possible targets, *(Continued on page 98)*

\*See "The *Bismarck* Found," NATIONAL GEOGRAPHIC, November 1989, and "How We Found *Titanic*," December 1985, both by Robert D. Ballard.



Searching the deep by remote control, Robert Ballard, seated at center, watches a sonar image of the Pacific seafloor as U.S. Navy crewmen maneuver their ATV—advanced tethered vehicle—which transmits the image. The submersible descends as the tether unreels from the mother ship. The search ends when a spectral sonar image (facing page) reveals the square black hole of an elevator shaft on *Yorktown*'s flight deck, 16,650 feet below.



# FINDING THE YORKTOWN

Battered by war and enshrined by memory, the 800-foot-long *Yorktown* rests upright, as if moored at the bottom of the Pacific. On June 6, 1942, as a salvage crew struggled to save her, the carrier was struck by two torpedoes fired by a Japanese submarine. She sank the next morning. Her three-mile plunge ended when she burrowed into seafloor silt, which covers the hull to the waterline. Searchers got their first glimpse of her on May 19, 1998, amazingly intact as shown in this artist's rendering. Guns still point skyward. Aircraft elevator shafts gape open in the wooden flight deck. Jutting from the starboard side of the flight deck, the "island," command heart of the carrier, was damaged by fire when a bomb struck nearby on June 4. That same day two aerial torpedoes made a jagged hole in the portside hull. The hangar deck is visible through bay doors.

ART BY RICHARD SCHLECHT; PHOTOGRAPHS BY DAVID DOUBILET WITH KEITH A. MOOREHEAD



## 1 BOW

Two 20-mm anti-aircraft guns jut from a gun tub at the bow beneath the flight deck. An anchor was jettisoned and cables made fast in an attempt to tow the ship from danger.





**2 ISLAND**

Below the windows are viewing slits of the armored lookout station. What may be the towing cable lies diagonally across the pilothouse.



**3 STERN**

The carrier's name is still faintly visible on its hull. The after end of the wooden flight deck was apparently torn away when the ship plunged to the deep, probably hitting stern first.



**4 TORPEDO DAMAGE**

A hole amidships on the port side shows where two aerial torpedoes hit on June 4, ripping away armor plate and opening the hull. Oil stains indicate that the torpedoes ruptured fuel tanks.



(Continued from page 94) we pulled it in and sent down the ATV. As soon as it hit the water, a hydraulic unit failed, reducing power by 60 percent. It took eight hours to reach bottom and, once there, had to be towed backward.

After an agonizingly slow search that took several more hours, one of the sonar units started to ping. For the first time in days I felt the thrill of discovery, that tantalizing moment when I believe I have found my quarry but have not yet seen it.

In the control van the pinging got louder, indicating a nearby target. Just as I was almost convinced we had finally found a ship, the outline of a scalloped rock outcrop came into view. Similarly, the second target turned out to be a mound of volcanic rock. Days of searching, and all we had to show for it were rocks. I left the control van and went out on deck to have a few moments alone with my frustration.

Running out of time and good weather, we set course back to the *Yorktown* search box. The ATV dived—but not to the bottom. Once again the submersible failed. And once again repair of the tether meant a 24-hour wait for the epoxy to cure.

Finally, on the morning of May 19, the ATV reached the bottom, 16,650 feet, near the site of the blob. Suddenly the sonar started pinging in the control van. Almost simultaneously I saw something on the monitor that may not seem remarkable—just a few mud balls. But visions of the *Titanic* instantly came to mind. This was splatter from a tremendous impact. Next came what I recognized as the edge of an impact crater. And then the sonar began painting an image that looked like a flight deck. I wanted to cheer, but in the crowded control van there's no room for emotion. And, I thought bitterly, maybe it would be just another false find.

The ATV moved closer and rose slowly, lights and cameras working perfectly. I could see the edge of a dark hole with flat decking around it. An elevator opening. Then I saw the ship's superstructure—the island—and I knew where we were. We were at the stern of an aircraft carrier. We had found the *Yorktown*.

---

Undersea explorer ROBERT D. BALLARD is founder of the JASON Foundation for Education, which involves schoolchildren in live electronic field trips.





Countless coats of gray paint still defend the carrier's bridge from corrosion more than a half century after it was swallowed by the Pacific. Some 30 crew members killed during the fighting went down with the vessel, but searchers discovered no sign of human remains.

DAVID DOUBILET WITH KEITH A. MOOREHEAD



## SURVIVORS REMEMBER: SMOKE, FIRE, VALIANT DEEDS,

Crewmen of the burning *Yorktown* tend to their ship and their fallen. Able-bodied men replace casualties. Corpsmen aid a wounded gunner. Such memories still burn bright for three of the battle's survivors: Flier Haruo Yoshino (top) leaped from the sinking *Kaga*. Aviation mechanic Bill Surgi (center) dropped into the sea from the listing *Yorktown*. Aerial gunner Harry Ferrier (bottom) flew with other airmen to defend Midway. Of the 18 men in his detachment, only he and his pilot, both wounded, returned alive.

(Continued from page 93) the *Enterprise*, had led 32 SBD Dauntless dive-bombers to where the Japanese fleet was supposed to be, only to look down at an empty ocean. His fuel was running out when he spotted a long wake made by a Japanese destroyer speeding north-northeast after attacking a U.S. submarine. McClusky surmised that the warship was heading toward the Japanese carriers and decided to follow it. About 25 minutes later McClusky's fliers were over the fleet. At 10:22, with a squadron behind him, he dived on the *Kaga*. Another squadron,



## SUDDEN DEATH, AND PLUNGES INTO OILY WATERS.

led by Lt. Richard Best, tipped over, aiming at the *Akagi*. Then 17 SBDs from the *Yorktown* arrived and dived on the *Soryu* as she was turning into the wind to launch planes.

Four bombs hit the *Kaga*, setting off gasoline-fed fires among the planes on deck. Two bombs hit the *Akagi*, one striking the amidships elevator, which crumpled into the hangar deck. Fires and explosions spread among 60-odd aircraft, most of them fueled and armed. Three bombs struck the *Soryu*, touching off explosions and fires on the flight

and hangar decks. In scarcely six minutes the three carriers were fatally ablaze and listing.

Haruo Yoshino, returning from a scouting mission, had seen U.S. torpedo planes close to the *Kaga*. "I landed and went to the pilot room," he says. "Then"—he points upward, referring to the dive-bomber attack. "I thought it was a trick."

When the first bombs hit, he was on the flight deck. "Smoke was coming up from the hangar deck," he recalls. "Torpedoes were exploding. And bombs. I jumped into the sea."

Yuji Akamatsu was eating breakfast aboard the *Kaga* when he heard the air-raid alarm. He went out on deck. A bomb hit nearby, knocking him unconscious. By the time he roused, "there were many explosions and fires," he says. "We could not put them out. We had to escape. I closed my eyes and jumped."

**T**HE FOURTH JAPANESE CARRIER—the *Hiryu*—had only hours to live. American dive-bombers would fatally wound her later that afternoon. But now from her deck, heading for the *Yorktown*, flew a vengeful force of 18 Val dive-bombers and 6 Zero escorts. U.S. fighters protecting the *Yorktown* got ten Vals; a wall of antiaircraft fire stopped two more. Four U.S. fighters dived on the last of the *Hiryu* bombers. The lead U.S. pilot squeezed his trigger. An electrical failure stilled his guns. As he pulled away in frustration, the other three U.S. planes followed his lead. The surviving Japanese dive-bombers flew on,

three coming in from astern the *Yorktown*, the others off to starboard.

"All hell broke out," Pete Montalvo recalls. He was on a 1.1-inch gun mount astern of the smokestacks on the starboard side. Dozens of guns ripped one of the planes into three pieces. But its bomb hurtled on, tumbling through the air. "It blew up about ten feet behind me," Montalvo says. "I remember feeling a wall of flame engulfing me. I ripped my helmet off and blood was covering my face and eyes. I called out for my mother. I looked around and saw one of my shipmates. He had no legs. The two sailors on the seats of the gun mount . . . there was nothing from their waist up."

The bomb tore open the flight deck. Red-hot shrapnel touched off fires in the *Yorktown*'s hangar deck. An officer quenched the flames by switching on the sprinklers and water curtains. A second bomb pierced the flight deck and exploded above the fire room, knocking out five of the ship's boilers. The carrier, which had

Ghostly guardian against an invasion that never came, a pillbox confronts a tranquil twilight on Midway. That tiny speck of land stands as a symbol not only of courage and determination, but also, wrote historian Samuel Eliot Morison, "of intelligence, bravely and wisely applied."



been twisting evasively at 30 knots, abruptly slowed to 6. Another bomb hit an elevator, plunged deep into the ship, and exploded.

Shipmates carried Montalvo to sick bay, five decks down. Lying in a lower bunk on the port side, he felt the concussion of the two torpedoes that hit during the next attack from the *Hiryu*. One of those torpedoes had been fired by Taisuke Maruyama, whose bomber Bill Surgi had seen as it flew off. Within two hours both men were in the water after obeying orders to abandon their ships.

Able-bodied men got Montalvo and the other wounded out of sick bay, dragging some across a listing deck too steep for carrying stretchers. Montalvo had only one good hand; he could not go down a knotted line to the oily sea. A shipmate told him to stand on his shoulders and hold on with his left hand. Somehow he got into the water, one of about 2,270 men later picked up by destroyers.

On the abandoned *Yorktown* some bodies still lay in sick bay. The dead were to go down with the ship. But two of the men left for dead were still alive.

George K. Weise had been firing a .50-caliber machine gun at the plane that dropped the second bomb. The explosion slammed his head into the gunsight, fracturing his skull. Half-conscious, his right side paralyzed, he lay in sick bay under eerie blue battle lights. He heard the order to abandon ship.

Hours later, in darkness and stillness, he heard Norman Pichette, another seaman, calling from a nearby bunk. They knew they had been given up for dead on a dying ship.

"What can we do?" Pichette asked. Weise, unable to move, told Pichette to get help.

Shortly after dawn on June 5, Pichette wrapped a sheet around his bleeding stomach wound and made his way up to the listing port side of the hangar deck, where he found a machine gun, its barrel aiming at the sea. With ebbing strength he fired the gun, alerting sailors on the nearby destroyer *Hughes*. A rescue boat took the unconscious Pichette back to the destroyer. He came to, living long enough to tell his rescuers about the other forgotten sailor. The boat returned for Weise.

"I remember being on a mess table on the *Hughes*," Weise says. "I got a blood transfusion from a doctor. It was his blood."

Now began an effort to save the *Yorktown*.

A tug arrived and started towing the carrier to Pearl Harbor. The destroyer *Hammann* tied up alongside the *Yorktown*. A 170-man salvage team went aboard, jettisoning aircraft, cutting loose an anchor, and trying to trim her by pumping seawater into empty fuel tanks.

"*Yorktown* was dark and dead and silent," one of the salvagers said later. But she was rallying. Counterflooding had reduced her list, and the weight reduction had raised her higher in the water, making towing easier.

**L**IE COMDR. YAHACHI TANABE, captain of submarine *I-168*, could hardly believe his luck as he peered through his periscope. The last time he had risen to periscope depth he had seen six destroyers guarding his quarry. Now, almost by chance, he had risen so near the *Yorktown* he would have to back away to fire torpedoes. Submerged about 500 yards from the carrier, he listened to the silence above him and wondered if the sonar operators were all at lunch. He maneuvered into position and fired four torpedoes, then swerved around and began his successful escape.

One torpedo struck the *Hammann*, ripping her in half. Two passed under the destroyer and hit the *Yorktown*. As the *Hammann* sank, her depth charges began exploding at preset depths; the concussions killed many men in the water. An officer on the *Yorktown* watched them disappear—the way a "windshield wiper erases the droplets from your windshield." Of the *Hammann's* 241 officers and crew, 81 died.

The *Yorktown* finally sank, with battle flags flying, shortly past dawn on June 7. By then U.S. carrier planes had claimed another ship: the cruiser *Mikuma*, sunk while withdrawing from the battle that would be the turning point in the Pacific war. Although that war would go on for three more years, the Japanese Navy would never again launch an offensive.

The battle cost 362 American lives, including those killed defending Midway. Japan lost 3,057 men. For the United States, Midway was a magnificent victory—a "glorious page in our history," as Admiral Nimitz said. But the words that a U.S. Navy officer wrote to his wife came closer to what survivors on both sides felt: "Let no one tell you or let you believe that this war is other than a grim, terrible business." □

For more on the Midway battle and the search for the *Yorktown* go to [www.nationalgeographic.com/midway](http://www.nationalgeographic.com/midway).

A SPECIAL PLACE

# Texas Hill

*Sun's barely up as Charles Mohr beads down the road to his cattle ranch in the Hill Country, the rugged reach of central Texas where limestone ledges poke through scrubby rolling hills. Not much has changed in its scattered small towns, until lately: "Outsiders come and go, opening and closing stores," Mohr says. "Those shops change as often as I change underwear."*

By JOHN GRAVES

Photographs by VINCENT J. MUSI



# Country





# D

URING MOST OF MY LIFE I've cherished the Hill Country, as have large numbers of my fellow Texans. Since well over a century ago the region has been a sort of reference point for natives of other parts of the state, and mention of it usually brings smiles and nods. Not much of it is spectacular like high mountains and craggy seacoasts and such places, but we care about it—the dissected, elevated landscapes unlike the areas where most of us live, the un-Texan cool spring-fed streams, the fishing and hunting if we're inclined that way, the people and their towns and farms and ranches and their rather distinctive history.

In earlier times farm families from flatter and more fertile lands within reach, sometimes two or three families in a group, would trek to the hills in wagons during summer, after crops needed no more care till harvest. The hill breezes were dry and healthy, the peaches and melons ripe on nearby friendly farms, the bass and catfish and perch active in clear streams beside which the visitors would set up camp under great pecans and oaks, staying for a week or two to fish and loaf and talk and eat and swim. When young, I knew old men and women who as children had regularly gone along on such expeditions, and their recollections were idyllic.

My own affection for the hills goes back not as far as those rememberers' did, but a bit farther than I like to admit. As a youngster in the 1920s and '30s I saw the region on trips south from Fort Worth with my family, and later in college days groups of us, with our girls and (back then) a faculty chaperon and his wife, would go there to sun and swim for long weekends at a "camp" with primitive cabins on a pretty river. Later still, while teaching in Austin after World War II, I came to know the hills better. Driving out to see relatives in the little German town of Boerne or friends with a cottage on the Guadalupe River upstream from Kerrville, I often strayed from the route to poke around. One special memory is of stopping off now and then at New Braunfels, where big springs feed a small lake in Landa Park, at the head of the short Comal River. Fishing, I would work along the riverbank or rent a tiny wooden skiff and row out on the lake to cast to bony Rio Grande perch, incredible but staunch fighters in the swirling water on a fly rod.

In recent decades, after a long spell away from Texas, my main trips to the hills have involved visits to friends near Fredericksburg, more sojourns with those on the Guadalupe, and every spring a rendezvous with a few old comrades on a stream that wanders through rugged country in Mason County. There we emulate our predecessors in such places by camping and fishing and philosophizing for four or five good days. At that season migrant birds from warblers to avocets and hawks are swarming through, and each evening we watch as a couple of million Mexican free-tailed bats rise in columns like windblown smoke from a nearby cave, starting out on their nightly bug hunt.

---

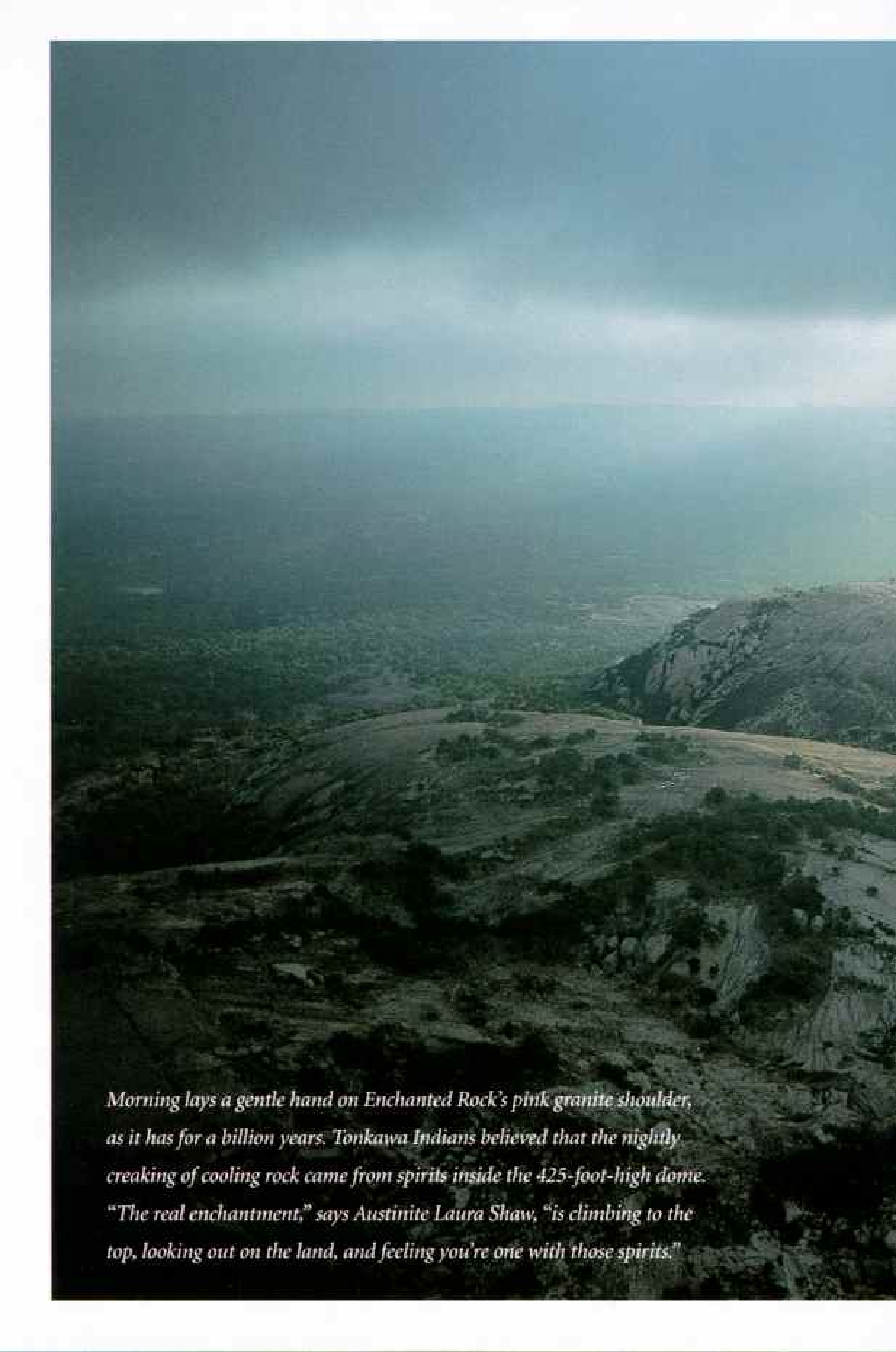
JOHN GRAVES lives on a stock farm in Glen Rose, Texas, not far from the Hill Country. He is the author of four books, including *Goodbye to a River*. Photographer VINCENT MUST's work appeared earlier in *GEOGRAPHIC* stories on the Shenandoah River (December 1996), Montserrat Volcano (July 1997), and Route 66 (September 1997).





SCHMIDT RANCH, GILLESPIE COUNTY

*The now-and-again yawn of the screen door is one of the few bothers to 84-year-old Henry Schmidt's porch-sitting solitude in front of his 100-year-old house. Descended from sturdy German settlers, Schmidt didn't sweat last summer's record heat; he didn't even use his fan. "These walls are thick," he says. "When a little breeze gets going, you can stand it easy."*



*Morning lays a gentle hand on Enchanted Rock's pink granite shoulder, as it has for a billion years. Tonkawa Indians believed that the nightly creaking of cooling rock came from spirits inside the 425-foot-high dome. "The real enchantment," says Austinite Laura Shaw, "is climbing to the top, looking out on the land, and feeling you're one with those spirits."*



ENCHANTED ROCK, GILLESPIE AND LLANO COUNTIES

**T**HE HILL COUNTRY is a swath of rumpled terrain whose eastern and southern edge sweeps in an arc from the Austin area down some 200 miles past San Antonio and west to not far from Del Rio on the Mexican border. This curving boundary is a rise of hundreds of feet from lower, gentler lands to the east and south and is known as the Balcones Escarpment or Fault Zone, the result of an upheaval millions of years ago. Here prairies end against heights dark with junipers and oaks, the valleys between them watered by cypress-shaded rivers and creeks, the escarpment itself spouting great springs here and there from its cavernous aquifer. The hills have a less emphatic border on their northwestern side, where valleys grow shallow and blend into the ranchlands of the wide semi-arid Edwards Plateau.

It isn't the same all over. Except in an igneous uplift in the northernmost counties, it consists of stacked, carved limestone layers that are the beds of successive ancient seas. But valleys over much of the region can be fairly wide, with good soils, whereas in the dry southwestern section nearest to Mexico, the Nueces and the Frio and their tributaries have cut deep narrow canyons in places—tough country though scenic, parched away from the streams, distant from big cities, still thinly peopled.

In 1718 Spanish soldiers and priests established San Antonio on a river issuing from escarpment springs, but their efforts to set up further missions and forts north of there were thwarted by the presence of two successive warlike Indian tribes. Both of these were horseback invaders from plains to the northwest—Apache to begin with, most of whom were later dispersed by the even fiercer Comanche.

The first Anglo-American colonists in Texas, arriving in the early 1800s, made no attempt to settle the hills but chose better farming land elsewhere. Hence the initial pioneers of the Hill Country, or a heartland portion of it, were more than 7,000 Germans brought here in the 1840s through the ineptitude of an organization of titled aristocrats in their homeland, the Society for the Protection of German Immigrants in Texas, usually called just the Society, or Verein. The land grant on which it bought colonization rights, sight unseen, turned out to be a drouthy vastness ruled by the Comanche, stretching from the northern edge of the hills out onto the Edwards Plateau itself, and by 1847, when the Verein went broke, only a handful of settlers had reached its southern boundary on the Llano River.

The rest had dropped off before reaching the hills, died in epidemics, populated the way stations of New Braunfels and Fredericksburg, or spread out from those centers to take up valley land and form communities in a strip running ultimately from San Antonio to beyond the Llano—today's German Hill Country. Duped or not, these hardworking people had come to stay, as their permanent stone houses and outbuildings and field fences still testify, and their orderly towns with churches, good schools, meeting halls, beer halls, and singing and shooting clubs.

A new wave of Anglos, slaveless highland Southerners for the most part, began moving into other parts of the hills, exploiting streamside cypresses for shingles and lumber at places that became towns like Kerrville and Bandera, establishing farms and ranches, and engaging in mortal combat with raiding Indians, nearly always Comanche in quest of horses and scalps and prisoners, who would remain for nearly three more decades the scourge of the Texas frontier.

The two kinds of whites mixed little in the beginning, separated as they





JUNCTION, KIMBLE COUNTY

*"It's like playing a whole football game in eight seconds," bullrider Sam Walker says of hanging on to 2,000 pounds of fury. A veteran at 18, Walker checks his gear before mounting up for his next ride in Junction's Bullriding Twist-Off. "It can be a tough life," he says. "I've broken ribs, pulled my arm out, and been knocked out twice; but I haven't been hurt real bad."*



NEAR WILLOW CITY, GILLESPIE COUNTY

*Deep in the heart of Texas, the Hill Country's limestone heights bend with the Balcones Escarpment and unfold west for some 200 miles. The rocky terrain has its soft spots; spring-fed rivers overflow with bass, catfish, and perch. And nowhere else in Texas is the show of wildflowers, such as purple vervain and fiery Indian blanket, more profuse—and striking—than here.*

were by different languages and ways of living and zones of settlement. But despite friction, some of it bloody during the Civil War and Reconstruction, the cultures gradually began to blend along their edges through intermarriage, business friendships, shared places of pleasure like the Saturday-night dance halls still popular in the region, and the evolution of a sort of Hill Country Western way of being. Over the years I've had several friends with both hill German and Anglo in their family backgrounds, and the combination appears usually to be a happy one, with more than a little in it of the Teutonic drive toward work and achievement.

"It sort of lights a fire under your tail, that mix," one of these friends once told me. "You've got to live up to those old Dutchmen."

“**T**HOSE OLD DUTCHMEN” together with their Anglo neighbors wrought changes in the hills, as have their descendants and a parcel of outsiders as well. When the first settlers came, the Ashe juniper that cloaks so many of the heights today—“cedar” to all Texans—was inconspicuous, confined to steep-walled draws and such places by occasional prairie fires, and the hills themselves were savannas of tall grass and oaks, too stony or steep for crops but excellent pastureland. Looking at their dark cedar blanket today, you find it hard to believe they played a notable part in the post-Civil War cattle boom, with roundups and trails to Kansas and lariat-swinging cowboys and all that. But they did, for a while at least, before open-range grazing damaged the grasses and much soil, letting water-hogging cedars and hardwood brush move in, drying up many hillside springs and the creeks they fed, and making sheep and Angora mohair goats the livestock of choice. In time the cedars created a new occupation, that of the “cedar choppers,” a special clannish breed of Anglos who moved from brake to brake, cutting fence posts. Those choppers are just about all gone now, and the people you see still working the cedars are usually Mexicans.

Most modern changes have had a familiar American flavor—big reservoirs on the Colorado above Austin and one on the Guadalupe; a network of fast highways including an interstate; a fungus that is destroying many of the region's age-old live oaks; conflicts over use of the water in the magnificent Edwards aquifer; and so on and on. Another change derives from an influx of city people that started many years back but has swelled recently—outdoorsmen, sightseers, sojourners, and immigrants, all seeking tranquillity and pleasant surroundings. San Antonians have always





appreciated the Hill Country and long ago started acquiring ranches and weekend nooks there. Houston natives, steaming in their semitropical coastal summers before air-conditioning, were drawn to the region despite the distance involved.

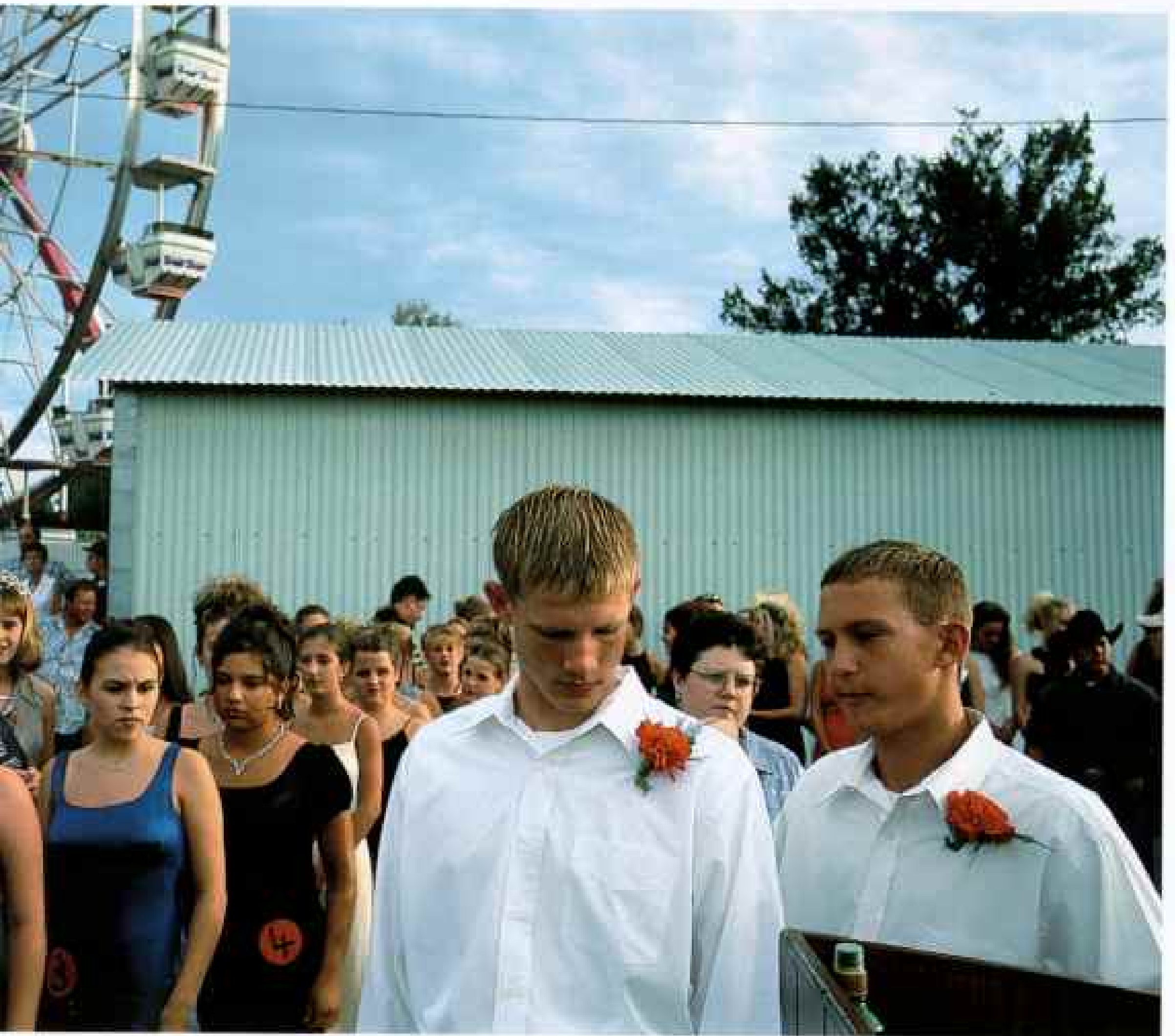
The cottage I used to visit on the South Fork of the Guadalupe above Kerrville, in an old Anglo zone of settlement, had been bought in the 1920s by my college roommate's Houston parents. The cool stream under its cypresses was fine wade-fishing, and there were Saturday-night whingdings at Crider's, a barbecue place with an open-air concrete dance floor beside the river. Here local cowboy and cowgirl types and ranchers and cedar choppers and businessmen mingled with tourist weekenders, artists, members of the Houston oil elite, young counselors from the area's boys and girls summer camps, and all manner of other folks. There was high-elbow dancing to a country band's beat, much consumption of beer, and always good humor, at least in my rose-tinted recollection. Crider's still exists, and though with the years my taste for loud and bibulous evenings has waned, I have driven by the place on Saturday night and noted with pleasure that despite bigger crowds it looks and sounds much the same as I remember it from 40 and 50 years ago.

Through much of the rest of the region this amiable invasion's less aesthetic results are perhaps most visible in German towns that not long ago were havens of serenity. At New Braunfels where I used to stop and fish, the lovely little Comal River below the springs is now overwhelmed by a huge water park with rides given coyly faux-German names like Blastenhoff and Surfenburg, and in season the river's daily hordes of inner tubers drifting downstream make happy noise and adorn the shores and stream bottom with emptied beer and soft-drink cans. Boerne, Comfort, even Fredericksburg the jewel—all are now ringed by standard American clutter and filled with tourist shops, serenity having dwindled away.

**A**T THIS POINT I need to confess that towns attract me less than the land that spreads out from them. Being a rustic type by taste and choice, I have special interest in the hills' countryside and its people, and in the changes there, which have been considerable. Nowadays it takes a little searching, for example, to find one of the small valley farmsteads, usually German and anciently solid in aspect, that is still in use by its founding family. The farms sustained such families for lifetime after lifetime of hard and satisfying labor, but in these days hard work for short pay has ceased to charm many heirs drawn toward urban bustle and cash. So the farmsteads get sold to developers or to city buyers who refurbish them as weekend or retirement homes. I know and like some outlanders who have loved and cared for such places for 30 or 40 years. But I can't help missing those leathery German oldsters who used to come out on the porch and give me road directions in a lilting accent, and tell me about their peach crop.

Unlike the farmers, the ranchers have tended to cling more tightly to family lands, despite drouth and predators and other natural troubles. In our cash-driven and city-oriented age, though, such people's income has not kept up with the times. Their troubles are things like withdrawal of government price supports for wool and mohair, a skittish cattle market, cancellation perhaps of a deer-hunting lease—a crucial segment of many ranches' income now—and occasional needs for solid cash to pay for machinery or hospital stays or a bright kid's college expenses. A further



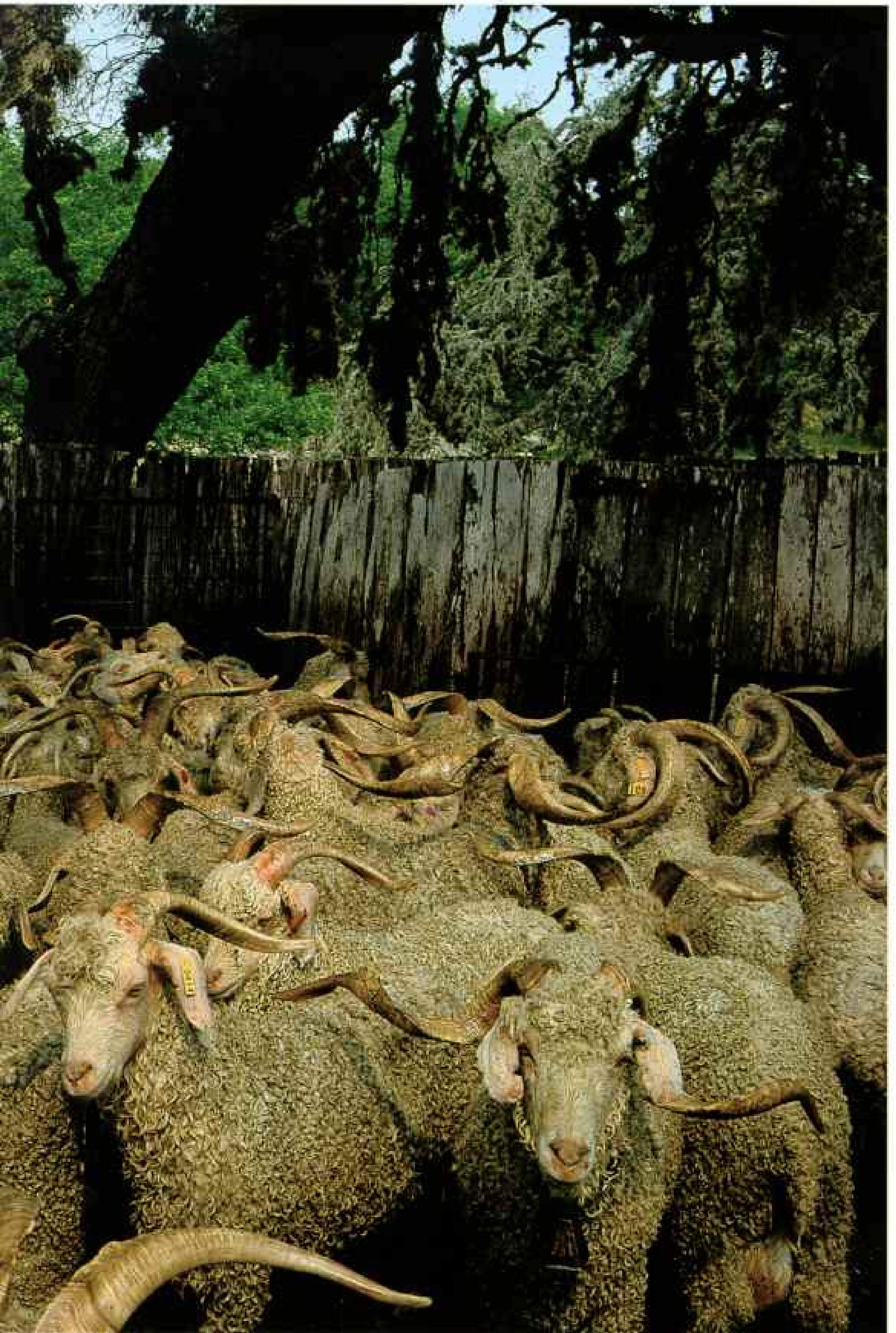


BLANCO COUNTY FAIR AND RODEO, JOHNSON CITY

*Trading blue jeans for ball gowns, high school hopefuls vying for the crown of Miss Blanco County wait their turn to be escorted before the judges. "Most of them spend a lot of time outside raising animals and helping out around their places," says contest coordinator Karen Freer. "This is their chance to get all dolled up and just be girls."*



*The pungent smell of chemical-soaked mohair drifts across Robin Giles's century-old ranch, where Angora billies drip-dry after a routine delousing. A decline in the fashion market for mohair has forced many Hill Country producers out of business, but Giles is hanging on. "We're storing the mohair," he says. "This ranch is our home; we plan to keep it going."*



HILLINGDON RANCH, KENDALL COUNTY

large if paradoxical problem is the Hill Country's present startling land prices, which belittle ranch work itself, since selling out would profit a family far more than does laboring their tails off ten and twelve hours a day on the patch of the planet's surface where they belong, where their forebears lived and died, where many of them fiercely want to stay.

Not long ago I revisited such a native, Robin Giles, a hale and powerful man in his 50s, at the ranch in northwestern Kendall County started by his grandfather in the 1880s. He and his wife, Carol, both college educated, run sheep and mohair goats and registered Black Angus cattle on some 10,000 acres of hilly land, of which Giles owns an inherited part and leases the rest from other heirs.

Goat shearing was in progress when I arrived, a fine uproar with adroit Border collies driving the beasts in batches from pens to a shed, where men shouting in Spanish dragged them baaing to a deck and with clattering powered shears peeled off a half year's growth of long white hair. Giles and Carol on a platform received each goat's yield and sorted it by grade into big suspended bags, to be tamped down by the feet of their two sons.

Mohair's value depends on things like fashions in clothing, and therefore the Gileses are storing theirs in the hope that the market price—lower just now than production costs—will rise. Wool is about the same, or worse. The ranch's Black Angus have excellent standing in the specialized purebred cattle market, but that business is not exactly booming either. However, Giles is not a despairing type. "We'll make out somehow," he said after lunch at a long oak table in the comfortable, airy, frame-and-stone house built by his grandfather. "We'll survive."

He is passionately attached to the ranch, using it with a full sense of its ability to produce, which he says can last forever if you treat the land right. The hard-learned formula for this is to employ the three species of livestock in such a way as to keep cleared land healthy—goats to browse hardwood brush and control resprouts of cedar, sheep to eat weeds and forbs, and cattle to thrive on the grass. Giles's own property, well grassed even in a time of drouth, devoid of cedar and with springs flowing from under the capstone of the flat-topped hills and ridges, bears witness to the efficacy of the formula when applied with love and knowledge.

Needless to say, he has no desire to sell out: "This is where I belong. Not anywhere else. I inherited it, and I don't believe I've even got the right to sell it. Besides"—with a smile—"what would I do with all that money that would give me half as good a life as I have right here and now?"

But the family has worrisome awareness that sooner or later parts of the ranch not owned by them might be sold and, being handy to Comfort and Fredericksburg and Kerrville, would then most probably be chopped into ranchettes for sale to city people. Nearby, there are already developments of that kind.

**F**OR HISTORICAL REASONS based primarily on people like the Gileses, the supervision of ruminants as an occupation has always had special cachet in Texas, and quite a few well-heeled city dwellers feel a need to classify themselves as ranchers, regardless of their aptitudes. While driving around in the Hill Country, you can make a sort of game out of spotting the flamboyantly varied entrance gateways of less tradition-conscious newcomers, which tend to be looming, humorless fantasies of wrought iron and native stone. What they are meant to say, I guess, is "Look, I'm a rancher!" but it comes





JAMES RIVER, MASON COUNTY

*Strung up on a mesquite tree branch, Josh Kramer's 16-pound yellow catfish will soon be finned, skinned, filleted, and fried. "I just roll it in cornmeal, add salt and pepper, and fry it in some hot oil," he says. Kramer and his buddies rounded out the fish fry with "a big salad, a bunch of french fries, leftover beans, peach cobbler made with tortillas, and Oreos."*

across as a more pecuniary statement, maybe "Look at my tax shelter!" Frequently the fences stretching out from these marvels are built of eight-foot-high net wire and enclose herds of exotic game animals of various fashionable species, such as axis deer and blackbuck antelope.

In fairness, many new ranch owners have been good for the land itself, if only because they don't have to make a living from it. Most have cedars bulldozed and grass replanted, and some actually care about ranching and use their places lightly and well. One of these, J. David Bamberger—an Ohio country boy who later, as he reticently puts it, "did well in business"—has not only spent decades and a slew of money on the effective restoration of an initially overgrazed, cedar-choked, thirsty 5,500-acre piece of Blanco County but has studied the plight of native ranchers with concern and wants to do something about it. His prescription is what he calls "people ranching," which he practices alongside the standard sort. It consists essentially of providing rural experiences—along with a healthy dose of land-stewardship training—to urbanites shut off from such things in their daily lives. Hunters pay premium lease prices to pursue his big bucks. Birders by the busload arrive to view the many species on the place, including rare warblers and vireos in preserved steep patches of cedar. Nature organizations make use of a well-appointed conference hall, and city-weary families or groups of friends, never many persons at a time, can relax for a spell in simple, isolated quarters beside a brimming creek.

He gives talks in the region in support of his idea, and I asked him how natives receive it. "They're interested," he said. "They know they need new approaches if they want to keep on ranching." But, a very honest man, he grinned wryly and added, "Some of them aren't temperamentally suited for dealing with the public. It takes a special quality, people ranching."

**C**HANGE APPEARS to be the main theme of this look at a region I have held dear. I am tempted to blame this on my own codgerly impatience with new ways, though in fact over the years I've become a sort of pessimistic acceptor of them. The Hill Country escaped emphatic change for a long time through its rough topography and its paucity of agricultural and mineral wealth, which preserved its landscapes and cultural flavors and the connection of its people to the land. But the preservation itself in turn made the region all the more enchanting to outsiders in our prosperous, discontented, questing time, finally bringing big change in a rush.

So be it, I suppose, for few places on Earth manage to stay as they have been in an era like this, and why should a wrinkled piece of Texas receive exemption? I'm grateful, though, for having experienced the hills earlier when change was slight, and for those stubbornly traditional natives who still hang on to what they are and do. Grateful too for corners and stretches change has barely yet touched, like a crooked narrow back route I sometimes take when heading north toward home, part asphalt and part gravelled caliche and part plain dirt or mud. It crosses purling creeks and stony ridges, and passes grassed hillsides, crumbling German rock fences, granite heights and strewn boulder fields, thick cedar brakes, mesquite-infested pastures, and small oak-shaded ranch houses with windmills and battered corrals where work-stained men in khakis tend their cattle. Along that road there are no flamboyant gateways, and near its end you come in sight of low, swaybacked Packsaddle Mountain, where in 1873 the region's last recorded Indian battle was fought. The Indians lost. □





SOUTHWEST CORNER, HILL COUNTRY

*Cool riverine currents wind through the Hill Country, bringing relief to cattle and white-tailed deer parched from the August heat. Like the river, the people of the region follow a steady, easy course. "We're people of the land," says one rancher. "It doesn't belong to us. We're just the caretakers."*



# THE POOLS



# OF SPRING

*Article and photographs by* GEORGE GRALL



*Engaging in the subtle rites of spring, a pair of spadefoot toads couples up in a Maryland vernal pool, flanked by toad embryos on stalks of grass. Filled by rain or melted snow, such temporary spring ponds are prime breeding habitat—part boudoir, part nursery—for thousands of species worldwide.*

## Life in a hurry: the lure of the vernal pool

When most people think of spring, they imagine sunshine, green grass, flowers in bloom. I think of frogs. Actually a chorus of frogs, croaking their hearts out in two large puddles of rainwater that used to form in a field every April near my home in Baltimore, Maryland.

Like many vernal, or springtime, pools, these were never more than a few feet deep, and they existed mainly from March until midsummer, when they dried to a layer of spongy mud. I spent much of my childhood marveling over the diversity of life that crawled out of those seasonal puddles, only vaguely aware of their critical role in the woodland ecosystems of North America. Even today when I hear the first frogs of spring calling from some distant vernal pool, I often find myself reaching for my raincoat, my boots, and my underwater cameras.

When I was about 17, I discovered a textbook pool in the Maryland Piedmont. I visited it recently in early April (below) and found masses





of spotted salamander eggs near the surface. Winter burrowers, these salamanders stir early from hibernation, breaking ground to breed in vernal pools. Since these waters are typically devoid of fish, salamanders can avoid most predators if they work fast; by mid-spring (left), when snakes and other late-sleeping

predators are about, their hatchlings will have grown into expert swimmers and hiders. As the pool dries through the summer, most amphibians leave. Usually by August the pool is so dry that terrestrial plants can emerge. Falling leaves and other detritus fill the depression with organic matter (below), fuel for next year's cycle.



BOX TURTLE, TERRAPENE CAROLINA



MAVA SPY INTICA



GEORGE GRALL developed his keen eye for natural history by roaming the woods and meadows near his childhood home in Maryland. This article, his fifth for NATIONAL GEOGRAPHIC, follows last month's piece on snapping turtles—one of Grall's "all-time favorite" animals.



BLUED AMERICAN/US

## Amphibian frenzy

*Self-starters, male wood frogs (top left) are among the first into the pool, anxious to stake their territory and begin advertising for mates, in voices as raucous as quacking ducks. So eager are the males that I've seen them in pools still frozen at the edges. Once mated, the frogs work together (middle): A male spills sperm over a female's eggs as they are being laid, using his feet to help force them from her body. About a month later tadpoles hatch and begin feeding on algae, here coating salamander eggs (bottom left). American toads don't arrive until April, but they soon make up for lost time. I saw several males trying to breed with one female (above) in an encounter so violent it looked like tackle football. I later found her drowned, with one male still clinging to her.*



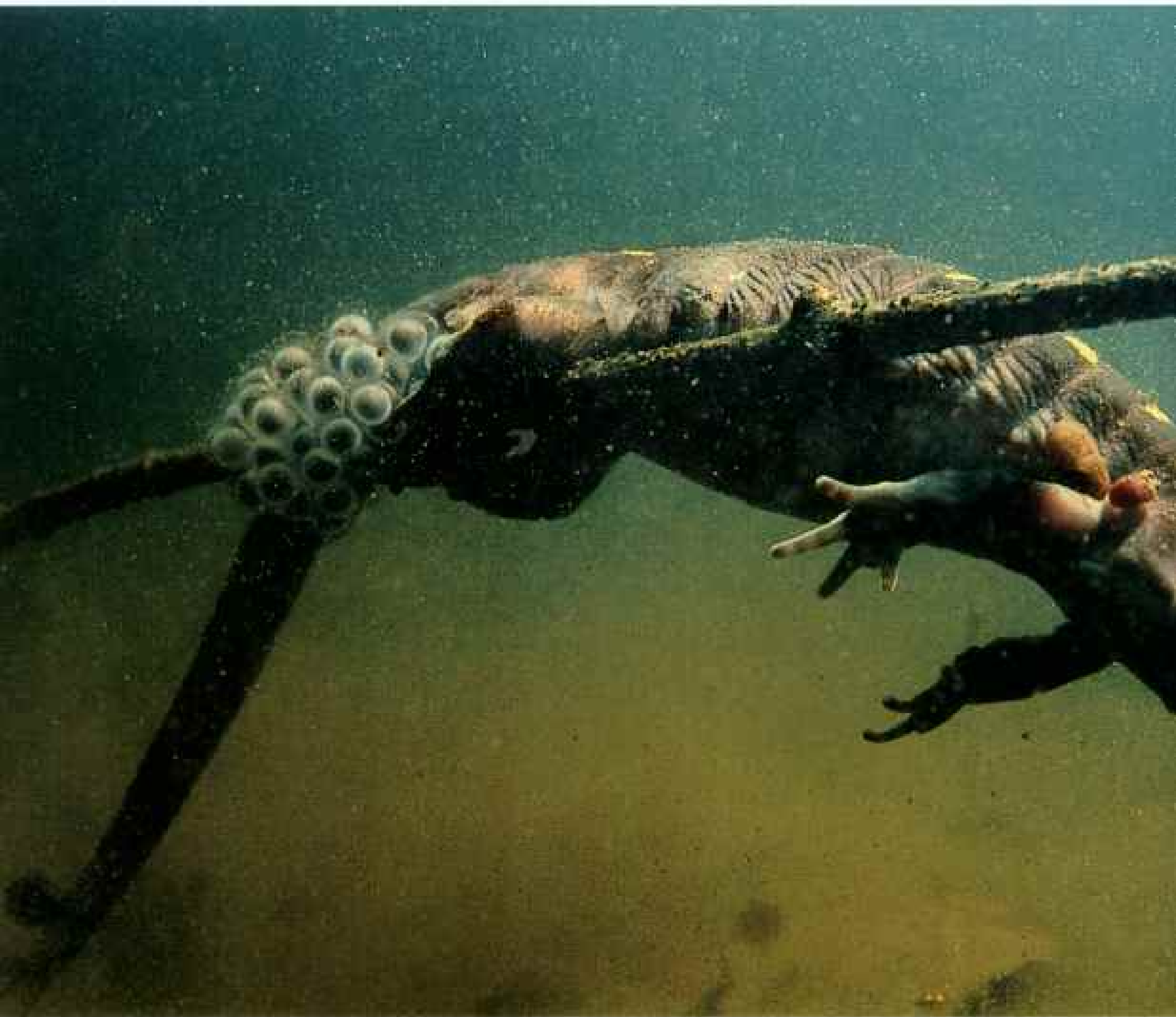
Surrounded by suitors



AMPHIBIENS ANGLIA ETIAM

*Outnumbered by males as much as ten to one, a female spotted salamander, at bottom, doesn't choose a mate so much as an attractive sperm packet from the dozens of white globules deposited by males in the water around her. When she's ready, she takes a selection of packets into her cloaca to fertilize the several hundred eggs within.*





## The hazards of spring

*After harboring her fertilized eggs for about a week, a spotted salamander chooses a sturdy twig beneath the surface and lays her eggs on it in a mass (above and middle right). If the pool gets enough sunlight, algae will form on the mass, which provides a perfect medium for the single-cell plants to attach to and grow. In turn, the algae transmit oxygen to the embryos, spurring robust development and raising their chances of survival. But the tiny amphibians still face many predators: Diving beetles (top right) feast on the eggs and larvae of salamanders, toads, and frogs, while a green darner dragonfly nymph (bottom right) rampages through the vernal pool like Godzilla, eating everything in its path. Here it devours a gravid back swimmer, whose eggs spill out onto a plant stem.*



HELLGRAMMID SP.



DRAGONFLY, ANAX JAMES BACK SWIMMER, NOTONECTA EBBYI



Coming out party



*Bursting their balloons, larvae of the spotted salamander hatch into a green broth of algae, entering the vernal pool equipped with budlike forelimbs and external gills. Voracious eaters, the larvae will consume anything they can swallow, including their hatching brothers and sisters. To dodge predators, they use the algae as cover.*



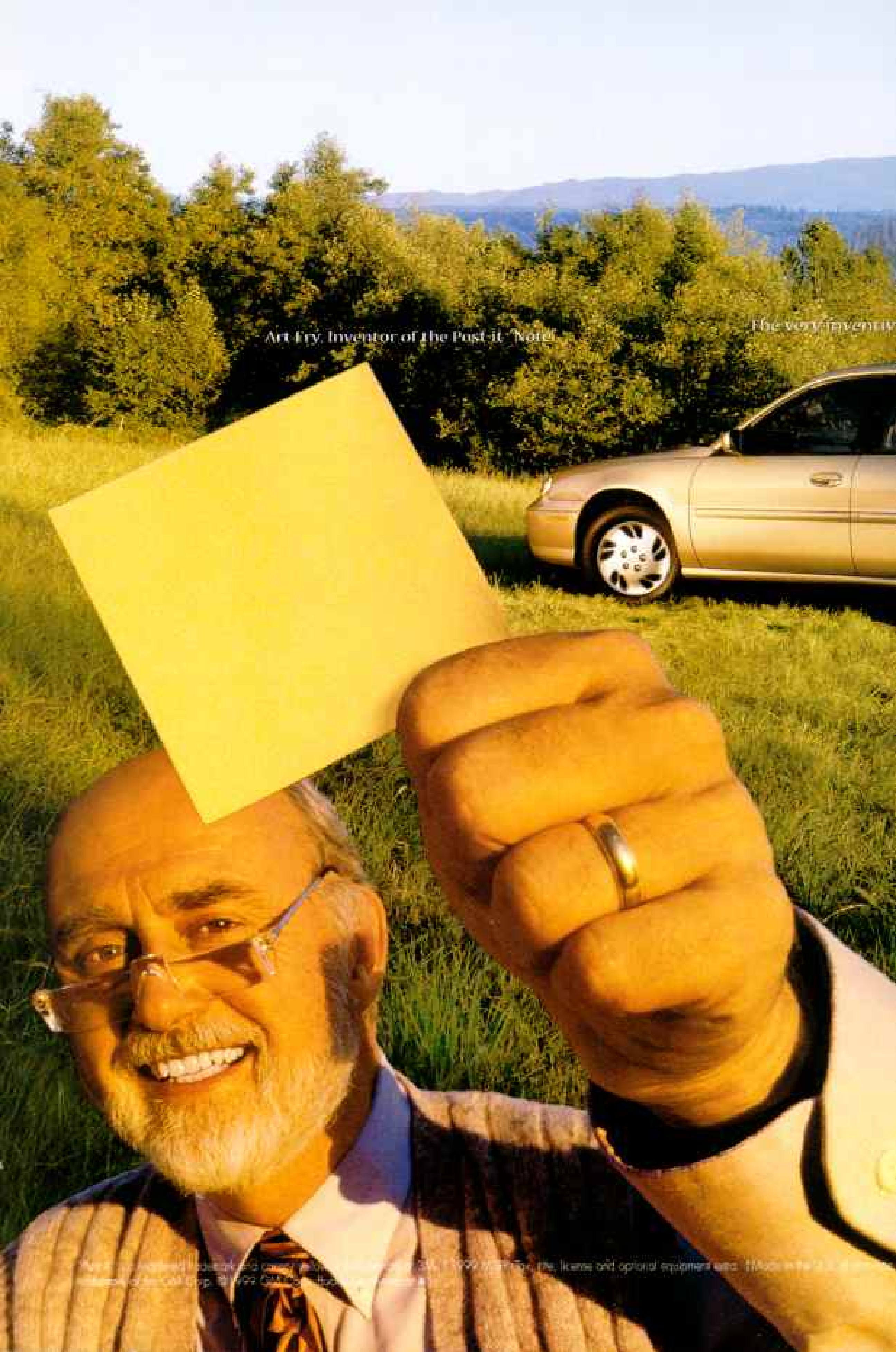
## Layaway plan

*Plump with eggs, a female red-spotted newt allows a male to grip her with his hind legs as he waves his tail, enticing her to accept his emergent sperm. Shortly after mating, the female will choose a plant (above right) on which to lay her eggs. Slowly and meticulously she lays one sticky egg at a time, then wraps it in a leaf like a burrito (right). A month later larvae will hatch from these tiny envelopes. Vernal pools are filled with such small miracles of life, yet they are inevitably threatened by suburban development. Last spring I stopped by one of my favorite pools, only to find it paved over for a parking lot. I wasn't the only one dismayed: Driven by instinct to return to the pool of their birth, dozens of frogs were hopping helplessly around the lot, looking for a place to breed. □*



NOCTURNAL MALE WHITEFOOT





Art Fry, Inventor of the Post-it Note

The very Inventor

© 1999 3M Company. All rights reserved. 3M, the 3M logo, Post-it, and Post-it Note are trademarks of 3M Company. All other trademarks are the property of their respective owners.



THINGS WE'VE NOTICED  
ABOUT AMERICANS:



WE KNOW

A GOOD IDEA

WHEN WE

SEE IT.

Passlock® theft-deterrent system - Lubed-  
for-life chassis - Battery/Rundown Protection  
- Standard antilock brakes - Breakaway dual  
outside mirrors - Headlamps that turn  
themselves on - A cup holder for 'lefties'

816.535\* - [www.chevrolet.com/malibu](http://www.chevrolet.com/malibu)


1-800-950-2438



The Car You Knew America Could Build!  
Malibu. Genuine Chevrolet.

©2000 GM Corp. Buckle up, America!





Yesterday, you  
needed all this.



Today,  
this is all  
you need.

The reliable  
HP All-in-One does it all:  
Prints, Scans, Copies and Faxes.

Completing your work just got easier thanks to the HP All-in-One.

Now, in one product, you get a professional quality printer, scanner, copier, and in some models a fax machine too.

So instead of wasting your time managing multiple products, the HP All-in-One helps you get your work done faster and more efficiently.

Every HP All-in-One is engineered

for years of reliable performance and backed by award-winning HP Customer Care and a one-year warranty.

Rather than using up all your desk space with four separate machines – get the one machine that does it all.

The HP All-In-One. Dependable. Easy to use. Designed to work smoothly with no compromise in quality or performance.



HP offers a variety of models to fit your needs and budget. Prices start at just \$399\*. Stop in and try one today.

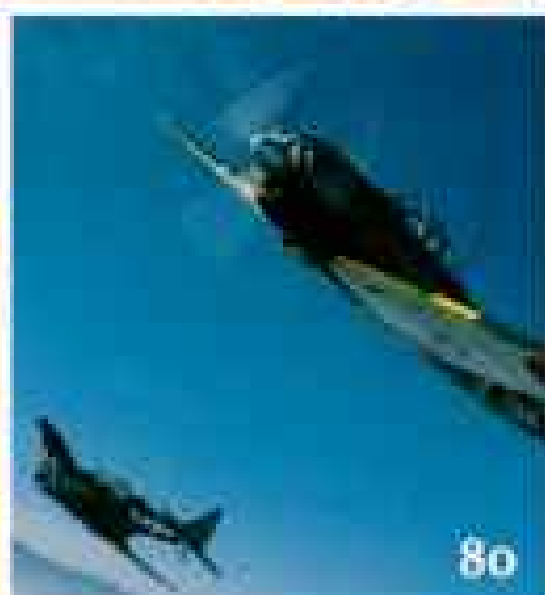
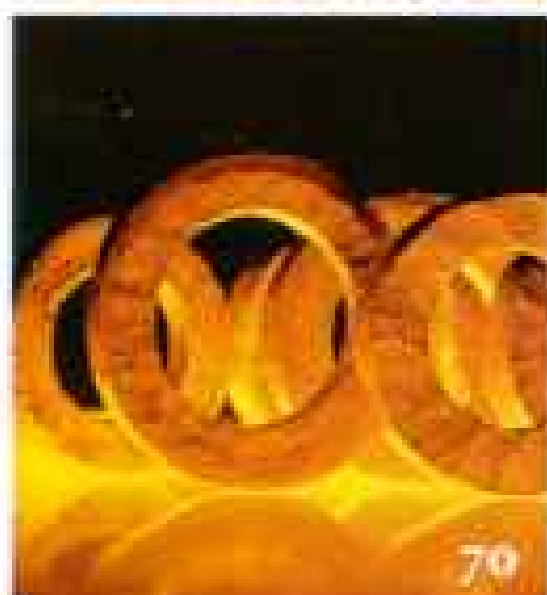
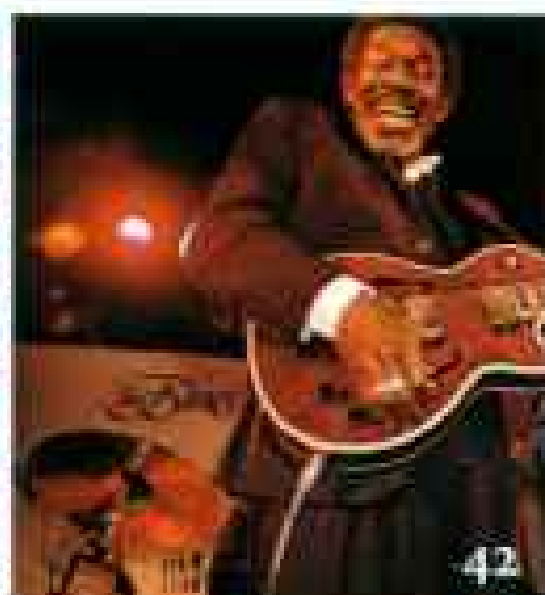
Available at most office product, computer and consumer electronic stores.  
For more information, visit our website at [www.hp.com/go/all-in-one](http://www.hp.com/go/all-in-one).  
\*Suggested retail price. Actual prices may vary.

 **HEWLETT®  
PACKARD**  
Expanding Possibilities

©1999 Hewlett-Packard Company

  
**NATIONAL  
GEOGRAPHIC**

APRIL 1999



- 2 **Galápagos: Paradise in Peril** *Tourism, development, and abnormal weather threaten the unique island ecosystem that inspired Darwin's theory of natural selection.*  
BY PETER BENCHLEY PHOTOGRAPHS BY STUART FRANKLIN
- 32 **Galápagos Underwater** *In the grip of El Niño the normally cold, rich seas that support a bountiful food chain warmed, with dire consequences to penguins, iguanas, and sea lions.*  
ARTICLE AND PHOTOGRAPHS BY DAVID DOUBILET
- 42 **Traveling the Blues Highway** *One of the largest internal migrations in U.S. history took place this century as black Americans left the South in search of social and economic equality, carrying with them the soulful music known as the blues.*  
BY CHARLES E. COBB, JR. PHOTOGRAPHS BY WILLIAM ALBERT ALLARD
- 70 **Journey to the Copper Age** *Archaeologists retrace a copper-trading route used 6,500 years ago and unearth discoveries that shed light on the lives of ancient metalworkers in the Middle East.*  
BY KATHERINE OZMENT PHOTOGRAPHS BY KENNETH GARRETT  
ART BY CHRISTOPHER A. KLEIN
- 80 **The Battle of Midway** *After crippling the U.S. Pacific Fleet at Pearl Harbor, Japan set out to deal it a death blow at Midway. Fifty-six years later former foes relive those harrowing hours as explorer Robert D. Ballard locates the grave of the U.S.S. Yorktown.*  
BY THOMAS H. ALLEN PHOTOGRAPHS BY DAVID DOUBILET
- 104 **Texas Hill Country** *Sit a spell by the cool, spring-fed streams of central Texas and you'll see why cityfolk are heading for the hills.*  
BY JOHN GRAVES PHOTOGRAPHS BY VINCENT J. MUSI
- 122 **The Pools of Spring** *As winter melts away, small ponds begin to dot the fields and woodlands of North America. By mid-spring they teem with salamanders and frogs; by late summer they are gone.*  
ARTICLE AND PHOTOGRAPHS BY GEORGE GRALL

## Departments

Behind the Scenes  
Forum  
Geographica  
From the Editor

Flashback  
On Screen  
Earth Almanac  
Interactive  
On Assignment  
Geoguide

## The Cover

*A trio of World War II-era U.S. Navy warplanes recalls the Battle of Midway. Photograph by David Doubilet.*

 Cover printed on recycled-content paper

For membership please call  
**1-800-NGS-LINE**  
(1-800-647-5463)

Special device for the hearing-impaired  
(TDD) 1-800-648-9787

# Behind the Scenes



## Heavens Above at Headquarters

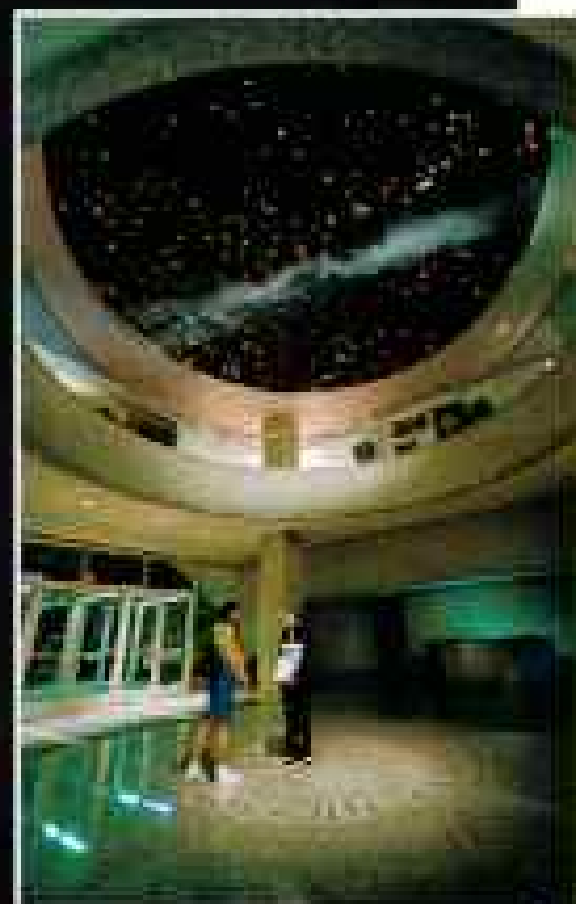
Why have a chandelier lighting the lobby of our newest headquarters building, wondered then Society President Gilbert M. Grosvenor, when we could have the moon and the stars? Or Saturn and the stars—which is what soon twinkled from the ceiling of the building, completed in 1984. The re-created night sky (above and right) appears as it did at 8 p.m. on January 13, 1888, in Washington, D.C.—the night the Society was founded.

Bringing the sky inside was no easy task.

First the positions of the stars were calculated by computers at the Cartographic Laboratory at the University of Wisconsin. Then Society staffer Charles Case edited the results and plotted the outline of the Milky Way.

This information was digitized and charted at full scale for the dome in 31 ten-foot-long strips. The strips were then taped together and cut into 12 wedges, with a 13th circular piece forming the center. Tiny light fixtures—710 of them, at three levels of brightness—mimic celestial glow, but even stars sometimes burn out. That's when Society technicians ascend 28 feet to the heavens on a hydraulic lift, bearing boxes of black-painted bulbs—with the tips left clear to make pinpoints of light.

And if any of our employees ever get lost, a compass rose designed into the polished granite floor beneath the sky orients indoor stargazers toward true north—and the Society's staff cafeteria.



## Model Employee

What would a warrior in biblical Jericho look like? Staff artist Chris Klein, asked to draw such a likeness for this issue's Copper Age story, needed a model to help him visualize the archer pictured on page 76.

"But the model we got was too big and pumped up," explains art researcher Ellie Boettinger. "He didn't have the body type of someone who lived back then." Enter Mark Bacon, a former designer for our international editions, who fit the bill—and the cotton sarong.



ALL BY NGE PHOTOGRAPHER MARK THEODOR

"I guess they thought of me because I'm kind of thin," said Mark, an avid bicyclist who grew up in Kentucky. "When Ellie called me in to see if I'd pose with the bow and arrow, I frightened everyone by starting to take my clothes off. They didn't know I had on bike shorts under my jeans."

After the modeling Mark decided to have some fun by walking around the Society offices, shirtless, in his loincloth and headband, but nobody said a thing. "Maybe that's because I was wearing my ID badge," joked Mark.

**BEAUTIFULLY DESIGNED.  
POWERFULLY BUILT.  
GENETICALLY ENGINEERED.**



© 2009 GM Corp.

**YUKON  
DENALI**

The GMC Yukon Denali is the great-great-grandchild of trucks that helped win wars, put out fires, and break the sound barrier. Not the typical stuff of a

luxury sport utility vehicle. But add to that four seats with heated, leather seating surfaces, a Bose® Acoustimass® audio system, refined suspension, and a powerful 255-horsepower Vortec V8 engine.

**GMC**®

and you have a new height of luxury. Call 1-888-GMC-DENALI or [www.denali.gmc.com](http://www.denali.gmc.com). Do one thing. Do it well.™

## Inspiring Images

"I have always been fascinated by the Maya," says Peter Disch Lauxmann of Miami. He visits Middle America as often as possible, but between trips he's found a way to keep a little bit of Mexico on his patio wall. Inspired by our February 1995 cover story, Peter and his former wife, Delphine Kendzia (right), painted this life-size reproduction of one of the Maya murals at Bonampak. Sketched freehand on stucco, then brought to life with acrylic paints, the work probably won't last the original's 1,200 years. "We used high-quality paints though," says Peter. "You just never know!"

Artist Ann Harwell (below) spent a lot of time in her North Carolina backyard in 1997, gazing at the sky. She enjoyed the nightly show by comet Hale-Bopp and wanted to make a quilt celebrating its arrival. But she needed photos to spark her imagination. "I looked everywhere for good pictures. I even



BRIAN SMITH (TOP); SIMON GRANTHE



had my kids drawing comet tails." When her December 1997 *GEOGRAPHIC* arrived, Ann says, "I squealed out loud. On pages 94 and 108 were the missing pieces of my design." Some 336 hours later her quilt, "Hale-Bopp/Fractured Symmetry," was done—but Ann wasn't. "I am still always looking at the stars."



In the summer of 1999,  
the Theory of Evolution will be rewritten.

The laws of nature will be broken.

The definition of matter will be forever altered.

The restrictions of gravity will be lifted.

And time will no longer move in one direction.

There is only one question.

**Are you ready?**<sup>SM</sup>

Are you ready to journey to a whole new universe,  
to explore worlds beyond your imagination, to spend days  
and nights living the vacation of a lifetime?

### MARVEL SUPER HERO ISLAND™

Are you ready to defy gravity on the  
The Amazing Adventures of Spider-Man™?  
Take a plunge on Doctor Doom's Fearfall™  
Get launched on the Incredible Hulk Coaster™



Are you ready to discover that myths and legends are alive and that  
Super Heroes actually exist? Universal Studios Islands of Adventure™ is a colossal new  
theme park opening at UNIVERSAL STUDIOS ESCAPE™ this summer in Orlando.  
Five unique islands where you'll find challenge and triumph at every turn. Experience the impossible.  
THE THEME PARK FOR THE 21ST CENTURY™ challenges you to... LIVE THE ADVENTURE™!

### THE LOST CONTINENT™

Are you ready to live the legends?  
On this island, ride Dueling Dragons™,  
a high-speed, near-miss roller coaster  
that battles across the skies. Get caught  
between the gods at Poseidon's Fury:  
Escape from the Lost City™  
Dine like a god at Mythos™





# UNIVERSAL STUDIOS FLORIDA

Are you ready to experience what it's like to be right in the middle of a movie? Spend days at Universal Studios Florida,® rated, "The Best Theme Park in the World,®" with over 40 unforgettable rides, shows and attractions. It's a destination uniquely its own.

Feel the exhilaration and drama that is the movies.

Universal Studios Florida.® Ride the Movies.®

\*Rick Nancey, author of Disney Like a Pro, published by Fodor's Travel Publications.



Are you ready to join the world's biggest party? Come to Jimmy Buffett's® Margaritaville® and the Hard Rock Cafe® Orlando. Dance at The Motown Cafe™ Orlando, Hard Rock Live® Orlando and Bob Marley - A Tribute to Freedom.™ Chow down at the NASCAR Cafe™ Orlando. Or dine at Emeril's® Restaurant Orlando, Universal Studios CityWalk.™ It's soul-stirring entertainment at its best.



AT UNIVERSAL STUDIOS ESCAPE®  
A LOEWS HOTEL

Are you ready to have VIP front-of-the-line access to theme park rides and attractions? Experience this as well as additional exclusive benefits while staying at the luxurious, new Portofino Bay Hotel at Universal Studios Escape,™ a Loews Hotel. Modeled after a romantic Mediterranean seaside village, the Portofino Bay Hotel is the first of five themed resorts planned at Universal Studios Escape.™





**SEUSS LANDING®**

Are you ready to hang with The Cat in the Hat™?  
On this island, you can ride on the Caro-Seuss-el™.  
Make a splash with One Fish Two Fish Red Fish Blue Fish™.  
Have lunch at the Green Eggs & Ham™ Cafe.

**JURASSIC PARK®**

Are you ready to travel back in time?  
On this lush green island, you can ride  
The Jurassic Park River Adventure™  
and discover the world of T-Rex.  
Pet a living, breathing dinosaur  
at the Triceratops Encounter™.  
Soar with the Pteranodon Flyers™.



**TOON TACDON®**

Are you ready to have Dudley Do-Right™  
come to your rescue? On this island, you'll take a  
tumble over Dudley Do-Right's Ripsaw Falls!™  
Hop aboard Popeye & Bluto's Bilge-Rat Barges!™  
Wander down Comic Strip Lane!™

Steven Spielberg, Creative Consultant  
Universal Studios Escape™ Theme Parks



**UNIVERSAL STUDIOS  
Escape™**

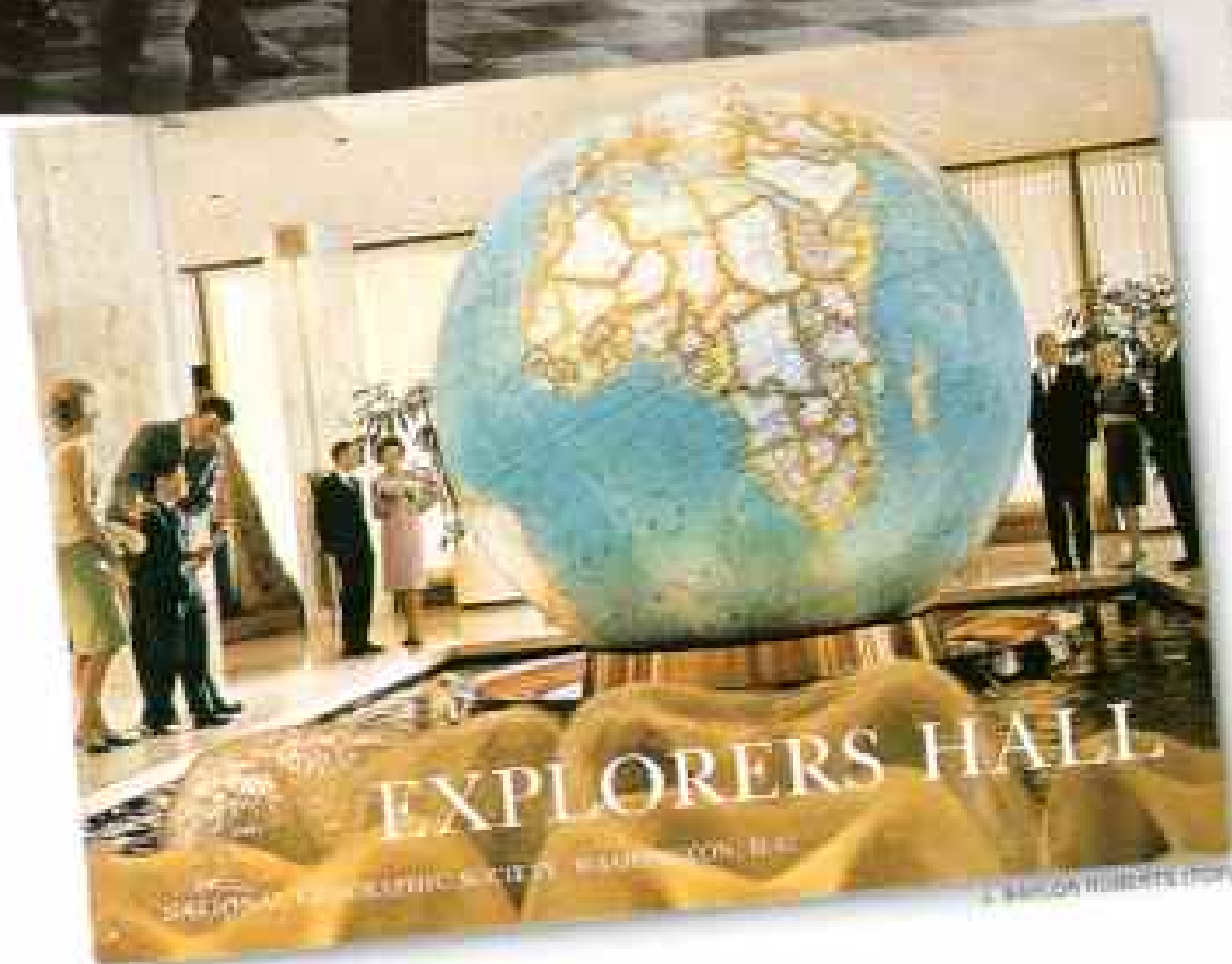
**Are you ready?™**

Give Us Three Days and Nights.  
We'll Give You a Whole New Universe.

Come to UNIVERSAL STUDIOS ESCAPE™ in Orlando, where you'll  
find two incredible theme parks, the world's biggest party  
at Universal Studios Citywalk™ and the  
luxurious Portofino Bay Hotel, a Loews Hotel.  
For more information, call 1-800-U ESCAPE  
or visit our website at [www.uescape.com](http://www.uescape.com) or  
[www.universalstudios.com](http://www.universalstudios.com), or contact your travel agent.



UNIVERSAL STUDIOS ESCAPE, Universal Studios Islands of Adventure, Universal Studios Citywalk™ & © 1999 Universal Entertainment, Portofino Bay Hotel  
Logo © 1999 Universal Park Hotel Partners. © 1999 UCSL UNIVERSAL STUDIOS ESCAPE, A Universal Studios/Islands of Adventure™ Experience.



### It's Something to See

"In the old days we weren't a tourist spot at all," says Leonard J. Grant, a retired vice president of the Society and longtime head of Explorers Hall. "People would visit headquarters to buy a map or a gift membership," he says. "We hung photographs or paintings behind the reception area (top) to give them something to look at while they waited."

In the 1930s these displays were supplemented with items from lecturers' and contributors' travels: Admiral Byrd's binoculars, instruments from the *Explorer II* balloon.

When our 17th Street building opened in 1964, there was finally room for a proper museum. "But we didn't have much to show," explains Grant. "We had always let the leaders of expeditions keep most of the

things they'd come back with."

A few major exhibits, such as Jacques-Yves Cousteau's sea sled and the world's largest free-standing globe (above), quickly proved so popular that the museum began a program of acquisitions. "We actually got a lot of our Peary items at auction," says Society conservator Robin Siegel.

And now? Renovations of Explorers Hall are being planned.

*Wherever Frank and Shirley went,  
OnStar was sure to.....*



*Help them plan a trip to Arizona.*

*Call them when their air bags went off.  
(Their car sent a signal to OnStar.®)*

*Make sure they were all right.  
(They slid into a nest of rattlesnakes.)*

*Offer to send an ambulance.*

*Check their engine by remote.  
(From 1,000 miles away.)*

*Pinpoint their exact location.*

*Order a tow truck.*

*Get them a cab to the hotel.*

*Notify their insurance carrier.  
(At Shirley's request.)*

*Suggest a great Mexican restaurant.*

*Get them to I-40.  
(After Frank got lost.)*

*Get them tickets to a baseball game.*

*Find the nearest gas station.*

*Warn them about road detours.*

*Call when their car was stolen.  
(And help the police track it.)*

*Contact them after the car was recovered.*

*Unlock their car doors by remote.  
(Frank locked the keys in the car.)*

*Tell them Tucson will be sunny and 86°.*

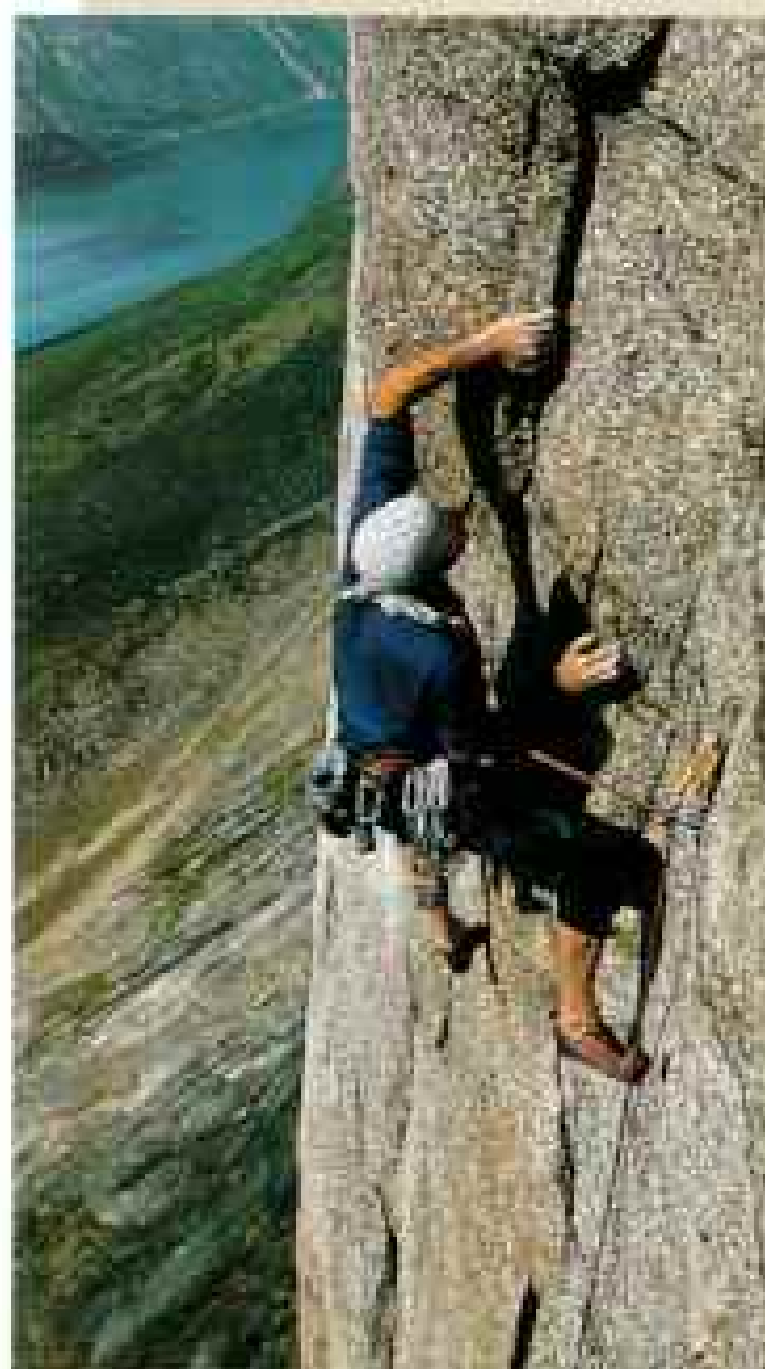
*How will you use it?*



*Wherever you go, here we are.™*

*The one-touch connection to people who can help.™ Call 1-800-ONSTAR-7 or visit [www.onstar.com](http://www.onstar.com).*

NATIONAL GEOGRAPHIC  
**ADVENTURE**



WOLFEY MOORE

## High Expectations for Adventure

This month the Society launches *National Geographic Adventure*.

"It's a magazine about a spirit and an approach to life," says Editor John Rasmus. "A magazine where readers learn about the extraordinary experiences of the world's finest explorers, and a place where they can find adventure for themselves."

The New York-based staff aims to thrill both experienced challenge seekers and armchair enthusiasts with the new bimonthly magazine. For the first issue climber Todd Skinner (left) grips the granite of Ulamertorsuaq in southern Greenland.



TOP: NATIONAL UNIVERSITY OF FINE ARTS AND MUSIC

## Yamamoto's Membership

While researching the Battle of Midway, author Tom Allen learned that Adm. Isoroku Yamamoto (above), the commander in chief of Japan's Combined Fleet during World War II, had been a Society member. According to Yoshimasa Yamamoto, the admiral's eldest son, the family received the *Geographic* through 1930. "I was always the first one to open the envelope when it arrived," remembers Yamamoto, now 77.

## Ambrose Honored

Stephen Ambrose, author of the Society's *Lewis & Clark, Voyage of Discovery*, received the nation's highest honor in the humanities in a November White House ceremony. The National Humanities Medal recognizes Ambrose's lifetime of achievements, which include *Undaunted Courage*, his first book on Lewis and Clark, *Citizen Soldiers*, and biographies of Presidents Eisenhower and Nixon. Ambrose also founded the National D-Day Museum and was historical adviser for the 1998 film *Saving Private Ryan*.

Professor emeritus of history at the University of New Orleans, Ambrose has been fascinated with the trail of Lewis and Clark for more than 20 years. It remains dear to his heart—and his family's. "Our



NATIONAL GEOGRAPHIC PHOTOGRAPHER SAM ABELL

granddaughter's middle name is Sacagawea," he notes in the preface to his Society book. And, he says, "We name our dogs after members of the expedition."

TEXT BY MAGGIE ZACKOWITZ

### ■ FOR INFORMATION

#### Call: 1-800-NGS-LINE

(1-800-647-5463)  
 Toll free from U.S., Canada  
 8 a.m. - midnight ET, Mon.-Fri.  
 8:30 a.m. - 7 p.m. ET, Sat.

Special device for the hearing-impaired (TDD) 1-800-548-9797

#### Write:

**National Geographic Society**  
 P.O. Box 98199  
 Washington, D.C. 20090-8199

#### Internet:

[www.nationalgeographic.com](http://www.nationalgeographic.com)



OCEANS, MOUNTAINS, FORESTS, **FEAR.**  
WHICH DO YOU **CONQUER** FIRST?

1 888 88 BOUND

[WWW.OUTWARDBOUND.COM](http://WWW.OUTWARDBOUND.COM)

WE CATEGORICALLY DENY



ANY CONNECTION



TO GOVERNMENT EXPERIMENTS

AT AREA 51.

There's no conspiracy here, just the 215 horsepower Isuzu VehiCROSS. Kept earthbound by rally-sport inspired shock absorbers and an advanced 4-wheel drive system. Basically, it's what happens when a bunch of engineers that don't make plain old cars read too many sports car magazines. And with only 2500 VehiCROSSes available, we can't confirm you'll actually get one, only that they exist.



**ISUZU**

Go further.



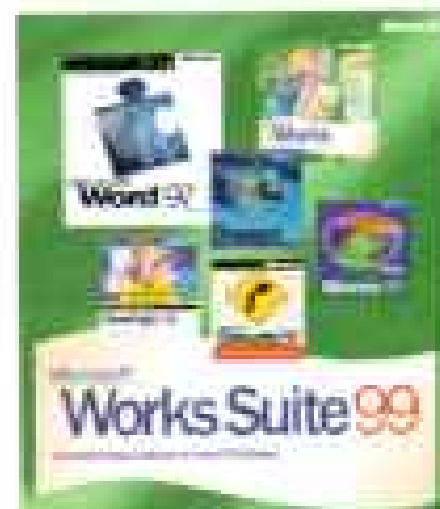
We can help with the everyday, computer-type stuff,  
but certain things, we'll leave up to you.

Microsoft® Works Suite 99 gives you so many tools to get things done around the house, you may start to think it can do anything. After all, it can help manage your personal finances, create letters and greeting cards, and research and write school reports. With Works Suite 99, you can do all these things and more for about the price of replacing a load of whites. So go ahead, start getting things done, but don't forget: while we can help you remember when to do your laundry, separating loads is your job.

With Works Suite 99 you get all six of these great Microsoft products for around \$100:

- Word 97 • Works 4.5 • Encarta® Encyclopedia 99 • Money 99 Basic
- Graphics Studio Greetings 99 • Expedia™ Streets 98

Learn more at [www.microsoft.com/works](http://www.microsoft.com/works)



# Forum

---

Readers of the December 1998 issue were saddened by the photograph of the red colobus monkey killed while crossing a newly paved road in Zanzibar (*Geographica*). Several suggested erecting rope bridges across the highway to help save this endangered animal.

## South China Sea

When I opened the December issue, I felt as if I had seen the picture on pages 6-7 before. And sure enough, it was aboard the U.S.S. *Blue Ridge*. I once stood at the exact same position as the photographer, looking straight ahead as the *Blue Ridge* hurried to Subic Bay in the Philippines. The day was October 6, 1980. I was one of more than a hundred boat people rescued by the *Blue Ridge* in the South China Sea after a long, horrible, suicidal escape from Vietnam.

THANH DIEP  
San Diego, California

The caption for the photograph of the beach at Nha Trang, Vietnam (pages 28-9), states that the city is "where the first U.S. servicemen sent to Vietnam arrived in 1952 to fix airplanes for French forces." This is not true.

An important yet little known aspect of WW II history involves the U.S. government's Office of Strategic Services operation in Indochina. Under orders from Lt. Gen. William "Wild Bill" Donovan, the O.S.S. sent teams to Indochina to train and work covertly with Ho Chi Minh against the Japanese near Hanoi. Also, according to declassified documents, in August 1945 the O.S.S. dispatched a military group, code-named Embankment, to Saigon to collect intelligence data about war crimes, POWs, and Japanese intelligence organization.

In September 1945 the team's leader, Lt. Col. Albert Peter Dewey, was ambushed and killed as he prepared to leave Saigon. He was the first American to die in Vietnam after the end of WW II.

KEITH JEFFREYS  
Los Angeles, California

## Dinosaur Embryos

On page 40 of the article on sauropod eggs, paleontologist Rodolfo Coria says "behavior rarely gets fossilized," and the author concludes, "we don't know if the hatchlings relied on adults for care." The sauropods were herbivores and very likely relied on symbiotic microorganisms for the digestion of their plant diet. One characteristic of modern herbivores that rely on symbionts is that they are born (or

hatched) without them and must acquire them from adults. In the case of ruminants, such as cows, regurgitated material full of microorganisms is consumed by the offspring. Somehow the sauropod dinosaurs must have inoculated their young with symbionts. While we may never know the exact mechanism by which they did this, close contact between offspring and adults would have greatly facilitated the process.

BETSEY DEXTER DYER  
Department of Biology, Wheaton College  
Norton, Massachusetts

## Barcelona

With their ancient roots, the regions of Spain are extremely diverse. Many were independent kingdoms for centuries until the two major ones, Castile and Aragon, joined in the 15th century. Today's Barcelona, with its light and shade, is the result of Spaniards from all over the country. You can't understand Barcelona without Spain, and you can't understand Spain without Barcelona.

JAVIER CRESPO  
Santander, Spain

As a native of Spain, I was excited to see the article on Barcelona, but when I began reading my enthusiasm waned. The article capitalizes on stereotypes to paint Barcelona as different from, and implicitly above, the rest of the country.

EMILIO VELLILA DÍEZ  
Belmont, Massachusetts

Congratulations on your article on Barcelona. As a Catalan, I think it provides a realistic view of the Catalan world and makes clear that Catalonia is distinct from the rest of Spain.

PERE-MIQUEL PARÉS I CASANOVA  
La Seu d'Urgell, Spain

As whimsical as his art nouveau style is, Gaudi's architecture, with all of its angular columns, is structurally logical. Undoubtedly, Antoni Gaudi was true to his *naixa* and *seny* Barcelona roots.

LLOYD C. ENGEL  
Mesa, Arizona

## Spain and Portugal Map

I was quite surprised to see that you included Navarra as part of the Basque region. The northern part of Navarra has clear Basque influence, just as the south and east have clear Aragon influence, because the provinces border one another. While it is true that some pro-independence Basques would like to see Spain's oldest kingdom as part of a seven-province Basque Country, which would also include parts of France, Navarrans express their own identity again and again at the polls.

CRISTINA MATEO-YANGUAS  
Pamplona, Spain

Every Portuguese knows the proverb "*De Espanha nem bom vento nem bom casamento*—From Spain come neither good winds nor good marriages." Remarkably, the Catalonians have a very similar





limelight

## See why Transitions Lenses are right for you.



When it comes to prescription eyewear, there's one easy, and satisfying choice - Transitions Lenses - the pair you'll wear the most. Indoors, outdoors, day, or night, Transitions Lenses adjust automatically.

Indoors they're virtually clear. Outdoors they darken to either a gray or brown tint. And they're lightweight plastic with 100% UV and scratch protection already built-in.

So when it's time to look for new eyeglasses, look for the lenses that are the most versatile,

lovelight



dinnerlight



porchlight



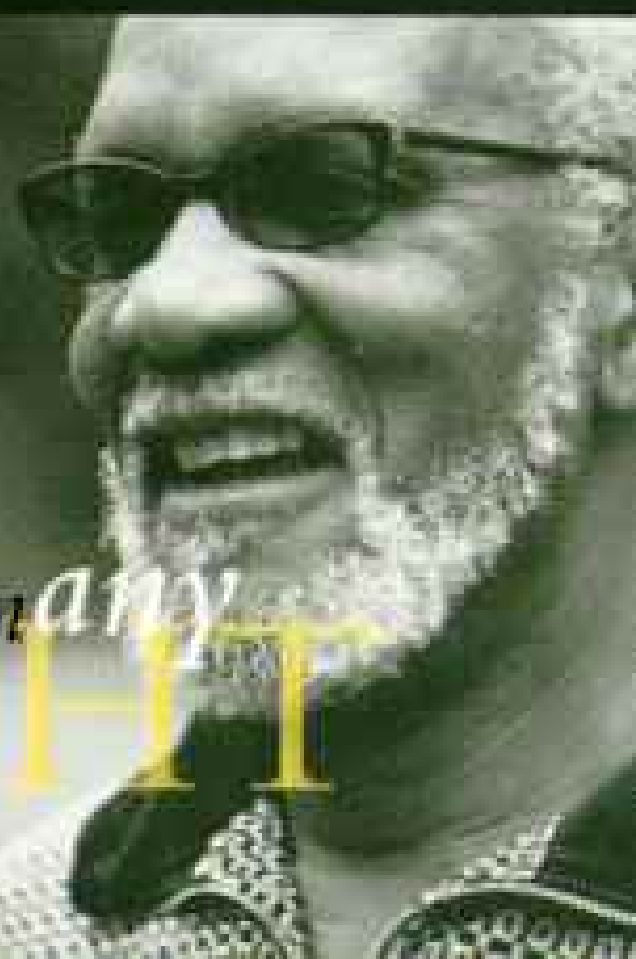
most comfortable and most practical for  
day-to-day wear. Look for Transitions Lenses.  
Available from your eyecare professional.

**Transitions**

[www.transitions.com](http://www.transitions.com)

Transitions is a registered trademark of Transitions Optical, Inc.

**RIGHT** *in any*  
**LIGHT**



proverb: "*De ponent ni bon vent ni bona gent*—From the west [i.e., Castile] come neither good winds nor good people."

FRANCISCO JOSÉ NUNES DOS SANTOS  
Pegões, Portugal

## Nunataks

It's always beautiful watching life around us. But when I see it grow under those extreme conditions, I can't help wondering if Mother Nature isn't shouting at us humans: "Let me do my job, and you'd be amazed at the miracles I can create!"

SANDRA RAITARSKI  
Tecamuchales, Mexico

One would expect that the asperities of such a cold climate would discourage any life-forms from taking a foothold. A square-foot scrimmage of creatures comes as a pleasant surprise. The adaptability, resilience, and frugality of small plants, rodents, and brittle insects show that "life conquers all" and does so depending on scant resources. We humans should imitate this pinch-and-save lifestyle.

ASIMAKOULAS DIMITRIS  
Agrinio, Greece

## Winslow Homer

"Something happened" to Homer in his mid-40s? Surely I'm not the first to suggest that he realized he was gay but couldn't accept it. How many dark, lonely, gloomy deathscapes would a guy paint because one babe informed him they were "just friends"?

JERRY LOYD  
Besse, Idaho

*The artist's private life has been the subject of much speculation—and a few academic papers—over the years, but according to the leading Homer scholars there is no evidence that he was homosexual.*

In your superb rediscovery of Winslow Homer I came upon a beautiful tangle of campfire sparks, frantic against a lake's complete calm (pages 76-7). But it was something in the caption—"where Homer . . . absorbed landscapes he would re-create"—that really caught my eye. With that simple phrase a photograph became a stop on a tour of a great artist's heart.

T. SHEPARD SOULES  
Atlanta, Georgia

The picture of the English village of Cullercoats taken on a dismal day (page 86) belies the fact that a few fishing cobbles still work from the harbor as they did in Homer's time. The same families carry out this trade, continuing a tradition that goes back to the 1600s. Winslow Homer is still talked about with a freshness that can come only from a community with a wealth of spoken history. My next-door neighbor's grandmother was Homer's favorite model, and Homer's watercolors show scenes that we still enjoy in the day to day.

STEVE RATCLIFFE  
Cullercoats, England

## Body Beasts

The article made me twitch. I kept wondering what body parts the horde of miniature monsters was about to stake out on me. For future articles of the same genre you could post a warning: "Not for the squeamish!"

DAVE WHITE  
Ajax, Ontario

Not mentioned in your article is cerumen (earwax) as a source of *Demodex* follicle mites. Other species are found in animals, including dogs, cats, hamsters, cattle, sheep, horses, and swine. As far as I know, *Demodex* species are restricted to mammals. It would seem likely that a search of the cerumen of other primates might show *Demodex* passengers.

WILLIAM J. MATHEY  
Nipomo, California

## Petra, Ancient City of Stone

Petra was depicted marvelously by Don and Annie Griffiths Belt, but one thing was missing—the superb lines of John W. Burgon regarding Petra's remains: "Match me such a marvel save in Eastern clime, / A rose-red city half as old as Time."

CARL COHEN  
Ann Arbor, Michigan

The wonderful photographs of the buildings in Petra, Jordan, look like something from an explorer's dream. In fact, they look like something from an explorer's feature film. Is Petra the site of the final resting-place of the Holy Grail in *Indiana Jones and the Last Crusade*?

GARY M. WOOD  
Racine, Wisconsin

*Yes, the facade of Al Khazneh (the Treasury) was prominent in the 1989 movie.*

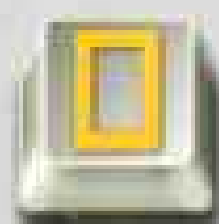
## Geographica

In August 1995, while flying from Port Alsworth on Lake Clark, we landed on the beach of Kamishak Bay just west of Augustine Island in Alaska. There on this isolated beach we found a little yellow toy duck. After reading "Tracking a Toy Flotilla," we finally know the story of our wilderness memento.

RICH AND MARGO TENNIS  
Eureka, Illinois

*Letters for Forum should be sent to National Geographic Magazine, Box 98198, Washington, D.C. 20090-8198, or by fax to 202-828-5460, or via the Internet to ngsforum@nationalgeographic.com. Include name, address, and daytime telephone. Letters may be edited for clarity and space.*

## NATIONAL GEOGRAPHIC ONLINE



Features, maps, questions, contests. Join the rest of the Geographic family in an electronic adventure. Shop the NGS Store. Visit our World Wide Web site at [www.nationalgeographic.com](http://www.nationalgeographic.com).



# PRO PLAN<sup>®</sup>

brand PET FOOD

*The Difference Is Real.*<sup>™</sup>

You can see the real Pro Plan difference when you *compare labels*. And you'll see the *results* of Pro Plan's high quality ingredients and nutrition in your cat: **Bright eyes. Sleek, shiny coat. Less waste.** An overall look of good health.

Try any one of the four great Pro Plan Cat Formulas, made with *real salmon, real beef, real chicken or real turkey*—and see the Pro Plan difference yourself.

You'll find Pro Plan pet foods at pet stores, feed stores and veterinarians.

*Now's the time to call*

**1-800-915-8877**

*Extension 562*

*and make your cat part of the Pro Plan team.*

Visit our web site at [www.proplan.com](http://www.proplan.com) to learn about all of our cat and dog products.

## COMPARE #1 INGREDIENTS

PRO PLAN<sup>®</sup> Salmon & Rice Formula **Real Salmon**

SCIENCE DIET<sup>®</sup> FELINE MAINTENANCE<sup>®</sup> Poultry By-Product Meal

IAMS<sup>®</sup> CAT FOOD Active Cats Chicken By-Product Meal

NUTRO<sup>®</sup> MAX CAT Adult Chicken Meal

BASED ON LABEL INFORMATION\*



Science Diet<sup>®</sup> Feline Maintenance<sup>®</sup> Cat Food is a product of Hill's Pet Nutrition, Inc.

Iams Cat Food<sup>®</sup> is a product of The Iams Company.

Nutro<sup>®</sup> Max Cat Food is a product of Nutro Products, Inc.

\*ALL LABELS CURRENT AS OF 7/98

© 1999 Pro-Vigors Pet Specialty Enterprises, A Division of Ralston Purina Company. Printed in U.S.A.

NATIONAL GEOGRAPHIC

# Geographica

## Knocking Geography and Physics Out of the Ballpark

As the new baseball season begins, fans and players turn their thoughts to . . . physics and geography, of course.

Like all hitters, Sammy Sosa (right), National League most valuable player in 1998, knows his wood bat has a sweet spot where he hits the ball best. But research by Rod Cross, an Australian physicist, shows it's really a "sweet zone," 5.9 inches to 7 inches from the end of the bat. When the bat strikes the ball within that zone, there is minimal bat vibration and less of an impulse for the batter's arms to jerk, giving him greater bat control.

Since 1949 the major leagues have burst out of their base in the Northeast to span the continent (map), sending Sosa and his teammates to many more cities. In its program for visiting school groups the Baseball Hall of Fame in Cooperstown, New York, looks at how population, climate, and transportation influence franchise location, the need for domed stadiums, and the use of artificial turf, driving home a solid educational message.



ROBERT BECK, MAJOR LEAGUE BASEBALL, PHOTOS; MAP BY BEN MCMILLAN



Major League  
Baseball Teams

● 1949

● 1999



## A Bloodcurdling Link to Vampires

Count Dracula, played here by Bela Lugosi, may not really have been a vampire. He may have had rabies instead.

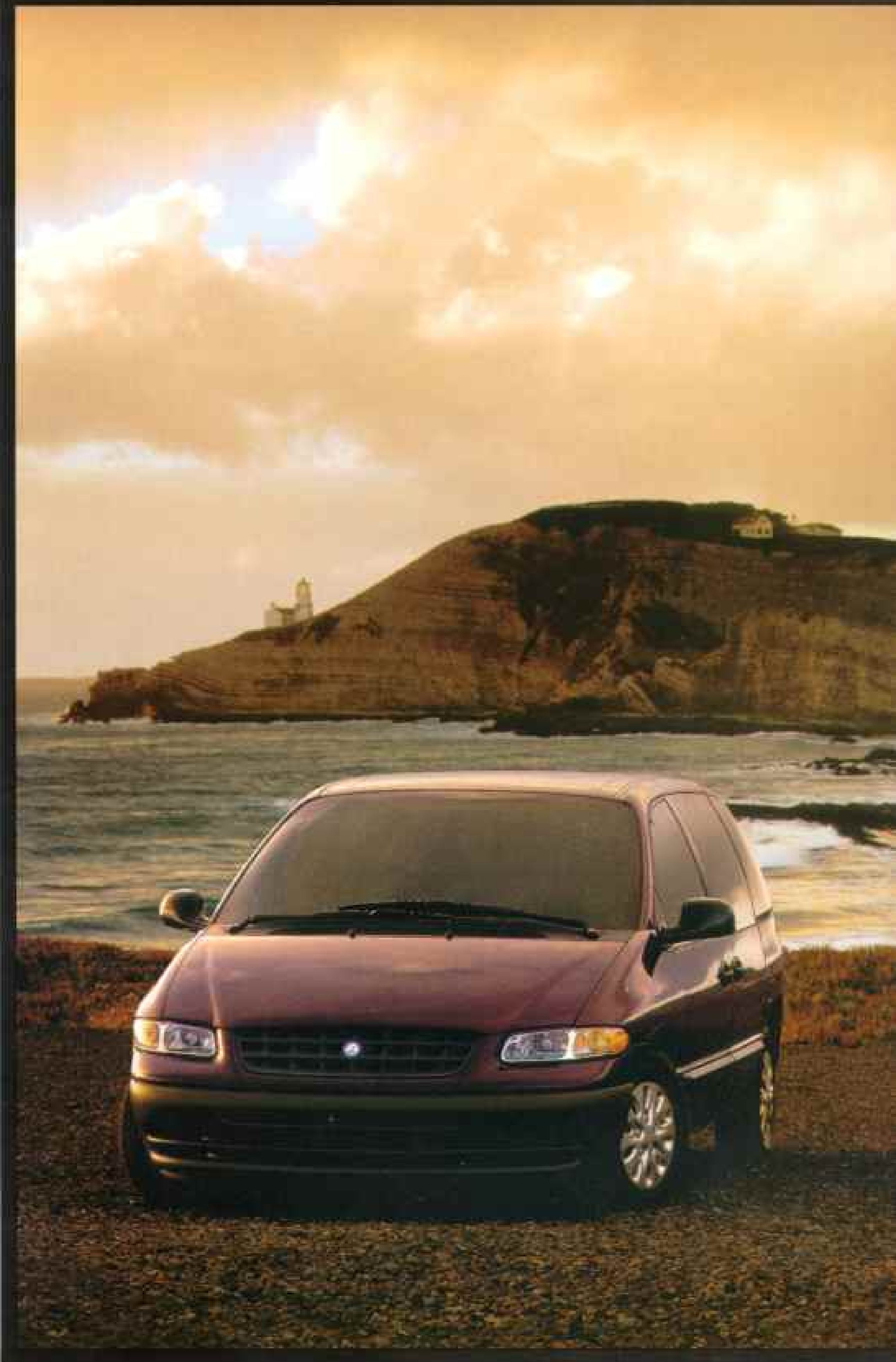
Lurid vampire legends tell of male corpses vacating their coffins at night to seduce women and attack humans and animals. Juan Gómez-Alonso, a Spanish doctor, was struck by similarities between the attributes of vampires and the symptoms of rabies, including hypersexuality, frothing at the mouth, and an intense reaction to bright light. Digging further into the subject, he learned that a rabies epidemic began in rural Hungary in the 18th century and spread across Europe just as the vampire tales proliferated. Gómez-Alonso believes peasants frightened by the bizarre behavior of rabies victims created the myths to explain it.

CULVER PICTURES



























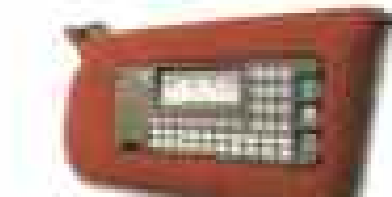











**Seven people at a time.**

**It was a revolutionary machine  
that broke new ground in technology.**

**Since 1983 it has continually  
moved the world forward.**



# Fifteen years later, the revolution

| 1983-84   | 1985-86   | 1987-88  | 1989  | 1990   | 1991   | 1992   |
|---|---|--|---|--|--|--|
|  <p>November 2, 1983: The very first minivan rolls off the assembly line in Windsor, Ontario. Let the revolution begin.</p>                |  <p>The camping package is introduced. It includes an 8'x10' canvas tent that actually attaches to the outside of the minivan.</p>   |  <p>Chrysler introduces its first minivan offering a V6 engine, increasing horsepower more than 42 percent.</p>             |  <p>Chrysler begins shipping its first minivans to Europe.</p>   |  <p>The first luxury minivan debuts. The ultimate minivan: Chrysler Town &amp; Country.</p> |  <p>Chrysler becomes the first company to put a driver's side air bag** in a minivan.</p>                           |  <p>The first ever integrated Child Seats debut, providing greater security and convenience.</p>      |
|  <p>The introduction of the minivan creates an entirely new and much-copied category of automobile.</p>                                   |  <p>Child protection rear door locks are introduced and quickly become an industry standard.</p>                                     |  <p>Wyager is the "#1 Domestic Minivan in Customer Satisfaction" according to J.D. Power and Associates* 1987 and 1988.</p> |  <p>Motor Trend announces Wyager is a "Top 10 New Car Buy."</p>   |  <p>One of Automobile Magazine's "All-Stars."</p>   |  <p>Second generation of minivan debuts with a new V6, available all-wheel drive and 70 percent new components.</p> |  <p>Chrysler Corporation minivan sales reach the 2,000,000 mark.</p>                                  |
|  <p>To be done right, a minivan needs to have front-wheel drive. It lowers step-in height and gives it carlike handling.</p>             |  <p>The minivan's towing capacity increases, making it even more useful.</p>   |  <p>Over 1,000,000 Chrysler Corporation minivans sold. Demand is so high we have to build another factory.</p>            |  <p>Wyager is the "#1 Domestic Minivan in Customer Satisfaction" according to J.D. Power and Associates.* That's three years in a row.</p> |  <p>2,000,000 Chrysler Corporation minivans sold.</p>                                     |  <p>Town &amp; Country is the "#1 Minivan in Customer Satisfaction" according to J.D. Power and Associates.*</p>   |  <p>Chrysler minivans become the first to offer rear phones.</p>                                    |
|  <p>Unlike big vans and long station wagons, the minivan actually fits in the garage.</p>  |  <p>One of Car and Driver's "Worst" in 1985.</p>   |  <p>Chrysler Corporation minivans reach nearly half a million in sales. Not bad for a new category.</p>                    |  <p>Wyager is the "#1 Domestic Minivan in Customer Satisfaction" according to J.D. Power and Associates.* That's three years in a row.</p> |  <p>Grand Voyager has the "Highest Resale Value" of any minivan.</p>                      |  <p>Wyager is named a Motor Trend "Top 10 New Car Buy."</p>   |  <p>Chrysler minivans become the first to offer rear phones.</p>                                    |
|  <p>The first award. The Zinc Institute Award of Excellence for our superior corrosion protection. Hey, you have to start somewhere.</p> |  <p>Versatile enough to carry a 4'x8' sheet of plywood or seven people. (Try that in a station wagon.)</p>                         |  <p>The first long-wheelbase minivan debuts, allowing for not only more cargo space but more legroom.</p>                 |  <p>One of Automobile Magazine's "All-Stars."</p>  |  <p>Grand Voyager has the "Highest Resale Value" of any minivan.</p>                      |  <p>Wyager is named a Motor Trend "Top 10 New Car Buy."</p>   |  <p>Debut of four-wheel anti-lock brakes with electrohydraulic technology for improved control.</p> |
|  <p>Eight-passenger seating becomes an option.</p>   |  <p>First adaptive transmission is launched. The system is capable of maintaining smooth shifts throughout a vehicle's life.</p> |  <p>The third consecutive Automobile Magazine "All-Stars" award.</p>  |  <p>Town &amp; Country is named Motor Trend's "Best of the USA."</p>   |  |  |  |

We knew we created something special. By inventing the minivan, we built much more than just an alternative to the station wagon. We started a revolution. We designed and engineered a vehicle that would transform America's streets and highways. It became a special part of our cultural and

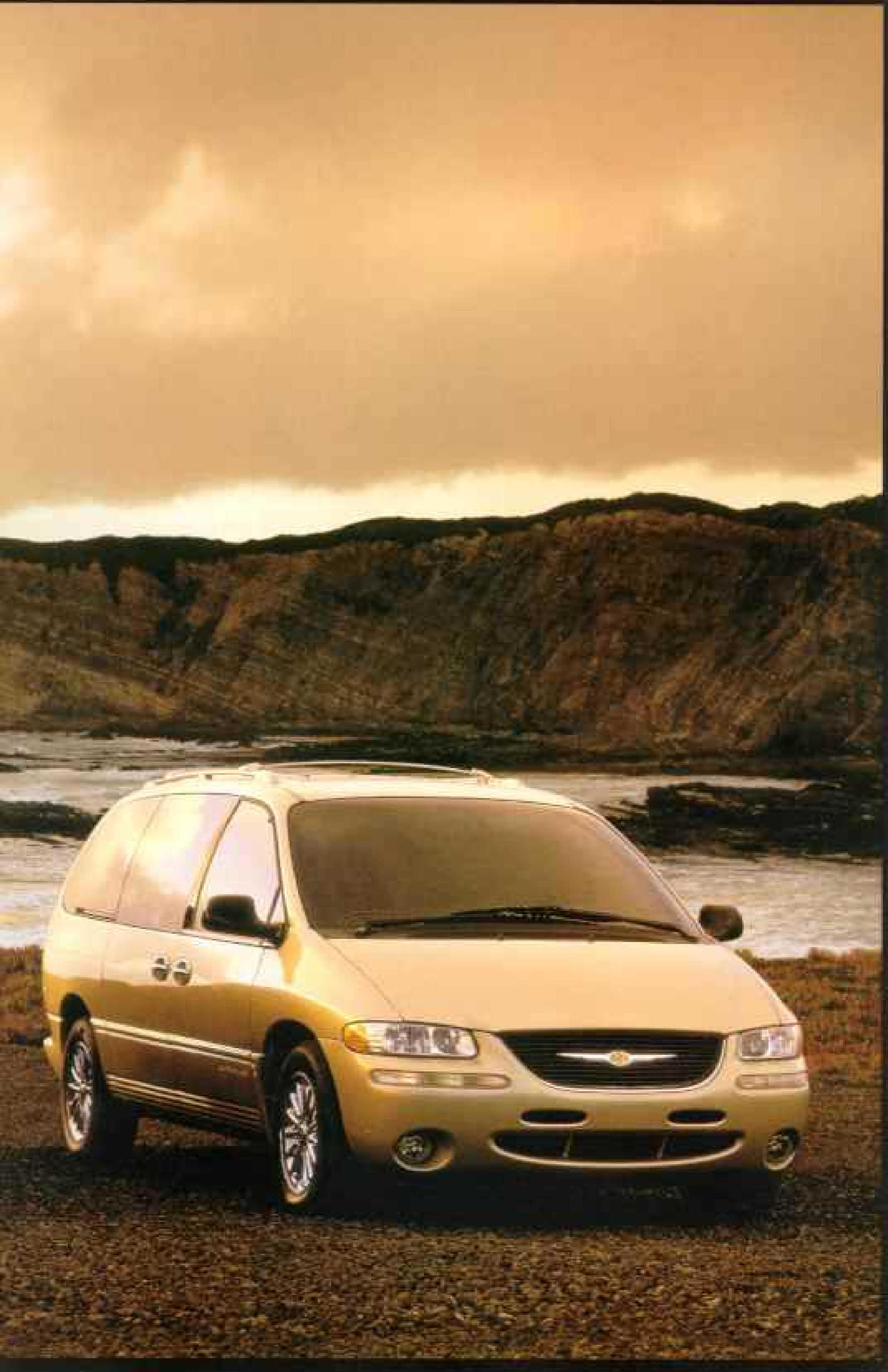
social fabric. And, over the next 15 years, we would lead every step of the way. Year after year, we continued to move forward by being the first minivan to offer such groundbreaking innovations as a standard driver's air bag.\*\* The first with dynamic side-impact protection. The first with dual sliding doors. The first with Easy Out

\*J.D. Power and Associates 1987-1991 Compact and Light Duty Truck Customer Satisfaction Studies. \*\*Always use seat belts. Remember a backseat is the safest place for children. †Town & Country won in 1996, 1997 and 1998. Strategic Vision's 1998 VES™ surveyed 32,191 Oct.-Nov. new vehicle buyers of 200+ models in the





The minivan from Chrysler and Plymouth.



CHRYSLER | PLYMOUTH



Town & Country Limited

Plymouth Voyager

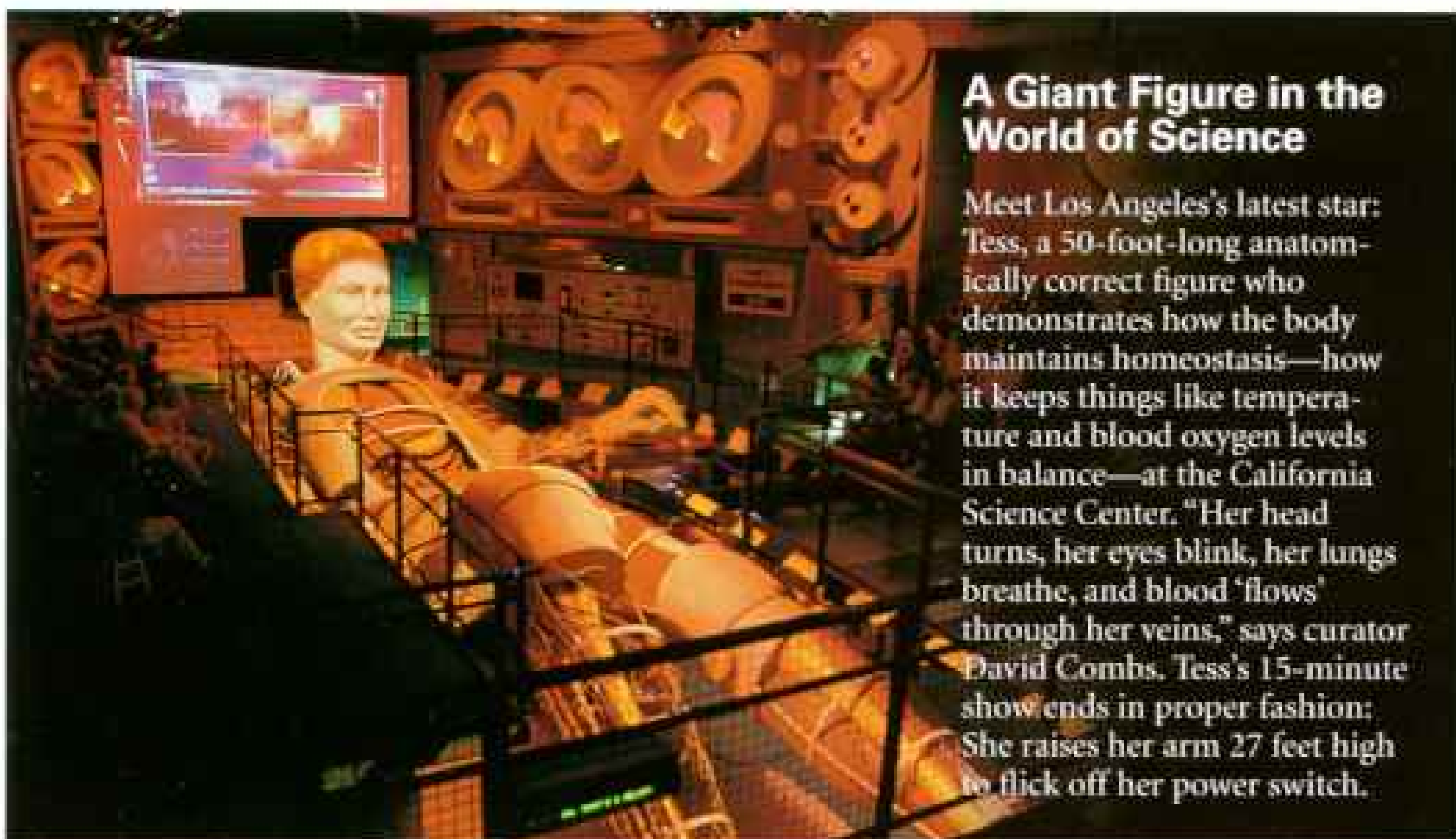
Town & Country LXI

## New Piece of an Evolutionary Puzzle

No one knows for sure when the ancestors of sea turtles first ambled off land and into the ocean. But this newly discovered, unusually complete, and exquisitely preserved sea turtle from a limestone deposit in Brazil—at 110 million years old the earliest known by 10 million years—answers key questions about that evolutionary journey, says Ren Hirayama of Japan's Teikyo Heisei University. Like modern sea



turtles *Santanachelys gaffneyi* had large glands near its eyes that secreted salt it absorbed from the sea, preventing dehydration. But its limbs ended in primitive paddles with some movable digits, not the rigid paddles of today's sea turtles. Hirayama believes the new find—about eight inches long—shows that the evolution of a salt-excreting system allowed these turtles to venture into the sea even before the complete development of rigid paddles.



## A Giant Figure in the World of Science

Meet Los Angeles's latest star: Tess, a 50-foot-long anatomically correct figure who demonstrates how the body maintains homeostasis—how it keeps things like temperature and blood oxygen levels in balance—at the California Science Center. "Her head turns, her eyes blink, her lungs breathe, and blood 'flows' through her veins," says curator David Combs. Tess's 15-minute show ends in proper fashion: She raises her arm 27 feet high to flick off her power switch.

REN HIRAYAMA/TOP; GEORGE STEINWETZ

### ■ NGS RESEARCH GRANT

## Living Underground in Jordan

Tucked away behind this wooden door in northern Jordan is a cluster of three underground rooms—a "habitation cave." In nearly three decades of research, anthropologist Øystein S. LaBianca of Michigan's Andrews University has found such caves all over Jordan. Usually occupied only during the winter, they contain cooking hearths, storage areas, and even rock-cut cisterns to collect rainwater. LaBianca believes Jordanian cave dwelling began in prehistoric times and has continued "on an on-again-off-again basis" ever since. In 1952 the government's housing census listed 1,140 cave residences throughout the country.



ØYSTEIN S. LABIANCA

## Echoes of World War II in Texas

It's a prosaic little artifact, this canteen (right) etched with views familiar to the soldier who owned it. But that soldier created these exotic scenes while interned at Camp Hearne, Texas—one of more than 370,000 German prisoners of war who spent part of World War II in 625 U.S. camps in 46 states.

Michael Waters, a Texas A&M University archaeologist, has been excavating the remains of Camp Hearne, which held 4,800 POWs soon after opening in 1943. "It took me several tries to find the site," he says. "It's overgrown with tall weeds and vines." But he soon began to unearth the flotsam and jetsam of daily life: buttons, belt buckles, German toothpaste tubes, dog tags, mess gear, rucksacks, religious medals. He also uncovered a miniature German castle built by prisoners (right) to pass the time. He interviewed local residents and went to Germany to talk to camp survivors about their experiences.

Many POWs were sent to work on the surrounding area's farms. A handful escaped. And one was beaten to death by ardent Nazi comrades who suspected him of anti-German sympathies. The camp closed after war's end in 1945. By that time its prisoners, like those in most U.S. camps, had embraced a favorite American song: "Don't Fence Me In."



JAMES LYLE (TOP); INTERNATIONAL COMMITTEE OF THE RED CROSS



GARY CAMPBELL (TOP); KAREN CHIN

## Dino Dung Reveals New Data

To *Tyrannosaurus rex* the young, cow-size, plant-eating dinosaur made a tasty meal. But scientists like Timothy T. Tokaryk of the Royal Saskatchewan Museum (left) and his colleague Wendy Sloboda, who found the huge hunk of dung *T. rex* deposited after digesting that meal, consider the remains a revelation. They learned that the coprolite held jagged pieces of bone (bottom left), indicating that the fearsome predator crushed its prey rather than swallowing it whole.

"Most reptiles today simply gulp food and let their digestive tract do the rest, and most of the prey is dissolved by the time it reaches the feces stage," says Karen Chin of the U.S. Geological Survey, who led the study. "But these chips were fractured before being digested." The 65-million-year-old specimen found in southwest Saskatchewan measures 17 inches long, six inches wide, and five inches high—twice as large as any previously known coprolite from a carnivorous dinosaur. *T. rex*, which grew to about 40 feet long, is the only carnivore ever found in the region large enough to produce a coprolite this size, Chin says.



**VIAGRA**<sup>®</sup>  
(sildenafil citrate) tablets  
Let the dance begin.

## A Birthday Party for a Moonscape on Earth

The March 1924 *GEOGRAPHIC* devoted 26 pages to R. W. Limbert's travels through the lava beds of southern Idaho, a barely known region of "scenic peculiarity." The article led President Calvin Coolidge to set aside 39 square miles of the beds as Craters of the Moon National Monument. "Ours is a story of volcanism, with lava flows every 2,000 years or so; the last one was 2,100 years ago," says James Morris, superintendent of the park, which marks its 75th anniversary this year. Among the celebrators: three Apollo astronauts who trained there in 1969 to learn about the geology of the moon—the real one.



BANDY OLSON, NGS IMAGE COLLECTION

## A Burial of Note at Teotihuacan

The mysterious city that dominated central Mexico nearly 2,000 years ago (*GEOGRAPHIC*, December 1995) has yielded a strikingly elaborate human burial. Arizona State University archaeologist Saburo Sugiyama made the find at the base of Teotihuacan's Pyramid of the Moon.

Sugiyama and his team excavated the skeleton of



BRAD LANE (BOTH)

a male at least 30 years old who died around A.D. 150 (above). He was seated with his hands crossed behind his back, suggesting that he was sacrificed



in dedication to the monument or to a ruler. The team also found more than 150 artifacts, including two greenstone sculptures, three obsidian figurines almost 20 inches long (left), and a large array of knives, blades, beads, and pendants.

"These were exceptionally rich offerings," says Sugiyama. Also in the tomb: skeletons of five large birds and what are likely two jaguars, apparently buried alive.



JAMES P. BLAIR, NGS IMAGE COLLECTION

## Tasty Clues to Wheat's Past Rise in Greece

The freshly baked loaves this Greek woman holds (left) may have an ancestry going back to the Bronze Age. British scientists studied the DNA of charred 3,300-year-old wheat grains found in storage areas at Assiros in northern Greece. They found that the DNA contains a gene responsible for the presence of proteins that yield springy, leavened bread—far earlier than such bread was thought to have been baked. It probably tasted

better than previously thought too, says Terry Brown, a molecular biologist at the University of Manchester Institute of Science and Technology.

The discovery also provides further evidence that prehistoric farmers grew two genetically distinct wheats. It thus bolsters the theory that the domestication of wheat, which took place within the Middle East's Fertile Crescent some 8,000 to 10,000 years ago, may have occurred there twice, by different peoples in separate locations.

TEXT BY BORIS WEINTRAUB



CLARITIN®

# Works for Me.

*I tried a million different kinds of over-the-counter antihistamines - they made me feel drowsy. Then my doctor prescribed nondrowsy Claritin. Claritin works for me. Your results may vary.*

*Joan Lunden*

Talk to your doctor about a trial of nondrowsy, 24-hour CLARITIN®. One tablet daily gives you 24-hour, nondrowsy relief from seasonal allergy symptoms. Studies show that the incidence of drowsiness was similar to that with placebo (sugar pill) at the recommended dose. Drowsiness may occur if you take more than the recommended dose.

Experience CLARITIN® - safe and effective relief for ages 6 and older. CLARITIN® is well tolerated. It has a low occurrence of side effects, which occurred about as often as they did with placebo (sugar pill). Most common were headache, occurring with 12% of people; drowsiness, 8%; fatigue, 4%; and dry mouth, 3%.

*Nondrowsy antihistamines, such as CLARITIN®, are available by prescription only.*

Call toll free 1-888-833-0003. Notify your doctor of other medication(s) you are currently taking. Consult your doctor for important information concerning this product.

Please see additional important information on next page.

Talk to your doctor about a trial of

Once-a-day

**Claritin®**  
10 mg (loratadine)

*Schering/MSD*

Copyright © 1998, Schering Corporation, Kenilworth, NJ 07033.  
All rights reserved. C02925/2298/9300 12/98 Printed in U.S.A.

[www.claritin.com](http://www.claritin.com)

# CLARITIN® brand of loratadine TABLETS, SYRUP, and RAPIDLY-DISINTEGRATING TABLETS

**BRIEF SUMMARY** (For full Prescribing Information, see package insert.)

**INDICATIONS AND USAGE:** CLARITIN is indicated for the relief of nasal and non-nasal symptoms of seasonal allergic rhinitis and for the treatment of chronic idiopathic urticaria in patients 6 years of age or older.

**CONTRAINDICATIONS:** CLARITIN is contraindicated in patients who are hypersensitive to this medication or to any of its ingredients.

**PRECAUTIONS: General:** Patients with liver impairment or renal insufficiency (GFR < 30 mL/min) should be given a lower initial dose (10 mg every other day). (See CLINICAL PHARMACOLOGY: Special Populations.)

**Drug Interactions:** Loratadine (10 mg once daily) has been coadministered with therapeutic doses of erythromycin, cimetidine, and ketoconazole in controlled clinical pharmacology studies in adult volunteers. Although increased plasma concentrations (AUC 0-24 hrs) of loratadine and/or descarboethoxyloratadine were observed following coadministration of loratadine with each of these drugs in normal volunteers ( $< 24$  in each study), there were no clinically relevant changes in the safety profile of loratadine, as assessed by electrocardiographic parameters, clinical laboratory tests, vital signs, and adverse events. There were no significant effects on QT intervals, and no reports of sedation or syncope. No effects on plasma concentrations of cimetidine or ketoconazole were observed. Plasma concentrations (AUC 0-24 hrs) of erythromycin decreased 15% with coadministration of loratadine relative to that observed with erythromycin alone. The clinical relevance of this difference is unknown. These above findings are summarized in the following table:

Effects on Plasma Concentrations (AUC 0-24 hrs) of Loratadine and Descarboethoxyloratadine After 10 Days of Coadministration (Loratadine 10 mg) in Normal Volunteers

|                            | Loratadine | Descarboethoxyloratadine |
|----------------------------|------------|--------------------------|
| Erythromycin (500 mg Q6h)  | +40%       | +45%                     |
| Cimetidine (300 mg QID)    | +103%      | +6%                      |
| Ketoconazole (200 mg Q12h) | +307%      | +73%                     |

This does not appear to be an increase in adverse events in subjects who received oral contraceptives and loratadine.

**Carcinogenesis, Mutagenesis, and Impairment of Fertility:** In an 18-month carcinogenicity study in mice and a 2-year study in rats, loratadine was administered in the diet at doses up to 40 mg/kg (mice) and 25 mg/kg (rats). In the carcinogenicity studies, pharmacokinetic assessments were carried out to determine animal exposure to the drug. AUC data demonstrated that the exposure of mice given 40 mg/kg of loratadine was 3.6 (loratadine) and 18 (descarboethoxyloratadine) times higher than in humans given the maximum recommended daily oral dose. Exposure of rats given 25 mg/kg of loratadine was 28 (loratadine) and 67 (descarboethoxyloratadine) times higher than in humans given the maximum recommended daily oral dose. Male mice given 40 mg/kg had a significantly higher incidence of hepatocellular tumors (combined adenomas and carcinomas) than concurrent controls. In rats, a significantly higher incidence of hepatocellular tumors (combined adenomas and carcinomas) was observed in males given 10 mg/kg and males and females given 25 mg/kg. The clinical significance of these findings during long-term use of CLARITIN is not known.

In mutagenicity studies, there was no evidence of mutagenic potential in reverse (Ames) or forward point mutation (CHO-HGPRT) assays, or in the assay for DNA damage (rat primary hepatocyte uncheduled DNA assay) or in two assays for chromosomal aberrations (human peripheral blood lymphocyte clastogenesis assay and the mouse bone marrow erythrocyte micronucleus assay). In the mouse lymphoma assay, a positive finding occurred in the nonactivated but not the activated phase of the study.

Decreased fertility in male rats, shown by lower female conception rates, occurred at an oral dose of 64 mg/kg (approximately 50 times the maximum recommended human daily oral dose on a mg/m<sup>2</sup> basis) and was reversible with cessation of dosing. Loratadine had no effect on male or female fertility or reproduction in the rat at an oral dose of approximately 24 mg/kg (approximately 20 times the maximum recommended human daily oral dose on a mg/m<sup>2</sup> basis).

**Pregnancy Category B:** There was no evidence of animal teratogenicity in studies performed in rats and rabbits at oral doses up to 96 mg/kg (approximately 75 times and 150 times, respectively, the maximum recommended human daily oral dose on a mg/m<sup>2</sup> basis). There are, however, no adequate and well-controlled studies in pregnant women. Because animal reproduction studies are not always predictive of human response, CLARITIN should be used during pregnancy only if clearly needed.

**Nursing Mothers:** Loratadine and its metabolite, descarboethoxyloratadine, pass easily into breast milk and achieve concentrations that are equivalent to plasma levels with an AUC<sub>0-24</sub>/AUC<sub>0-24</sub> ratio of 1.17 and 0.85 for loratadine and descarboethoxyloratadine, respectively. Following a single oral dose of 40 mg, a small amount of loratadine and descarboethoxyloratadine was excreted into the breast milk (approximately 0.03% of 40 mg over 48 hours). A decision should be made whether to discontinue nursing or to discontinue the drug, taking into account the importance of the drug to the mother. Caution should be exercised when CLARITIN is administered to a nursing woman.

**Pediatric Use:** The safety of CLARITIN Syrup at a daily dose of 10 mg has been demonstrated in 188 pediatric patients 6-12 years of age in placebo-controlled 2-week trials. The effectiveness of CLARITIN for the treatment of seasonal allergic rhinitis and chronic idiopathic urticaria in this pediatric age group is based on an extrapolation of the demonstrated efficacy of CLARITIN in adults in these conditions and the likelihood that the disease course, pathophysiology, and the drug's effect are substantially similar to that of the adults. The recommended dose for the pediatric population is based on cross-study comparison of the pharmacokinetics of CLARITIN in adults and pediatric subjects and on the safety profile of loratadine in both adults and pediatric patients at doses equal to or higher than the recommended doses. The safety and effectiveness of CLARITIN in pediatric patients under 6 years of age have not been established.

**ADVERSE REACTIONS. CLARITIN Tablets:** Approximately 50,000 patients, aged 12 and older, received CLARITIN Tablets 10 mg once daily in controlled and uncontrolled studies. Placebo-controlled clinical trials at the recommended dose of 10 mg once a day varied from 2 weeks' to 6 months' duration. The rate of premature withdrawal from these trials was approximately 2% in both the treated and placebo groups.

REPORTED ADVERSE EVENTS WITH AN INCIDENCE OF MORE THAN 2% IN PLACEBO-CONTROLLED ALLERGIC RHINITIS CLINICAL TRIALS IN PATIENTS 12 YEARS OF AGE AND OLDER

|            | PERCENT OF PATIENTS REPORTING      |                     |                                   |                                     |
|------------|------------------------------------|---------------------|-----------------------------------|-------------------------------------|
|            | LORATADINE<br>10 mg QD<br>n = 1926 | PLACEBO<br>n = 2545 | CLEMASTINE<br>1 mg BID<br>n = 536 | TERFENADINE<br>60 mg BID<br>n = 584 |
| Headache   | 12                                 | 11                  | 8                                 | 8                                   |
| Somnolence | 6                                  | 6                   | 22                                | 9                                   |
| Fatigue    | 4                                  | 3                   | 10                                | 2                                   |
| Dry Mouth  | 3                                  | 2                   | 4                                 | 3                                   |

Adverse events reported in placebo-controlled chronic idiopathic urticaria trials were similar to those reported in allergic rhinitis studies.

Adverse event rates did not appear to differ significantly based on age, sex, or race, although the number of nonwhite subjects was relatively small.

**CLARITIN REDTABS (loratadine rapidly-disintegrating tablets):** Approximately 500 patients received CLARITIN REDTABS (loratadine rapidly-disintegrating tablets) in controlled clinical trials of 2 weeks' duration. In these studies, adverse events were similar in type and frequency to those seen with CLARITIN Tablets and placebo.

Administration of CLARITIN REDTABS (loratadine rapidly-disintegrating tablets) did not result in an increased reporting frequency of mouth or tongue irritation.

**CLARITIN Syrup:** Approximately 300 pediatric patients 6 to 12 years of age received 10 mg loratadine once daily in controlled clinical trials for a period of 8-15 days. Among these, 188 children were treated with 10 mg loratadine syrup once daily in placebo-controlled trials. Adverse events in these pediatric patients were observed to occur with type and frequency similar to those seen in the adult population. The rate of premature discontinuance due to adverse events among pediatric patients receiving loratadine 10 mg daily was less than 1%.

ADVERSE EVENTS OCCURRING WITH A FREQUENCY OF  $\geq 2\%$  IN LORATADINE SYRUP-TREATED PATIENTS (6-12 YEARS OLD) IN PLACEBO-CONTROLLED TRIALS, AND MORE FREQUENTLY THAN IN THE PLACEBO GROUP

|                                      | PERCENT OF PATIENTS REPORTING     |                    |   |
|--------------------------------------|-----------------------------------|--------------------|---|
|                                      | LORATADINE<br>10 mg QD<br>n = 188 | PLACEBO<br>n = 262 | CHLORPHENIRAMINE<br>2-4 mg BID/TID<br>n = 170 |
| Nervousness                          | 4                                 | 2                  | 3   |
| Wheezing                             | 4                                 | 2                  | 5   |
| Fatigue                              | 3                                 | 2                  | 5   |
| Hypokinesia                          | 3                                 | 1                  | 1   |
| Abdominal Pain                       | 2                                 | 0                  | 0   |
| Conjunctivitis                       | 2                                 | <1                 | 1   |
| Dysphonia                            | 2                                 | <1                 | 0   |
| Malaise                              | 2                                 | 0                  | 1   |
| Upper Respiratory<br>Tract Infection | 2                                 | <1                 | 0   |

In addition to those adverse events reported above ( $\geq 2\%$ ), the following adverse events have been reported in at least one patient in CLARITIN clinical trials in adult and pediatric patients:

**Autonomic Nervous System:** Altered lacrimation, altered salivation, flushing, hypotension, impotence, increased sweating, thirst.

**Body As A Whole:** Angioneurotic edema, asthenia, back pain, blurred vision, chest pain, earache, eye pain, fever, leg cramps, malaise, rigors, tinnitus, viral infection, weight gain.

**Cardiovascular System:** Hypertension, hypotension, palpitations, supraventricular tachyarrhythmias, syncope, tachycardia.

**Central and Peripheral Nervous System:** Biphasicospasm, dizziness, dysphonia, hypotonia, migraine, paresthesia, tremor, vertigo.

**Gastrointestinal System:** Altered taste, anorexia, constipation, diarrhea, dyspepsia, flatulence, gastritis, hiccup, increased appetite, nausea, stomatitis, toothache, vomiting.

**Musculoskeletal System:** Arthralgia, myalgia.

**Psychiatric:** Agitation, anorexia, anxiety, confusion, decreased libido, depression, impaired concentration, insomnia, irritability, paranoia.

**Reproductive System:** Breast pain, dyspareunia, menorrhagia, vaginitis.

**Respiratory System:** Bronchitis, bronchospasm, coughing, dyspnea, epistaxis, hemoptysis, laryngitis, nasal dryness, pharyngitis, sinusitis, sneezing.

**Skin and Appendages:** Dermatitis, dry hair, dry skin, photosensitivity reaction, pruritus, purpura, rash, urticaria.

**Urinary System:** Altered micturition, urinary discoloration, urinary incontinence, urinary retention.

In addition, the following spontaneous adverse events have been reported rarely during the marketing of loratadine: abnormal hepatic function, including jaundice, hepatitis, and hepatic necrosis; alopecia; anaphylaxis; breast enlargement; rhythms multifarica; peripheral edema; and seizures.

**OVERDOSAGE:** In adults, somnolence, tachycardia, and headache have been reported with overdoses greater than 10 mg with the Tablet formulation (40 to 180 mg). Extrapyramidal signs and palpitations have been reported in children with overdoses of greater than 10 mg of CLARITIN Syrup. In the event of overdosage, general symptomatic and supportive measures should be instituted promptly and maintained for as long as necessary.

Treatment of overdosage would reasonably consist of emesis (ipecac syrup), except in patients with impaired consciousness, followed by the administration of activated charcoal to absorb any remaining drug. If vomiting is unsuccessful, or contraindicated, gastric lavage should be performed with normal saline. Saline cathartics may also be of value for rapid dilution of bowel contents. Loratadine is not eliminated by hemodialysis. It is not known if loratadine is eliminated by peritoneal dialysis.

No deaths occurred at oral doses up to 5000 mg/kg in rats and mice (greater than 2400 and 1200 times, respectively, the maximum recommended human daily oral dose on a mg/m<sup>2</sup> basis). Single oral doses of loratadine showed no effects in rats, mice, and monkeys at doses as high as 10 times the maximum recommended human daily oral dose on a mg/m<sup>2</sup> basis.

Schering Corporation  
Kenilworth, NJ 07033 USA

Rev. 3/98

1962842ET-JBS

CLARITIN REDTABS (loratadine rapidly-disintegrating tablets) are manufactured for Schering Corporation by Schering DGS, England.

U.S. Patent Nos. 4,382,233 and 4,371,516

Copyright © 1997, 1998, Schering Corporation. All rights reserved.

Purina ONE<sup>®</sup> Special Formula For Cats

Is Made With



# Real

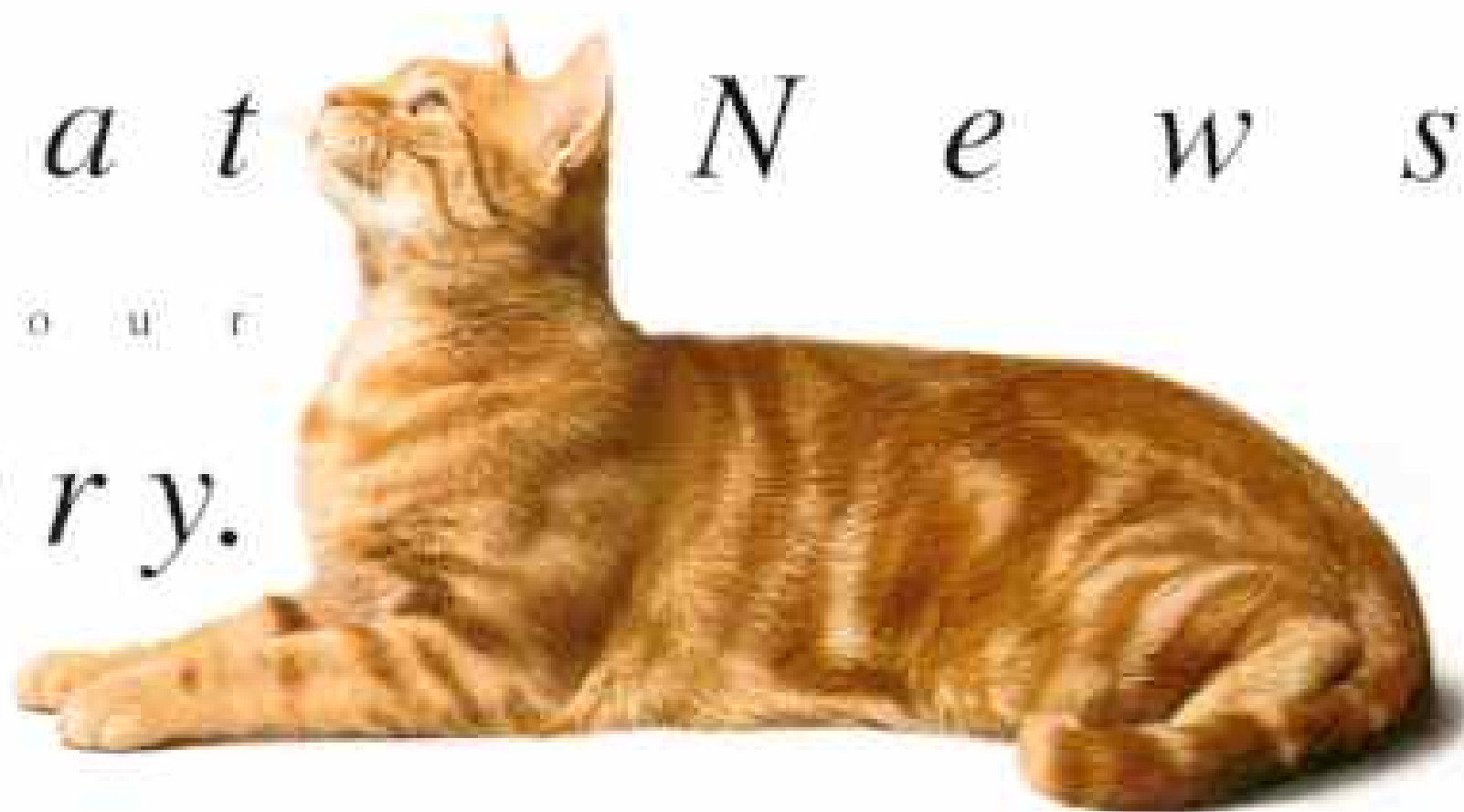
Chicken.

Good News For Your Cat.

Great News

For Your

Canary.



*Okay, so your cat would like nothing better than a Birdle sandwich, hold the bread. The good news*



*is, you can give him food he craves and still maintain domestic peace. Purina ONE<sup>®</sup>*

*Special Formula for cats is made with real chicken, an excellent source of the protein cats need. Plus, we added other wholesome ingredients to ensure your cat gets 100% balanced nutri-*

*tion. And Special Formula reduces his urinary pH and is low in dietary magnesium, which helps to maintain a healthy urinary*

*tract. For a complete adult diet for your cat, give him*

*Purina ONE. Special Formula. Your canary will thank you*

*for it. For more information or to receive a special offer, call 800-787-0078, ext. 2031.*



©1998 National Purina Company

[www.purina.com](http://www.purina.com)

PURINA ONE



SECOND TO NONE



IN HIS QUEST TO REACH THE  
PLANET'S FOURTEEN HIGHEST PEAKS,  
ED VIESTURS RELIES ON HIS  
EXPERIENCE, STAMINA AND WILL.

AND HIS ROLEX.



Asked why he monitors the timing of his ascent and descent so meticulously with his Explorer II, Viesturs doesn't mince words. "Reaching the summit is optional," he says. "Getting back down isn't."



  
ROLEX

Rolex Explorer II Officially Certified Swiss Chronometer. For the name and location of an Official Rolex Jeweler near you, please call 1-800-36ROLEX. Rolex, , Oyster Perpetual and Explorer II are trademarks.

# NATIONAL GEOGRAPHIC MAGAZINE

WILLIAM L. ALLEN, *Editor*

ROBERT M. POOLE, *Associate Editor*

ROBERT L. BOOTH, *Managing Editor*

## SENIOR ASSISTANT EDITORS

JUDITH BROWN, *Production* • WILLIAM T. DOUTHITT, *Special Projects*

BUCK GORE, *Science* • DAVID JEFFERY, *Legends*

KENT J. KOBERSTEEN, *Photography* • PETER MILLER, *Expeditions*

JOHN G. MITCHELL, *Environment* • BERNARD OHANIAN, *International Editors*

OLIVER PAYNE, *Manuscripts* • CONSTANCE H. PHELPS, *Layout and Design*

LESLEY B. ROGERS, *Research* • W. ALLAN ROYCE, *Illustrations*

CHRISTOPHER P. SLOAN, *Art*

## EDITORIAL

**Assistant Editors:** Don Barr, Mike Edwards, Peter L. Fofonoff, Jeff L. Sverdow, Jane Vessels, Meg Nottingham Walsh. **Senior Writers:** John L. Eliot, Cathy Newman, Pat J. Vesilind. **Senior Editorial Staff:** Lynn Addison, Lisa Moore LaRoe, Carol B. Lubyk, Alan Manson, William R. Newcott, Thomas O'Hall, Jennifer Rank, Cliff Tapp, Boris Weintraub, A. R. Williams, Margaret G. Jackowitz. **Editorial Staff:** Cassandra Franklin-Barbajosa, Hilal J. Hoffmann, Glenn Deland. **Research:** Michelle A. Sweeney, Assoc. Director; Senior Researchers: Carolyn H. Anderson, Judith F. Bell, Kathy B. Maher, Barbara W. McConnell, Jeanne E. Peters, Abigail A. Tipton. **Researchers:** Elizabeth Cornell, Alice J. Dunn. **Legends:** Victoria C. Duchesneau. **Planning Council:** Mary McFawn, David W. Woodell.

## ILLUSTRATIONS

**Photography:** Susan A. Smith, Asst. Director; Sam Abel, William Albert Alford, Jodi Coati, Chris Johns, Michael Nichols, Studio; Mark Thraasen, Photo Engineering; Lawrence B. Maurer. **Illustrations Editors:** Dennis R. Dimick, Asst. Director; John A. Esthate, Research Grant Projects; Bert L. Fria, Todd James, Elizabeth Cheng Kist, Bruce A. McElfresh, Kathy Moran, Kurt F. Mutschler, Christopher Scapula, Susan Westman. **Layout and Design:** Robert Gray, Lisa Lyttin, David C. Whitmore. **Typography:** Betty Clayman-Dailey, Kay Kober Harting, Douglas M. McKinney. **Art:** Nicholas Krüger, Asst. Director; Christopher A. Klein, Artist; Darcy J. Bolado de Luna, Research; Carolyn R. Sumnerville. **Engraving and Printing:** Janet C. Ewins, Director; Judy L. Garvey, William D. Richerts.

## EDITORIAL SERVICES

**Administration:** Neva L. Falk, Asst. to the Editor; Maria Gonzalez, Staff; Maria-Teresa Lawrence, Business Manager; Brian E. Strauss, Electronic Publishing; Sara L. Anderson, Sandra M. Dene, Antanie E. Lampathakis, Karen Dufort Sigh, Chelene S. Warr, Control Center; Carol L. Dumont, Director; Travel: Ann C. Judge, Director. **Audiovisual:** Edward J. Sapp. **Communications:** Mary Jeanne Jacobsen, Director; Public Affairs: Barbara H. Felton, Barbara S. Mohler. **Image Collection:** Mauri A. Mulvihill, Director; William D. Pirry, Image Sales; Carolyn J. Harrison, John A. Rutter. **Information Services:** Carolyn F. Dewell, Director; Correspondence: Joseph M. Barton, Jr., Director; Library and Indexing: Susan Filer Carby, Director; Ann C. Barnson, Ellen D. Brocoe, Janet Dumitrowski, Barbara Penfold Fenn, Records; Ann E. Hubbs, Translations; Kathryn A. Bass, Director; Sgrid Block. **Lectures and Public Programs:** K. Andrew van Duyn, Director; Scott A. Braker, Gregory A. McGruber.

## ADMINISTRATION

**Accounting:** Michael J. Cole, Asst. Controller; Larry E. Dowdy, Janet C. Yates. **Administration:** Mary L. Barton, Myra A. McLellan, Barbara A. Williams. **Asst. to the Chairman:** Karen S. Marsh. **Asst. to the President:** Deloris J. Drabberg. **Circulation:** Elizabeth M. Safford, Director. **Development Office:** Margaret Sears, Director. **Educational Services:** Robert L. Graham. **Expeditions Council:** Rebecca Martin, Director. **Explorers Hall:** Susan S. Norton, Director; Nancy W. Beers, Susan A. Balfinger, Richard McVane. **Financial Planning:** Stephen R. Visk, Director. **General Services:** Robert A. Cole, Director. **Geography Education:** Robert E. Divil, Director; Mary Lee Ellen, J. Jim Ferguson, Karen E. Gibbs, Roger B. Hirschland, Kimberly H. Hulse. **Human Resources:** Robert E. Howell, Carol E. Lang, Directors; Barbara Duxworth Dese. **Information Systems:** Carl H. Kim, George F. Hutto. **International Publications:** Robert W. Hernandez, Director. **Law:** Susan Burke, Angela M. Ghisla, Suzanne R. McDowell, Deputy General Counsel. **Member Services:** Christina C. Aberghis, Robert V. Koering, Directors. **Promotion:** Joseph S. Fowler, Director; Joan M. Anderson, James V. Bullard, Robert L. Feige, Charles F. Hermann III, Deborah A. Jones. **Research and Exploration Committee:** Kristin S. Scott, Kathy Williamson. **Treasurer's Office:** Barbara J. Constant, Asst. Treasurer. **United Kingdom Office:** Jennifer Mowley, Director.

## PRODUCTION SERVICES

Hans H. Wagner, Director. **Manufacturing:** George V. White, Director; John T. Dunn, Assoc. Director. **Pre-Press:** Geoffrey T. McConnell, Director; Martin G. Anderson, Philip E. Flude, Bernard D. Quarick. **Printing:** Joseph M. Anderson, Sheme S. Harrison, Michael R. Portillo, Ronald E. Williamson, Dana L. Yates. **Quality:** Bill M. Aldridge, Director; Faj M. Crawford.

## ADVERTISING

Andrea Vaughn, National Sales Manager; Ron Bonhoff, Western Manager; Laurie L. Kubacki, Chicago Manager; Sherburne F. Naulty, Eastern Manager; John Patton, Southeast Manager; Philip G. Reynolds, Midwest Manager; Michel Saghaï, International Director; 30 Change-Eyeses, 75008 Paris; David D. Woodruff, Detroit Manager; Washington: Gail L. Moffat, Director; Business Administration: Penelope B. Todd, Director; Marketing Services: Gail M. Jackson, Production Manager.

## EDUCATIONAL SERVICES OF THE SOCIETY

**Book Division:** Charles Kogut, Asst. Director; Barbara A. Payne, Editorial Director; Elizabeth L. Newhouse, David David Griffin, Design; Barbara Brownell, Copywriter; Kevin Murray, Trade; Senior Editors: John G. Agrone, Lisa Benstead-Va, Melba C. Christian, Tom Melham. **Traveler:** Keith Belovos, Editor; Paul Martin, Managing Editor. **World:** Susan Mondshain Torgia, Editor; Scott S. Sturkey, Managing Editor. **Education Products:** David Beason, Director.

## NATIONAL GEOGRAPHIC VENTURES

C. RICHARD ALLEN, *President*

**Television:** Timothy T. Kelly, President; Todd Berman, Marketing/Devs; Sandra G. McGivern, National Geographic Channel; Nicole Nixon, Exec. Producer; Specials: Michael Rosenblatt, Exec. Producer; Explorer; Kathleen F. Telle, Public Relations; Andrew Will, Programming/Production; Patricia Garg, Film Library; Cassi Omer, Asst. to the President. **Interactive:** Lawrence R. Liu, Managing Director; Online: Mark R. Holmes, Editor; Valerie A. May, Managing Editor; CD-ROM: Robert W. Madden, Editor; Thomas J. Stanton, Vice President. **Maps:** Allen Carol, Managing Director; Kevin P. Allen, Map Services; Steven D. Lowndes, Finance; Daniel J. Ortiz, Map Ventures; Dierdra Bevington-Arred, Richard Bullington, Debbie J. Gibbons, Martin Golden, A. Russell Little, Juan Vellos, Project Managers; John A. Bonner, Relief Artist. **Enterprises:** Linda Berkeley, Exec. Vice President; Lynn Gutter, Travel and Catalog. **Administration:** Francis A. Marshall, Finance; Samuel H. Millstone, Business Development; Mitchell Pevant, New Media.

Copyright © 1999 National Geographic Society. All rights reserved. NATIONAL GEOGRAPHIC and Yellow Border: Registered Trademarks of Mosaic Registrars. NATIONAL GEOGRAPHIC assumes no responsibility for unsolicited materials.



## NATIONAL GEOGRAPHIC SOCIETY

*"For the increase and diffusion of geographic knowledge."*

THE NATIONAL GEOGRAPHIC SOCIETY is chartered in Washington, D.C., as a nonprofit scientific and educational organization. Since 1888 the Society has supported more than 6,400 explorations and research projects, adding to knowledge of earth, sea, and sky.

JOHN M. FAHEY, JR., *President and CEO*

*Senior Vice Presidents*

TERRENCE B. ADAMSON, SANDRA H. GILL

NINA HOFFMAN, DALE A. PETROSKY

ROBERT B. SIMS

*Vice Presidents*

CHRISTOPHER A. LIEDEL, *CFO*

H. GREGORY PLATTS, *Treasurer*

BERNARD J. CALLAHAN, KITTY CARROLL COLBERT

J. SCOTT CRYSTAL, MARY P. DONOHUE

WILLIAM R. GRAY, DONNA L. HASSLINGER

GEORGE E. NEWSTEDT, EDWARD A. BENO, JR.

## BOARD OF TRUSTEES

GILBERT M. GROSVENOR, *Chairman*

REG MURPHY, *Vice Chairman*

JOEL ALBRITTON

*Chairman, Riggs Bank N.A.*

WILLIAM L. ALLEN

THOMAS E. BOLGER

*Chairman, Executive Committee, Bell Atlantic*

FRANK BORMAN

*Chairman and CEO, Parlex Corporation*

LEWIS M. BRANSCOMB

*Kennedy School of Government, Harvard University*

J. CARTER BROWN

*Director Emeritus, National Gallery of Art*

MARTHA E. CHURCH

*President Emerita, Hood College*

MICHAEL COLLINS

*President, Michael Collins Associates*

JOHN M. FAHEY, JR.

NINA HOFFMAN

JOHN JAY ISELIN

*President, The Cooper Union*

JAMES C. KAUTZ

*Limited Partner, Goldman, Sachs & Co.*

J. WILLARD MARRIOTT, JR.

*Chairman and CEO, Marriott International*

FEORETTA DUKES MCKENZIE

*Former Superintendent of Schools, District of Columbia*

PATRICK J. NOONAN

*Chairman, The Conservation Fund*

NATHANIEL P. REED

*Businessman-Environmentalist*

WILLIAM E. REILLY

*Former Administrator, Environmental Protection Agency*

ROZANNE L. RIDGWAY

*Former Assistant Secretary of State*

B. FRANCIS SAUL II

*Chairman and President, B. F. Saul Company*

ROBERT B. SIMS

## TRUSTEES EMERITUS

Owen R. Anderson, Robert L. Braden, Lloyd H. Thant,

George M. Elsey, William Graves, Cary P. Heikens,

Mrs. Lyndon B. Johnson, Laurence S. Rockefeller,

Robert C. Seamans, Jr., Frederick G. Veszburg

## RESEARCH AND EXPLORATION COMMITTEE

George E. Stuart, *Vice President and Chairman*

Richard S. Williams, Jr., *Vice Chairman*; Martha E. Church,

H. J. de Bie, John M. Francis, Linda Merzante,

Bernard G. Nieckmann, David Pimentel, Peter H. Raven,

Charles H. Southwick, John H. Steele,

Hans-Otter Suet, George E. Watson, Henry T. Wright

## EDUCATION FOUNDATION

Larry M. Proffer, *Executive Director*

Our new SUVs average 1/3 less smog-forming emissions than government requirements.



15 of our new SUVs combined run cleaner than a single car made back in the 1960s.

Lower emissions mean less acid rain, which is better for all of us.



A sensor in all Ford, Lincoln and Mercury SUVs helps maintain low emissions.



[www.ford.com](http://www.ford.com)

1-800-352-3535

ONLY ONE THING SMELLS BETTER  
THAN A NEW CAR.



Juniper Pass

Wednesday

I remember camping with my grand-  
father up here in the Rockies. I don't ever  
want to see this place change.

That's why I'm back here testing our  
new sport utilities. From now on, every  
Ford, Lincoln and Mercury SUV will be a  
low emissions vehicle.

Of course, their famous performance  
won't change; only their emissions will.  
I feel really good about the effect that'll  
have on our environment. And I'm sure  
the plants and animals do, too.



EMISSIONS TECHNICIAN

STEVE KERBY

VEHICLE

EXPLORER

YEAR

2003



Ford Motor Company

BETTER IDEAS. DRIVEN BY YOU.™

ENVIRONMENT

OFF

THE IRIDIUM NAME AND LOGO ARE TRADEMARKS  
AND SERVICE MARKS OF IRIDIUM LLC © 1997

A  
DETAILED MAP  
OF YOUR  
CALLING AREA  
CAN BE OBTAINED FROM  
NATIONAL GEOGRAPHIC.



The world's first handheld global satellite phone and paging network is here. Now your wireless service can cover the earth.

**IRIDIUM**

IN THE U.S. AND CANADA CALL 1-888-IRIDIUM EXT. 4895 calling planet earth

IN OTHER COUNTRIES PLEASE CALL +407-659-1889 OR VISIT US AT [WWW.IRIDIUM.COM](http://WWW.IRIDIUM.COM)



## The true measure of

For nearly half a century, Toyota Land Cruisers have been travelling the globe, creating

a sport utility vehicle is not

paths where there once were none. Now they're even better equipped for the journey. The

where it can go.

V8-powered Toyota Land Cruiser with available seating for eight. Darwin would approve.

But rather, where it has been.



**TOYOTA** | everyday

1-800-GO-TOYOTA ♦ [www.toyota.com](http://www.toyota.com)

©1998 Toyota Motor Sales, U.S.A., Inc. Buckle Up! Do it for those who love you. Toyota reminds you to Tread Lightly!®

VOL. 195, NO. 4



APRIL 1999

# NATIONAL GEOGRAPHIC



RETURN TO THE

## BATTLE OF MIDWAY 80



GALÁPAGOS ISLANDS 2   GALÁPAGOS UNDERWATER 32   BLUES HIGHWAY 42  
COPPER AGE 70   TEXAS HILL COUNTRY 104   VERNAL POOLS 122

# Land, Sea or Air



## We're Out There

The commitment of the Anheuser-Busch Adventure Parks to conservation and wildlife preservation spans all seven continents and keeps us working around the clock, 365 days a year. With help from environmental partner organizations and people like you, SeaWorld and Busch Gardens have been out there

making a difference for more than 40 years.

To us, caring for the environment means rolling up our sleeves.

Whether conducting research to help preserve the few remaining black rhinos or caring for endangered Hawaiian monk seals and Lear's macaws, our commitment to conservation runs deep.

Entertaining millions of people in our parks each year allows us to share our knowledge, experience and passion for the environment. For we believe the creatures that

inhabit our land, sea and air are a precious gift we all share.



[www.seaworld.com](http://www.seaworld.com)



SeaWorld rescues, rehabilitates and releases more marine animals than anyone on earth.

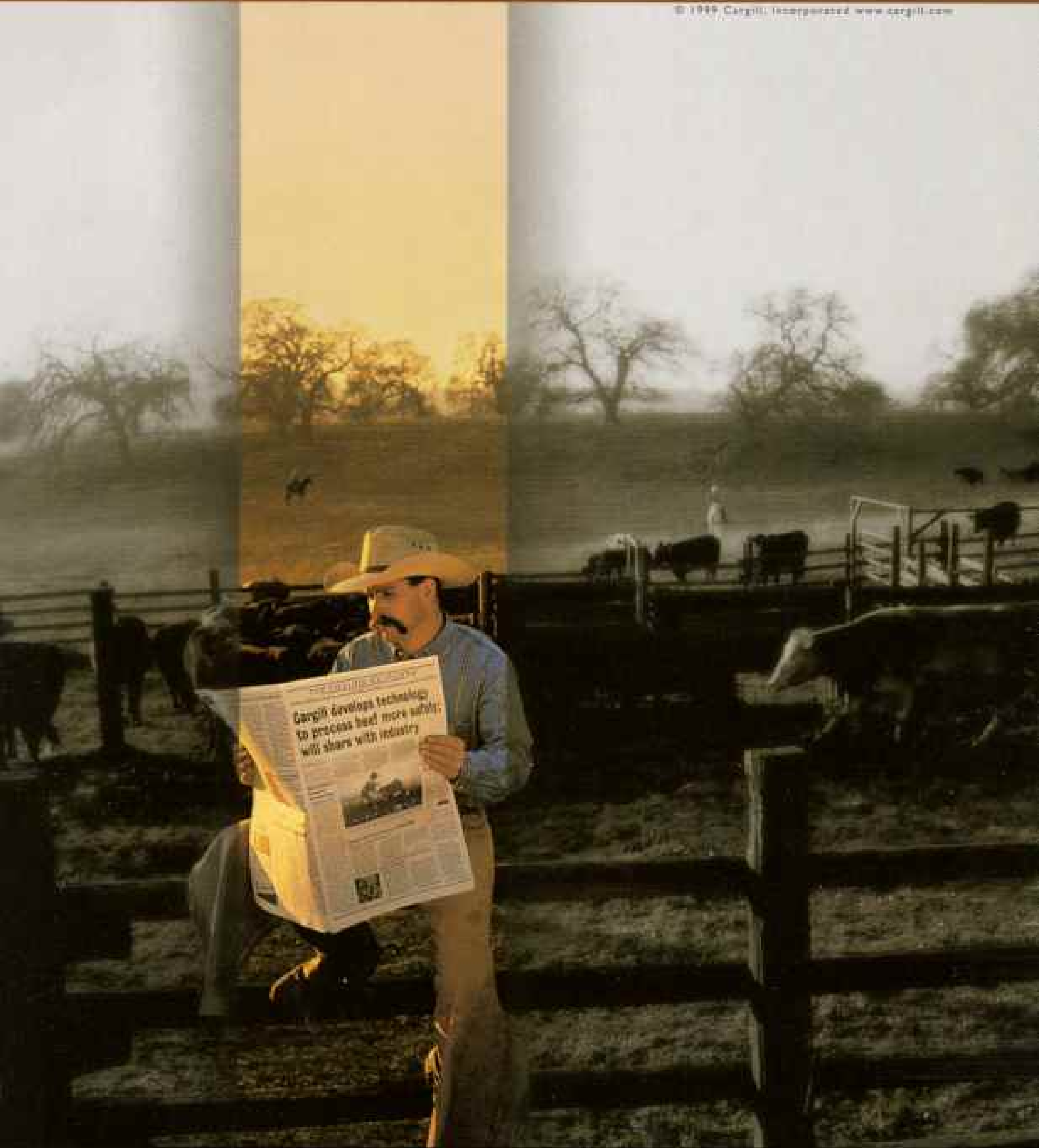


[www.buschgardens.org](http://www.buschgardens.org)



We mill wheat into flour. Process barley into malt. And produce sweeteners from corn in the U.S., Brazil, and Europe. We produce and process poultry in Thailand. Trade agricultural commodities and foreign currencies on the world's major exchanges. And operate 19 meat processing facilities in North America, where these days, there's some good news for everyone.

© 1999 Cargill, Incorporated. www.cargill.com



**IT'S NOT JUST WHAT WE DO.  
IT'S HOW WE DO IT.**



# FLASHBACK



FRANCIS HEDGE

■ FROM THE GEOGRAPHIC ARCHIVES

## Sitting Pretty

No vernal pool could spawn these spans. *Victoria amazonica* water lilies, native to South America, can reach 20 feet in circumference and support up to 300 pounds each—though in Salem, North Carolina, about 1892 all they held were four kids and a dog on a chair. Physician Henry Bahnson propagated the plants in his backyard pond, where this group was photographed. Perching children atop the massive leaves was all the rage in water gardens of the time. But these free-floating youngsters may have felt some free-floating anxiety. In the 1901 book *Old Time Gardens* writer Alice Earle Morse recalled of her own youthful lily-sitting: "I have never forgotten it, nor how afraid I was of it; for someone wished to lift me upon the great leaf to see whether it would hold me above the water. . . . I objected to this experiment with vehemence."

This photograph has never before been published in the magazine.



See? There it is. Right under the cargo area. The spare tire that used to be out in the open is now carefully tucked inside a well underneath the cargo floor. That leaves more room for your gear and provides easy access to a clean tire, should you ever need it.

That's just one of the many interior refinements we've made to the all-new 1999 Jeep Grand Cherokee. There's also an available all-new overhead console with 13 programmable features to help make this one of the most user-friendly sport utility vehicles around.

To find out what else is hidden inside our newest 4x4, visit us at [www.jeep.com](http://www.jeep.com) or call 1-800-925-JEEP. The thoughtfully designed Jeep Grand Cherokee. You'll find all the improvements easy to swallow.

**Jeep**

THERE'S ONLY ONE

THE ALL-NEW JEEP GRAND CHEROKEE  
THE MOST CAPABLE SPORT UTILITY EVER\*

\*Based on AMCI overall on- and off-road performance tests using Grand Cherokee with available Quadra-Drive™ and V8 engine. Jeep is a registered trademark of DaimlerChrysler.

NATIONAL GEOGRAPHIC

# OnScreen



■ EXPLORER, APRIL 14

## Searching for Ships Lost in the Battle of Midway

A hunt is on in the depths of the central Pacific as the National Geographic Midway Expedition—led by Robert D. Ballard, who found *Titanic* and the ghost ships of Guadalcanal—aims to locate, map, and explore Japanese and U.S. ships sunk during the Battle of Midway, the turning point of the Second World War in the Pacific.

Their "searchlight" in the sea is the torpedo-shaped MR-1 (above), a towed sonar-search system developed by the University of Hawaii's School of Ocean and Earth Science and Technology. Last May it pinpointed a large object on the ocean floor—the U.S.S. *Yorktown* (right), lost in action on June 7, 1942. The aircraft carrier lies 16,650 feet below the surface, three-quarters of a mile deeper than *Titanic*. "On this expedition," says Ballard, "we've pushed back the frontier of deep-sea exploration."

EXPLORER's *Battle for Midway* documents the search and recounts the epic naval battle. Ballard was accompanied on the quest by four World War II veterans—two Americans and two Japanese. For them modern technology was a time machine, bringing back memories of fire and fury and fallen comrades.



### ■ PROGRAM GUIDE

**National Geographic Specials**  
NBC. See local listings.

**National Geographic EXPLORER**  
TBS. Wednesdays, 8:05 p.m. ET.

**National Geographic Videos and Kids Videos** Call 1-800-627-5162.

Programming information accurate at press time; consult local listings or our website at [www.nationalgeographic.com](http://www.nationalgeographic.com).

Look for the National Geographic Channel when traveling abroad.



## The Transderm Scōp® patch is clinically proven to work better than Dramamine®



**Transderm Scōp is more effective and longer lasting than Dramamine™ at preventing the nausea and vomiting of motion sickness.** Just peel off the backing and press it behind your ear at least four hours

before boarding and relax. The medicine is consistently absorbed for up to three days. You can even shower with it. For shorter trips, remove the patch when no longer needed and the effects wear off. **In clinical studies, 5 out of 6 people did not report drowsiness with Transderm Scōp.**

**Ask your doctor about Transderm Scōp when you make your travel plans.**

Not for children or those with glaucoma, difficulty in urinating, or an allergy to scopolamine or other belladonna alkaloids. In clinical studies, some side effects were noted, including blurred vision, dryness of the mouth (in two-thirds of users) and drowsiness (reported incidence less than 1 in 6). While using this product, you should not drive, operate dangerous machinery or do other things that require alertness. Avoid using alcohol. If you are elderly, your physician should exercise special care in prescribing this product. See adjoining page for additional information on potential adverse reactions or side effects.

**Available by prescription only.**

**ASK YOUR DOCTOR ABOUT**  
**TRANSDERM SCŌP®** scopolamine 1.5mg

Call 1-888-670-SCOP [www.transdermscop.com](http://www.transdermscop.com)

Dramamine is a registered trademark of Parke-Davis & Upjohn. © 1998 Hoechst Consumer Health, Inc.

\* Compared to Dramamine dimethylhydrate tablets. \*\* Based on total drug.

# Transderm Scop®

scopolamine 1.5 mg

Transdermal Therapeutic System

Programmed to deliver *in vivo* approximately 1.0 mg of scopolamine over 3 days.

## Brief Summary

(For full prescribing information, see package insert.)

**INDICATIONS AND USAGE:** Transderm Scop is indicated for prevention of nausea and vomiting associated with motion sickness in adults. The patch should be applied only to skin in the postauricular area.

**CONTRAINDICATIONS:** Transderm Scop is specifically contraindicated in persons who are hypersensitive to the drug scopolamine or to other belladonna alkaloids, or to any ingredient or component in the formulation or delivery system, or in patients with angle-closure (narrow angle) glaucoma.

**WARNINGS:** Transderm Scop should not be used in children and should be used with special caution in the elderly. See **PRECAUTIONS**.

Since drowsiness, disorientation, and confusion may occur with the use of scopolamine, patients should be warned of the possibility and cautioned against engaging in activities that require mental alertness, such as driving a motor vehicle or operating dangerous machinery.

Potentially alarming idiosyncratic reactions may occur with ordinary therapeutic doses of scopolamine.

## PRECAUTIONS

**General:** Scopolamine should be used with caution in patients with pyloric obstruction, or urinary bladder neck obstruction. Caution should be exercised when administering an antiemetic or antimuscarinic drug to patients suspected of having intestinal obstruction.

Transderm Scop should be used with special caution in the elderly or in individuals with impaired metabolic, liver, or kidney functions, because of the increased likelihood of CNS effects.

Caution should be exercised in patients with a history of seizure or psychosis, since scopolamine can potentially aggravate both disorders.

**Information for Patients:** Since scopolamine can cause temporary dilation of the pupils and blurred vision if it comes in contact with the eyes, patients should be strongly advised to wash their hands thoroughly with soap and water immediately after handling the patch. In addition, it is important that used patches be disposed of properly to avoid contact with children or pets.

Patients should be advised to remove the patch immediately and contact a physician in the unlikely event that they experience symptoms of acute narrow-angle glaucoma (pain in and redness of the eyes accompanied by dilated pupils). Patients should also be instructed to remove the patch if they develop any difficulties in urinating.

Patients should be warned against driving a motor vehicle or operating dangerous machinery while wearing the patch. Patients who engage in these activities should also be aware of the possibility of withdrawal symptoms when the patch is removed. Patients who expect to participate in underwater sports should be cautioned regarding the potentially drowning effects of scopolamine. A patient brochure is available.

**Drug Interactions:** Scopolamine should be used with care in patients taking drugs, including alcohol, capable of causing CNS effects. Special attention should be given to drugs having anticholinergic properties, e.g., tricyclic alkaloids, antihistamines (including meclizine), and anti-depressants.

**Carcinogenesis, Mutagenesis, Impairment of Fertility:** No long-term studies in animals have been performed to evaluate carcinogenic potential. Fertility studies were performed in female rats and revealed no evidence of impaired fertility or harm to the fetus due to scopolamine hydrobromide administered by daily subcutaneous injection. In the highest-dose group (plasma level approximately 500 times the level achieved in humans using a transdermal system), reduced maternal body weights were observed.

**Pregnancy Category C:** Teratogenic studies were performed in pregnant rats and rabbits with scopolamine hydrobromide administered by daily intravenous injection. No adverse effects were recorded in the rats. In the rabbits, the highest dose (plasma level approximately 100 times the level achieved in humans using a transdermal system) of drug administered had a marginal embryotoxic effect. Transderm Scop should be used during pregnancy only if the anticipated benefit justifies the potential risk to the fetus.

**Nursing Mothers:** It is not known whether scopolamine is excreted in human milk. Because many drugs are excreted in human milk, caution should be exercised when Transderm Scop is administered to a nursing woman.

**Pediatric Use:** Children are particularly susceptible to the side effects of belladonna alkaloids. Transderm Scop should not be used in children because it is not known whether this system will release an amount of scopolamine that could produce serious adverse effects in children.

**ADVERSE REACTIONS:** The most frequent adverse reaction to Transderm Scop is dryness of the mouth. This occurs in about two thirds of the people. A less frequent adverse reaction is drowsiness, which occurs in less than one sixth of the people. Transient impairment of eye accommodation, including blurred vision and dilation of the pupils, is also observed.

The following adverse reactions have also been reported on infrequent occasions during the use of Transderm Scop: disorientation, memory disturbances, dizziness, restlessness, hallucinations, confusion, difficulty urinating, rashes and erythema, acute narrow-angle glaucoma, and dry, itchy, or red eyes.

**Drug Withdrawal:** Symptoms including dizziness, nausea, vomiting, headache, and disturbances of equilibrium have been reported in a few patients following discontinuation of the use of the Transderm Scop system. These symptoms have occurred most often in patients who have used the system for more than three days.

**OVERDOSEAGE:** Overdose with scopolamine may cause disorientation, memory disturbances, dizziness, restlessness, hallucinations, confusion, psychosis, convulsions, bronchospasm and respiratory depression, and muscular weakness. Should these symptoms occur, the Transderm Scop patch should be removed immediately, adequate hydration should be maintained, and appropriate symptomatic treatment initiated.

**CAUTION:** Federal law prohibits dispensing without prescription.

Distributed by  
Novartis Consumer Health, Inc.  
Summit, NJ 07901-1312

©1998

## OWN A PIECE OF AMERICAN HISTORY



Minimum  
purchase \$100

### ORIGINAL MINT CONDITION SAINT-GAUDENS DOUBLE EAGLE \$599.

When Teddy Roosevelt commissioned sculptor Augustus Saint-Gaudens to design the magnificent Double Eagle \$20 gold piece, little did he know that years later his cousin, Franklin, would have most of these beautiful works of art melted down. Today, surviving Double Eagles are as rare and revered as the American bald eagle itself.

### A SOLID INVESTMENT OPPORTUNITY

The Saint-Gaudens Double Eagle is an outstanding tangible asset investment for today's volatile economy. Now you can own one of these investment-grade, mint-condition coins for \$599.

CALL TODAY 1-800-464-2582, Ext. 784  
[www.blanchardonline.com](http://www.blanchardonline.com)

PRICE INCLUDES DELIVERY, DATES OUR CHOICE. PRICES AND AVAILABILITY SUBJECT TO CHANGE WITH NO NOTICE. LIMIT 1 PER CUSTOMER.

# BLANCHARD



## Explore New Worlds. Volunteer.

We're asking... Has anyone ever asked you to volunteer? Well, we are now — because you have the experience, know-how and wisdom to make a difference. No one is more qualified to help improve the lives of men, women, and children in your community. As an RSVP volunteer you can match your talents and interests to what needs to get done in your area. Spend part of your retirement doing what you do best — and see how you can bring out the best in someone else. Call the Retired and Senior Volunteer Program today.

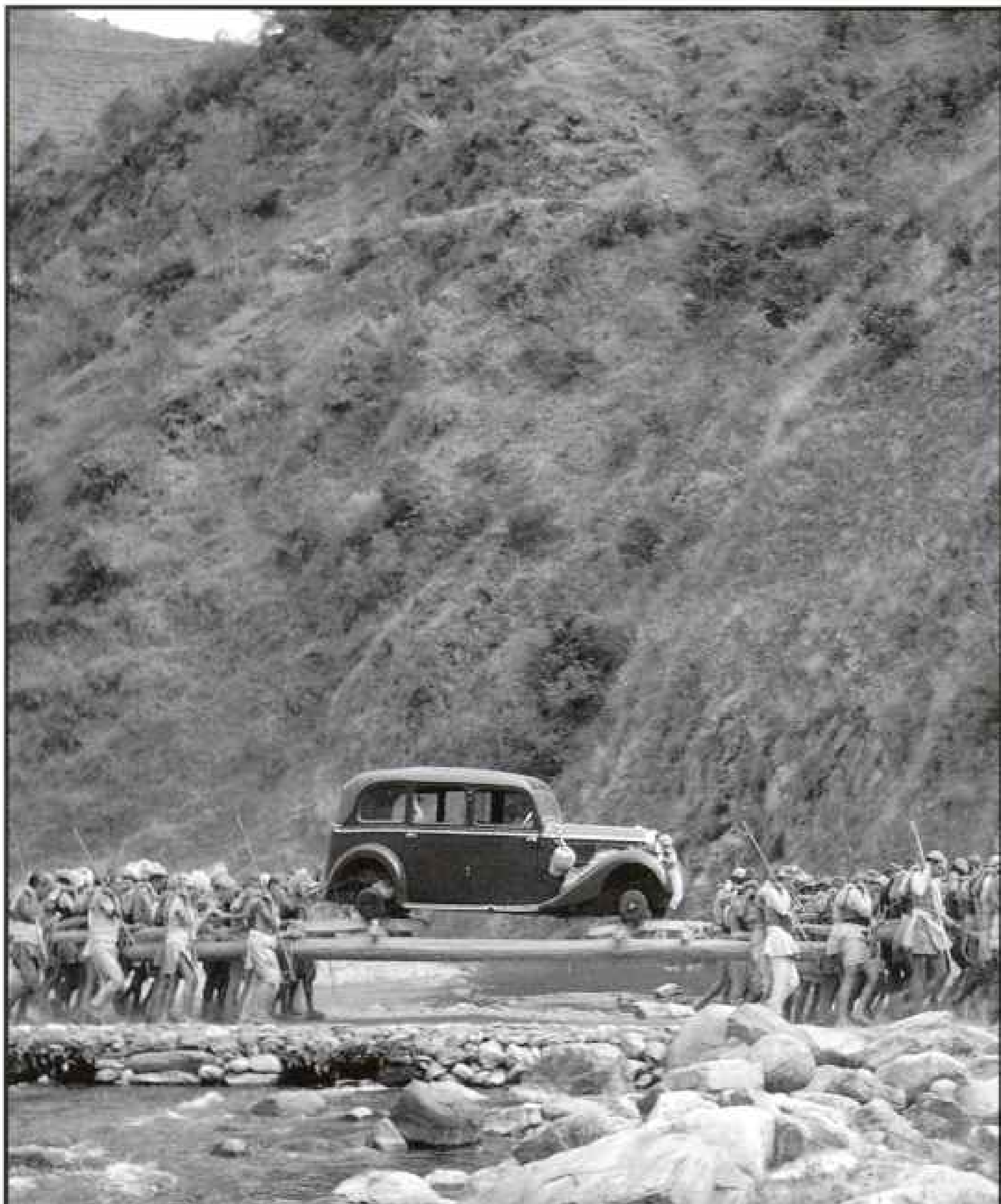


# RSVP

Call 1-800-424-8867

TDD: 1-800-833-3725

Serve Your Community. Join RSVP!



**Your Monday morning commute just got more interesting.**

Follow explorers like Peary, Goodall and Ballard on the most momentous expeditions of the 20th century. You'll hear the actual voices of these legendary travelers and share their defining moments. Listen to *Geographic Century*, part of the Radio Expeditions series, airing Mondays on National Public Radio's *Morning Edition*® with Bob Edwards. Visit [www.npr.org](http://www.npr.org) for a listing of NPR® stations. And enjoy your trip.



*Geographic Century* is made possible by Lands' End Direct Merchants.

# Earth Almanac

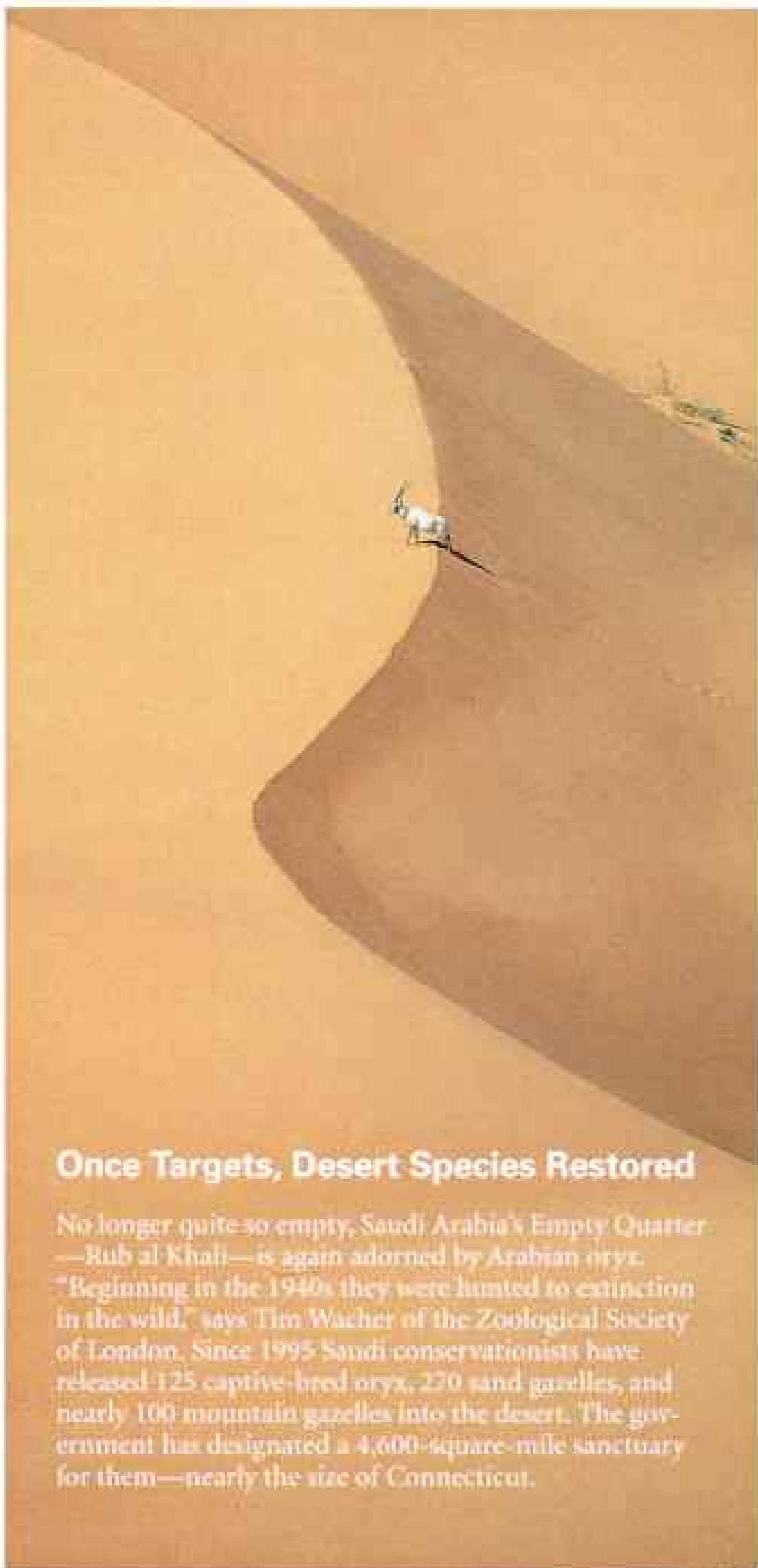


GRAHAM ROBERTSON

## Australia Aims at Seabird Bycatch

A wandering albatross met a sad end off eastern Australia, some 5,600 miles from its home on South Georgia Island near Antarctica. It was hooked and drowned on a baited longline intended to catch tuna. Longliners ply most oceans and in Antarctic waters set lines as long as 80 miles with thousands of hooks. An estimated 40,000 albatrosses were hooked annually in southern oceans in the early 1990s. As a result, two species are endangered, and the wandering albatross is considered vulnerable.

Australia is developing a plan to reduce the carnage. Fishermen may be required to set their hooks at night and use thawed bait and extra weights so the lines will sink quickly. Fishing boats now must fly bird-scaring streamers.



## Once Targets, Desert Species Restored

No longer quite so empty, Saudi Arabia's Empty Quarter—Rub al Khali—is again adorned by Arabian oryx. "Beginning in the 1940s they were hunted to extinction in the wild," says Tim Wacher of the Zoological Society of London. Since 1995 Saudi conservationists have released 125 captive-bred oryx, 270 sand gazelles, and nearly 100 mountain gazelles into the desert. The government has designated a 4,600-square-mile sanctuary for them—nearly the size of Connecticut.

TIM WACHER





Mercury Mountaineer. Imagine yourself in a Mercury



full-time All-Wheel Drive • leather seating surfaces • Securilock™ passive anti-theft system • running boards • 800 446-3888 • [www.mercuryvehicles.com](http://www.mercuryvehicles.com)



DAVID PFENNIG

## Animal Cannibals: A Risky Diet

Why is cannibalism in nature so rare? Animals that eat their own may bite off fatal mouthfuls, ecologist David Pfennig and his University of North Carolina team have found. They raised four groups of cannibalistic tiger salamander larvae and fed

them different diets. Some ate salamanders of a different species, either healthy larvae or bacteria-laden ones. Other tigers ate larvae of their own species, either healthy—like this one—or diseased. All the groups thrived except the one that ate its sick brethren. Nearly half that group died from bacteria carried by its own kind.

## Tale of a Tongue

Gray whales often feed with open mouths in cold water. But they lose little body heat through their tongues, researchers John Heyning and James Mead found. The tongue's specialized blood vessels act as heat exchangers. Warmth from the blood in arteries is captured by surrounding veins and carried back into the body before it is lost.



ART BY CLARET PARKER



BARBARA STON, BALTIMORE SUN

## Farmers Flood Fields to Create Wetlands

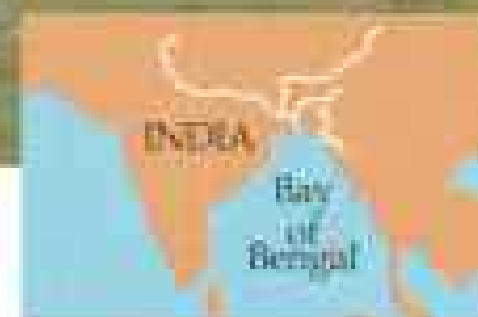
People like Bruce Nichols once helped farmers drain swamps to grow crops. Now they're doing the opposite. A U.S. Department of Agriculture conservationist, Nichols (above) wades through part of a 163-acre wetland he designed for a Maryland farm. He's worked with some 30 farmers to build about a thousand acres of swamp-land; federal funds compensate most landowners.

"With the grain surplus and the present economic turmoil in agriculture, farmers are eager to do this with marginal lands. It will attract waterfowl," Nichols says. Such small efforts help slow the nationwide loss of an estimated 120,000 acres of wetlands a year.



Ganges River Dolphin (*Platanista gangetica*) Size: Length, 2 - 2.6 m Weight: 80 - 90 kg Habitat: Ganges, Brahmaputra, Meghna, Karnaphuli and Sangu Rivers and their tributaries on the Indian subcontinent  
Surviving number: Estimated at fewer than 2,000

Photographed by Roland Seitre



## WILDLIFE AS CANON SEES IT

A lone Ganges river dolphin breaks the surface for a breath of air. This dolphin's lensless eyes distinguish only between light and dark, but using echolocation it navigates murky, often turbulent rivers, swimming slowly yet rarely stopping. This sonar also detects fish, which it seizes with a snap of its long beak. As a side-swimmer, the dolphin can move easily in shallow water; while its flipper

undulates freely from side to side, one fin tip grazes the bottom for orientation. The Ganges river dolphin is threatened by pollution, gill nets, poaching, dams and degradation of riverine habitat. As a global corporation committed to social and environmental concerns, we join in worldwide efforts to promote greater awareness of endangered species for the benefit of future generations.

*Digital Camera*  
A marriage of Canon's expertise in cameras and digital image-processing, the PowerShot Pro70 offers pro-level quality with features such as a 1.68-million-pixel CCD sensor and 2.5x power-zoom lens.



Watch "NATURE" on PBS. The program is funded, in part, by Canon U.S.A., Inc.

**Canon**

## Used Improperly, Anti-Bear Spray May Backfire

Backcountry hikers in Alaska often carry canisters of red pepper spray as a defense against an attacking bear. Sprayed in the bear's eyes or nose, the product may deter a charge. But U.S. Geological Survey biologist Tom Smith has made a startling discovery. If used improperly—on tents, food containers, clothing, or other objects—the spray's residue could actually *attract* bears.

"I sprayed it onto a beach and then watched a sow and her cubs rolling in the gravel, just having a heck of a time," Smith says. Bears can pick up the spray's scent from a quarter of a mile away, he adds. Spraying a campsite could create



ART BY BRIAN KJHGH

danger for the next people to use it. The residue appears to be a stable compound that lingers for weeks. Smith thinks bears' natural curiosity about strange scents explains the attraction.

## Help for Costa Rica's Vulnerable Crocs

Shot four times by poachers, this American crocodile—guarded in Costa Rica—survived. One of a few hundred on the Rio Grande de Tárcoles, the animal was abandoned by its captors when they were chased by conservationists. Later photographer David Rose drove it to the Jaco crocodile preserve for treatment. Last year the preserve and other groups released 400 captive-raised baby crocs into the wild.



DAVID ROSE



HARTMUT SCHWARZBACH, STELL PICTURES

## Exotic Weed Strangling Lake Victoria

All choked up: A boat at the Kenyan port of Kisumu is marooned by an infestation of water hyacinths. Native to Latin America, the weed reached Africa by the late 1800s, possibly imported by gardeners. In rafts as thick as four feet, the plants can double in area in a matter of days and plague many important ports. The cost in lost fisheries and hydro power as well as damaged water supplies may total 150 million dollars a year. Although some scientists want to use chemicals on the plants, Geoffrey Howard of the World Conservation Union says other aquatic life would also be affected. Two species of South American weevils were turned loose on the lake nearly three years ago to eat the hyacinths. "The effects are beginning to show, but it may take years to achieve the desired level of control," Howard says. Meanwhile the hyacinths are also harvested mechanically.

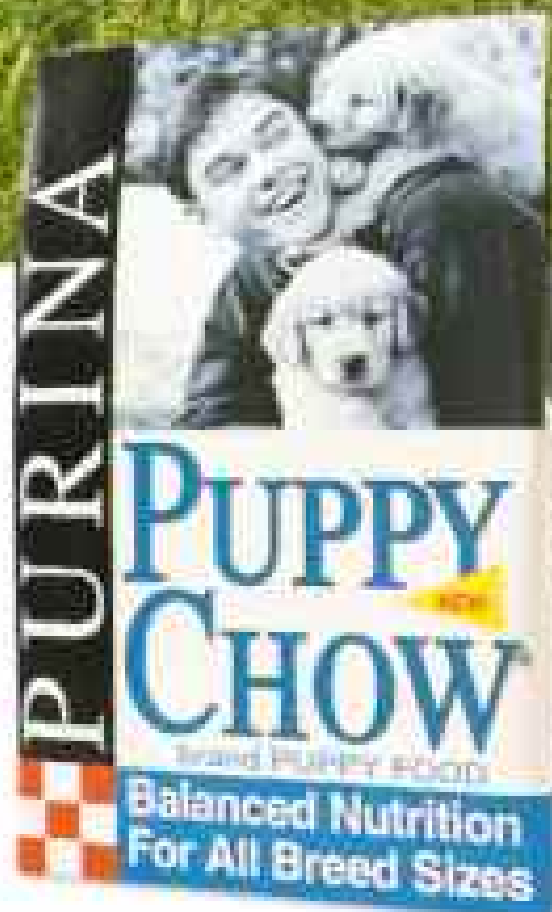
TEXT BY JOHN L. ELIOT



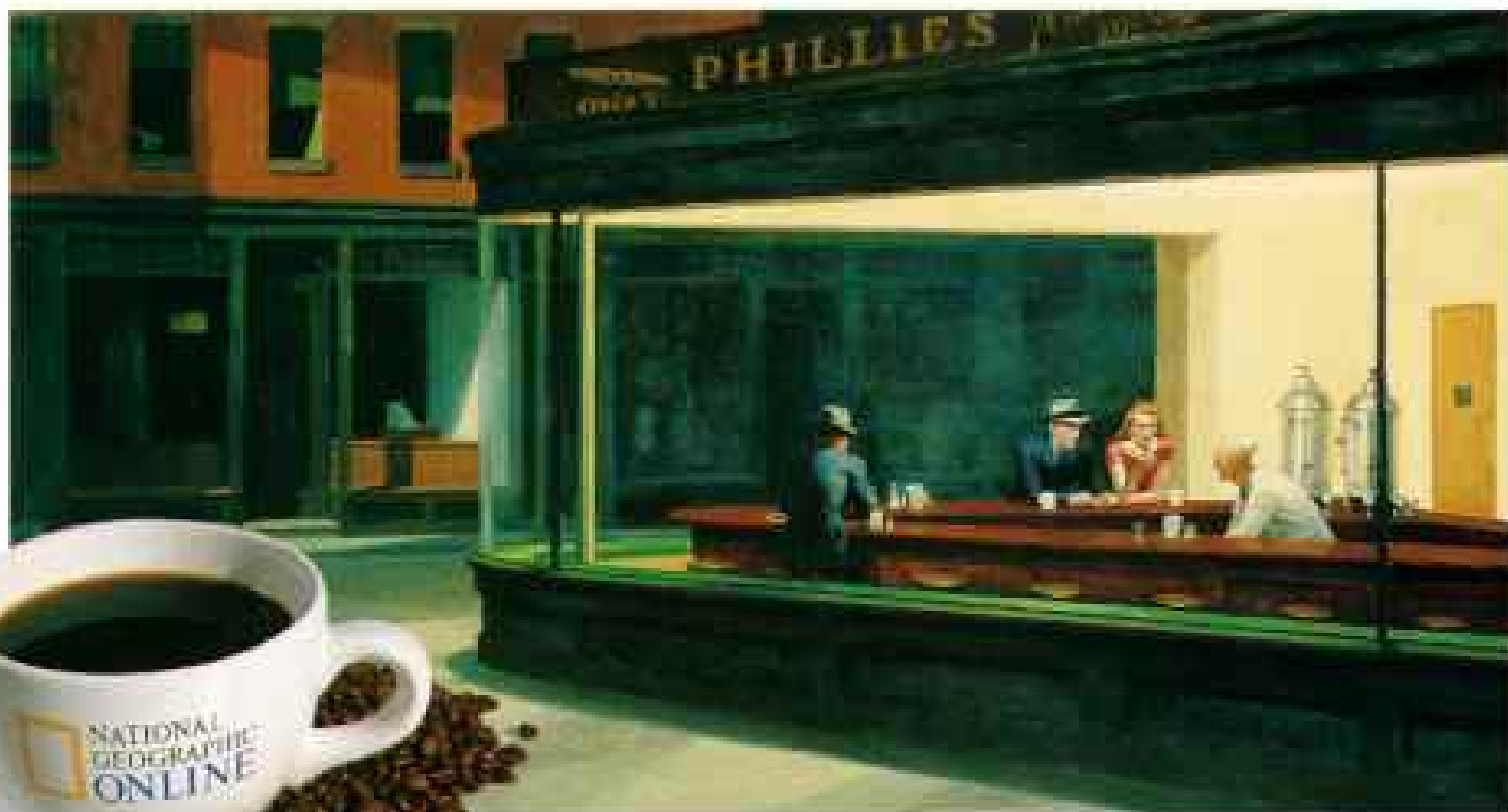
It's gotta be the **Puppy Chow**®

Purina® has reformulated Puppy Chow puppy food and there's no better way to get your puppy off to a great start. It's highly digestible, so your puppy's system takes in more of what it needs to build strong bones and muscles—and help support a healthy immune system. New Purina Puppy Chow. The nutrition he needs now for a long, strong and exceptional life. Contact us at 1-800-817-4787 or at [www.puppychow.com](http://www.puppychow.com) for a FREE Incredible Puppy Care Kit.

**INCREDIBLE PUPPY FOOD.  
INCREDIBLE PUPPIES.™**



# Interactive



"NIGHTHAWK" BY EDWARD HOPPER, ART INSTITUTE OF CHICAGO

■ ONLINE

## Coffee: A Cyber Serving

Do you drink much coffee? In the 1700s the French philosopher Voltaire reportedly downed 50 cups a day. Legend has it that when others denounced the brew as a poison, Voltaire retorted, "I have been poisoning myself for more than 80 years, and I am not yet dead." Nor is the debate over coffee's effects or how to brew a perfect cup. Get a sip of this hot topic at [www.nationalgeographic.com/coffee](http://www.nationalgeographic.com/coffee).

■ Find field dispatches from Tom Allen, author of "Return to the Battle of Midway" in this issue, along with images, interviews, and a forum at . . . /midway.

■ Discuss the "blues highway," the route that took many black musicians from the Mississippi Delta to Chicago and great fame at . . . /ngm/9904.

■ FOR INFORMATION

E-mail for Interactive: [ngi@ngs.org](mailto:ngi@ngs.org)

E-mail for Member Services: [ngsline@customersvc.com](mailto:ngsline@customersvc.com)

CD-ROMs: In the U.S. and Canada call 1-800-881-8919; elsewhere call 1-916-939-1004.

■ ONLINE

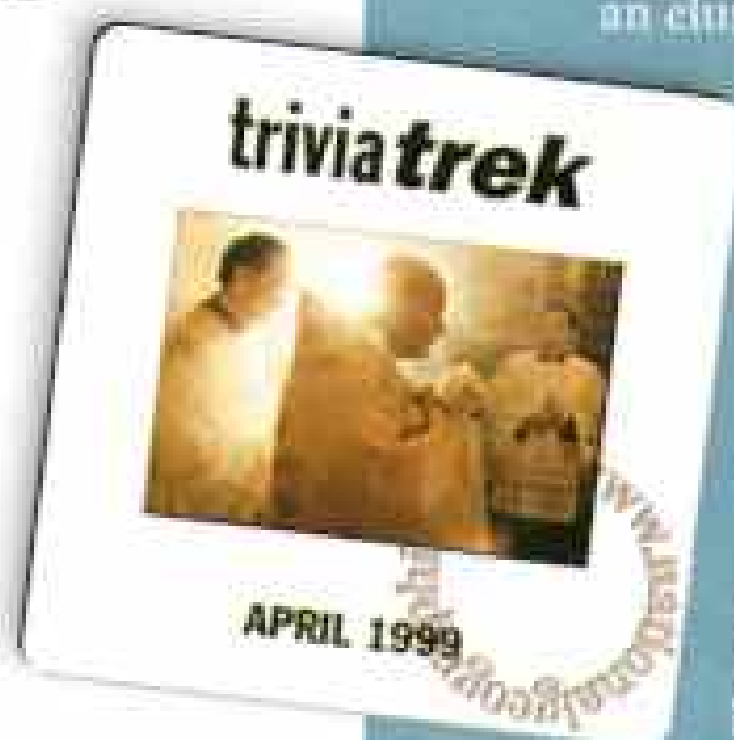
## Calling All Digital Detectives

Welcome to Trivia Trek! Each month we'll point you toward an elusive fact on our

website. Be one of the first people to find it, and we'll post your name at [www.nationalgeographic.com/trek](http://www.nationalgeographic.com/trek).

Your first challenge is to find out which NATIONAL GEOGRAPHIC photog-

rapher was startled by the following greeting from Pope John Paul II: "So you're the one who's trying to do things differently around here. Well, God bless you."



# Renaissance Cruises

Great Places. Great Times.  
...we'll take you there.



MEDITERRANEAN AND  
COASTAL SPAIN  
CRUISE TOUR VACATIONS  
INCLUDE:

10-day Mediterranean and Coastal Spain  
cruise in an ocean view cabin

## BONUS!

BUY CATEGORY A, B, C OR D  
AND GET AN EXTRA HOTEL  
NIGHT IN LISBON AND  
BARCELONA FREE!

plus:

**FREE**

Round-trip air

**FREE**

Deluxe hotel stay in Lisbon

**FREE**

Deluxe hotel stay in Barcelona

INTRODUCING THE BRAND NEW R2

## MEDITERRANEAN AND COASTAL SPAIN

14-DAY CRUISE TOUR VACATIONS

EXCLUSIVE OFFER! SAVE \$4,600 PER CABIN!

from  
only **\$2,999** per  
guest

EXCLUSIVE 1999 INAUGURAL  
SEASON SAIL DATES

August 9 • August 19 • August 29  
September 8 • September 18 • September 28

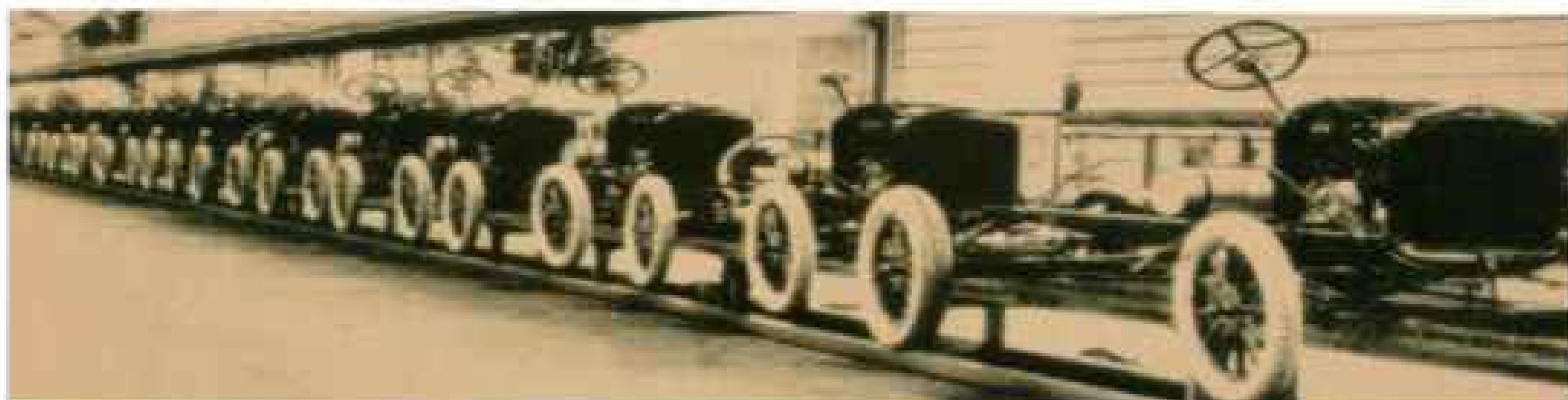
**GET THE LOWEST PRICES  
BUY DIRECT AND SAVE!**

CALL  
TOLL  
FREE **1.800.789.4687**

[www.RenaissanceCruises.com](http://www.RenaissanceCruises.com)

This offer requires \$2000. All prices are per guest, based on double occupancy. We subject to availability and require full payment at time of purchase. Government fees and charges are \$240 per guest additional. Offer includes round-trip economy air. Choice of cabin and fare category (B or D) is at the sole discretion of Renaissance Cruises. All prices subject to the terms and conditions of Renaissance Cruises' Privacy/Guests' Ship Registry Terms.

Henry Ford dreamed of "making the desirable affordable."



Obviously, it's a recurring dream.  
Introducing the \$17,995\* Ford Taurus.

Every innovation helps lower costs, for us and for you. That's why the lowest price ever on today's Taurus is \$1000 less than last year for the same equipment.\*\* And that same spirit of innovation has made Ford Taurus **the only car in its class to earn a five-star ★★★★★ government front crash test rating!** More affordable. More desirable. Designed for safety.

This could be the car Henry Ford dreamed of.

Ford Taurus

*Second Generation airbags†* *3.0-liter V-6*  
*Power windows. Air conditioning. All standard.*



1-800-358-FORD or  
[www.fordvehicles.com](http://www.fordvehicles.com)

\*2000 Taurus LX MSRP. Tax, title extra. \*\*Based on MSRP of '99 Taurus LX vs. MSRP of '98 Taurus LX. (Driver and passenger front crash test. Government database only useful in comparing vehicles within 500 pounds. Class is medium cars starting under \$20,000. †Always wear your safety belt and secure children in the rear seat.)



# On Assignment



JERRI VONETZ

## ■ VERNAL POOLS

### A Photographer's Rite of Spring

The pool was shallow, but the problem was deep for photographer George Grall.

"I'd be shooting in one foot of water over two feet of mud. I had to figure how to photograph the animals without scaring them off, and also without stirring up the muck and ruining the picture."

The solution? He launched a stealth attack via air mattress (above). "You have to be creative," says the photographer, who once fashioned a floating camera housing from a plastic-foam beer cooler.

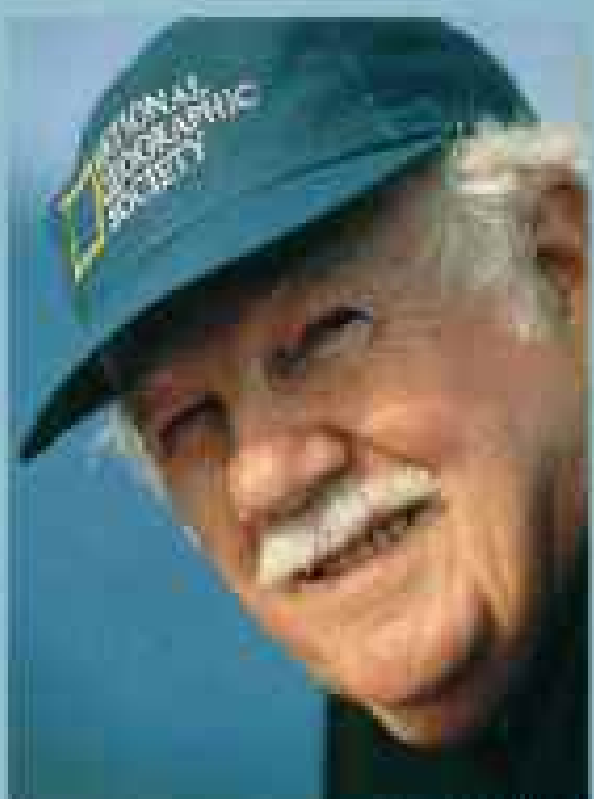
George, staff photographer at the National Aquarium in Baltimore, Maryland, used scientific papers, local word of mouth, and his own outdoor experience to be in the right place at the right time for this story. That often meant the middle of the night in the middle of nowhere—in the cold and rain. "And still sometimes there'd be nothing to shoot." So he learned to chase the spring. If he missed the salamanders' egg laying in the Piedmont, he might catch it slightly later when warmer weather reached the mountains. But he had to act quickly. Seasons may move slowly, but a salamander, says George, "never gives you a second chance."

## ■ BATTLE OF MIDWAY

### Winning Ways at Sea

Too young to fight in World War II, author Tom Allen still kept the home front safe in Connecticut. "I was a junior air-raid warden," he says. "I learned the silhouettes of all the German planes, just in case any bombers showed up over Bridgeport."

Still fascinated by the war, Tom spent a month on board the *Laney Chouest* to document



TIMOTHY DOWNEY

the search for the *Yorktown*, sunk during the Battle of Midway. "We had two crews: a Navy and a civilian one," says Tom, himself a Navy veteran. "Everyone worked well together."

But playing well together was another matter. "I beat Bob Ballard at hearts once; he never forgave me," says Tom. A member of the crew provides clarification: "Tom didn't beat just Bob Ballard at hearts. He beat everyone on the ship!"

NATIONAL GEOGRAPHIC  
*Geoguide*



## A Close Look at the Galápagos

■ Examine the map on page 10. What is the latitude of the Galápagos? How is their location reflected in the name of the country that owns the islands?

■ To understand how the Galápagos “poke” through the ocean in the image on pages 10-11, you can make a model of the island group. Cover the bottom of a baking dish with Play-Doh, then pinch up areas to simulate volcanoes. Slowly flood the pan with water tinted blue with food coloring until just the peaks remain above water, as islands.

■ As tourism brings visitors—and development—to the Galápagos, the threat to the environment grows. What can be done to satisfy the needs of visitors and local people and protect the

environment at the same time?

■ Introduced species—guava trees, pigs, and goats—have severely affected native plant and animal populations in the Galápagos. Have any introduced species, such as starlings or kudzu, caused problems where you live?

Sleek divers that feed on fish, blue-footed boobies touch bills during courtship rituals. Stephen Earsom (below) of the Charles Darwin Research Station seeks new ways to determine sex in young tortoises, raised for release in the wild.



BOTH BY STUART FRANKLIN

You just read a story about the

# Galápagos Islands.

But it's not the only island adventure around.



## Galápagos Islands

More than 90,000 articles, pictures, videos, interactivities, sounds, and 360° views – all on either DVD or CD.

It's the best-selling **Microsoft® Encarta® Reference Suite 99**,

with more content than ever before. Designed for the world you live in today.



You'll even be surprised at what you stumble across. Learn more at [encarta.msn.com](http://encarta.msn.com)



Includes:  
**Encarta Encyclopedia Deluxe 99**  
**Encarta Virtual Globe 99**  
**Microsoft Bookshelf® 99**

**Microsoft**

Where do you want to go today?™

© 1999 Microsoft Corporation. All rights reserved. Microsoft, Bookshelf, Encarta, and Where do you want to go today?™ are either registered trademarks or trademarks of Microsoft Corporation in the United States and/or other countries.