VOL. 185, NO. 4 APRIL 1994

NATIONAL GEOGRAPHIC

The Everglades
Dying for Help

NATIONAL GEOGRAPHIC

APRIL 1994

COVER: Newborn alligators—not yet good swimmers—find a safe perch atop their mother's crown in the Everglades. Photograph by Chris Johns.

Cover printed on recycled-content paper.

The Everglades:

Everglades National Park has been dying for decades, its waters dirtied and diverted by development upstream. Task forces, technical reports, and talk

Dying for Help

have thus far failed to fix the problem. Maybe this land—rattlesnakes and all—is not so lovable; while our heads say ecosystem and biodiversity, our hearts still say swamp.

The "shooting gallery," an illegal dump on the park's edge where gun lovers let loose, is now a target of the National Park Service. It is acquiring 107,600 acres of wetland, including this tract, to help restore the park's natural flow of freshwater.

By ALAN MAIRSON
NATIONAL GEOGRAPHIC EDITORIAL STAFF

Photographs by CHRIS JOHNS

SOMEWHERE NEAR HELLS BAY, John Buckley stops paddling his canoe. Hot and puzzled, he grabs his water bottle, takes a couple of warm swigs, then stares intently at his map and compass. John and I are on a four-day trip to explore the backcountry of Florida's Everglades National Park, and after carefully reviewing all our data, we confidently conclude that we don't have a clue where we are. "Let's try this one," says John from the aft seat as we drift past another watery alleyway, one of thousands that twist through this labyrinth of mangrove trees. I reach out with my paddle and pull a few strokes, hard, while John steers us into the narrow channel. He keeps hoping we'll hit open water, but we dead-end—again.

This cul-de-sac looks like all the others we've seen—a dense green wall, its baseboard a web of spindly prop roots that grip the dark, placid water. John surveys the situation and says, "Let's go back and try again." We head north, blundering around the mangrove maze like a pair of laboratory mice.

We turn a corner and see a towering buttonwood tree, its branches draped with a few scraggly gray locks of Spanish moss. "That'd be a great landmark," says John, "if I had any idea where we were."

Luckily John and I found our way back to familiar waters. But when it comes to the Everglades, the people of South Florida haven't been so fortunate. For years they have groped for a coherent, consistent approach to the area: Is it a swamp to be drained? A mosquito-infested wilderness to avoid? A watershed to tap? An ecosystem to cherish and preserve?

Literally, a "glade" is a clearing in the forest, and more than a century ago someone evidently saw South Florida's sea of saw grass bordered by mangrove trees and gave this region its name. Back then the Everglades was a broad sheet of moving water—50 miles wide and six inches deep—that flowed unimpeded over a huge, porous bed of limestone shaped like the blade of a gardener's trowel.

The blade's handle began in the middle of the Florida peninsula, near Orlando, and ran south, through broad marshes that once bordered the Kissimmee River, to Lake Okeechobee, the Everglades' source. The blade itself began on Okeechobee's southern shore, where the water spilled over and spread out in a gentle southwesterly arc, feeding aquifers beneath the coastal ridge to the east and flowing freely over the surface to Florida Bay and the Gulf of Mexico.

But for more than 110 years, people have monkeyed with that system, building canals, levees, and water impoundments to satisfy human needs. The results for Everglades National Park, which is situated on the tail end of this watershed, have been devastating: The wading bird population has crashed, Florida Bay—which constitutes one-third of the park—is dying, and animals whose ranges extend beyond the park have lost critical habitat. All of which only compounds the problems faced by the 14 species of wildlife in the park that are either threatened or endangered, including the American crocodile, southern bald eagle, and loggerhead turtle.

This environmental erosion, though, is yesterday's news. Ever since the park was established in 1947, the press has bemoaned its sorry state. A sampler: "Last Chance for the Great Swamp" (1992), "Everglades National Park: An Imperiled Wetland" (1983), "Everglades Not Everlasting: The Human Threat" (1974), "Last Chance to Save the Everglades" (1969), "The Heavy Stench of

Death Grows Steadily Over Glades" (1967).

Even the original version of Marjory Stoneman Douglas's classic book, *The Everglades: River of Grass*, concludes with a chapter titled "The Eleventh Hour"—a warning that the environmental witching hour was upon us. The year? 1947.

Why has this park, after hemorrhaging in full view of the public for more than 45 years, failed to inspire the American people to stop its destruction?

"I suspect some of it is wrapped up in the American image of national parks," says Bruce Babbitt, Secretary of the Interior. "Until recently the image has been large mountains and glaciers . . . [but] there aren't any glaciers in the Everglades, there aren't any grizzly bears, there aren't any 500-foot waterfalls. We've been a little slow in expanding our image of parks to include equally important but more subtle kinds of ecosystems."

Or as Patti Webster, an environmental activist, puts it, "Getting people interested in saving the manatee isn't a problem, but getting them to love a swamp is a real challenge."

■ "In Florida the roseate spoonbill is making its last stand in the continental U. S.," a congressional committee reported in 1932. To protect spoonbills—like this one feeding with an egret—and a dazzling variety of wildlife, a corner of the Everglades was set aside as a national park in 1947.

THE WEEK BEFORE I LEFT for Everglades National Park, friends and colleagues tried to prepare me. "It's a *subtle* park," they said, "an *interesting* place." They told me about the *mysterious* mangroves, the *unique* saw grass prairies that cover about one-third of the park, and the *quiet grace* of Florida Bay. Although the park has lots of *character* and *personality*, its beauty can take a while to appreciate, they said. So don't jump to conclusions. Give the place a chance.

I felt as if I were embarking on a blind date with a woman who didn't get out very often.

When I arrived, I realized why: In the sisterhood of national parks, Everglades is the big,

The canoes haven't changed—Glen Simmons and Don Edwards built them using Seminole Indian designs—but the scenery has. "I used to see a million birds in one look," says Glen, a lifelong Everglades resident. "Blackened the skies for hours."

shy girl who rarely makes a dramatic first impression. At 1.5 million acres, she's the second largest national park in the lower 48—yet she isn't among the nation's ten most visited parks. She's marshy, often buggy, and not very accessible.

Without any dramatic outcrops, some areas of the park appear practically two dimensional. For instance, standing atop the observation tower in the Shark River Slough, I see a vast blanket of brown saw grass dappled with bayheads—tree islands that grow in depressions in the park's limestone bed. Yet the trees are so far away they don't give the scenery any depth or dimension. On this cloudless day the earth and sky occupy the same vertical plane—a borderless mural, half brown, half blue.

Which is certainly *subtle*—though not the stuff of most park rangers' dreams.

"We call it a revolving-door park," says ranger Chuck Noll. "There are very few people who get into the Park Service with the ambition of working in the Everglades. Everybody wants to work at the Grand Canyon and Yellowstone and Yosemite, those big parks, the real popular parks."

Chuck and his wife, Jenny, moved here from Pennsylvania in 1991. "It's a real tough place to live in the summer," says Chuck. "The temperature gets up to 95° with 100 percent humidity, and there are thunder and lightning storms like I've never imagined, and every day the mosquitoes are so thick you can't breathe. It's miserable."

Even the dry season can be rough going. My visit began in early February, and unseasonably heavy rains have kept the mosquitoes active. This becomes uncomfortably obvious one day when I hike along Snake Bight Trail, a tree-lined path that was built by digging a long, narrow ditch and piling up the dirt alongside. The trail's shoulder slopes into the ditch, a water-filled borrow pit where mosquitoes love to breed.

And on this hot, sticky day they're out in force, jabbing me through the long-sleeve jersey that's pasted to my body with sweat. I swat them, speckling my yellow sleeves with my own blood. Like an idiot, I forgot to pack

---

The work of Pacific Northwest native CHRIS JOHNS has been seen in NATIONAL GEOGRAPHIC since 1984. His most recent assignment, "The Hard Ride of Route 93," appeared in the December 1992 issue. He lives in Virginia's Blue Ridge Mountains with his wife and two daughters.

What's wrong with the Everglades?

Though treated like a swamp, the Everglades was once a river, 50 miles wide and six inches deep. A century ago it flowed unimpeded from Lake Okeechobee to Florida Bay, but as farmers and developers moved in, the Everglades has been polluted,

Algae cloud the water near popular fishing and diving spots along the Florida Keys.

paved over, and partitioned. Engineers chopped up the river with an elaborate system of canals, dikes, and pipes to provide South Florida with freshwater and flood control.

The park, which sits at the bottom of this plumbing system, receives much of its water through guillotine-like gates along the Tamiami Trail. The problem is, these water deliveries—their quality, quantity, distribution, and timing—don't adequately mimic the Everglades' natural rhythms, so the ecosystem has suffered. Even the shape of the park hints at its sad condition; on a map it looks like a bird—its neck stretched to the northwest, its wings raised in flight away from Miami.

ENDANGERED WILDLIFE

SNAIL KITE

Draining in the Everglades killed this bird's main source of food—apple snails. Fewer than 900 snail kites remain in Florida, the bird's only U. S. habitat.

BALD EAGLE

After eating fish laced with DDT, eagles laid eggs with abnormally thin shells that collapsed before the embryos matured. A ban on DDT has helped stabilize eagle populations.

AMERICAN CROCODILE

Three breeding populations remain in the U. S.—in the park, on north Key Largo, and beside a nuclear power plant (see pages 14-15).

WOOD STORK

One of its nesting sites was hit hard by a big freeze in 1989—then hit again by Hurricane Andrew in 1992. Last year only 25 breeding pairs nested in the park, compared with 4,000 in the 1930s.

RED-COCKADED WOODPECKER

Before the park opened, loggers cut down this bird's nesting sites—old-growth pine trees. Damage done by Hurricane Andrew has delayed plans to reintroduce the species.

■ Plans to give the fog-laced park more water would periodically dry out areas upstream where Miccosukee Indians give airboat rides. Less water worries tribe members like Kenny Cypress, who needs the tourist dollars to support his son, Kent.

insect repellent, but I'm well prepared compared with a middle-aged couple I saw along the way—he in shorts, she in a sleeveless blouse. They walk a few steps, then suddenly stop, twist, and smack themselves repeatedly like a pair of masochistic dancers.

All this during the dry season, from November to June, when the bugs supposedly subside and the tourists arrive. But missing the mosquitoes is no guarantee of a great vacation, according to Gary Sabbag, former general manager of the Flamingo Lodge, Marina and Outpost Resort. "If people go to Orlando first and visit Universal Studios and Disney World, they get excitement, fireworks, lasers. Then when they come down here, it can be very boring to them."

Comparing an amusement park with a national park may make as much sense as comparing a discotheque with a museum, but tourists seem to do exactly that. The park attracted 1.8 million visitors—an all-time high—in 1972, which happened to be Disney's first full year of operation. Since then, annual attendance hasn't topped 1.4 million.

"We call it the Mickey Curtain," says Sabbag. "People go to Orlando and think they've seen the spectacular stuff in Florida."

VISITORS to Everglades National Park do best to forget the spectacular and focus on the sublime—the more than 600 kinds of animals (not including the 60 species of mosquitoes and scores of critters that have never been counted) and 900 plant species that are found in a variety of habitats, including the mangrove forests, the dry pineland ridge (elevation seven feet), the broad, shallow sloughs that carry freshwater through the park, and several types of tree islands, such as bayheads and tropical hardwood hammocks. For all this natural variety, the park has been designated an international biosphere reserve and a United Nations world heritage site.

Buttonwoods and poisonwoods, rat snakes and pygmy rattlers, black-whiskered vireos and red-shouldered hawks—they're all here to see if you slow down and seek them out.

"The orchids were my first love," says Roger Hammer, a Dade County naturalist, when we go exploring one day. "When I mention the word 'orchid' on my wildflower walks, people suddenly perk up. There's a mystique about them I just can't explain."

Roger showed me one of his loves—a spectacular cowhorn orchid with yellow, cigar-shaped stems that looked succulent enough to eat. Its location, though, must remain a secret. "Orchid collectors," explains Roger. "They don't understand that collecting one is a crime against nature"—and a violation of park regulations.

We hop in my car, drive down the main park road, then stop beside a double dome of cypress trees. We step off the pavement and

To get a better grip on crocodile behavior, wildlife biologist Joe Wasilewski studies a five-year-old beside the Turkey Point nuclear power plant. Unlike their alligator cousins, American crocodiles are endangered, but they have bred successfully in canals that carry water to cool nuclear reactors adjacent to a 25,000-acre wildlife sanctuary. "Nobody bothers them," says Joe, "except us scientists."

slog into the warm, calf-deep water. Our sloshing flushes out a roost of wood storks that rise in unison, their long necks extended, their black-fingered wings beating like tom-toms. In the bare branches above us, a barred owl hoots. Over here there's a palm warbler; over there a yellow-bellied sapsucker. And clinging to the bark of a cypress tree, two lizards clutch in a carnal embrace.

Twenty feet away, cars and campers whoosh by to the tourist village of Flamingo.

GETTING AWAY to the Everglades had a whole different meaning in the mid-1800s. The Seminole Indians tried to escape here when the U. S. Army came to capture them and force them out West. A member of one Army expedition, intrigued by the Everglades' interior, wrote: "No country that I have ever heard of bears any resemblance to it; it seems like a vast sea filled with grass and green trees, and expressly intended as a retreat for the rascally Indian, from which the white man would never seek to drive them."

Politicians didn't love the place either. In the 1840s, Florida's first state legislature called the Everglades "wholly valueless" and appealed to Congress for help in draining the swamp. The digging and dredging didn't begin in earnest until 1905, when newly elected Governor Napoleon Bonaparte Broward began fulfilling his campaign promise to build the "Empire of the Everglades."

By the 1920s the public was snapping up land in Florida as fast as it was offered. Miami was booming. Ernest Coe, a 59-year-old landscape architect from New England, moved there to set up a business—but got sidetracked by the Everglades.

■ Ruthlessly hunted a hundred years ago, great egrets were shot for breeding plumes sold to adorn ladies' hats. Bans on egret hunting and on transporting feathers helped stop the slaughter. So did a change in women's fashions.

Where others saw land ripe for development, Coe saw a geographically peculiar and biologically diverse treasure. The idea of creating a national park in the Everglades had been circulating even before Governor Broward's reign, but Coe took action.

He helped establish the Everglades National Park Association and became its tireless, stubborn, single-minded director. A tall, thin man in a white seersucker suit, Coe became a missionary for the park project, spreading his gospel to anyone who would listen.

He envisioned a national park extending from the coral reefs off Key Largo north to the Big Cypress Swamp—more than two million acres that would have made Everglades the largest national park in the lower 48.

Coe's ambitious plan, which antagonized too many people, wasn't implemented, but it proved to be prophetic. When President Harry Truman dedicated Everglades National Park in 1947, the coral reefs off Key Largo were excluded; 13 years later Florida made the area a state park. Big Cypress was left unprotected too, until 1974 when almost half the swamp was set aside as a national preserve.

Ernest Coe had spent 22 years of his life—and all of his money—to realize his dream of establishing Everglades National Park. The effort left him, at the age of 81, a financially broken man.

"Little did I consider that I would ever get into my present fix financially and wouldn't of, other than that from this devotion to the national park," Coe wrote to a friend in 1948. "Anyway, it will be here long after I am forgotten and that's something."

WHAT REMAINS would break Ernest Coe's heart. Since the late 1940s, politicians have pushed the transformation of the Everglades into high gear. They instructed the Army Corps of Engineers to dredge, dike, and divert to provide flood control, create and irrigate farmland, dry out land for new homes and businesses, and supply freshwater to the millions of newcomers to South Florida.*

Today more than 1,400 miles of canals and levees crisscross the region, constricting the top three-quarters of this water body like a concrete-and-steel corset.

"South Florida was not meant to be lived in by so many millions of people," says Nathaniel Reed, a Hobe Sound businessman and environmentalist. "Without flood control, mosquito control, and air-conditioning they couldn't possibly live here. Their demands are straining the entire ecosystem."

More than 50 percent of the Everglades' wetlands have disappeared, destroying wild habitat and disrupting the natural flow of water into the park.

"Think about how the marsh system used to

*See "South Florida Water: Paying the Price," by Nicole Duplaix, NATIONAL GEOGRAPHIC, July 1990.

work," says Bob Johnson, a hydrologist for the park. "It would take a year for the rainfall around Lake Okeechobee to reach the Tamiami Trail. Rain would produce a very gradual rise in water levels and then a long persistent flow well into the dry season."

Now the water supply is controlled by the Corps and the South Florida Water Management District, which, thus far, have been unable to mimic the park's historic hydrologic patterns. That's been especially bad for the wading birds.

"We had individual colonies in the thirties that had over a hundred thousand birds in them nesting," says John Ogden, the park's veteran biologist. "A big colony in the park now has two or three thousand birds."

Years ago, wading birds started nesting earlier in the dry season, in November or December. That's when water along the wetlands' shallow edges would recede, leaving behind pools densely concentrated with fish that the wading birds would feed to their young.

But draining the Everglades' shallow periphery has forced the birds to postpone nesting until the deeper areas dry down in February and March. This delay means that some years the birds are still trying to feed their fledglings when the summer rains begin. When the water levels rise, the fish disperse, leaving the chicks hungry—or dead.

"I sometimes despair," Ogden tells me. "I watch visitors at Anhinga Trail or down at Flamingo, and they're totally thrilled when they see one heron or one alligator. Are they satisfied? It looks like they are. Does that mean that we're not convincing them that there's a problem? They see three herons and say, 'So what's wrong? I've had a great day.' "

To learn more about the park's birds, I enlisted the help of Bill Smith and his wife, Sue, two locals who love birds and know where to find them.

Around hammocks and ponds near the south end of the park we wandered while Bill beckoned the birds—pishing ("psshh, psshh") and squeaking (by loudly smooching the palm of his hand). He was far less interested in the park's marquee attractions—the egrets, the eagles, the roseate spoonbills—than in smaller, less colorful species.

"Oohhh. . . ," sighs Bill, pointing to some black feathers and a big beak on a branch 20 feet away. "That's a smooth-billed ani. They're from the West Indies and are found in the United States only in southern Florida." Peering through his binoculars, Bill smiles, delighted and transfixed.

■ Miles of melaleuca trees get chopped by chain-saw crews trying to rid the park of the exotic plant. Imported from Australia at the turn of the century to dry up this "swamp," melaleuca sucks up water and has spread rampantly, overrunning many native plants.

The birds. So often, when people talk about saving Everglades National Park, they invoke the birds, but Bill doesn't buy it.

"That's too simplistic an argument," he says. "The real reason to save this wilderness is: It's wilderness. Shouldn't there be something as unique as this?"

MOST OF THE PROBLEMS affecting Everglades National Park are linked to problems upstream. To study them, the park established a separate scientific division—the South Florida Research Center in 1978.

"I should be managing research and getting the right answers to the questions of the future in a methodical, rational way," said Michael Soukup, then director of the center. "But out here it's like a MASH unit: We've got more corpses than we know what to do with—and we can't do it all."

Among the casualties is the park's native vegetation—the saw grass, the mangroves, the bayheads, the hardwood hammocks—which is being overrun by exotic trees. The invaders include the Brazilian pepper, the Australian pine, and an aggressive species of tree that scientists call *Melaleuca quinquenervia*—and others call the "Everglades Terminator."

One morning in the clearing behind the research center, I pull on a crash helmet and flame-retardant flight suit and hop into a helicopter with pilot Greg Grande and biological technician Jay Anderson, who are taking off on one of their daily sorties. Armed with chain saws and machetes, Jay and his two-man crews have been trying to create a melaleuca-free buffer zone between the northeast corner of the park and the outside world.

Melaleuca was imported from Australia at the turn of the century by the men who were trying to drain the Everglades. They believed


EXOTEC

A white blanket of egrets once covered this mangrove island on Rodgers River, but in the past 50 years the number of wading birds that nest in the park has plummeted 90 percent. This threadbare rookery now ranks among the park's largest.

melaleuca would soak up far more water than other plants. The problem is, the trees adapted to Florida all too well, rapidly muscling out native species.

"See all those trees," says Jay, pointing down to a willowy canopy that spreads out for miles. "That's all melaleuca."

We land and Jay jumps out—a machete in one hand, a bottle of purple-tinted herbicide in the other. He hacks down a few melaleuca seedlings, then sprays the stumps to kill them.

"It's the ideal weed," says Jay, hoisting a five-foot-tall specimen. It can germinate on land or in water; it produces massive quantities of seeds; it spreads fast, invading 50 acres a day throughout Florida; and, perhaps most important of all, it has no natural enemies here.

Not yet, anyway. Government entomologists have imported melaleuca-eating bugs from Australia and are studying them, under strict quarantine, to find the perfect predator—one that will attack the melaleuca but nothing else. This search for a biological control may take years, so Jay and his crews keep busy hacking, chainsawing, and spraying.

"We're going to be continually re-infested from adjacent areas unless our neighbors treat their melaleuca," says Doug DeVries, supervisor of the park's exotic control program. "But eventually we need biocontrol to succeed. We're just keeping the park alive until a cure is found."

THE PATIENT took a heavy hit in August 1992, when Hurricane Andrew raged across South Florida, cutting across the middle third of the park. Biologists worry that exotic trees will invade heavily damaged areas—the mangrove estuaries that were flattened on the western side of the park and the tree islands torn up in the park's interior.

One morning I stroll along the trail that runs through Paradise Key. Usually a dark, jungle-like thicket, this hammock now looks as though someone came through with a rototiller. Uprooted trees, broken limbs, and rotting leaves litter the ground. Many trees are still standing, although some seem awfully naked; I see one royal palm that had its fronds stripped away by the storm, leaving behind a trunk that looks like a whitewashed telephone pole. In fact, most of the canopy, which used to keep the hammock comfortably cool, has been blown away, opening up the view and raising the temperature to well above normal.

■ Mouth-to-mouth at mealtime, egrets feed their chicks small wads of chewed-up fish. Human alteration of the park's natural water cycle has made it difficult for adult birds to find fish, and many chicks perish (opposite).

Even Florida Bay, which stretches from the southern tip of the mainland across to the Florida Keys, shows signs of sickness too. Once sparkling, the bay has recently turned a dull, sick shade of green.

"We've deprived the bay of freshwater from the mainland, and the resulting hypersalinity has been stressful to most organisms out there," says marine ecologist Mike Robblee. Salinity levels in the bay have climbed to 70 parts per thousand—more than twice the normal level—contributing to a massive sea

grass die-off that has denuded the bottom.

That's had a ripple effect. The sea grass serves as a nursery for pink shrimps, which later migrate west to the Dry Tortugas. Without that nursery the shrimp population has dwindled, leaving Tortugas fishermen with meager hauls.

Nor is there enough sea grass to absorb the nutrients stored in the bay's sediments. Algae thriving on these nutrients have spread like an oil slick across most of the bay.

"You can usually see the bottom here," says my fishing guide, Jess Motter, as we motor across the Intracoastal Waterway and enter the park. Forget the bottom, I thought. I can't even see the middle—and the top looks almost dense and green enough to mow.

We stop near Buchanan Bank, bait our hooks with live shrimps, and then—before casting—scan the surface for the fin of a bonefish. We see none. So we stow our rods and head south, closer to the keys, and cast artificial jigs for tarpon. Not even a nibble. What's a fishing guide to do?

"You can go without fish all day if you can show customers crystal-clear water, life in the water, a few birds and stuff," says Jess. "They like it and think they've found their little bit of paradise. But you can't bring 'em over here in this kind of garbage."

TO RESTORE THE FLOW of freshwater to Florida Bay, Richard Ring, Superintendent of Everglades National Park, has his eye on 5,000 acres of land adjacent to the park's main entrance. The land is now in farms irrigated by freshwater that would otherwise nourish the park.

"This area is critical to the park, and some of these lands may have to be acquired publicly," Ring tells me. "To provide adequate water levels to Taylor Slough, the water table in that area may have to be kept high enough to preclude farming."

Such talk drives James Humble crazy. He is chief executive officer of the South Dade Land Corporation, which represents the farmers.

"You're dealing with a religious movement," Humble told me one afternoon. "The national parks, their constituency, the environmental movement. You're basically looking at a religious thing. If you challenge the underlying assumption about what's happening around the park, you're a bad guy."

Humble is a voluble, bowling ball of a man with a Tennessee twang who, when he gets rolling, questions just about everything—such as the new water studies that contradict the old water studies ("Have they grown more wise?" he asks me), the preservation ethic of the national parks ("anti-evolutionary . . . species come and go . . . we're part of nature too"), and the gloom-and-doom encyclicals from environmentalists who want to persuade taxpayers to buy more land for the park. "If you're going to do a sales job on the public, you have to create a crisis."

By the 1980s, conditions in the park had deteriorated far enough to attract the attention of Washington. Congress passed and President George Bush signed the Everglades National Park Protection and Expansion Act, which authorized the addition of 107,600 acres to the existing 1.4 million acres.

The new area, located in the corner of the park closest to Miami, is being acquired to restore the natural flow of freshwater into the Shark River Slough and to help the wildlife. But the expansion has been a rude awakening for plenty of people: Approximately 60 percent of the acquisition area is privately owned by some 10,000 individuals, most of them absentee landlords who purchased the property through the mail or over the phone, sight unseen.

Suckered by fast-talking salesmen, people paid as much as $17,000 for 1.25-acre, waterlogged parcels valued around $650, according to Dennis Higgins, chief appraiser for the National Park Service's Land Acquisition Office in Naples. "The sad part is, the majority are in this category," says Higgins.

Arturo Hernandez didn't make that mistake. Years ago he looked carefully before purchasing 70 acres of dry land on which he built his dream house: a two-story, Spanish Mediterranean villa with six bedrooms, seven bathrooms, a huge kitchen, a sunken living room, and a special suite for Arturo, featuring a jet-black Jacuzzi. The house stands practically all by itself at the end of Richmond Drive.

The government offered Arturo $680,000 for his estate, but he insists it's worth more and worries he'll be unable to afford a comparable piece of land where he can rebuild. Ultimately, though, Arturo knows he must reach an agreement with the Park Service, which can condemn the property and force him out.

"I've got nothing against the park's project," says Arturo, a 60-year-old semiretired

Cuban immigrant. "I like animals. But where am I going to go? I worked 33 years of my life for this land and this house, and I think this is my last chance."

NOW THERE'S TALK in South Florida about a big fix of the Everglades, an overhaul that would remove some of the region's surface plumbing—the canals and levees, the locks and spillways. This project could restore the natural flow of water in parts of the Everglades and give the ecosystem another chance.

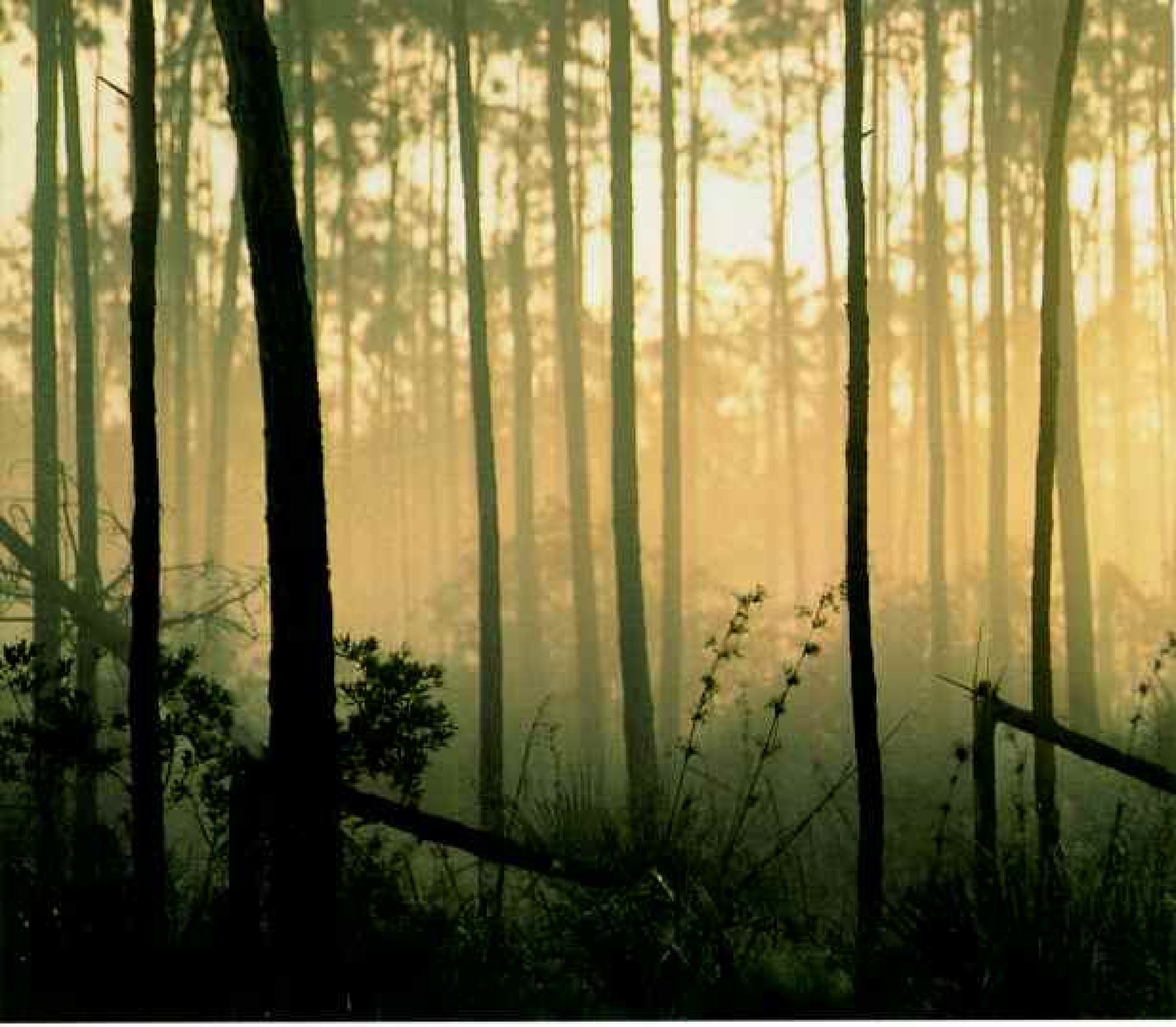
Yet the hurdles are formidable: The overhaul will cost billions of dollars, there's no consensus about what "Everglades restoration" specifically means, the symptoms of the Everglades' disease are more obvious than the cure, and not all the powerful players in South Florida are pulling in the same direction.

Several years ago, for instance, the federal government sued the state of Florida for failing to enforce regulations that would stop the sugar farmers south of Lake Okeechobee from polluting the Everglades. Although state and federal authorities finally reached a settlement, the farmers could keep the case tied up in court for years.

■ "You want tomatoes? Then give us water," say farmers along the L-31W canal, part of the park's eastern border. "You want wildlife? Then restore the Everglades," say environmentalists. One proposed solution: Buy out the farmers and grow tomatoes somewhere else.

And then there's the bureaucratic hurdle—the large number of government agencies whose authority can overlap, making Everglades cleanup a byzantine, frustrating affair.

The mission of the National Park Service, for instance, is to protect the integrity of large ecosystems; the U. S. Fish and Wildlife Service is supposed to protect individual species as part of their enforcement of the Endangered Species Act. So when Everglades National Park recently endorsed a plan that would restore water flow to the park but disrupt one



■ A high point in the park, the pinelands rise a mere seven feet above sea level. As the elevation drops, this dry land gives way to freshwater glades to brackish mangrove forests to salty Florida Bay, where the smart camper comes equipped with a mosquito net.

of the primary nesting areas of the snail kite, an endangered bird, the U. S. Fish and Wildlife Service objected, claiming the plan would "jeopardize the continued existence of the snail kite."

This policy paralysis recently drove Secretary of the Interior Babbitt to establish a federal task force that will try to coordinate Everglades cleanup and restoration. Why does Babbitt think his initiative will succeed after so many others have failed?

"There are two reasons," he told me. "First, I have a mandate from the President of the United States to make this work. Second, I think the attitudes have changed in Florida, and that's terribly important. I have a letter from Governor Chiles on my desk. It's a very emotional letter saying, look, you've got to make this work. These people are really ready. The governor is saying 'Do it!' "

LIVING NEXT DOOR to a national park might sound idyllic, but for the folks in Everglades City the park's size and proximity have been a mixed blessing. Situated just beyond the park's northwest border, Everglades City was once a busy commercial fishing village where the locals ran their boats out to the Ten Thousand Islands to catch mullet and pompano, stone crabs and oysters.

"Thirty years ago it was a dream," says Larry Demere, a local fisherman and lifelong resident. "You fished how you wanted, where you wanted, and caught what you wanted."

Not any more. In 1985 the park banned commercial fishing in its waters, calling it an incompatible use of a protected resource.

It's a tough ban to enforce, especially in December, when schools of mullet swim from the Gulf of Mexico into the park's shallow waters to spawn. Fishermen line up their boats at the park's northwest border and wait.

The big demand for mullet roe has inflated the fish's price—three men can haul in 5,000 dollars' worth on a good day—and that pushes some fishermen over the edge. They sneak into the park, net some fish, and try to scoot back out before a ranger shows up.

"We chase 'em all the time, and, believe me, a lot of times we don't catch 'em," says Darlene Koontz, a ranger who patrols the Gulf Coast. "They've got fancier equipment, faster boats, faster motors, cellular phones. This year during mullet season they watched this ranger station better than we did."

Playing cat and mouse with the law is an old game in the Ten Thousand Islands. The intricate coastline, the shoal waters, and the absence of people have made this region a perfect haven for rum-running during Prohibition, alligator poaching, and, more recently, marijuana smuggling.

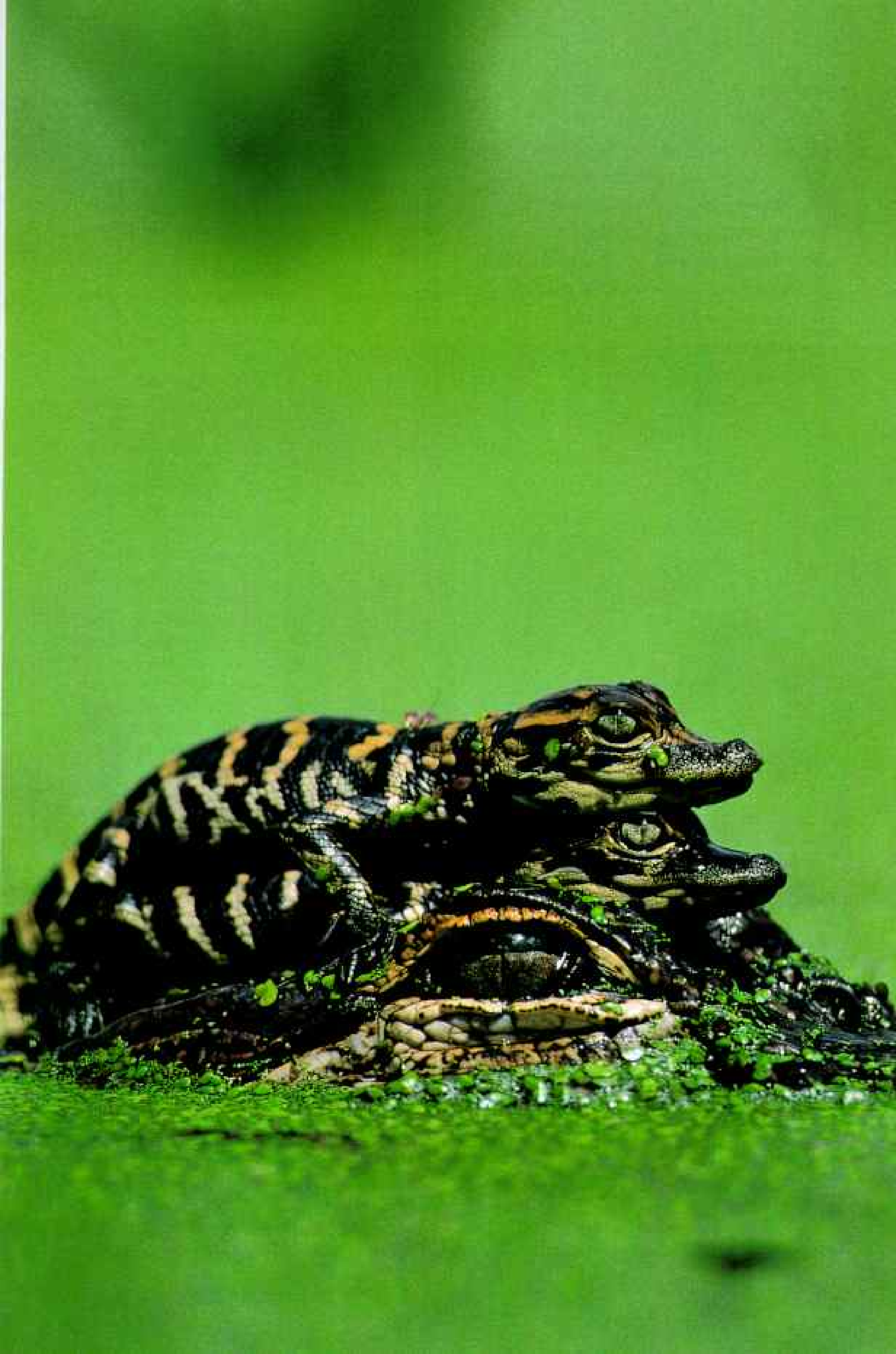
In the late 1970s and early '80s, drugs came into Everglades City by the boatload, and so did the money. Suddenly some folks were driving Lincoln Continentals, wearing gold necklaces, and paying *(Continued on page 32)*

Jaws of Life

With 70-odd teeth and a notoriously nasty bite, female alligators demonstrate a delicate touch when the time comes for their eggs to hatch. After laying about three dozen, a female covers her clutch with mud and leaves, then protects them. As the embryos incubate in the sun, they exhale carbon dioxide, which seeps into

the nest, forming a weak acid that coats the shell. Slowly the shell thins. After nine weeks, some hatchlings can poke their snouts through the shell and emerge, while others emit grunts that elicit help from the mother. Gently grasping an egg in her mouth, she rolls it on her tongue, feeling for signs of life (see following pages).

After tongue-testing one of her eggs and feeling no movement inside, a female alligator knows it's infertile—so she eats it (above). If she senses something stirring, though, she gently cracks the shell open, then tilts her head forward to let her baby emerge (below). With their stomachs still heavy with egg yolk, newborn alligators aren't strong swimmers and, lacking agility, are vulnerable to predators. So when venturing into water, they often hitch a ride with mother, who can keep a close eye.



■ Marjory Stoneman Douglas, now 104, wrote *The Everglades: River of Grass* in 1947. Although the book became a bible to the legions who love this region, Douglas spent very little time communing with the frogs and the saw grass (opposite). "Too buggy, too wet," she once explained. "The Everglades and I have the kind of friendship that doesn't depend on constant physical contact."

(Continued from page 27)

with $100 bills. All that ended with Operation Everglades, which law enforcement agents launched in 1981. When the dust finally settled after several big busts, more than 100 people in this town of 500 had gone to jail.

Many of them are now being released, and when they come back home, they'll drive down Route 29 into Everglades City and see the new billboards for Jungle Erv's airboat tours, the Barron River Marina and RV Park, Suzie's Station Gift Shop-Museum-Art Gallery, and the Last Frontier Restaurant.

THE MICCOSUKEE INDIANS live just inside the park's northern border. The tribe signed a 50-year agreement with the National Park Service in 1964 that permits them to stay on their land—a long, narrow strip beside the Tamiami Trail, which is sandwiched between the park and Water Conservation Area 3A. The Miccosukee maintain their own tribal council, court, school, and police department, and many of the tribe's 400 or so members work at the general store, gas station, restaurant, cultural center, or new bingo hall. Others give tourists airboat rides in the water conservation area; only Park Service airboats are allowed in the park.

Yet despite all the modern facilities, some visitors show up expecting something completely different. "We had a group of people visit from Denmark," says Steve Tiger, a tribe member who books busloads of tourists to the village. "They said this place was not real because they know what Indians look like. They know Indians live in tepees, dance around fires, wear war paint and loincloths, and hunt buffalo. They wanted Indians to come out with tomahawks and raid the buses.

"We told them our Indian village may not be what you want, but it is real."

The contrast between the reality of Everglades National Park and what visitors expect has been a perennial problem.

"Twenty years ago everyone expected it to look like the set of *Gentle Ben*—swamps and airboats and live oak trees and lots of Spanish moss," says Pat Tolle, a spokeswoman for the park. "We told them that wasn't the Everglades; that was the Okefenokee Swamp."

Even now it's easy to arrive at the park with unrealistic expectations. There are, for instance, no coots on Coot Bay Pond. There are no flamingos in the tourist village of Flamingo. There is no white water on Whitewater Bay.

But the people who can set their expectations aside, who can forget those old nature films with the huge flocks of birds blotting out the sunset, and who don't mind the bugs and flatness and heat, well, those people have been known to fall in love with this place.

Consider, for instance, my navigationally challenged paddling partner John Buckley and his wife, Donna, who frequently take their houseboat into the park's backcountry for two-week research expeditions. "Everything here has a curve, a twist, an ellipse," says John. "That's good for you when you spend all your time in rectangles and straight lines."

Or consider a fellow like Archie Jones, an energetic, elfin 83-year-old who has a long-standing fascination for *Liguus fasciatus*, better known as the Florida tree snail. Years ago, when it was still legal, Archie collected thousands of them for their colorful shells. He saved some and transplanted rare varieties into hardwood hammocks around the park. Nowadays he likes to stop by these hammocks to see how those snails' descendants are getting along.

One day I join him on a visit. We pull on our boots, spray on some bug dope, and hike through the saw grass somewhere east of Rock Reef Pass. The water here has receded for the season, leaving behind a blanket of brown, serrated saw grass that snags at my jeans, and a lumpy, gray bed of limestone that sometimes collapses beneath my feet.

Archie hardly breaks stride as he marches toward a hammock that doesn't have any obvious point of entry. It's an almost impenetrable jumble of trunks, branches, and leaves.

"Everybody's getting excited about how Hurricane Andrew devastated these hammocks," says Archie. "Everybody is all concerned about these poor snails, that they might be baked by the sun. The fact is, snails do better when the hammock is open because their food—like mold and algae—grows better. And snails breed like rabbits." By Archie's reckoning, the snail populations should increase tenfold in the next four years.

As we climb over the trees to the center of the hammock, I ask for hints to help me find a "lig."

"To hunt snails, you've got to think like a snail," Archie says. "It helps to not have too high an IQ." Besides that, he tells me to go slowly and to look closely and carefully—which I do—but Archie spots a snail first.

"See that *dryas*?" he says, pointing to a yellow-banded shell with a pink tip that had sealed itself to a tree. "That's a two-year-old. I wonder where the young ones are?"

We hike onward and explore several different hammocks. We spot a *luteus* with a delicate yellow wash, an almost pure white *eburneus*, and a handsome *walkeri* with chestnut-colored bands and a pale pink tip.

By late afternoon we're both getting tired, so we call it quits and drive off to get a couple of cool mango milk shakes. Archie, who likes to

■ Light at the end of the Everglades tunnel may be a much discussed plan to restore the region's natural flow. Or it may be the lights of Miami and Homestead, part of the urban locomotive chugging straight at the park.

call himself an "old fossil," looks happy, a man at peace with the world.

"At 83 I still get a kick out of snail hunting," he says. "It's a labor of love."

After five weeks in Everglades National Park I can recall a handful of memorable moments—like the hike with Archie or the afternoon in the backcountry when I spotted a pair of dolphins near the mangrove trees. They surfaced, exhaled through their blowholes with a wet sigh, then sucked in more air before thrashing underwater for fish.

Or the morning I canoed through the Ten Thousand Islands, and the hazy sunshine turned the sea and sky the same shade of gray, erasing the seam between heaven and earth.

Or the evening on Florida Bay when hundreds of ibis lined the sky, each flock flying in single file—long, white, undulating

ribbons drifting off to a key somewhere.

But frankly there were far too few magic moments. As I'd been warned, the Everglades were indeed *subtle*—often too subtle for me. Some days I felt as though I were wandering through a museum stripped of its artifacts, which may explain why I was never romanced by this park.

"It's possible to put this ecosystem back together again," says Bill Robertson, the park's senior biologist. All its natural components are still intact, he says, albeit on a much smaller scale. And Robertson should know: He's been working here since 1956, so he's heard and seen it all—the hurricanes, the fires, the natural and man-made droughts, and all the breathless pronouncements about the park's imminent demise.

"This ecosystem has some resilience to it, more than it's given credit for," he tells me. If the park is so resilient, I ask him, if it has managed to survive repeated beatings during the past 45 years, why should the public heed the cries for help this time around?

"Because," Robertson says, "you have to admit the possibility that when you get knocked down often enough, after the next blow you won't get up." □

RUSSIA'S LAND

KAMC

OPEN TO THE WORLD AFTER A HALF CENTURY OF SECRECY, RUSSIA'S PENINSULAR

OF FIRE AND ICE

HATKA

OUTPOST ON THE PACIFIC'S VOLCANIC RIM ROCKS WITH TREMORS OF FREEDOM AND CHANGE.

Scooped from a wild river in western Kamchatka, the spring smelt harvest is dried in the Itelmen village of Kovran. Predecessors of the native Itelmen arrived on the peninsula perhaps 14,000 years ago.

Brooding over Petropavlovsk, Koryakskaya is the more benign of two active volcanoes that pose a constant threat to the capital's 273,000 residents. Living in shoddily built housing blocks, most fear earthquakes more than eruptions.

By BRYAN HODGSON
Photographs by SARAH LEEN

STEAM LACED WITH SULFUR boils from the surface of the hot spring. The water temperature hovers somewhere between agony and bliss, a swirling mix of icy snowmelt and mineral-charged upwellings heated by the magma at the heart of a nearby volcano called Khodutka.

"You can see now why I enjoy being a volcanologist," says Yuri Doubik, as we float side by side in the early morning darkness. This is Kamchatka's section of the Pacific Ring of Fire, a wilderness of fuming peaks, ancient lakes, and end-of-the-world lava flows, bubbling with luxurious natural hot tubs like this one.

Here in the Russian Far East the day is dawning, but it's still yesterday in Moscow, nine time zones west. That seems appropriate. Yesterday's communist leaders turned Kamchatka into a Cold War fortress. But now a new breed of regional politicians and businessmen are turning their backs on Moscow, wanting instead to link the 182,000-square-mile region with the flourishing economy of the Pacific Rim, renew historic ties with Alaska, and turn their fisheries and adventure-tourism potential into hard, capitalistic cash.

By any standard, it's a great buy.

At the moment, I'm exploring Kamchatka's 500-mile-long stretch of volcanoes, but it's just one facet of a land twice as large as England, Scotland, and Wales combined. Here timeless forests and tundra abound with brown bears, sables, foxes, and deer. In my travels I've met native peoples I never knew existed, traded yarns with officers of the former KGB, and glimpsed a world beyond ideologies where workaday Russians are beginning a new political day amid the economic shambles of the old.

Many of the region's 470,000 residents live in concrete apartment blocks that separate Petropavlovsk Kamchatskiy, the capital, from its glorious backdrop of volcanoes. I found a better perspective on the waterfront, where Nikolskoye Hill overlooks sprawling miles of shipyards and docklands lining Avacha Bay, one of the great natural harbors of the world.

The hilltop path winds like a country lane through birch trees and meadows green with the spendthrift wealth of the brief Siberian summer, past the tomb of 44 British and French soldiers who died in a failed Crimean War invasion in 1854. Here you can count rusty trawlers lumbering off to earn a living on the Pacific Ocean or Bering Sea. Occasional MiG jet fighters rip the sky, a modern counterpart to a historical drama that began in 1740 when Vitus Bering built a village here, named it for St. Peter and St. Paul, and sailed away to explore the Aleutian Islands and southern Alaska, which were soon added to the empire of the Russian tsars.

Kamchatka has been focused on America ever since, I learned from Irina Viter, head of the history department at Petropavlovsk's museum. Pre-Soviet history is a specialty much valued now as Russians rediscover a more colorful and successful past.

BRYAN HODGSON recently retired after 28 years with NATIONAL GEOGRAPHIC, as an illustrations editor and then a senior writer. This is his 18th article for the magazine. Freelance photographer SARAH LEEN's work for the GEOGRAPHIC has taken her to Alaska, California, Canada, Uganda, and Siberia. She has also participated in the *A Day in the Life* series of books in the U. S., Spain, Italy, Russia, and China.

Fur-trading Cossacks began bringing Kamchatka's native groups—the Even, Itelmen, and Koryak—under the Russian thumb in the late 1600s. In this century, however, natives were gradually outnumbered: first by refugees from Stalinist oppression, then by workers drawn to the high wages of the Far East.

"The sea otter drew Russian fur traders to the Aleutians right away. It was valued as much as sable," she said. "When the Russian-American Company was formed, Petropavlovsk became an important base for our settlements in North America. After we sold Alaska to the United States in 1867, Russia forgot about Kamchatka, but many American whalers lived here. We even elected an American named Edmund Sandalin as mayor between 1870 and 1880."

Another American, named Washington Baker Vanderlip, offered to buy the province in 1920 from the new Soviet state, Mrs. Viter told me. "Lenin offered instead a 60-year concession. But he couldn't accept Vanderlip's demand that Kamchatka should remain a capitalist province." The deal fell through.

Seventy-two years later, I discovered, capitalism flourishes as though it had never really been away.

"Yagoda? Ikra?" Cheerful countrywomen in Petropavlovsk's public market offer scarlet temptations I can't refuse: succulent strawberries and fresh salmon caviar. Nearby stalls display bouquets of immaculate carrots, tomatoes, radishes, and potatoes, newly harvested from private plots and gardens outside the city. Prices are high. My modest purchases cost the equivalent of a week's pay for many Russians. Yet there is no shortage of shoppers. They elbow one another around displays of Russian vodka and American cigarettes, of smuggled Chinese jeans and jackets and tennis shoes. Along with wads of rubles, I see dollars changing hands, not just the hundred-dollar bills of the flourishing black market but also the crumpled tens and fives and even pocket change of everyday commerce.

Dollars are the only protection Russians have against runaway inflation. They are also vital to Kamchatka's future, says Peter Premyak, chairman of the regional Soviet of People's Deputies. "Our fishermen earned 50 million dollars in hard currency last year, selling walleye pollock, crab, and salmon to Japan and America," he told me. "But Moscow requires us to sell these dollars to them for rubles. Our biggest problem is keeping hard currency to modernize our fishing industry."

Premyak is a retired naval officer who gave up on communism long before Russian President Boris Yeltsin abolished the party in 1991. Now Premyak strides restlessly around his office, trailing pipe smoke and ideas that not long ago were thought treasonous: Workers should own the means of production and reap the benefits of their labor.

"We catch a million tons of fish a year. Two-thirds is sent to other parts of Russia, as property of the state. We sell the rest ourselves on the international market, but Russia takes 68 percent of that revenue too—and then charges us export taxes on top of everything.

"So far, regions do not have rights like those your states have in America. That must change."

THE BIGGEST CHANGE may come from tourists, whose supply of dollars can vanish readily into the unofficial local economy. Today it's possible to fly from Anchorage to Magadan to Petropavlovsk on Aeroflot, the state-run airline, or sail into Avacha Bay aboard luxury cruise ships from various countries that ply the more adventurous waters of the world. Kamchatka offers unspoiled beauty, though travel outside the capital is better suited to hardy souls untroubled by no-star hotels and local airlines plagued by fuel shortages and lack of spare parts.

Vladimir Samarski has the answer. He offers helicopter charters. If you're lucky, he'll fly you himself.

"I've flown here for 27 years. I know every rock and birch tree personally," he said as we loaded food and camping gear aboard his orange-and-blue Mi-8 helicopter, a venerable 24-passenger behemoth with an 82-foot rotor span and long-range fuel tanks.

For three days we traveled over Kamchatka's volcanic region. Here was Klyuchevskaya, at 15,584 feet the volcanic queen of all Russia, less than 10,000 years old and still growing. Nearby Bezymyannaya, or No-Name, had spent its grandeur in 1956 in a monstrous explosion rivaling the 1980 eruption of Mount St. Helens in the United States.

I had thought of volcanoes only in terms of disaster but learned that their alchemy could transform the earth, their moods enthrall even those who best know their dangers. Flying over Malyy Semlyachik, I saw a crater lake turned robin's-egg blue by sulfur and chlorine. I

Young recruits for the Pacific Fleet arrive in Petropavlovsk for submarine training. In 1983 Kamchatka, then off-limits, became a symbol of the suspicion and hostility of the Soviet military when commanders ordered an attack on a wayward Korean airliner.

asked Vladimir to land there, and as we approached the 5,118-foot summit in fierce freezing winds, I watched his ancient sneakers on the pedals, his burly hand on the controls, delicately meeting every gust. Not far away the hull of a crashed helicopter warned what could happen if you got it wrong.

"This is my swallow," Samarski said delightedly after we landed. Eagle, I thought, might be a better word.

Later, standing on the lava flow of Tolbachik, volcanologist Doubik described his own exhilaration during the 1975 eruption. "It was awful, but very beautiful—huge clouds of ash, laced by lightning. Bombs were raining down, lumps of liquid lava. We ran around collecting them for study. That was a nice time—a lot of fun."

ON OCCASION, volcanoes seem to have a little grim fun for themselves. At Kurilskoye Lake, a 50,000-year-old caldera in southern Kamchatka, scientists added phosphate fertilizer to the waters in the early 1980s, hoping to increase the growth of algae and thereby improve the survival rate of salmon hatchlings that feed on them. Then, in 1981, a volcanic eruption in the Kuril Islands dumped thousands of tons of nutrient-rich ash into the lake. In 1990 six million adult salmon returned from the sea, and attempted to spawn in an area with space for only 1.5 million.

"It was a stinking mess," said Katya Lepskaya, a hydrobiologist who studies the lake's salmon population for the Kamchatka Scientific Research Institute.

"People don't agree on whether the volcano or the experiment was to blame," Katya said as we watched video footage made by her husband, Alexei Maslov, of thrashing salmon literally battling one another to spawn while ruined eggs floated amid ghostly corpses. "But the lake is back to normal now. This year we counted only 1.3 million salmon returning to spawn."

We tested a selected specimen for lunch, poached with wild garlic and garnished with caviar. Kurilskoye Lake is really a neighborhood, I learned. Katya and Alexei were married here and live here for eight months a year, teaching elementary school subjects to their children, Liza, eight, and Viktor, five, and serving as unofficial hosts for itinerant hunters, fishermen, and fellow scientists.

Among them is Igor Revenko, a young game manager of Kamchatka's southern region, who has studied Kamchatka's huge brown bears for eight years. Kurilskoye is a prime breeding area, he told me, and bears emerge from hibernation hungry, sex starved, and irritable. Three weeks earlier one had pulled a camper from his tent and mauled him, then been killed by local residents.

Kamchatka possesses between 10,000 and 20,000 bears, Igor told me, but there is no money to take a census. That makes it hard to estimate the impact of hunting. About a thousand are killed legally each year—300 by foreigners who pay at least $10,000 for the chance—and the rest by professional hunters. But poaching is widespread. Bear gallbladders, valued as medicine in China and Korea, sell for as much as $400. Bearskins are worth $200.

I wouldn't want to put a price on the powerful medicine pressed into my hand by young Liza Maslova—a broken tooth from the rogue bear. I decided I would regard it as an amulet against bad temper, if not against bad luck.

Urban purgatories in a natural paradise, Kamchatka's industrial towns offer few diversions for bored youth—though outdoor wonders surround them. The fishing port of Ozernovskiy languishes

in a grime of smoke from a coal-fueled power plant and canning factories. Though the peninsula has abundant reserves of geothermal energy, capital for development is nonexistent.

Fur traders have roamed Kamchatka since 1696, when Cossacks were sent down from Chukotka to collect *yasak*, the imperial fur tribute, from native groups. Cossacks collected furs for themselves as well, a tradition now being renewed by modern hunters who, in the pay of regional state farms, range the wilderness to trap fox, sable, squirrel, mink, lynx, and wolverine.

"They pay us 1,200 rubles—about $6—for a sable that will sell for $150 in Irkutsk," a bearded hunter told me, hunched over a bowl of moose stew in a candlelit cabin near the Kamchatka River. "So we have all agreed to give the company only 30 percent of our skins and keep the rest to sell for ourselves. In this way, we can live."

Making a living in Kamchatka has never been easy. Many of the hunters are descended from prosperous peasants who fled here to escape famine and Stalinist repression in Siberia. They settled in the Kamchatka River Valley, built sturdy wooden villages, and began harvesting forests of spruce, larch, aspen, and birch.

Socialist planners caught up with them in the 1960s, industrializing the harvest with machinery and clear-cutting methods and leaving denuded tracts to fend for themselves. Trees require 60 years to mature in Kamchatka's 120-day growing season, and almost 30 percent of the forest had vanished before conservationists, three years ago, persuaded Moscow's bureaucrats to begin selective cutting, allowing younger trees to grow and reseed.

This method requires more time (and is still rejected by some loggers in the old-growth forests of the U. S. Pacific Northwest and British Columbia in Canada). But it has meant financial salvation for loggers like Sergei Trofimov.

I met him in a virgin forest of 200-year-old spruce trees about 20 miles north of Milkovo, in the broad alluvial valley of the Kamchatka River. Bouncing on the trampoline-like undergrowth of moss and fern, I had been heading toward a whining of tree-cutting machinery that was clearing the logging road.

"I came from Belarus 25 years ago, because wages were three times higher in the east," Sergei told me. "I retired at 50, but inflation has robbed me of my pension. So I must work again." I told him that Americans usually retire at 65. He shrugged. "Too late for us. In Russia we're *dead* by 65! You should have bought Kamchatka from us when you bought Alaska!"

HARVESTED LOGS are gathered into huge rafts at Kozyrevsk, north of Milkovo, and towboats take them the last 125 miles to Ust Kamchatsk on the Pacific Ocean. I wanted to hitch a ride and also see the Kamchatka River through the eyes of the Cossacks who traveled this section late in the 17th century.

"A five-day trip with the towboat. Twelve hours if you come with me," said Yuri Shulzenko, a game warden who plies the river regularly to prevent out-of-season salmon fishing. We set forth in his small outboard, zipping from one side of the winding river to the other to take advantage of the current. The river is the main highway to the sea, busy with barges of supplies and fuel as well as the plodding towboats, all threading between slender poles planted each day to mark shifting sandbars.

We had started on a fine summer day, but as we approached the coast, blue skies gave way to a bitter wind and soul-drenching fog. When Yuri stopped at a small outpost called Nizhne Kamchatsk to have lunch with meteorologist Nikolai Muleyanov, I was ready to accept his friend's offer of hot tea made from tree fungus ("Good for the kidneys!") and an all-purpose forecast: "Fickle, the weather," he growled. "In Kamchatka the earth is a piece of ice or a piece of mud."

Ust Kamchatsk's docks spilled over with logs bound for Japan. For Valery Oleynik, an inspector with the Kamchatka River Fishery Protection Service, that was a symbol of problems, not progress.

"Timber cutting has severely damaged the watershed," he said. "Runoff is more rapid, causing floods and erosion. The water table drops. Lakes are becoming shallower, even drying completely. Rivers are becoming silted. That has caused a decline in salmon spawning. This year we'll be allowed to catch only 3,000 tons of salmon, compared with 10,000 tons ten years ago!"

It sounded familiar, I told him: U. S. conservationists are still battling loggers to stop them from sacrificing salmon for trees.

Joint ventures like Petropavlovsk's Dutch-Swiss-Russian supermarket make profits, even though prices are out of reach for those limited to their official salaries. While hardships of economic transition are rampant, Kamchatka's underground economy is hot with cash, as evidenced by a thriving market for used Japanese cars.

The salmon has been the staff of life for humans on the peninsula since migrating peoples arrived from Central Asia and settled along the river perhaps 14,000 years ago. Their successors—the Itelmen, Koryak, Even, and Chukchi peoples—formed cultures based on sea hunting and reindeer herding.

Colonization by the Russians brought disease, war, and intermarriage. Today some 10,000 people of all these ethnic groups are officially recognized as natives, although much of their culture has been lost.

I got a vivid first glimpse of what survives when a troupe of Koryak tribal dancers from the northern village of Ilpyrskiy arrived in Petropavlovsk for a concert and let me watch a rehearsal in my hotel. With a thunder of drums, women dressed in elaborate deerskin costumes began sinuous dances evoking the movements of the sea and the grass, acting out the movements of reindeer, the hunting of a whale. There were songs of the crow, sardonic and powerful, and the sibilant lust of a small animal hunting a fat fish, and finally the fairy tale of a wedding, performed with such sensuous energy that I was distracted from the explanation being given by native spectators Larisa Varinova and Ludmila Pravdoshina.

Mere fragments of native culture and language survive, they told me, because of the government's decision to concentrate natives in central townships, assign them to state farms, and place their children in schools where only the Russian language is taught. Kamchatka was dotted with abandoned villages. But now some people are returning to the old sites under a government decree that restores their ancestral territorial rights.

"It is a beginning," Larisa said. "But it will be a long time before the newcomers give up control."

BOTH BY PAT MORROW, MORROW PHOTOGRAPHY

Kamchatka's tallest volcano was in a combustive mood (above) on a night this past July when climbers arrived to scale its 15,584-foot summit. The next day, as Klyuchevskaya belched plumes of ash, the party climbed its extinct neighbor, Kamen, instead.

A newcomer in the 18th century named Stepan Krasheninnikov summed up Russian ambivalence about the natives after a three-year scientific sojourn in Kamchatka. "Only in their power of speech do [these natives] differ from animals," he wrote. "Nonetheless . . . they believe that the earth, sky, air, water, land, mountains and forests are inhabited by spirits whom they fear and honor more than their god . . . [and are] convinced that there is no way of life happier and more agreeable than their own."

On Dobrzhanskiy Island, a rocky speck in the northern gut of the Sea of Okhotsk, I found a graceful reminder of that agreeable life. On the summit were scores of whale ribs, propped upright against a dome of rock so they were visible from the encircling sea. They were grayed by numberless seasons and surrounded by tundra plants in autumnal red and gold. Thus the old sea hunters honored the spirits of their prey, inviting the migrating animals to return. Whales are no longer hunted, but a scattering of lesser bones, of seal and fox and deer, indicated that the tradition wasn't dead.

I'd flown north and west with Vladimir Samarski to find some of the people who were returning to abandoned village sites. He knew many of them well, having befriended the natives after he had been forced to assist in the evacuations years before.

"It was very sad. Many people ran away into the taiga. We had to chase them. That was a bad time," Samarski said. "Now we can enjoy ourselves. In small villages you find bigger hearts."

First he found Alla Kechgichavina, a full-blooded Even, who was camped beside the Icha River, an ageless Asian elf wearing hip boots, babushka, and canvas parka and carrying a much used rifle.

"Come and see our beautiful river," she said, and led us to a rocky outcrop where we immediately attracted a shimmering veil of mosquitoes. "They are a punishment for you, Volodya, for not coming for a long time," she teased.

Alla is 56, retired now after 30 years as a professional hunter and trapper. Unusual for a woman? Yes. As an orphan living with a

Bonanza for bear hunters, Kamchatka draws hundreds—like Mexican businessman José Guerrero, who paid $24,000 for two bears. He took home not just the skins but also the skulls, which are easier to measure for the trophy books.

widowed stepsister and her nine children, she saw they couldn't survive without a hunter in the family.

"So I gave up the idea of being a schoolteacher and married a hunter instead," she said. "We had a nice life. Samarski came often then. He flew in any kind of weather, at the most dangerous times, to bring us food and medicine when nobody else would come. My husband died in 1979. But I feel very rich now. I have everything here—animals, birds, the taiga." She cocks a speculative eye at Samarski: "It's just a pity I'm so old!"

Practical reasons as well as sentimental ones draw natives like Gavriil Kikhlyab, a Koryak, and his wife, Galina, back to the land. I met them at the mouth of the Pyatibratskaya River on the Sea of Okhotsk coast. With their two children, Oksana and Natasha, the family had moved here from the town of Palana to go into business.

"This is my place. I was born here," he said. "I have spent most of my life herding reindeer for the state farm. Now we catch salmon and dry them to sell to the herders. Also I care for their horses. Any time we wish, we can ride to the town."

The move has restored a useful life for his father, Penelkut Solodyakov, 81, whom I met on the shore, disassembling fish with practiced ease. He had an even more important task, the old Koryak told me proudly: "Now I am teaching my grandchildren their own language."

An hour's flying time north is Rekinniki, another abandoned village now being reoccupied. There we were accosted by a tall Russian, who blustered: "You'll never understand this place unless you live here!" I noticed native faces in the background, discreetly silent. One of them belonged to Oleg Kichgelkhut, 23, whose three-year military service had given him a sense of a wider world before he returned to tend one of the hundreds of reindeer herds that form a major part of the northern economy.

"It is decided to give reindeer into the hands of those who actually take care of them," he said. "I hope soon to have a herd of my own." He took us to a tumbledown house that was once his mother's. He wants to restore it, he said, and live here with his wife. To me it looked beyond repair—but I'm not a good judge of possibilities in a country whose people must of necessity build on the ruins of the past.

Past, present, future: They seemed to blend as we returned to Petropavlovsk, flying for hours over bare serrated peaks, range upon range, and coursing down valleys laced with slender golden rivers smelted by the sun. I came to feel a sense of awe in this northern land, then of peace, as my fragments of observation blended into a mystery I had no need to understand.

I HAD ONE MORE JOURNEY to make: to sail with Vitus Bering on his final voyage.

Bering died in 1741 after his ship, *St. Peter*, was driven ashore on Bering Island. Archaeologists found his grave in 1991 and flew his bones to Moscow for study. Now he was to be reburied on the island with full military honors.

I joined the funeral party aboard the coast guard destroyer *Kedrov*. As we sailed past the jagged rocks called Three Brothers that guard the entrance to Avacha Bay, rays of sunlight burst through clouds that hurled themselves against the volcanoes like frozen surf. It seemed a fitting requiem for an old and honorable man of the sea.

I hadn't expected to meet him in person, but that's how it felt when

An inner sanctum within a wilderness, the Valley of the Geysers bubbles and fumes in the heart of Kamchatka's volcano country. Untainted by commerce, the valley is visited mainly by day-trippers flying in by helicopter.

Professor Viktor N. Zviyagin, of the Scientific Research Institute of Forensic Medicine, showed me the bronze memorial portrait he had created from a cast of Bering's skull. Here was a robust man of about 50 years, magisterial and perhaps a little sad, unlike the picture that had for more than 200 years depicted him as portly, petulant, and distinctly unheroic.

"We know that the picture was of his uncle," Professor Zviyagin said. "Nobody really knew what Bering looked like. We wanted to reflect his personality rather than just applying muscle and flesh to his skull in a mechanical way. So we looked at the men he gathered around him, strong and able, feeling that he would recruit men like himself. We know he was courageous, very disciplined in obeying orders, caring much for the well-being of his crew. I believe our portrait of him is true—with perhaps a touch of our own feelings too."

A surging ground swell prevented our landing on Bering Island. The funeral procession became a short march to the fantail, where the small casket containing the explorer's bones was loaded aboard *Kedrov*'s helicopter and flown to shore to be interred by the members of the island's military garrison.

Kedrov was a special ship, designed to hunt submarines. Only a few months earlier her crew had been members of the elite border guard of the KGB.

"Russia and America have the same enemy now," said Valery Yunoshev, deputy division commander, who had invited me to the bridge on our return trip to Petropavlovsk. "We both fight illegal fishing by foreign trawlers in the Bering Sea."

WHILE THE FORMER KGB relishes its new role, the Russian naval force at Petropavlovsk is finding less and less to do. With the collapse of the Soviet Union, funds are short, and there is little money for the families of officers who form the backbone of a largely conscript force. Ships and submarines now spend much of their time tied up at the dock. And according to Vice Adm. Yuri Shumanin, the local commander, the Cold War may not really be over.

"Two American subs are always in our region," he told me. "There's always an intelligence-gathering ship about 15 miles offshore. Each week we can see six or eight patrol planes from Adak and Shemya Islands in the Aleutians." In 1983 a Korean Air Lines plane strayed off course and flew over Kamchatka's radar defenses and missile submarine base before Soviet defenders shot it down over Sakhalin Island, killing all 269 aboard. The Kremlin branded the flight a U. S. plot. Not until 1992 did Russian leaders admit that they had located the wreckage, listened to the black box cockpit tape recorder, and found no evidence the crew was aware of their error.

Admiral Shumanin knew nothing of this. "I'm a submariner," was all he said. "And it was before my time."

The time to end ideological warfare will never come for many Russians. "I am a communist in my soul. Only if we turn back to the Communist Party can we stabilize the economy," said Mikhail Maschkovtsev, a former party official who publishes *Yedinomyshlennik*, or Unity in Thought. Its 8,000 readers are dedicated to a government monopoly of all trade, foreign and domestic. "Privatization of large-scale industry creates a bandit economy. And liars cannot lead us. A person cannot believe for 30 years and then change himself completely."

Floating factory, the *Blyukher* hauls in about 50 tons of king crabs a day from the fertile banks of the Sea of Okhotsk. In the dark and crowded hold, the 427-member workforce cooks and cans them for market.

Big game for the fishermen of Rekinniki, 600 pounds of bearded seal will provide winter meat and a cash crop of skin and fat. These sea hunters, Coastal Koryak, are close kin of the inland Reindeer Koryak.

But the outside world can't be kept at bay. In 1991 when 30 cadets from Kamchatka's merchant marine college took a training cruise aboard the three-masted training frigate *Pallada*, 19-year-old Andrei Mironenko brought back some stunning news for his schoolmates.

"We spent four days at Dutch Harbor in the Aleutian Islands," he told me. "We met Americans no older than I am who fished for salmon, pollock, and crabs in small boats. We learned that they got government loans to buy their boats and earned up to $15,000 a month to make the payments. Then they owned the boat!"

AMERICAN IDEAS AND tastes also set the agenda for Kamchatka's state-owned fishing industry. One day I spotted a brand-new trawler in the harbor that looked very much like sophisticated Seattle-based trawlers I had seen.

"It is just the same, built by the Norwegians," said Captain Valery Sologubov when I boarded the *Admiral Zavoyko* to get a tour of spotless fish-processing machinery and a bridge crammed with the latest electronic gear. "We even have a new machine that slices off an extra micro-thin layer of fat under the skin to produce low-fat pollock fillets for the American market. That adds greatly to the value of our catch." The ship is leased to a Kamchatka company by its Liberia-based British owners; the fish is sold to a U. S. fishing company for hard currency.

"In our first season we paid the lease and had some profit," said Captain Sologubov. "In eight years we'll own the boat." Ownership. The very idea still alarms many Russians, especially when official policies blur the property lines.

"The government is now selling shops to private people—not to the people who worked in them, but the new rich who have gathered capital in some way," said Tatyana Kostynets, a business reporter for the local TV station. "Under the old laws, such manipulations were called crimes. But now, when I wanted to find out about a certain company, a government minister told me, 'You don't count the money in other peoples' pockets. If yours are empty, it's your own fault.' Without clear laws, a lot of us don't really understand what is good or bad."

Father Yaroslav Levko thinks he has an answer. He is a 32-year-old Russian Orthodox priest whose hawk nose and wild black beard are softened by brown eyes that say faith is possible, and a gentle smile that says you might even enjoy it. Presiding over a new cathedral overlooking Avacha Bay, he has baptized more than 50,000 adults since he arrived in Petropavlovsk seven years ago.

"For so many people with no religious education, I ask them only 'Do you believe in God?' " he told me. "And I ask them only to promise to be kind in their deeds and to visit church occasionally. The main thing is kindness."

I went to say farewell to Anna Barkovskaya, a housekeeper who had befriended me at the Oktyabrskaya hotel.

"I feel we are living in a fantasy," she said when I asked what she was thinking about the future. "My ancestors were from Belarus. They migrated to Siberia, and many died on the way. Stalin called them *kulaks*, greedy peasants, and persecuted them. So we escaped to Kamchatka and tried to do what we were told. Now they want us to be kulaks again!"

I asked what the word really meant.

"Independent people!" she replied. And flashed a golden smile. □

The bones of 18th-century mariner Vitus Bering—unearthed on Bering Island in 1991 with the remains of his crew—are returned to the island after being verified by experts. Rostislav Maslov Bering, a direct descendant from Lithuania,

pays his respects to the man who explored Alaska and the Aleutians for Russia. Only 300 or so Aleuts remain on Bering Island, and that number was diminished by one when two-month-old Dmitri Ladygin died just before Bering's reburial.

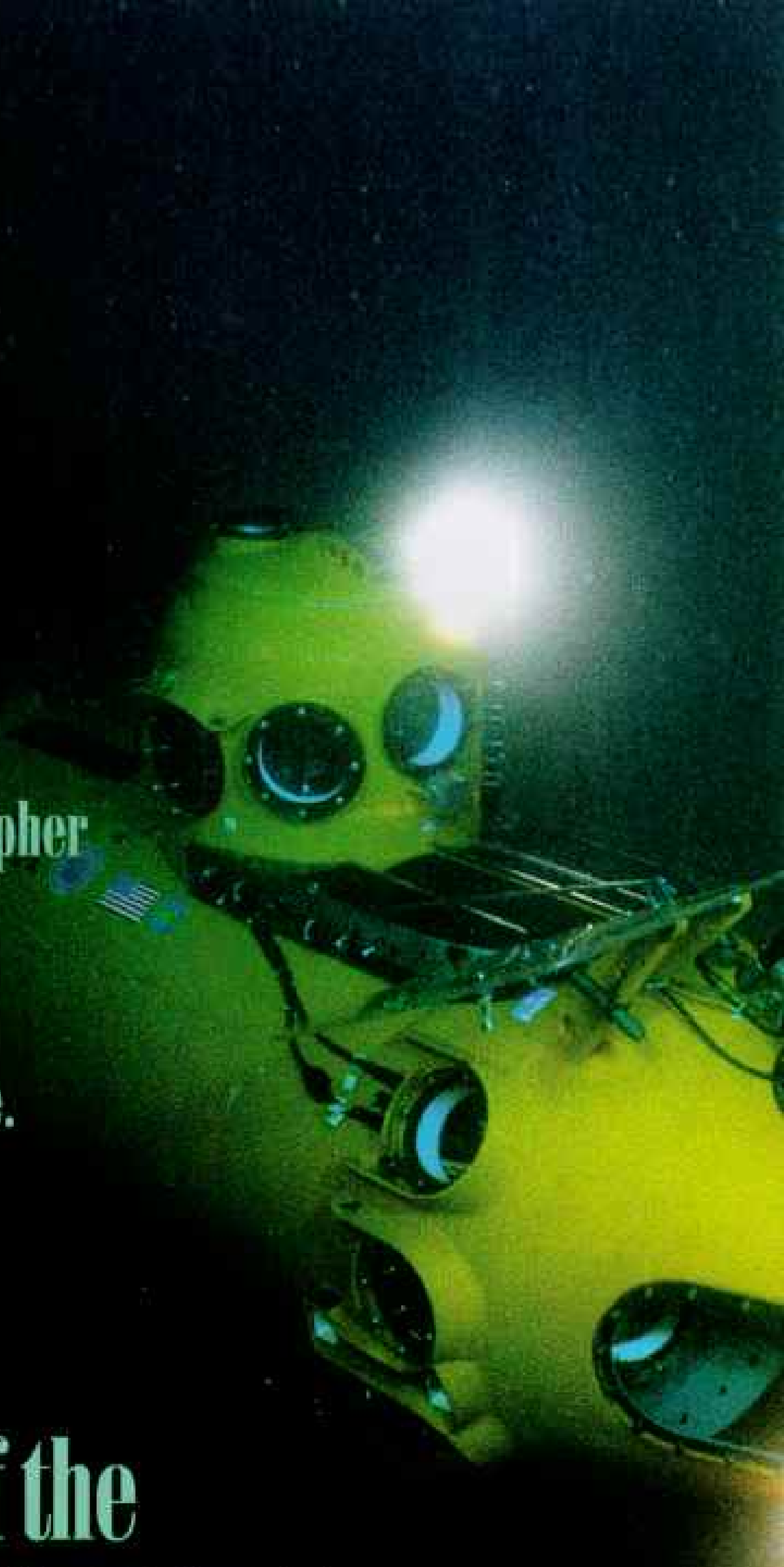
Reindeer Harvest

Ritual of love and death on the tundra

"Forgive us, reindeer," the Koryak of northern Kamchatka say as they chase their animals with lariats, pull them from the herd, and dispatch them with a spear. Despite years of Soviet collectivization, the Koryak and the neighboring Chukchi remain spiritually bound to the animals that assure their survival in this life and beyond. Only the spirits of the deer, they believe, can deliver human souls to "the other side." Thus an animal must die for a departed human. In giving water to the dead deer, the utmost respect is paid for its sacrifice.

Honoring their dead kin, the Koryak cook and eat every scrap of meat from the first day's harvest of sacrificial reindeer. On the second day, ritual acts—like the daubing of deer blood on children's faces—continue as the regular harvest begins. Cold evenings on the tundra are passed in communal singing, as deerskin drums and psychoactive mushrooms inspire participants to heights of musical improvisation. □

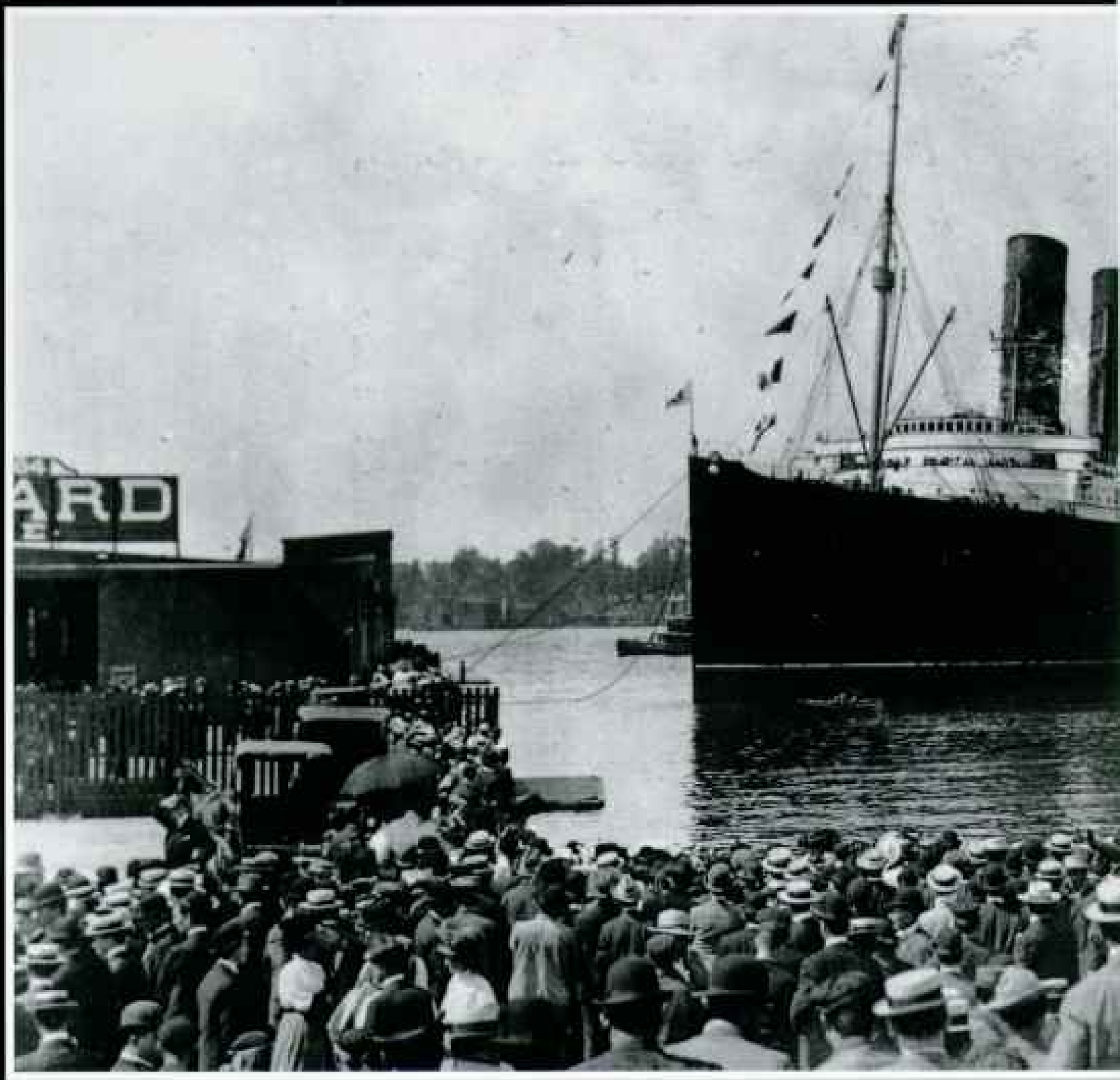
In the bright lights of a mini-submarine, the rudder of a once great luxury liner remains frozen in a desperate turn toward land. Using advanced technology, a renowned oceanographer takes a closeup look at the most puzzling sea tragedy of our time.



The Riddle of the LUSITANIA

Text by ROBERT D. BALLARD
WOODS HOLE OCEANOGRAPHIC INSTITUTION

Photographs by JONATHAN BLAIR



OCEAN TRAVEL

NOTICE!

TRAVELLERS intending to embark on the Atlantic voyage are reminded that a state of war exists between Germany and her allies and Great Britian and her allies; that the zone of war includes the waters adjacent to the British Isles; that, in accordance with formal notice given by the Imperial German Government, vessels flying the flag of Great Britian, or of any of her allies, are liable to destruction in those waters and that travellers sailing in the war zone on ships of Great Britian or her allies do so at their own risk.

IMPERIAL GERMAN EMBASSY,

WASHINGTON, D. C., APRIL —, 1915.

OCEAN TRAVEL

CUNARD

EUROPE VIA LIVERPOOL

LUSITANIA

Fastest and Largest Steamer now in Atlantic Service Sails

SATURDAY, MAY 1, 10 A. M.

Transylvania - Fri., May 7, 5 P.M.
Orduna, - - - Tues., May 18, 10 A.M.
Tuscania, - - - Fri., May 21, 5 P.M.
LUSITANIA, - Sat., May 29, 10 A.M.
Transylvania, - Fri., June 4, 5 P.M.

Gibraltar—Genoa—Naples—Piraeus

They knew of the danger. Passengers boarding the British liner R.M.S. *Lusitania* at New York's Pier 54 on May 1, 1915, for the voyage to Liverpool, England, knew of Germany's threat to sink ships in the war zone around the British Isles. The two nations had been fighting for nine months. Some travelers may even have seen the ominous notice (left) published in newspapers that morning. But few imagined that a civilized nation would attack an unarmed passenger steamer without warning.

Built eight years earlier to

COBH HERITAGE CENTRE (BELOW); THE BETTMANN ARCHIVE

outperform record-holding German liners, the *Lusitania* was the pride of the Cunard Line. Propelled by giant turbine engines, she could make 25 knots. Her owners described her as a "floating palace." Arriving in New York (above) on her maiden voyage in 1907, she was thronged by admirers.

German authorities, however, now saw her as a threat. They accused the British government of using the *Lusitania* to carry munitions and other contraband across the Atlantic. A medal (right) cast by a Munich metalworker in August 1915 depicts the *Lusitania* carrying a warplane and a cannon under the satirical comment, "No contraband." On the reverse side, a death figure sells tickets to passengers beneath the words "Business first," implying that Cunard knowingly put civilians at risk.

With her four towering funnels the *Lusitania* looked imposing, even invincible, as she left New York on her last voyage. A week later she lay shattered at the bottom of the Celtic Sea—where our team, sponsored by the National Geographic Society, explored her for nearly two weeks in the summer of 1993.

Boston Evening Globe

EVENING EDITION—7:30 O'CLOCK—LATEST

LUSITANIA SUNK

Not Known How Many Passengers Saved

TORPEDOED BY GERMANS REMAINED AFLOAT 12 HOUR

The Evening Telegram

BASEBALL EXTRA

UPI/BETTMANN

The Evening

RACING RESULTS

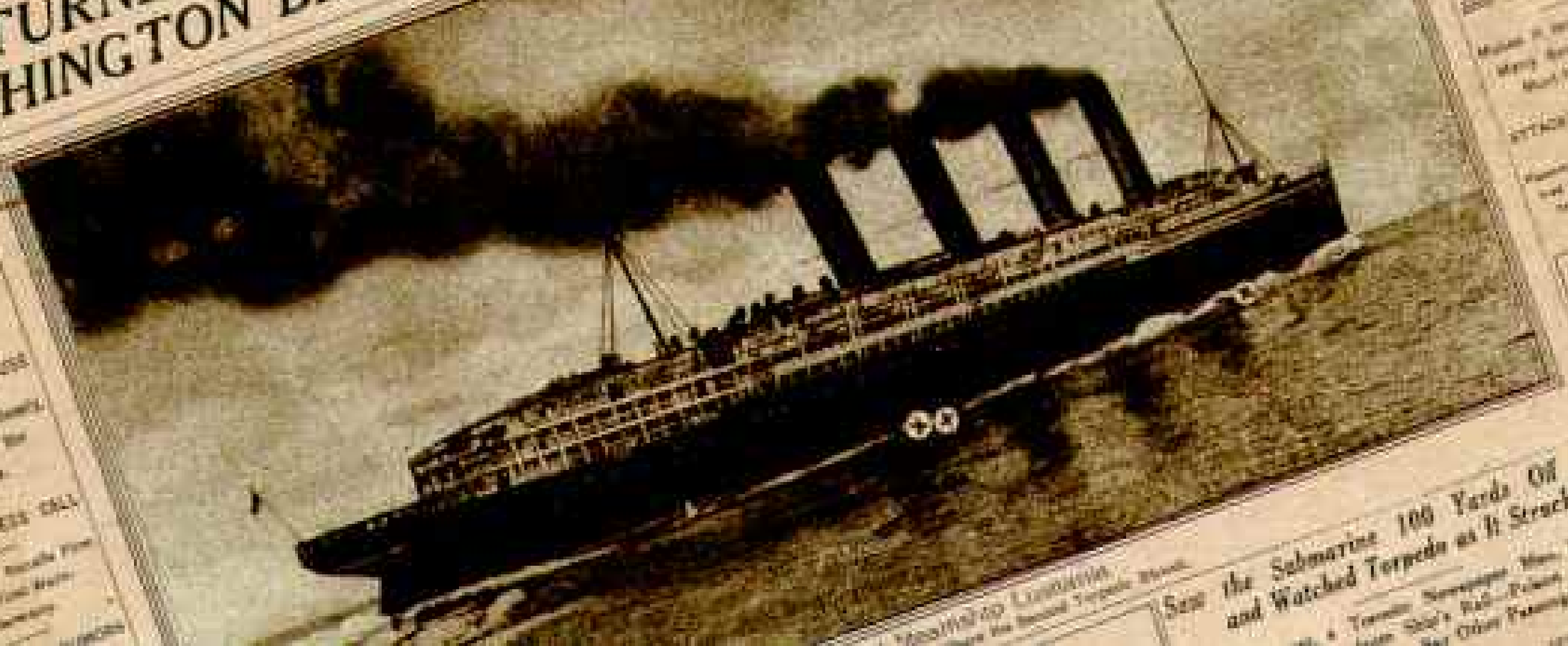
LUSITANIA BLOWN UP BY GERMANS; LOSS OF LIFE REPORTED SLIGHT

EXTRA

9:30 A. M.

The New York Times.

TANIA SUNK BY A SUBMARINE, PROBABLY 1,260 DEAD;
WICE TORPEDOED OFF IRISH COAST; SINKS IN 15 MINUTES;
T. TURNER SAVED, FROHMAN AND VANDERBILT MISSING;
CAPT. TURNER BELIEVES THAT A GRAVE CRISIS IS AT HAND
WASHINGTON



Saw the Submarine 100 Yards Off and Watched Torpedo as It Struck Ship

Waither Schwieger (left), the 30-year-old commander of the German submarine U 20, couldn't believe his luck. Just when he thought the massive passenger steamer was going to escape along the south coast of Ireland, the ship turned sharply toward him. It couldn't have run a better course if it voluntarily intended to come within torpedo range, he told a friend. From roughly 750 yards, he fired a single torpedo. It was 2:10 p.m., May 7, 1915.

Leslie Morton, an 18-year-old lookout on *Lusitania*'s bow, spotted thin lines of foam racing toward the ship. "Torpedoes coming on the starboard side!" he shouted through a megaphone, thinking the bubbles came from two projectiles. Capt. William Turner (right) saw the wake from the navigation bridge just before impact. It sounded like a "million-ton hammer hitting a steam boiler a hundred feet high," one passenger said. A second, more powerful explosion followed, sending a geyser of water, coal, and debris high above the deck.

Listing immediately to starboard, the liner began to sink rapidly at the bow, propellers rising to the surface as passengers tumbled down her slanted decks. Lifeboats on the port side were hanging too far inboard to be readily launched, those on the starboard side too far out to be easily boarded. Several overfilled boats spilled occupants into the sea.

"Find all the kiddies you can," Alfred G. Vanderbilt, the ship's most famous passenger, told his servant. The millionaire sportsman, not a good swimmer, spent his last minutes putting life jackets on youngsters. He was never seen again.

As the ship went down, one of the giant funnels sucked a woman down inside, only to blow her out again in an explosion of steam. Covered with soot, she survived.

The great liner disappeared under the waves in only 18 minutes, leaving behind a churning jumble of swimmers, corpses, deck chairs, oars, and a large mass of wreckage. Looking back upon the scene from his submarine, apparently even Schwieger was appalled. He later called it the most horrible sight he had ever seen.

Word of the catastrophe raced across the Atlantic. Headlines in Boston and New York shouted

BROWN BROTHERS

the terrible news. Of 1,959 people aboard, only 764 were saved. The dead included 94 children and infants.

Questions were immediately raised. Did the British Admiralty give the *Lusitania* adequate warning? How could one torpedo have sunk her? Why did she go down so fast? We hoped to discover some answers when we visited her watery grave.

CULVER PICTURES (LEFT, CENTER AND BOTTOM, AND ABOVE)

ILLUSTRATED LONDON NEWS PICTURE LIBRARY (ABOVE); BOWMAN GRAY COLLECTION, UNIVERSITY OF NORTH CAROLINA, CHAPEL HILL

"Bodies were laid out on the piers like cordwood," said William Swanton of Queenstown, Ireland, who was nine when the fishing boats arrived with the *Lusitania*'s victims. (In one rescue boat, a woman had been pulled alive from a pile of corpses when her eyelids fluttered.) "My sister took jugs of hot soup down to the waterfront for survivors. We had 13 strangers in our house that night."

The scene in Queenstown was gruesome. Beneath flickering gas lamps men and women searched through the dead for their spouses and children. Volunteers (above) carried unidentified bodies to makeshift morgues to await burial in three mass graves on a hillside overlooking the Irish countryside.

Americans were outraged by the attack, which claimed the lives of 123 of their fellow citizens. Newspapers called the torpedoing "deliberate murder" and a "foul deed," and politicians, including former President Theodore Roosevelt, demanded reprisals against Germany. A provocative poster published in Boston (facing page) depicted drowning innocents and urged Americans to enlist in the armed forces.

The attack on *Lusitania* is often credited with drawing the United States into World War I. This is only partly true. Three months before the sinking President Woodrow Wilson had vowed to hold Germany to "strict accountability" for its submarine attacks. Yet he also knew that the American people, despite their anger over the *Lusitania*, did not yet favor going to war. It would be almost two years before the U. S. joined the conflict in Europe.

From the moment she went down, the *Lusitania* was surrounded by controversy. A British judge laid full blame for the tragedy on the submarine commander. The German government, meanwhile, pointed a finger at British officials, claiming they had made the liner a legitimate military target by arming her—a charge that was never proved.

Within days of the sinking, German sympathizers in New York came up with a conspiracy theory: The British Admiralty, they said, had deliberately exposed *Lusitania* to harm, hoping she would be attacked and thus draw the U. S. into the war. Later some analysts even accused Winston Churchill, then First Lord of the Admiralty, of masterminding the plan, citing a letter he wrote before the attack saying how important it was "to attract neutral shipping to our shores, in the hope especially of embroiling the United States with Germany." Other scholars, however, denied that Churchill could have been so cold-blooded and cited warnings sent by the Admiralty to *Lusitania* prior to the attack.

Perhaps the biggest puzzle of all was why the liner sank so fast. Newspapers at the time speculated that the torpedo had struck war matériel in a cargo hold, causing a mighty internal explosion—the secondary blast reported by survivors. Divers later reported a huge hole in the port side of the bow opposite where munitions would have been stored.

Hoping to settle the issue once and for all, we sent our robot vehicle, *Jason*, from the Woods Hole Oceanographic Institution, down to photograph the damage. But when our cameras swept across the hold, we got a big surprise: There was no hole.


ENLIST

No sign of explosion

Our small robot, *Homer*—guided by a grid map of the seafloor created by acoustic transponders—inspected the *Lusitania*'s bow, including part of its underside. We found no evidence that U 20's torpedo had detonated an explosion in a cargo hold (dashed line), undermining one theory of why the liner sank.

PAINTING BY WILLIAM H. BOND

LARRY NIGHSWANDER, NGS STAFF

She looked more like a junkyard than a luxury liner when we first saw the *Lusitania* last July. Plunging bow first into 295 feet of water, the 785-foot-long ship slammed into the bottom while her stern was still at the surface. The force of the impact crumpled the stem of her bow and cracked open her hull amidships. After she crashed down on her starboard side, her decks collapsed, spilling debris onto the seafloor.

Remnants of snagged fishing nets (facing page) shroud the wreck where she lies 13 miles south of the lighthouse at the Old Head of Kinsale (above). A strong current and turbid water hindered our three underwater vehicles. In this painting, *Jason* photographs the *Lusitania*'s name, while *Homer*, a small robot from the Harbor Branch Oceanographic Institution, peers under the hull, and *Delta*, a yellow submarine from Delta Oceanographics, inspects the crack amidships.

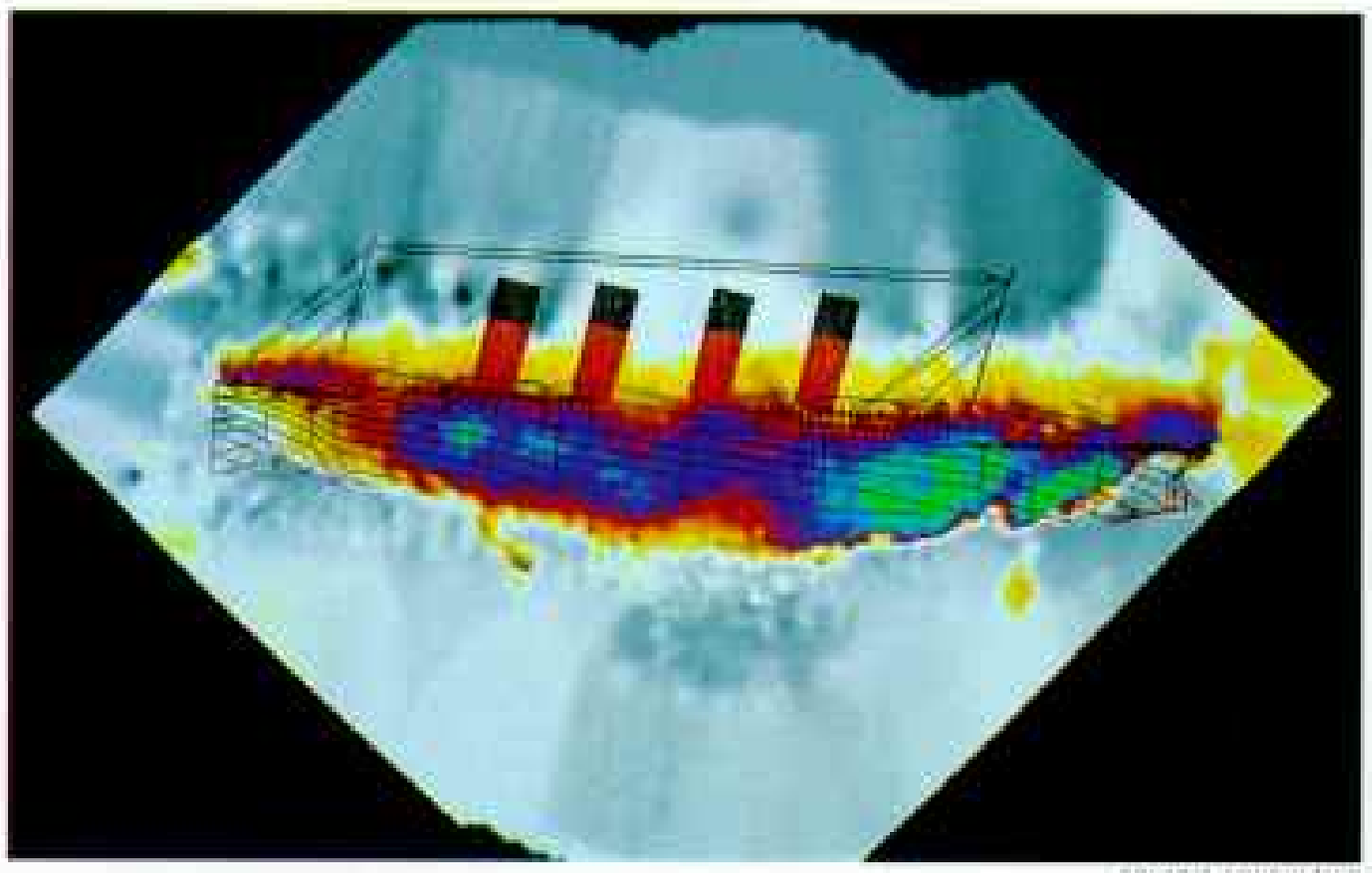
The liner's giant funnels have long since turned to rust, her lifeboats have rotted away, and human remains have been consumed by sea creatures.

In the 48 hours before the attack on the *Lusitania*, the German submarine U 20 had sunk three ships off Ireland's southern coast. Yet Captain Turner, who had received warnings by wireless from the British Admiralty, took only limited precautions as he approached the area. To save fuel en route, as Cunard had instructed, the *Lusitania* was using just three of her four boiler rooms; when attacked, she was making only 18 knots.

Our eyes beneath the waves, the 3,000-pound vehicle *Jason* (left) is retrieved from the Celtic Sea after a long day's work. Fitted with cameras and powerful lights, the robot sent video images of the wreck by fiber-optic cable to our control room on the surface ship, *Northern Horizon*. Robot pilot Martin Bowen (above, at center) maneuvers *Jason* with a joystick, while engineer Bob Elder (far left) relays instructions to the robot's computers. Artist Ken Marschall, at right, and I watch for recognizable objects on the monitors.

Besides using *Jason* to make a visual survey of the *Lusitania*, we aimed the robot's high-frequency sonar at the liner's broken hull to create a computerized, three-dimensional diagram of how the wreck looks today. Onto this color-coded image we superimposed a 3-D image of the way she appeared when built (below) to guide our investigation.

From these data we discovered that the *Lusitania*'s hull had been flattened—in part by the force of gravity—to half its original beam. We also found the place between the third and fourth funnels where the ship's back was broken—the location of the largest rooms, the first-class lounge and dining salon. This was the same area where the *Titanic* split in two, suggesting a relative weakness amidships in this class of vessel.



POLARIS CONSULTING

Seeing the name for the first time was like reading a tombstone: Here lies the *LUSITANIA*. An eerie marine growth covers her steel hull, and her superstructure has turned into ghostly wreckage.

A strong current at the bottom made it hard to maneuver *Jason* on our first day. As we got closer to the wreck, we were blinded by schools of pollack attracted to our lights. Then suddenly the *Lusitania*'s massive portside hull loomed into view, her red antifouling paint still visible, just as the *Titanic*'s had been when we found her eight years before.

We'd been told that previous divers had removed the raised brass letters of the *Lusitania*'s name. So as we crept along the bow, we were surprised to find what appeared to be a faded "L" and a faint "U." Elated, we continued spelling out her name like schoolchildren. The letters "ITAN" are visible in outline across the top of our photograph (far right).

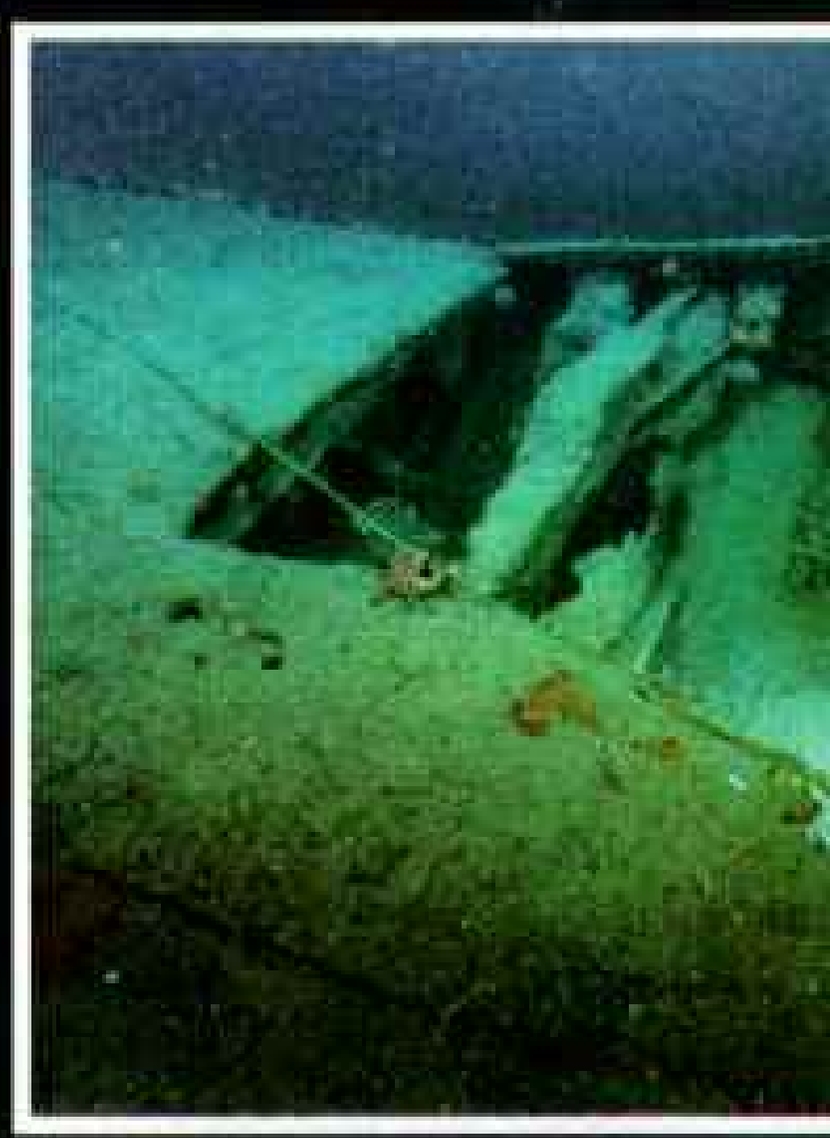
Questions about her cargo have haunted the *Lusitania* since the day the ship went down. The Germans have always claimed she was carrying illegal munitions—which, in fact, she was. The manifest for her last voyage reads like a contraband shopping list. Not only was she defying the German blockade to deliver wartime essentials such as motorcycle parts, metals, cotton goods, and food, but she was also carrying 4,200 cases of rifle ammunition, 1,250 cases of shrapnel (not explosive), and 18 boxes of percussion fuses. In 1982 salvagers recovered several boxes of the fuses, which bore the initials of the Bethlehem Steel Corporation (above).

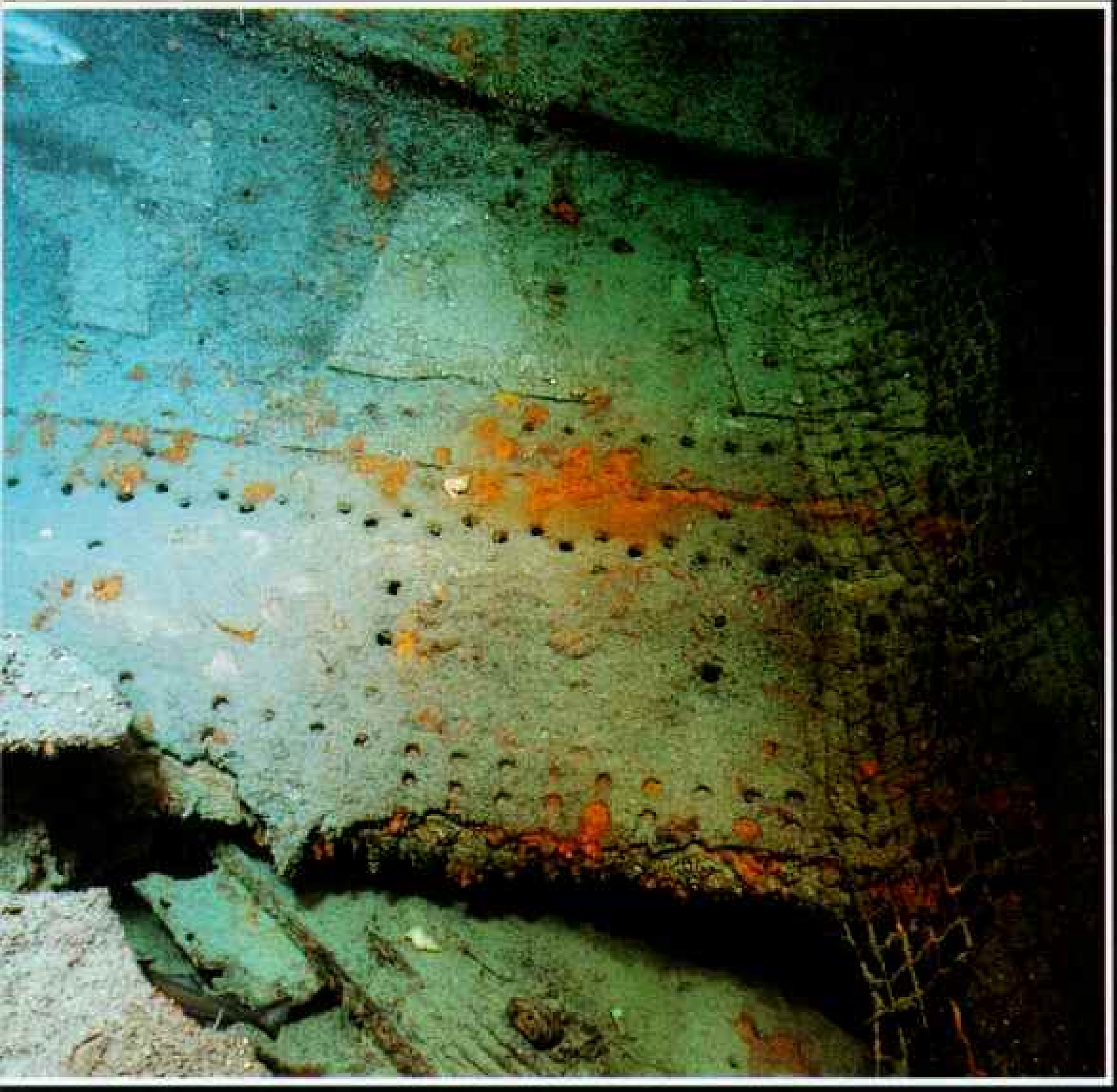
But as our investigation suggested, such war matériel did not cause the secondary blast that sent the *Lusitania* to the bottom. So what did? Was it the ship's giant boilers bursting as cold seawater flooded her hull? If so, then why didn't survivors from the boiler rooms report a catastrophic explosion?

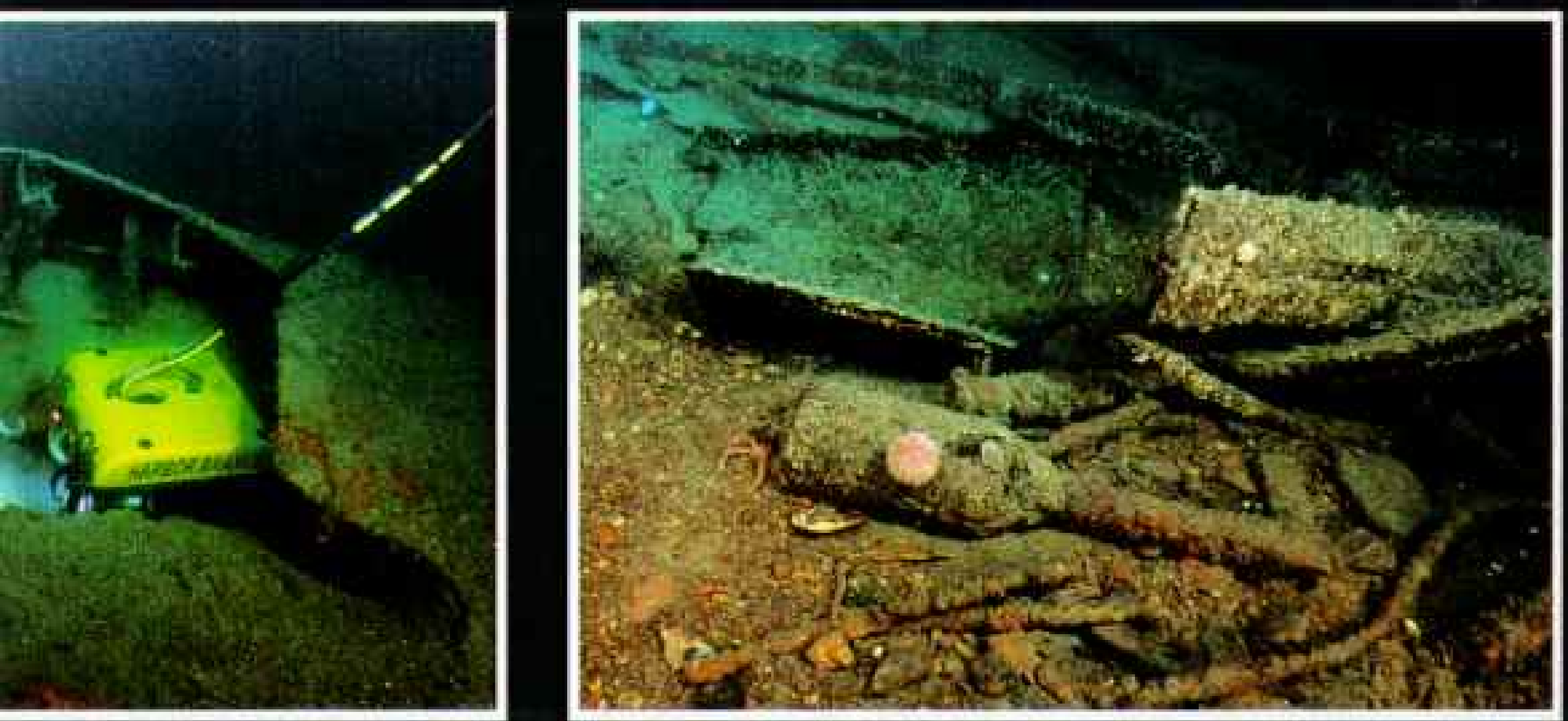
A more likely possibility was a coal-dust explosion. The German torpedo struck the liner's starboard side about ten feet below the waterline, rupturing one of the long coal bunkers that stretched along both sides. If that bunker, mostly empty by the end of the voyage, contained a large amount of volatile coal dust, the torpedo might have ignited it. The *Titanic*'s sister ship, *Britannic*, which was sunk not long after the *Lusitania*, is believed to have suffered such a blast. That would also explain all the coal we found scattered on the seafloor near the wreck.

PADDY O'SULLIVAN

Some damage to the *Lusitania* had little to do with the German attack. Salvage divers in 1982 cut a neat hole in her stern (right) to recover silverware and other items. Our robot, *Homer*, was small enough to go inside for a quick look around. Smaller holes in the hull near the bow were made by "hedgehog" mortar bombs fired during World War II, when enemy submarines were suspected of using the wreck as a hideout. Home to a lone sea urchin, an unexploded bomb (far right) lies near the damaged superstructure.







Tossed together on the bottom, the skeleton of a first-class shower stall—still attached to a bathtub—lies beside the boxlike cover of a skylight from one of *Lusitania*'s upper decks, illustrating the confused nature of the wreckage. When the ship struck the bottom, her superstructure appears to have slid off the starboard side onto the sand.

Rumors of diamonds, gold, and other valuables locked away in *Lusitania*'s safes have prompted salvage attempts over the years, though no treasure has ever been reported. In 1982 a team led by Oceaneering International removed three of the vessel's four brass propellers, two bow anchors, and a ship's bell, as well as silverware, china, and several boxes of what were later revealed to be suspender clips.

A ceramic pitcher made especially for Cunard was salvaged in 1982. We discovered a stack of china resting on a deck near the stern (bottom), where it may have been packed in a wooden box or thin metal dish holder that has since deteriorated.

OCEANEERING INTERNATIONAL


TO THE MEMORY OF ALL WHO PERISHED BY
THE SINKING OF THE LUSITANIA MAY 7 1915
AND IN THE CAUSE OF UNIVERSAL AND
LASTING PEACE

"She's still my baby," says Alice Drury (right, at left) of Audrey Pearl Lawson Johnston, giving her hand a squeeze. As an 18-year-old English nurse, Alice was one of two nannies traveling on the *Lusitania* with Maj. and Mrs. Warren Pearl, an American couple, to care for their children: three-month-old Audrey, Stuart, five, Amy, three, and Susan, two. Preparing to give Audrey a bottle, Alice had just laid her on a shawl on the bed in her cabin when the torpedo hit.

"I heard a terrific thud and knew what had happened right away," she says.

Gathering up Audrey in the shawl, she tied both ends around her own neck like a sling, grabbed Stuart by the hand, and headed up the stairs for the portside boat deck.

A crewman put Stuart in a lifeboat about to be lowered. But when Alice tried to board, the sailor told her it was full. So, without a life jacket and with Audrey around her neck, she jumped into the water beside the lifeboat. A woman in the boat grabbed Alice by her long, flowing auburn hair and pulled her aboard.

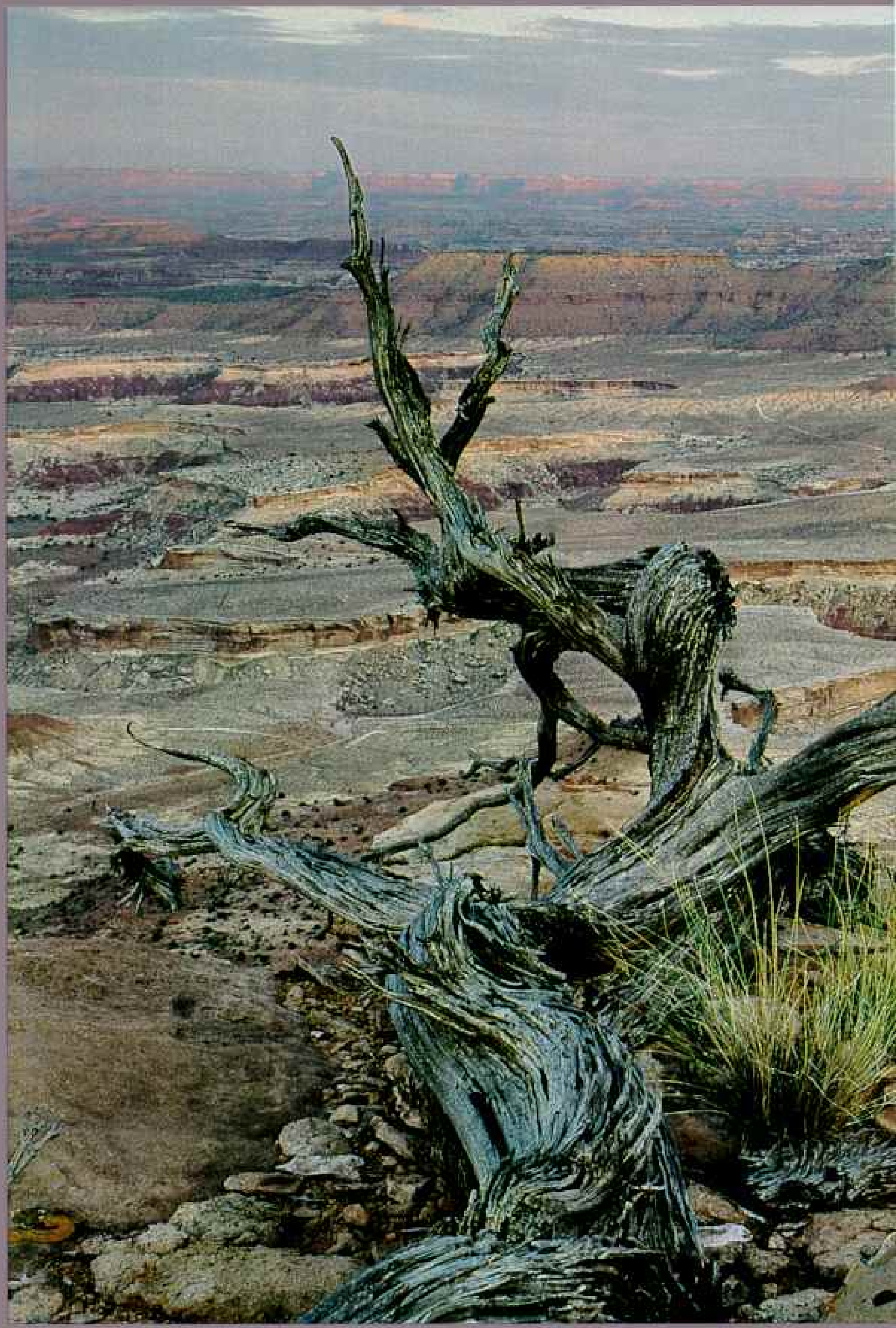
"My hair saved our lives," she says.

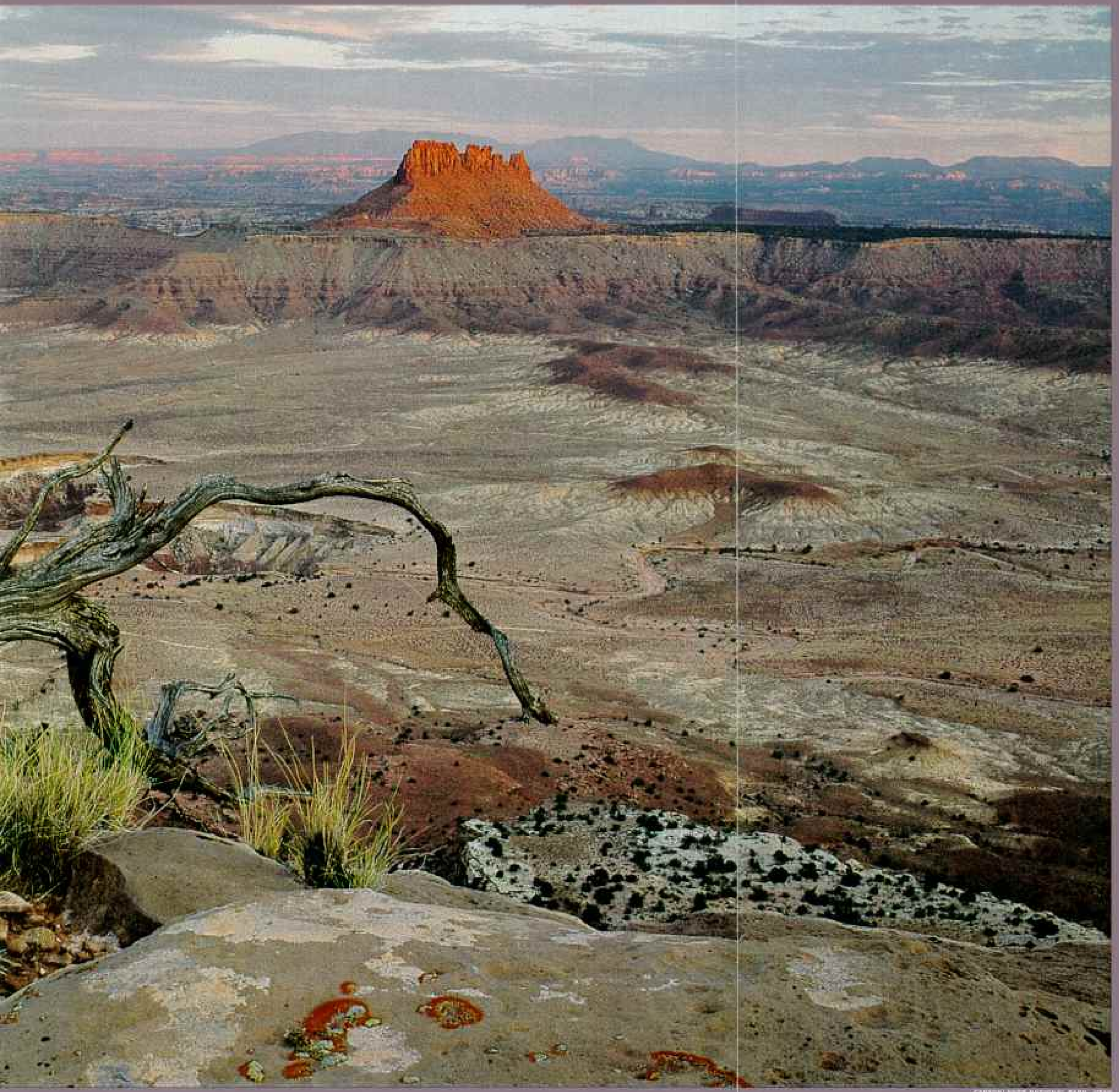
Audrey's parents were rescued too. But Amy and Susan and the other nanny, Greta Lorenson, who was looking after them, were never seen again. Alice and Audrey have remained close ever since.

A monument to the *Lusitania*'s victims, survivors, and their rescuers gets a scrubbing by Richard Brennan, at left, and Ted McNamara in Cobh, Ireland, formerly Queenstown. The town's name was changed in 1920, about the time of Ireland's independence from the United Kingdom. The Gaelic inscription beneath the angel reads, "Peace in God's name."

For a three-year-old American boy "foully murdered by Germany," peace will forever be mixed with anger on the stone marking his grave at the old cemetery at Cobh (below).

Though relations among nations have healed in the years since, the horror and fascination of the *Lusitania* have never diminished. Our exploration of her was like a somber return to the scene of a crime. With our high-technology tools we searched for the "smoking gun" that might solve her riddles. But the truth about the sinking of the *Lusitania* remains as murky as the dark Celtic Sea. □





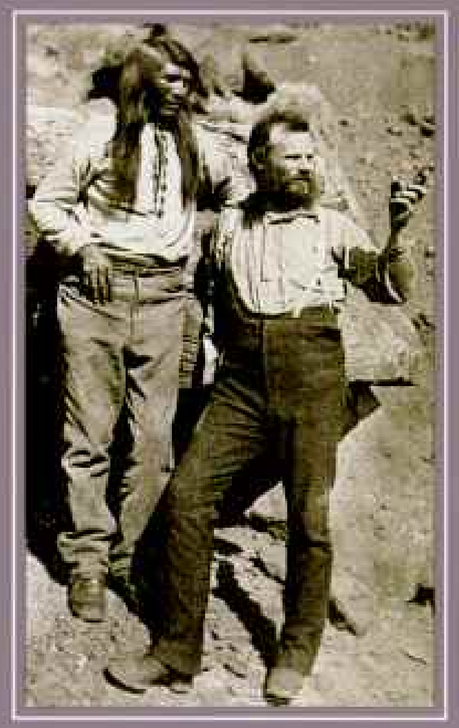
CANYONLANDS NATIONAL PARK, UTAH

Barren desolation is stretched before me; and yet there is a beauty in the scene. The fantastic carvings . . . with the bright and varied colors of the rocks, conspire to make a scene such as the dweller in verdure-clad hills can scarcely appreciate.

—JOHN WESLEY POWELL, MAY 1869

JOHN WESLEY POWELL

Vision for the *West*



Friend of the Paiute and of presidents, John Wesley Powell won acclaim by braving rapids of the Colorado to lead the first exploration by whites of the Grand Canyon. A gifted naturalist and public servant, he opened a young nation's eyes to the promise—and limitations—of its western lands.

BY PETER MILLER

PHOTOGRAPHS BY BRUCE DALE

BOTH NATIONAL GEOGRAPHIC STAFF

MODERN-DAY ADVENTURERS RUN HORN CREEK RAPIDS ON THE COLORADO RIVER

John Wesley Powell was in trouble, and he had no one to blame but himself. The stubborn, one-armed explorer was clinging to the face of a cliff, toes jammed into a crevice, body

BARRAN COLLECTION

Sunrise tints the sandstone face of Arizona's Toroweap Overlook (opposite), 3,000 feet above the Colorado River in the Grand Canyon. As Powell and his nine-man crew swept down the unexplored river in 1869, he carried a locket (above) bearing pictures of himself and his wife, Emma Dean.

pressed against the sandstone, the fingers of his only hand grasping an outcrop above.

The date was July 8, 1869. He and nine crewmen were halfway through their celebrated voyage down the Green and Colorado Rivers—the first descent through the Grand Canyon. With former Army Sgt. George Y. Bradley, Powell had set out that morning to climb a thousand-foot precipice to survey the route, then a blank on maps of the American West. Scrambling through gulches and over benches, the two had reached the base of a sheer wall, where they were forced to inch along narrow ledges. That was where Powell made his big mistake:

Here, by making a spring, I gain a foothold in a little crevice, and grasp an angle of the rock overhead. I find I can get up no farther, and cannot step back, for I dare not let go with my hand, and cannot reach foothold below without. I call to Bradley for help.

As Powell anxiously watched, his companion climbed up to the rock above his head. But he was still just out of reach.

The moment is critical. Standing on my toes, my muscles begin to tremble. It is sixty or eighty feet to the foot of the precipice. If I lose my hold I shall fall to the bottom, and then perhaps roll over the bench, and tumble still farther down the cliff. At this instant it occurs to Bradley to take off his drawers, which he does, and swings them down to me. I hug close to the rock, let go with my hand, seize the dangling legs,

and with his assistance, I am enabled to gain the top.

And so the great explorer was rescued by the gallant Bradley—minus his trousers.

His friends would have laughed, I think, as Powell retold the story years later. They would be crowded around a smoky table at a Washington, D. C., men's club with their beards and starched collars—geologists, cartographers, geographers, anthropologists, hydrologists, politicians.

Waving a cigar as he speaks, Powell strolls back and forth beneath the gaslight chandeliers, a stout, whiskery fellow with a bulbous nose, bushy eyebrows, and a confident manner. They call him the Major, a title he earned as a Union artillery commander during the Civil War, when he lost his right arm below the elbow at the Battle of Shiloh.

He looks every inch the stern officer, but those at the table know he has a mischievous sense of humor. During his second trip down the Green and Colorado Rivers, in 1871, he liked to amuse fellow crewmen by belting out the hymns of his Methodist youth—"The dear blessed Bible, the fam-i-ly Bible"—in the ruined voice of an old woman.

The men laugh, drink their brandy, and demand more stories. But Powell has other things on his mind. He wants to talk seriously about the problems of the West. He wants to discuss the region's lack of water and its foolish land laws. He wants to describe his plans to bring order to chaotic western settlement. He wants to tell them about the misfortunes of native peoples and their vanishing cultures.

But the men have heard it all before. They know their friend's head is filled with big ideas. They make him tell another story.

A lone cannon stands at the edge of Bloody Pond in Shiloh National Military Park in Tennessee, yards from where Captain Powell lost his right arm below the elbow to a Confederate rifle ball in April 1862. The stump, too sensitive to bear an artificial arm, pained him throughout his life, but Powell returned to duty after 11 months, eventually earning a promotion to major. During lulls in the fighting, the Major—as he would forever be known—scoured the fields for fossils and arrowheads.

I WISH I COULD HAVE been there to hear the Major speak. Almost alone among his contemporaries he recognized the West for what it was—not an empty desert, as some feared, nor a fertile paradise, as others claimed, but a challenging new land demanding a new style of living. As an explorer, scientist, reformer, and bureaucrat, he understood the region better than anyone else alive. And he spent a lifetime pursuing a dream: To make the West a better place to live, not through money and power, as was the custom on the frontier, but through science and reason.

If you have ever bought a government map to go hunting or backpacking, you owe a nod of thanks to Powell, who helped create the United States Geological Survey in 1879. As its second director he launched a complete topographic mapping of the nation, a 54,000-map project completed only in 1991.

When you bite into an apple from Washington State or a peach from California, you may be tasting the fruits of Powell's labor. Western agriculture is watered by the hundreds of dams and thousands of miles of canals built by the Bureau of Reclamation and inspired by his ideas about irrigation.

Even the fact that you are holding this magazine is proof of Powell's lasting influence. He was one of 33 men who founded the National Geographic Society on January 13, 1888.

Though he faced bitter disappointments during his lifetime—especially at the hands of Westerners themselves—Powell left a rich

legacy to the nation, laying the foundation for federal land policy, elevating the status of government science, and planting the seeds of the conservation movement.

More than a rough-and-ready explorer, he was a visionary.

THE FIRST TIME I SET EYES on the Grand Canyon, I remembered Powell's warning: *A year scarcely suffices to see it all. . . . You cannot see the Grand Canyon in one view, as if it were a changeless spectacle from which a curtain might be lifted, but to see it you have to toil from month to month through its labyrinths.*

My 14-year-old son, Charley, and I did not have as much time as that. But as we hiked down the twisting Kaibab Trail to the Colorado River at the bottom of the canyon, we were hoping, in the week we did have, to share a taste of Powell's great adventure.

The canyon opened up before us with all the drama we had imagined. After we dropped below the ponderosa pine forests of the South Rim, we descended narrow ridgelines past crumbling cliffs of white sandstone, red limestone, chocolate sandstone, and maroon shale, descending 4,700 feet to the river. There, exhausted and thirsty, we joined a group of travelers in wooden dories for the last leg of a voyage in Powell's wake.

The group, led by veteran river guide Brad Dimock of Flagstaff, Arizona, was retracing Powell's route from the Green River in Wyoming. Following the Green into Utah, where it joins the Colorado, the modern adventurers had skimmed across Lake Powell (created in 1963 by Glen Canyon Dam and named for the Major), traversed the white water of Marble

Hills laugh with delight as burgeoning

CRUISE CANYON, 2004

bloom is spread in the sunlight.

—JOHN WESLEY POWELL, 1895

The river rolls by us in silent majesty; the quiet of the camp is sweet; our joy is almost ecstasy.

—JOHN WESLEY POWELL, AUGUST 1869

Canyon, then plunged into the depths of the Grand Canyon. The big rapids lay ahead.

Pausing at roughly the same spot where we joined Brad and the others, Powell had confessed some doubts to his journal:

We are three-quarters of a mile in the depths of the earth. . . . We have an unknown distance yet to run; an unknown river yet to explore. What falls there are, we know not; what rocks beset the channel, we know not; what walls rise over the river, we know not.

Charley and I felt the same uncertainty as we pushed off in the dories. Brad reassured us: "Powell faced all kinds of difficulties we don't have any more. He had lousy boats. He had no idea how to run rapids. He didn't know what to expect. We've had more than 120 years of experience with this river."

We tried to recall these comforting words a few days later as we drifted toward the gut-shaking rumble of Lava Falls Rapids, which drops 20 feet in a hundred yards.

Brad took our boat to the right side of the rapids to avoid the powerful lateral wave that gushes from the 12-foot ledge at the start of Lava Falls. Aiming straight for the center of the big V-shaped waves that followed, we hit the first few perfectly, our bow plunging into each trough and flying up to meet the next crest. Then a wall of water crashed down on our heads, soaking us to the skin. Charley whooped in delight as it hit, and I turned to see him hanging on with both hands.

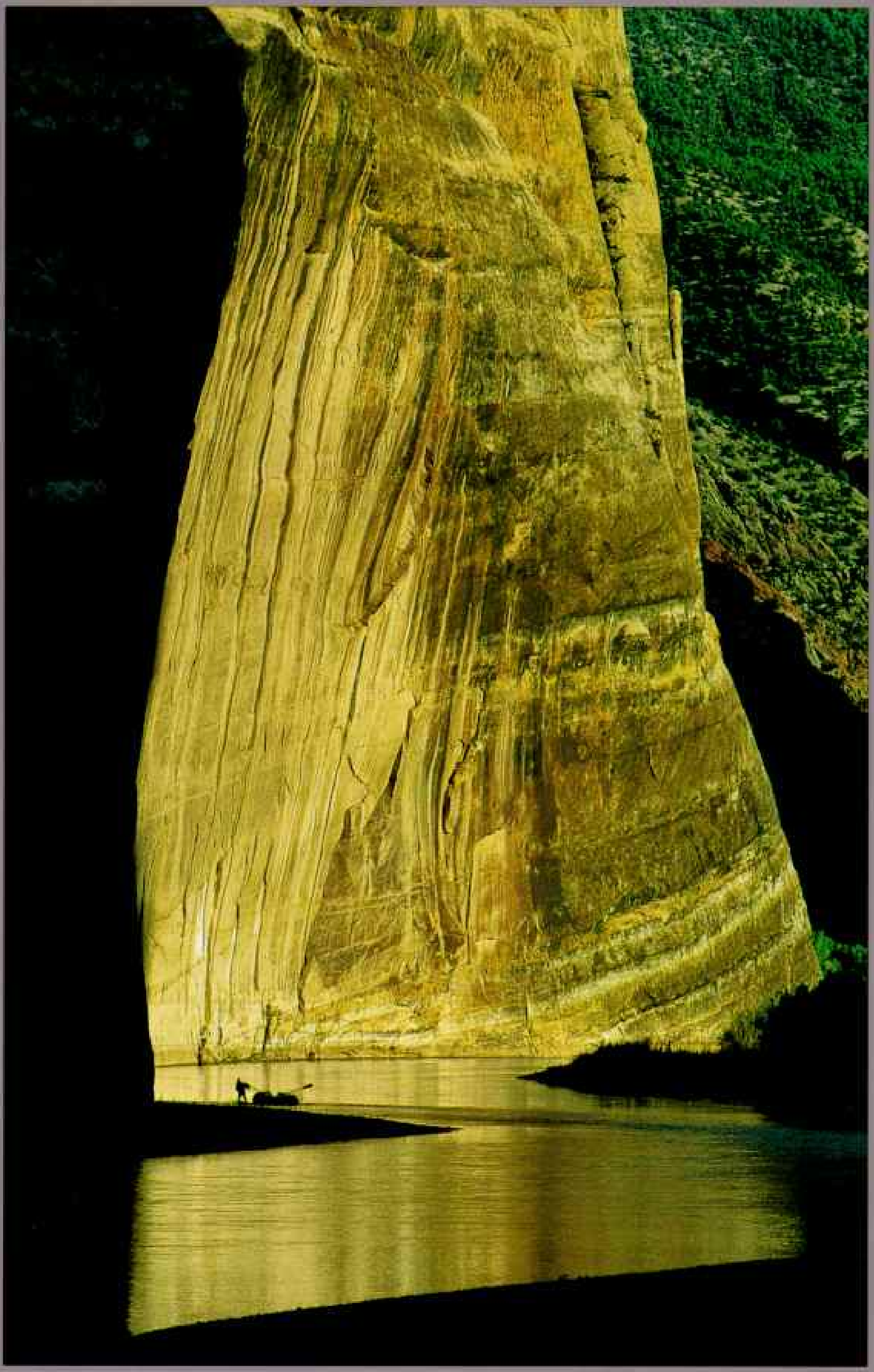
The ride was so fast it almost seemed too easy. But as we bailed out the dory, I realized Charley and I had gotten our wish after all. For a few hair-raising seconds we had tasted the exhilaration that drove Powell to live his life on the edge of the unknown.

To understand John Wesley Powell, the explorer and scientist, you must remember that he grew up on the frontier. The son of an itinerant Methodist preacher, young Wes, as his family called him, was managing their backwoods Wisconsin farm by the time he was 12.

His parents, Joseph and Mary, were part of the nation's great western migration. After leaving England in 1830, they moved from New York State, where Powell was born in 1834, to Ohio, Wisconsin, and later Illinois, raising eight overachievers along the way.

Joseph wanted his son to prepare for the ministry. But Wes preferred to wade creeks looking for shells or to dig into prehistoric Indian mounds for arrowheads. When he left home to study natural history in college, his father refused to pay the tuition. When he returned from war without his right arm, his father told him to be sensible and settle for a more traditional occupation.

At playful moments, Powell and his men bounced their voices off the walls of Echo Park (right), where the calm Green and Yampa Rivers give no warning of the rapids ahead. An inscription downriver may date from a return trip, Powell's Colorado Exploration Expedition two years later.



"Wes, you are a maimed man," he said. "Get this nonsense of science and adventure out of your mind."

But Wes had a partner for his ambitions in his adventurous first cousin, Emma Dean. Married in 1861, they traveled the West together after the Civil War. In 1867 she became one of the first women to climb Pikes Peak.

Taking a job as professor of natural science at Illinois Wesleyan University in 1865, Powell led a group of students into the still wild Rocky Mountains two years later. There, surrounded by spectacular peaks and gorges, he seized upon the bold idea of exploring the Grand Canyon.

Conquistadores had peered over its rim in 1540, and an Army engineer had reached its western end by steamboat in 1857, yet next to nothing was known about it. Trappers told Powell of waterfalls, whirlpools, and underground passages. He recorded in his journal a Paiute's description of a warrior trying to run the rapids: "The water go h-oo-woogh, h-oo-woogh; water pony (boat) h-e-a-p buck; water catch 'em; no see 'em Injun any more! no see 'em squaw any more! no see 'em papoose any more!"

Unfazed, Powell forged ahead.

He commissioned four boats from the Bagley Boat Yard in Chicago: three 21-foot craft of white oak and a more nimble 16-foot pine vessel for scouting. He designed them himself, adding watertight compartments to hold barometers, chronometers, thermometers, sextants, compasses, and food for what he anticipated might be a ten-month expedition.

PICTURE THE SCENE in Green River, Wyoming Territory, on May 11, 1869. The frontier town is a cluster of unpainted wooden shacks in the shadow of a butte called Castle Rock—a makeshift oasis in a sea of sagebrush, hastily constructed only a year before as a Union Pacific Railroad terminal.

Powell and his brother, Walter—still emotionally scarred from his Civil War experience in a Confederate prison—are supervising the unloading of the four boats from a Union Pacific railcar. A motley crew is there to assist: Sergeant Bradley, five trappers, a teenage mule driver, and an English adventurer named Frank Goodman.

The trappers are just shy of sober. To kill time before Powell arrived, they tried to drink

POWELL COUNTRY

"More than once have I been warned by the Indians not to enter this canyon," said Powell before setting out with a crew that included five trappers and a teenage mule driver. Into four wooden boats they loaded a ton of surveying gear, food for ten months, and the 37-star U. S. flag. Their destination, the Green and Colorado Rivers, appeared on maps of the day as a 500-mile-long blank—inspiring Powell to "add a note to the great sum of human knowledge."

MAY 24, 1869

The crew shoves off from Green River, Wyoming Territory.

JUNE 8

One of the boats is dashed at Disaster Falls. Also lost: a third of the expedition's food supply.

JULY 2

Powell climbs out to restock supplies at the Uinta Indian Agency.

JULY 18

Stopping to recaulk leaky boats, Powell's crew prepares for the unknown Colorado.

AUGUST 3

A welcome stretch of calm river: "We glide hour after hour," writes Powell.

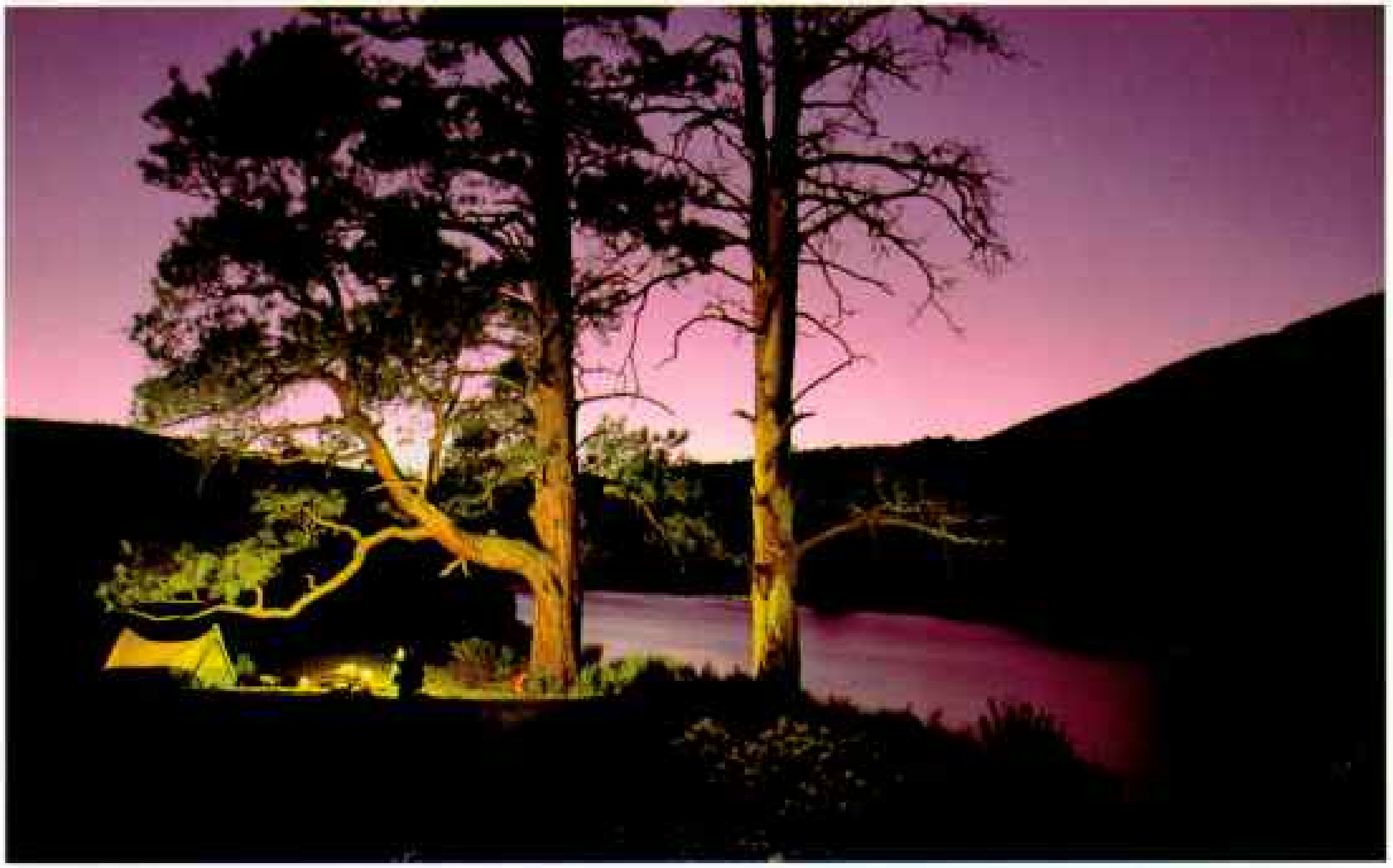
AUGUST 17

"We have now only musty flour sufficient for ten days, and a few dried apples," Powell writes. "We must make all haste possible."

To spare men and boats, the cautious Powell often orders the vessels portaged or lowered with lines through the roaring waters.

A better equipped Powell returned to the Green and Colorado Rivers in 1871, accompanied by photographer E. O. Beaman, who hauled along two tons of camera equipment. His lens captured the men camping (right) at Little Hole on the Green River in northern Utah, where Powell told his diary of the stately pines, still standing today (below).

HILLERS COLLECTION, NATIONAL ARCHIVES



up all the whiskey in town, failing only, one admits, because tavern keeper Jake Fields "persisted in making it faster than we could drink it."

The lofty purpose of Powell's expedition, the 35-year-old self-taught scientist tells the *Chicago Tribune*, is "to make collections in geology, natural history, antiquities, and ethnology." He does not realize that, within a matter of weeks, the journey will become mainly a struggle for survival.

About one o'clock on May 24, a small crowd gathers near the railroad bridge to see Powell and his explorers off.

We raise our little flag, push the boats from shore, and the swift current carries us down.

They lose a third of their provisions on day 16—barely 150 miles into the thousand-mile journey—when a boat splits open on a boulder, spilling food, tools, and weapons into the rapids. Only three barometers and a keg of whiskey the crew had smuggled aboard are salvaged. The Englishman leaves the party shortly after that, hiking out to an Indian

No roof but the old pines above us, through
which we could see the sentinel stars
shining from the deep blue pure sky.

—J. C. SUMNER, MEMBER OF THE 1869 CANYON EXPEDITION

agency. The men begin to grumble about the heat, the mosquitoes, the lack of food, and the backbreaking work of portaging the boats around the wildest rapids.

"The Major as usual has chosen the worst camping-ground possible," Bradley complains. "If I had a dog that would like where my bed is made tonight I would kill him and burn his collar and swear I never owned him."

No one questions Powell's bravery. Day after day, they watch him run the rapids as if he were riding a bronco, clinging to a leather strap attached to his boat. But the men chafe at his military orders, mock his preoccupation with geology, and challenge his decisions.

Not only are they "up against it for grub," says trapper Billy Hawkins, but they have also begun to lose their hats and clothes. To cover his bareness, Hawkins decides to "cut holes in my shirt tail and [tie] the loose ends around my legs." Major Powell says he is dressed "when he has his life preserver on."

THE GRUMBLING comes to a head on day 96. Down to their last sack of flour, the party encounters rapids that seem worse than any before. "This is decidedly the darkest day of the trip," Bradley tells his journal. "The water dashes against the left bank and then is thrown back against the right. The billows are huge and I fear our boats could not ride them if we could keep them off the rocks. The spectacle is appalling to us."

Three of the trappers, Bill Dunn and brothers Oramel and Seneca Howland, tell Powell they have had enough. They want to climb out of the canyon and walk to a Mormon settlement. Reviewing his notes, Powell judges the nearest towns to be no more than four days away. He too is tired, hungry, and discouraged by confinement in this "granite prison." But succeeding means too much:

To leave the exploration unfinished, to say that there is a part of the canyon which I cannot explore, having already almost accomplished it, is more than I am willing to acknowledge. . . .

Despite Powell's admonitions, the three men depart. After a tough climb out of the canyon to the North Rim, they are ambushed and killed by a party of Shivwits warriors.

Meanwhile, Powell and the five remaining crewmen survive the rapids at what is now called Separation Canyon. In two days, on August 29, they emerge from the gorge into a low, rolling desert near the mouth of the Virgin River. Powell is triumphant.

Now the danger is over, now the toil has ceased. . . . The river rolls by us in silent majesty; the quiet of the camp is sweet; our joy is almost ecstasy.

Years later a reporter would ask Powell for the secret of his success. How did the great explorer get through the Grand Canyon on his first try?

"I was lucky," he said.

When news of his adventure spread around the country, Powell was cheered like a returning astronaut. America in 1869 was hungry for heroes of the West, and the Major fit the bill.

He became a star of the lecture circuit. At Pike's Music Hall in Cincinnati—following a performance by the Yankee Kitchen Choir—Powell delivered an hour-and-a-half talk, without notes, on "Canyons of the Colorado." He speculated on the forces of upheaval and erosion that created the Grand Canyon—concepts that other geologists were just beginning to explore.

We think of the mountains as forming clouds about their brows, but the clouds have formed the mountains. Great continental blocks are upheaved from beneath the sea by internal geologic forces that fashion the earth. Then the wandering clouds, the tempest-bearing clouds, the rainbow-decked clouds, with mighty power and with wonderful skills, carve

We are three-quarters of a mile in the depths of the earth. . . . We have an unknown distance yet to run; an unknown river yet to explore.

—JOHN WESLEY POWELL, AUGUST 1869

out valleys and canyons and fashion hills and cliffs and mountains. The clouds are the artists sublime.

His instant fame opened doors. Congress gave him $10,000 to establish the Geographical and Geological Survey of the Rocky Mountain Region. A collection of relatives and amateur scientists, the Powell Survey undertook a second expedition down the Green and Colorado in 1871-72 to do more mapping of the canyons; they roamed the Utah Territory for nine years conducting geographic studies.

But Powell's fascination with the region went beyond adventure and geology. He was increasingly drawn to its native peoples. He got to know Ute in Colorado, Navajo and Hopi in Arizona, and Southern Paiute in Arizona, Utah, and Nevada. He learned to speak both Ute and Southern Paiute.

At a time when the U. S. Army was waging war against Native Americans, Powell moved freely among western tribes without a military escort. "I can get along with the Indians by peaceable methods much better," he claimed. His success in studying native cultures led to the founding in 1879 of the Smithsonian Institution's Bureau of Ethnology, which he directed for 23 years.

Powell spent several months in 1872 living in the plateau country north of the Grand Canyon with the Kaibab Paiute, a people he described as "more nearly in their primitive condition than any others on the continent." He collected samples of their clothes, tools, and handicrafts, compiled lists of words, listened to myths, and watched them dance:

Around they went, old men and women, young men and maidens, little boys and girls, in one great circle, around and around, all singing, all keeping time with their feet, pat, pat, pat, in the dust and sand; hoarse voices; high, broken, screaming voices; mellow, tender voices; but louder than all, the thump and screech of the orchestra.

THE FIRST SNOW had fallen a few nights before I drove out to the Kaibab Reservation in Arizona. Workers from the Tribal Housing Authority were up on the roofs of the small, modern bungalows, wrapping plastic tarps around air conditioners for the coming winter. Out here on the high plateau the icy wind can chill to the bone. About 120 people live in the village on the 120,000-acre reservation.

Powell's main contact among the Kaibab Paiute was their leader, Chuarumpeak, a tall man with a strong, handsome face.

"Chuarumpeak was my grandfather," said Elva Drye, an elderly woman I met in her son's kitchen. "My grandmother told me he used to go around with this man, Powell, who had an arm missing."

Years before, I had been told, Ute in Colorado had given Powell the name Right-arm-off. But Mrs. Drye had heard a different story.

"They called him Kah-puh-rats," she said politely. "There's a kind of rat in the desert that has tiny legs like that. His name comes from that."

"You mean they called him Rat-arm?" I said in surprise.

"Well, they didn't say it to his face."

Powell admired the Kaibab Paiute as individuals but regarded their culture as savage. Because science, he believed, was the "chief agency of civilization," no society could claim to be advanced in which "coughs are caused by invisible winged insects, rheumatism by flesh-eating bugs too small to be seen, and the toothache by invisible worms." Ironically, scientists of his day were reaching conclusions surprisingly similar to those of the Paiute: Diseases could be caused by microscopic organisms such as bacteria.

Touched by their poverty, he urged the Kaibab band to leave their home and move to the Muddy Flats Reservation in Nevada. There

HILLERS COLLECTION, NATIONAL ARCHIVES

Powell's throne was an armchair lashed to the gunwales, where he made note of passing rock strata and rallied his crew with poems such as Sir Walter Scott's "Lady of the Lake," which lauds "the will to do, the soul to dare."

they could farm and learn to become more like whites. He did not want them to lose their land and traditions, yet he saw no choice "but to remove them from the country or let them stay in their present condition, to be finally extinguished by want, loathsome disease, and the disasters consequent upon the incessant conflict with white men."

In this, at least, the Major was wrong. Most Kaibab stayed in their homeland and survived the hard times.

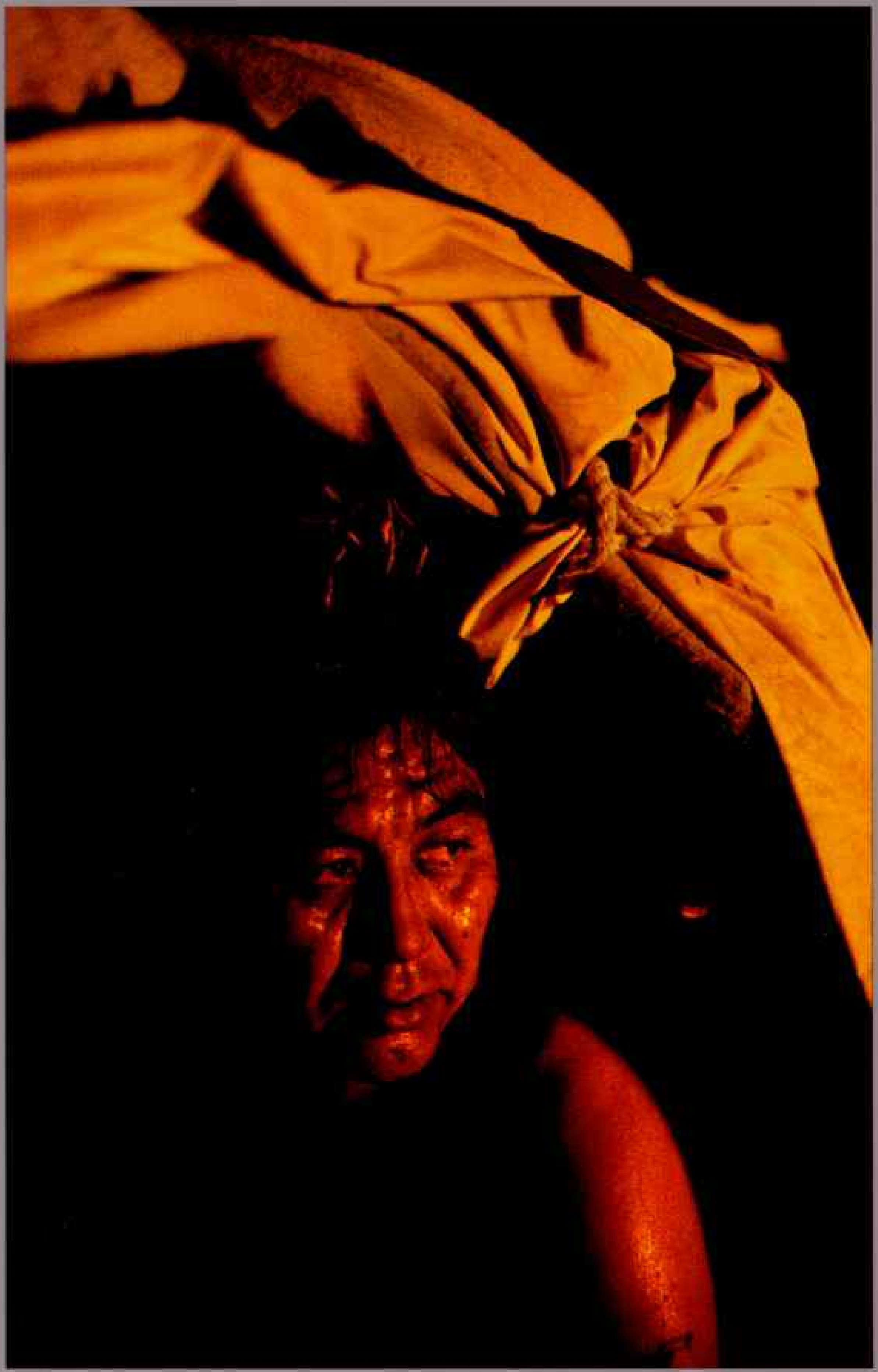
"We've been through a lot of changes since Powell's day," 53-year-old Vivian Jake told me. "But we haven't lost our culture. We can still sing. We can still do the dances."

BY 1872 POWELL knew that his future lay in government science, not in teaching. He resigned from his university position and moved to Washington, D. C., where decisions were being made about the West. He and Emma bought a town house a few blocks from the red sandstone towers of the Smithsonian Institution, where he was given a modest office.

Washington was in the grip of a massive public works project. Its broad streets, which had been "seas of mud or beds of dust," as one resident complained, were being paved with wooden blocks or concrete, following the plan of the District's new governor, "Boss" Shepherd. The community's first sewers were replacing open gutters and canals. Trees were being planted. What had been described as a "slovenly and comfortless Southern town" was becoming a city to be proud of.

Science was also on the rise in the capital. The nation's lawmakers, faced with rapid industrialization, urbanization, an influx of immigrants, and the headlong settlement of the West, were turning more frequently to experts for advice. Powell wanted to help.

A likable, gregarious fellow, the Major was soon well-known about town. His blunt face, with his glittering eyes, comical nose, and unruly whiskers, was not a handsome one, wrote one friend, "but it was one which could not be overlooked in any assembly." Neighbors greeted him as he took his only child, Mary, on walks to see the unfinished Washington Monument, then about a third its eventual height, or to visit the Smithsonian building, where he showed off his own collection of Indian crafts.



He had a talent for making friends. Upon meeting Mississippi Congressman C. E. Hooker, who lost his left arm in the battle at Vicksburg, the Major joked about the two of them wasting so many gloves. From then on, whenever he bought a new pair, he sent his unneeded right glove to Hooker.

When walking, Powell unconsciously held the tender stump of his arm with his left hand to protect it. He lived most days in pain but never let it slow him down. During his surveying in Utah, he refused a driver for his buggy, preferring, a friend wrote, "to mount the box and, with his one hand, manage the four-horse team over the rough and trackless regions."

SHUTTLING between Washington and the arid high plateau region of Utah, Arizona, and Colorado to carry out his surveys, Powell realized that he had a cause to promote.

The problem was water. As settlers pushed deeper into the public domain, claiming free land under the 1862 Homestead Act, they were moving into areas without enough rainfall to support them. Speculators and land promoters might describe the dusty plains as "a flowering meadow of great fertility, clothed in grasses and watered by numerous streams," but Powell knew the truth.

From the short-grass prairies of western Nebraska, Kansas, Oklahoma, and Texas all the way to the Sierra Nevada in California, crops such as wheat, corn, and cotton could not grow without irrigation. And even if every drop of every available stream was diverted, he figured, there was only enough water to irrigate a fraction of the territory.

Fearing a disaster, Powell suggested a radical plan. In an 1878 report to the secretary of the interior, he proposed that the government sell no more western farmland that did not have access to water. Too many newcomers were ending up on worthless land. He also argued that property boundaries should not be arbitrarily straight but rather should encompass natural watersheds to avoid competition for streams. And he urged that farmers be encouraged to build irrigation systems in groups, instead of relying upon unscrupulous private water companies.

"In the whole region, land as mere land is of no value," Powell said. "What is really valuable is the water privilege."

His approach was revolutionary: to replace the haphazard individualism of the frontier with cooperative action based on science. It was a direct challenge to the rough-and-tumble way the West was being settled.

Powell's ideas about water management came from the Mormons of Utah, who had learned how to survive in the desert. In the oasis community of Kanab, Powell watched springwater flowing down ditches along tree-lined streets and irrigating orchards of apples, pears, and cherries.

Lorenzo Brown, an 85-year-old alfalfa farmer who lives just across the border in Arizona, told me how the system worked.

"It was all cooperative," he said, handing me his old black ledger filled with dates and times. Using the same system as the original settlers, Brown and other Mormon farmers collected water from a local spring in ponds. Then, according to the schedule in the book, they released it into ditches to irrigate each man's fields. "Everybody got a turn."

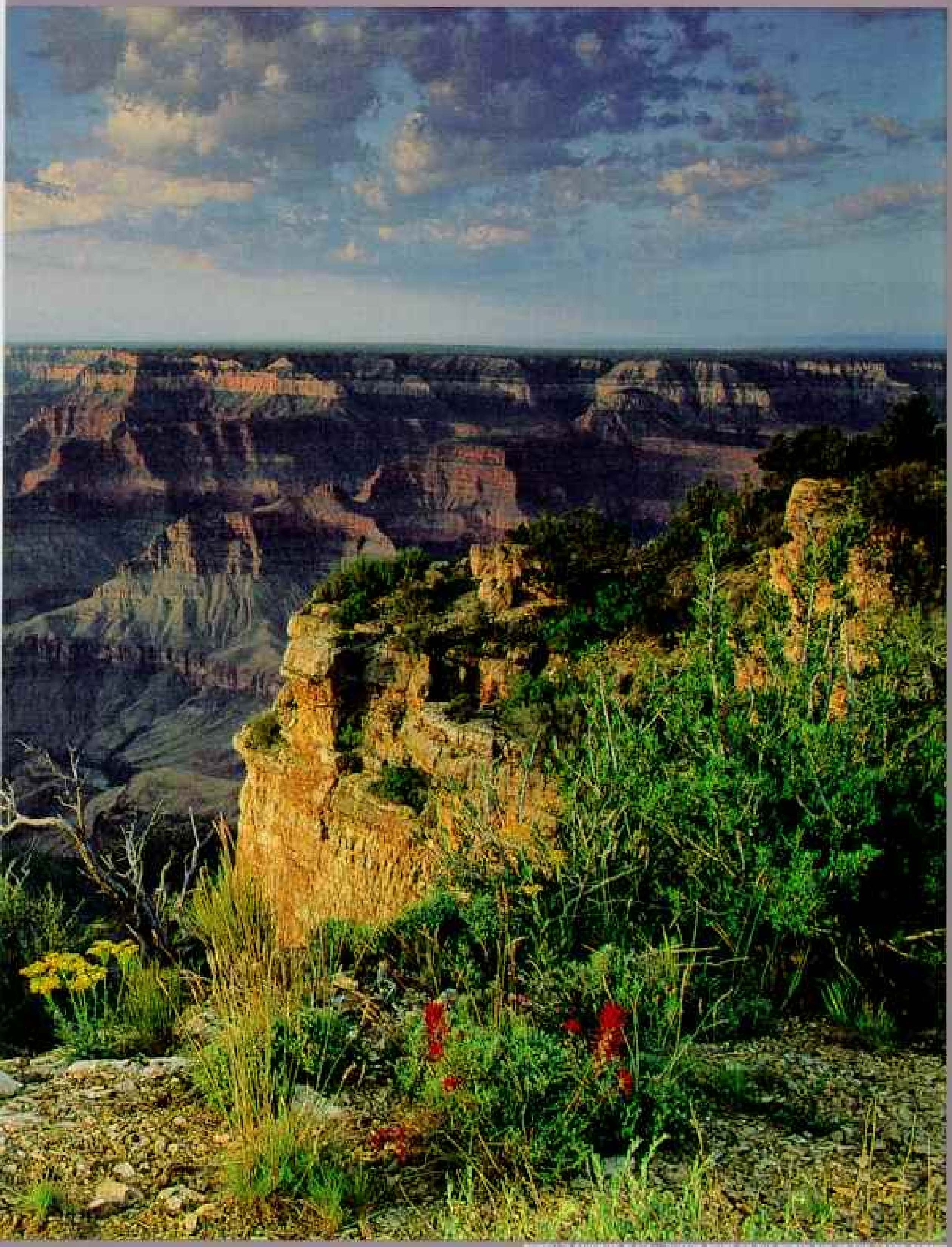
The Major's plan to distribute water, however, was rejected by Westerners. His proposal threatened the wealthy ranchers, land speculators, railroads, mining companies, and water monopolies that already controlled the best streams. Politicians branded him a "revolutionist," a "charlatan," an "intermeddler in affairs of which he has no proper conception." His report was brushed aside.

Powell didn't give up. In 1881 he became director of the U. S. Geological Survey, a fledgling experiment in government science that he had helped create two years before. Under its first director the Survey was mainly a tool of the mining industry. But the Major, believing that government science should benefit all the people, expanded the bureau's activities. Today, as the largest and most respected organization of its kind in the world, the Survey is charged with predicting volcanic eruptions and earthquakes, scrutinizing water quality, estimating oil reserves, and producing some 90,000 maps.

When a severe drought struck the West in the late 1880s—as Powell had predicted one

Fresh from the sweat lodge, Kaibab Paiute spiritual leader Benn Pikyavit recalls tribal elders trading stories about Powell, a student of native cultures who moved freely among western tribes without a military escort.

You cannot see the Grand Canyon in one view, as if it were a



POWELL'S FAVORITE PLACE—SUNSET POINT ON THE NORTH RIM OF THE GRAND CANYON

changeless spectacle from which a curtain might be lifted. . . .

—JOHN WESLEY POWELL, 1895

would sooner or later—he got a second chance to reform the region's land and water laws. After watching their fields crack to dust, tens of thousands of settlers were abandoning their farms. These pioneers had huddled in sod houses on treeless plains, burned buffalo chips for fuel, endured blizzards, prairie fires, and plagues of locusts. But the drought was too much. Congress turned to Powell.

A GREAT BATTLE was about to erupt over western irrigation. It began in March 1888 when William "Big Bill" Stewart of Nevada pushed a resolution through the Senate authorizing Powell to do a survey of potential dam sites. It was a move Big Bill would soon regret.

An unlikely ally for the Major—one historian describes him as a conservative dragon "whose cave was the smoke-filled room"—Stewart was a blustery champion of both irrigation and big business. He expected Powell to do a quick study of the most obvious damsites, then step aside for private developers.

But the Major had other ideas. "I think it would be almost a criminal act," he said, "to . . . allow thousands and hundreds of thousands of people to establish homes where they cannot maintain themselves." Instead of preparing a hasty survey, he began mapping irrigable land in the entire public domain—an area five times the size of Texas—a project he knew could take a decade to complete.

Big Bill Stewart was enraged. A careful scientific study was the last thing he wanted. Worse, the General Land Office suspended all land sales in the region until Powell finished his work. Furious, Stewart vowed to destroy the Major.

At a series of blistering hearings he accused Powell of mismanaging irrigation survey funds. "Every representative of the arid region—and I think there is no exception—would prefer that there would be no appropriation to having it continue under Major Powell," he fumed. Behind the scenes he spread rumors about the Major's private life: "I have made some inquiry and find that his habits with women are scandalous."

Powell ignored the personal remarks and fought back like a seasoned pro. Testifying to legislators, he distributed photographs of himself with Indians to remind them of his heroic past. He lobbied fellow scientists for support and wrote magazine and newspaper articles to rally the public. For years he had hired sons and nephews of congressmen as summer help at the Geological Survey. Now he ordered his staff to dance with those officials' wives and daughters at formal parties. Anything to buy time for his men in the field.

But time was one thing he couldn't hustle. In his bid to give Washington control over western development, the Major was bucking a century of hurry-up custom. No one on the frontier wanted government planning, not even the small farmers Powell was trying to help. They wanted land—right away.

Against this boosterism, Powell didn't

Moving to Washington, D. C., in 1872, Powell (seated, at far right) became the founding president of the Cosmos Club, where scientific leaders of the day met over billiards and whist. He navigated the capital's legislative waters skillfully, persuading Congress to create the United States Geological Survey and the Bureau of Ethnology—both of which he would lead. In January 1888 he joined 32 others to establish the National Geographic Society, of which his friend Alexander Graham Bell (standing, at center) would later become president.

PAINTING BY BOB CROFUT

stand a chance. With Stewart wielding the scalpel, Congress sliced Powell's 1891 budget from a proposed $720,000 to $325,000—and eliminated the irrigation survey. The battle was over. The public domain was reopened. Within three years Powell resigned as director of the Geological Survey and effectively withdrew from public life.

Trading his business suit for knickerbockers, a Norfolk jacket, and a black fedora, Powell spent his last summers at a cottage on the coast of Maine. His wispy hair was turning white, but he seemed to regain some of the enthusiasm of his explorer days. He worked on philosophical essays, dictated letters to his secretary, and organized excursions with other vacationers.

When his close friend Alexander Graham Bell heard in September 1902 that Powell's heart was failing, he rushed to Maine from his summer home in Nova Scotia. During their years in Washington the two men had taken long buggy rides through the countryside, debating the great ideas of the age: the nature of language, evolution, gravity, even atomic theory. But the famous inventor arrived too late. Powell had died hours earlier, at 6 p.m. on the 23rd, with Emma and Mary at his side. He was 68.

Proud to be a public servant, he had never

Powell's watchful eye roamed the Maine landscape from this window during the last summer of his life, as the effects of a stroke drained his strength. Here, at his bungalow in Haven, the man forever linked

with the arid West died surrounded by eastern water in 1902. His ideas about irrigating the West, controversial in his lifetime, inspired dams that revolutionized the region in the new century.

In the whole region [the West], mere land is of no value. What is really valuable is the water privilege.

—JOHN WESLEY POWELL, APRIL 1877

looked for financial profit in his work. Emma was forced to ask Bell to help arrange a small congressional pension.

Powell left much more to his country—especially to the West. When President Theodore Roosevelt asked Congress in June 1902 to create a new federal irrigation program—which would grow into the Bureau of Reclamation—he invoked Powell's career.

"If we could save the water running to waste," Roosevelt said, "the western part of the country could sustain a population greater than even legendary Major Powell dreamed."

Indeed, Powell could never have foreseen the degree to which the federal agencies he inspired would change the face of the West with dams, canals, pipelines, and power plants. In the decades since he died, every major river has been harnessed for irrigation, flood control, drinking water, electricity, or recreation—sometimes at the expense, some have said, of the region's natural beauty.

Today's West would amaze, and probably trouble, Powell. Though he would be impressed, no doubt, that farmers in the prairie states have learned how to tap the vast Ogallala aquifer, he would not be surprised to learn how quickly overuse has endangered its supply. We can only imagine what he would think of desert cities like Phoenix or Las Vegas, with their water-guzzling lawns, golf courses, and swimming pools. Would he admire the ingenuity that built them? Or would he question their planning and ask, "Where are you getting all this water?"

But Powell did not live long enough to take sides in the 20th century's battles between big dam proponents and environmentalists. Having set the stage for the debate between growth and preservation, he departed.

TO PAY OUR RESPECTS to the Major, my son Charley and I made our way one autumn afternoon to a crowded office in the back corridors of the Smithsonian's National Museum of Natural History. There we found Powell's brain resting in an old-fashioned specimen jar.

Ever the man of science, Powell had made a bizarre wager with his colleague and future National Geographic Society president W J McGee. Despite his own modest stature, the Major playfully claimed that his brain was larger than that of his bearlike friend. McGee accepted the challenge, and the two men left instructions in their wills for a renowned surgeon to perform the necessary measurements.

We knew there was nothing this inanimate object could teach us about the restless, talented dreamer Powell had been. But we couldn't help staring.

"It's so big," Charley whispered.

As the surgeon had confirmed years before, Powell's brain, at 1,488 grams, was 5 percent bigger than McGee's. He had won his bet.

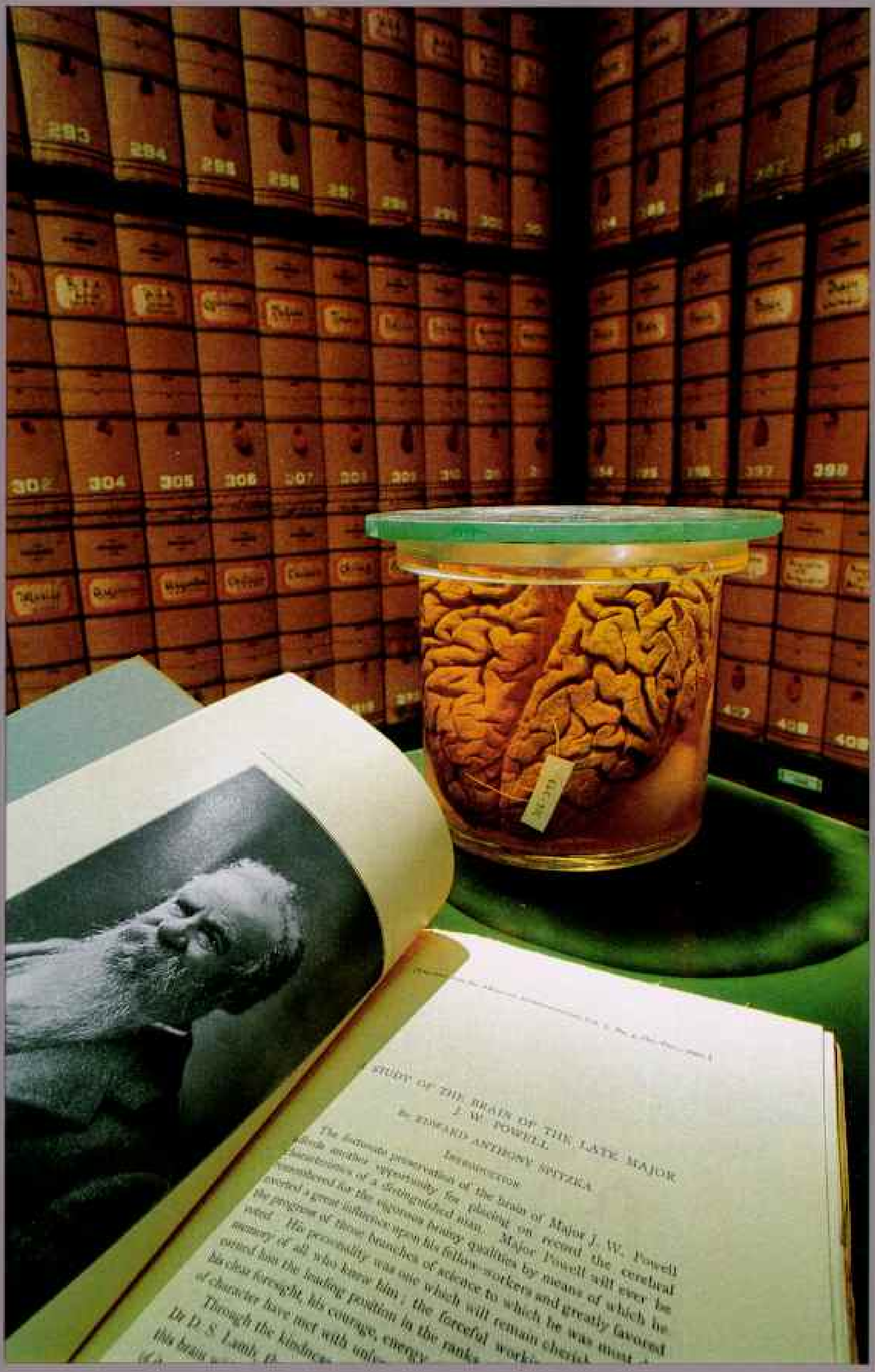
Powell always thought big. That was his way. Extending his mind over epochs of geology and human culture, he had seized upon the West's most fundamental questions. He delighted in its expansive, elemental beauty.

At the end of a particularly rewarding day in Arizona, where Powell and a crew of archaeologists were examining a pueblo ruin, the Major came up with one of his better ideas.

"Make ready my steed," he called to his saddle boy. "We are going to see the sun set."

With irresistible gusto, he led a group out to watch the golds and pinks and reds of the evening. Then, as the sun disappeared below the horizon, he burst into song. □

A scientist to the end, Powell willed researchers his brain—which now rests in a preservative at the Smithsonian Institution. "Things large to others were small to him," wrote his friend W J McGee. "Things great to him were past the reach of most others."


STUDY OF THE BRAIN OF THE LATE MAJOR
J. W. POWELL
BY EDWARD ANTHONY SPITZKA
Instructor
The following presentation of the brain of Major J. W. Powell will ever be
a notable artifact by reason of a distinguished man. Major Powell will ever be
remembered for the vigorous pluck with which he fought against
the progress of those diseases of science to which he was most
mind. His personality was one which will remain cherished
memory of all who knew him; the forceful worker,
of character have met with unfa
Through the kindness
Dr D. S. Lamb, I

Taking advantage of a rare clear day, a team of climbers in southern Chile

CHILE'S UNCHARTED

By JACK MILLER

makes up time during a visit to one of the world's last unexplored ranges.

CORDILLERA SARMIENTO

Photographs by GORDON WILTSIE

A revelation of soaring, ice-encased peaks rewards determined climbers. After weeks of paralyzing weather, they finally approach the 6,550-foot summit of a mountain they called Gremlin's Cap. A nearly permanent cloud cover has kept the 40-mile-by-15-mile coastal range—a finger of the Andes—wrapped in mystery. The expedition, led by author Jack Miller, marked the first successful attempt to penetrate this terra incognita.

WHY ARE WE doing this to ourselves? Rarely a day passed in two months that this question didn't moan in my mind as my friends and I tried to make headway in the forbidding Cordillera Sarmiento. My own doubts spoke up when blizzards and williwaws—ferocious ocean winds squeezed through canyons and fjords—imprisoned us in tents and snow caves for days on end, when toes turned black with frostbite, when even a modest fishing run (right) left us wetter and colder.

But another voice spoke louder. It said: "There are few places on earth where no one has walked, and I've pursued this one for years. I want to show it to the world."

Having climbed and guided in the Andes for three decades, achieving several first ascents, I found that it was this uninhabited, cloud-hidden range in the fjordlands of southern Chile that truly obsessed me.

Only the mistiest accounts of its existence have been recorded since Ferdinand Magellan sailed along the southwest coast of South America in 1520, after his discovery of a passage between the Atlantic and Pacific Oceans. I am surprised this remote mountain chain even has a name. It honors Pedro Sarmiento de Gamboa, the Spanish navigator who pursued Francis Drake along the coast in 1579 and afterward produced detailed maps of the islands at the tip of the continent.

For all my years in the region, I had had only two glimpses of the peaks. Then the unimaginable happened: A clear day dawned over the Sarmiento in February 1990. I rushed to charter a plane and once airborne feasted my eyes. Beneath me appeared dozens of glacier-wreathed summits, several rising 7,000 feet straight out of the fjords. I knew I had to try to explore them. With funding from NATIONAL GEOGRAPHIC, the Shipton/Tilman Grant of W. L. Gore & Associates, and Ladeco Chilean Airlines, I organized an expedition that set off two years later.

For this demanding adventure I handpicked a crew of friends, all expert climbers and skiers, who, like me, wanted a chance to make the first ever trip into a spectacular place. Rob Hart, rowing the raft, is an outdoor-gear manufacturer from Montana. He had flown with me on that magically clear day and was now hooked. Joining him were Tyler Van Arsdell, at rear, right, a former commercial fisherman from Cape Cod—a man used to nasty weather and tight quarters—and the late Phillip Lloyd, a tough South

African climbing guide who fell to his death last December on a similar expedition. Our group also included fellow Coloradan Peter Garber, who has roughed it for months at a time in the region, and photographer Gordon Wiltsie, a veteran of expeditions to both Poles.

We left in early August aboard *Trinidad*, a sturdy 50-foot wooden boat, sailing out of the Chilean fishing port of Puerto Natales, nearest village to the Sarmiento. We timed our visit for the southern winter because, despite the drawbacks of short days and the cold, local reports suggested that we could find openings of calm weather.

Trinidad pitched and bucked on the gray seas. We were traveling in the latitudes known to mariners as the Furious Fifties, where winds charge in like freight trains from Antarctic waters. Ten woozy hours later I saw the cliffs of the Sarmiento between blasts of spray breaking over the bow. The pilot had told me about Jaco, the spirit in local folklore that guards the Fjord of the Mountains, which we now entered. Clinging to the rail, I poured a stream of Chilean *pisco*—brandy—into the sea, calling out to Jaco for safe passage. We would need all the luck we could get.

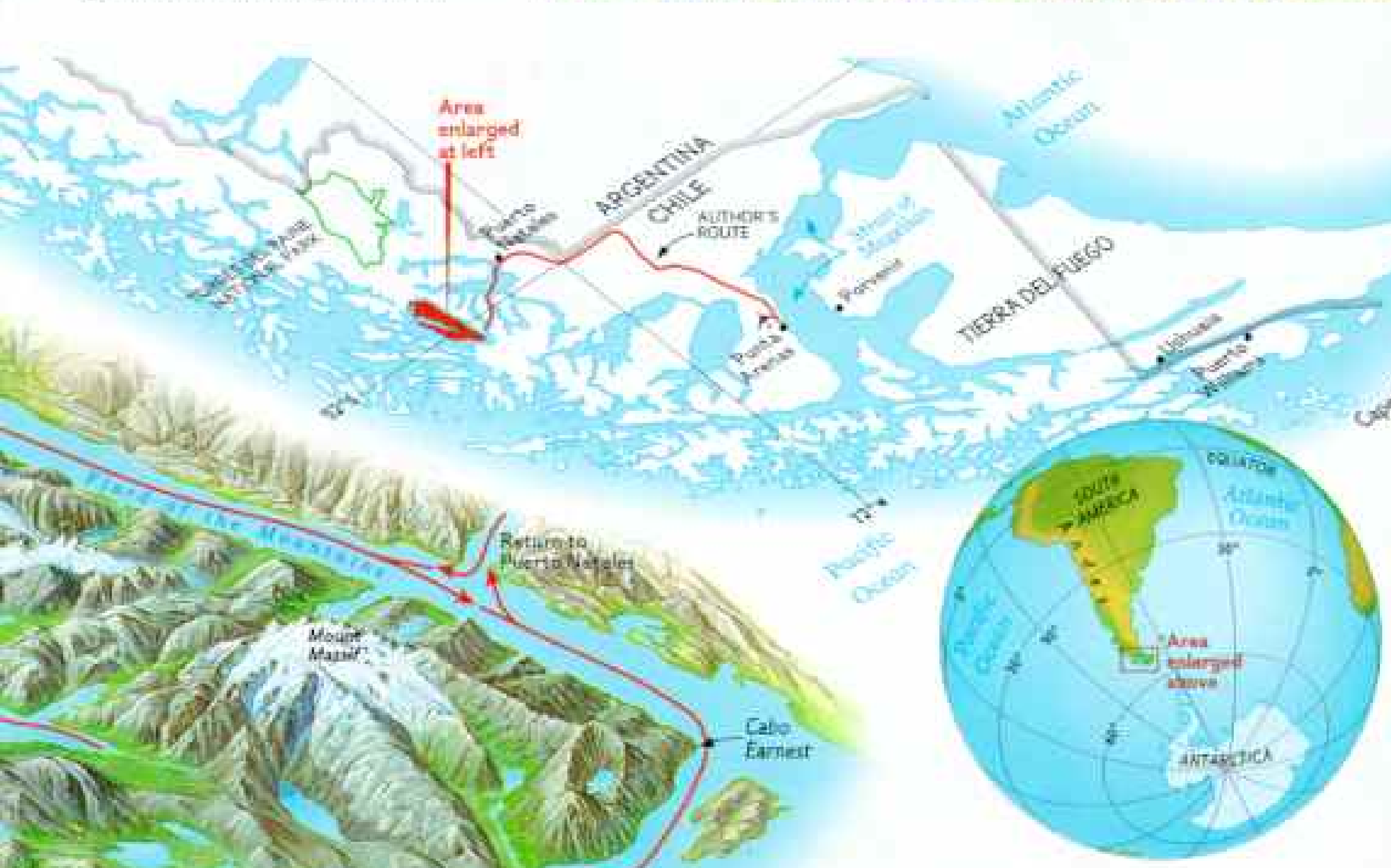
Peak names and elevations provided by author.
Scale varies in this perspective.
NGS CARTOGRAPHIC DIVISION
PAINTING BY JOHN A. BURNER

GREEN WAS THE COLOR we least expected when we landed on the Sarmiento. Instead of skiing atop several feet of winter snow, we found ourselves sinking into boggy turf, victims of an unseasonably warm spell. We scrambled to build platforms for our tents, our feet getting soaked in climbing boots that were designed for snow and ice, not puddles.

Mosses and lichens carpeted the rocks above an iceberg-littered bay (far left) that we paddled to one morning. In the summer-like conditions the glacier calved tons of ice as we watched, the wave from one thundering crash nearly flipping our raft. I hated to think how short a time we would have survived in the frigid water.

After several days of exploring, our progress thwarted by glacial canyons and snarly icefalls, we discovered a route to the peaks. It followed the high ground above the glacier, on what we called No Problema Ridge. To reach the ridge, we had to hack through rain forest, our skis catching on limbs, our boots slipping off logs. We flagged our way every few feet to avoid getting lost. Along the way I stopped to collect fern samples from one leaning giant, a southern beech (below).

A caracara (left), a carrion-eating falcon, followed us once. It would land on branches above our heads and eye us. "Maybe it's waiting to see if we die," Gordon joked nervously.



Previously a little-known spot on charts, the Cordillera Sarmiento reveals itself as a complex region of glaciers, fjords, and sheer peaks. The author based his map measurements on readings from the Global Positioning System, a network of U. S. navigational satellites.

WITH NO TIME to waste, Pete Garber, roped to a lead climber, propels himself toward the summit of South Face, at 6,970 feet the highest peak our expedition would climb. Almost disbelieving of the sunny weather, we had bolted from our high camp at dawn and by noon we were skiing up the gentle summit slope, the world below lost in clouds.

We howled, we danced, we

hugged. First ascents are a climber's dream. We saw the same things the high-flying condors of the area see, peaks 80 miles north in Torres del Paine, Chile's famous climbing park.

That day we reached five other summits in an orgy of mountaineering. It would be our last hurrah. The next day hurricane-force winds pinned us in camp. Instead of rejoicing, we were soon wondering how we would escape.

MOUNTAINEERS are stoic types, but the wind at our high camp—this unceasing, screaming wind—scared us. With our boat expecting us in a few days and our hopes of reaching the range's highest summit, La Dama Blanca, imperiled by the storm, I came up with a plan to buy us time. I would take two men to base camp and radio *Trinidad* to delay our pickup. We would then ski back to the snow cave with fresh supplies and wait out the storm.

The weather had other ideas. With conditions worsening, we were rolling up our big Himalayan Hotel tent when a gust tore it from our hands and sent it flying over a ridge. Pete ran after it and minutes later returned ashen-faced.

"The wind picked me up and threw me," he said. "I never found the tent."

I walked away to collect my own shaken thoughts (below). This gust was nearly as strong as blasts I had clocked at 140 miles an hour on the island of Tierra del Fuego. During a lull three of us tried to descend, but less than 200 yards out the wind found us. We crawled for shelter behind a rock and shouted to one another to go back.

Without a tent we had to enlarge the snow cave (right) to fit the six of us inside. Under normal circumstances, a snow cave is a snug, pleasant shelter, where we can hole up like bears in a den, making tea, playing cards, yakking about our greatest thrills in climbing. But this cave felt like a dungeon, cramped and dripping. Every two hours someone had to crawl out to shovel the entrance free of snow so we could breathe.

Two days later, as the wind still roared, we gave in to desperation and made a forced march, floundering under 70-pound packs as we retreated off the mountain. All of us swore at our predicament. But, funny how it works: Once aboard *Trinidad*, with boots drying, stomachs filled, hands warm, we were ready for more.

Denied the summit as storm clouds boil over the horizon, **Rob Hart** scrabbles down the ice-coated mountain we called the Fickle Finger of Fate. Held back by frostbitten toes, I spent the last weeks of the trip exploring the fjords of Taraba Sound and mapping the lush forest. My colleagues, though, were fixated on this sheer 4,500-foot spire. Only on the final day did the weather relent, allowing Phillip and Pete, after a mad dash, to claim the top.

AN UNSULLIED CORNER of the world surrounds us at the pinnacle of Gremlin's Cap. For all the hardships and frustrations we endured, we know we are lucky to have explored such a pristine place. We left behind nothing but a few names to put on a new map, and we carried away, to the Instituto de la Patagonia in Punta Arenas, weather data and a host of botanical specimens for study.

Who will follow us is a question I fear to answer. One day we surprised a fishing boat whose crew had been cutting old-growth cypress for fence posts. What will prevent other loggers from coming here to chop the virgin forests?

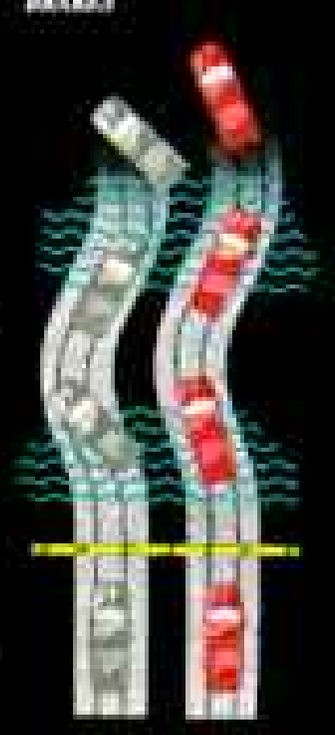
Chile has an admirable record in setting aside wilderness preserves. With our eyewitness accounts and our photographs and map data, I hope to help persuade the government to continue its good work and designate the Cordillera Sarmiento a national park.

We limped off the Sarmiento and boarded *Trinidad* in full storm. By the time we had shuttled our gear aboard from the raft, we were soaked to the bone. We looked at our gaunt, bedraggled selves and started laughing. Would we return? Yes, in a heartbeat. □

INTRODUCING *MOTOR TREND'S* "TRUCK

To hear the editors of *Motor Trend* talk about the new Dodge Ram is to realize the rules have changed. They proclaimed the Ram to be "...a new standard by which full-size pickups will be judged." And declared it "...a force with which to be reckoned." Our sentiments exactly.

Dodge Magnum series V-6, V-8 and Cummins Turbo Diesel engines wrote the book on power. And with the new Ram's available Magnum V-10†, they're getting two cylinders better. To the tune of 450 lb ft of torque and 300 horsepower.



Ram makes a powerful statement when it comes to safety, too. It has one safety feature no full-size pickup ever had before. A standard driver's airbag.* There's also available four-wheel anti-lock brakes. Along with high-strength steel door beams. And a dozen other safety features.

There's no rule saying trucks have to ride like trucks. That's why we gave our new Dodge Ram a new frame and improved suspension travel. We just wouldn't hear of making a noisy pickup, either. Fact is, we worked very hard to make our new Ram a standard for quietness.

Sure, pickups have always been workhorses. Now

OF THE YEAR."

they're a convenient place to conduct business. With an available center console between the front seats. Behind the seats, there's plenty of room for an ingenious optional storage system. And back in the bed, you'll find a set of tie downs so well engineered, they can support the weight of the entire truck.

We've provided an extra measure of protection, too – using more exterior galvanized steel than any other full-size pickup on the road, and making substantial use of anti-chip materials.

Here's one last point to consider: Ram also has more maximum payload than other full-size pickups. Not to mention the terrific amount of weight it carries…with the editors of *Motor Trend*.

DODGE RAM THE NEW DODGE
A DIVISION OF THE CHRYSLER CORPORATION

*For still more information, call 1-800-4A-DODGE. †Now available for order. *Always wear your seat belt for a fully effective airbag.*

How teachers can make the best

use of space in their classrooms.

From solar systems to spelling lessons, an Apple® Macintosh® computer makes just about any kind of learning more exciting, more enjoyable, more relevant. Instead of merely lecturing, teachers can use a Macintosh to guide their students as they actively explore new subjects—with interactive software that utilizes sound, color, animation and video clips. Instead of writing ordinary papers, students can use a Macintosh to bring their projects and reports to life like never before, by including charts, graphs, clip art and photographs. And with the addition of an overhead projection device, everyone in the classroom can use a Macintosh to deliver engaging, full-color presentations like the one you see here. Most important of all, Macintosh is the easiest computer to set up, learn and use—so anyone can plug it in, turn it on and immediately start taking advantage of its many capabilities. All of which helps explain why the most popular personal computer in classrooms today is Macintosh. The computer that gives teachers the most important power they can have. The power to motivate, stimulate, inspire. The power to be your best.®

Red-bellied Lemur *Genus:* Eulemur **Species:** rubriventer **Adult size:** Body length, 36–42cm; tail, 46–54cm **Adult weight:** 1.5–2.0kg **Habitat:** Rain forests at higher altitudes in eastern Madagascar **Surviving number:** Unknown

Photographed by Frans Lanting

WILDLIFE AS CANON SEES IT

Rarely revealing its presence by sight or sound, the red-bellied lemur inhabits inaccessible rain forests, where steep slopes are densely covered in trees, mosses and tangled lianas. These elusive creatures stay together in small family groups, feeding mainly on fruit, and certain leaves and flowers when available. Populations are now sparsely scattered throughout Madagascar's dwindling east coast forest. To save endangered species, it is vital to protect their habitats and understand the role of each species within the earth's ecosystems. As a global corporation committed to social and environmental concerns, we hope to foster a greater awareness of our common obligation to ensure that the earth's life-sustaining ecology survives intact for future generations.

REX WARNER (ABOVE); JOE BEYNON

Crossing the Pacific on a Bamboo Raft

In the third century B.C. the Emperor of China sent a mariner named Hsu Fu to search the Pacific for the drug of immortality. On his second attempt he failed to return.

Last year adventurer Tim Severin (below, standing) and four crew members sailed from Asia on a bamboo raft called the *Hsu Fu* to see if such a vessel could cross the Pacific. "I had regarded the idea of ancient vessels crossing the Pacific as unlikely until I read a book by Joseph Needham, a Cambridge University scholar, suggesting that the most suitable vessel would have been a sailing raft," says Severin, who once crossed the Atlantic in a leather boat (NATIONAL GEOGRAPHIC, December 1977). He learned that bamboo fishing rafts still sail off Vietnam and commissioned a 60-foot, three-masted version, outfitted with cotton sails and rattan rigging.

Hsu Fu embarked from Hong Kong and rode the current to Japan. Then, 75 days out of Japan, stormy seas (top) broke rattan lashings. Crewmen dived to refasten them (left, upper), but they continued to deteriorate. On day 104, only a thousand miles west of California, Severin alerted the U. S. Coast Guard. The Coast Guard searched its computer database of up-to-the-minute merchant ship positions worldwide and asked a Japanese-owned containership, *California Galaxy*, to pick up the waiting crew (left). They looked back to see their vessel drift off alone, its bamboo largely intact. With stronger fastenings this type of raft could have reached land, Severin says.

National Geographic, April 1994

THE NEW BONNEVILLE

Driver & Passenger Airbags

Anti-Lock Brakes

Traction Control*

Variable-Effort Power Steering

6-Speaker Sound System

Leather Seating Areas*

Theft-Deterrent Key System

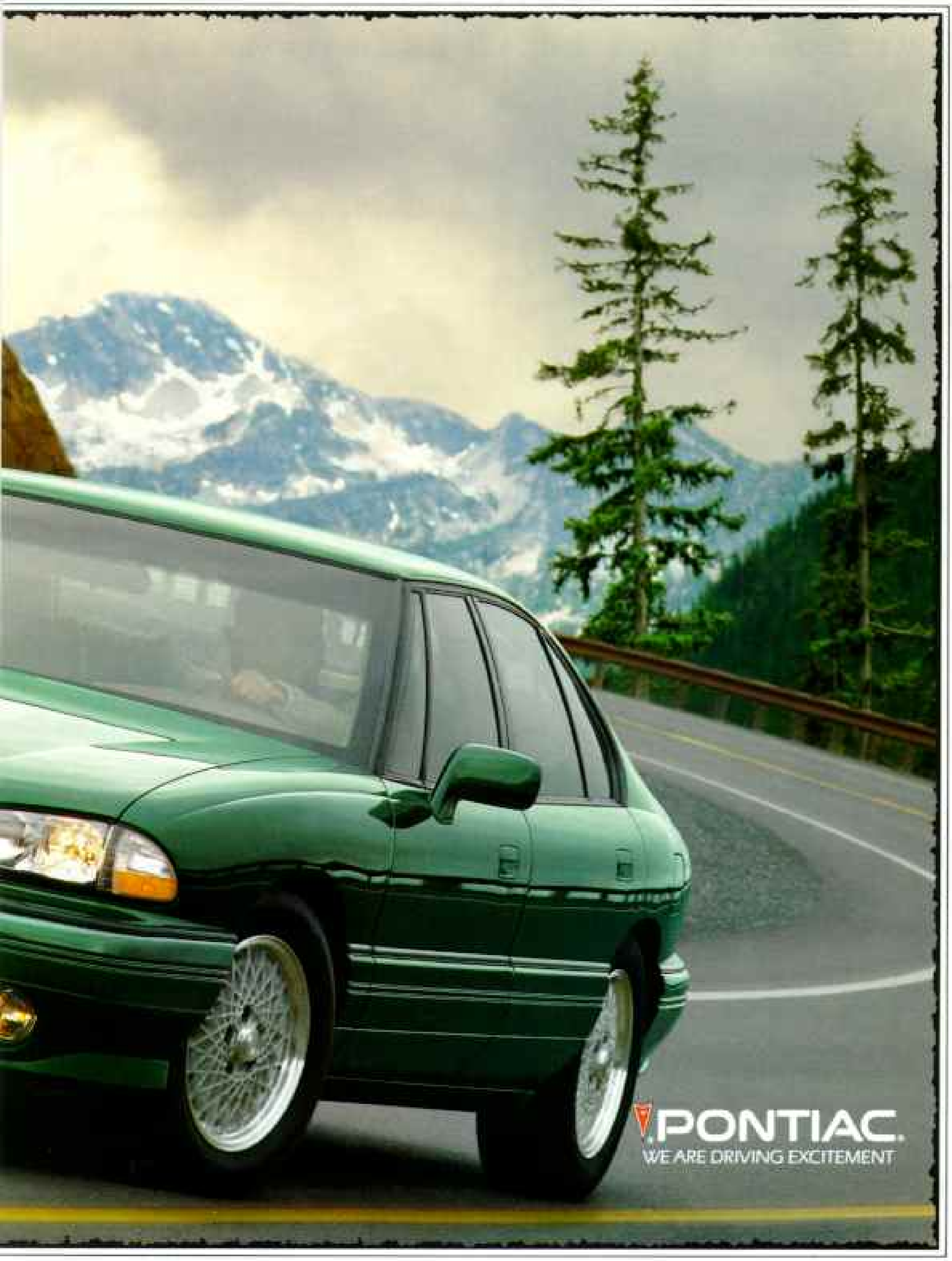
Remote Keyless Entry*

*Available Equipment

You could spend thousands more on a luxury import. But why?

PONTIAC CARES with a 3-year/36,000-mile no-deductible bumper-to-bumper limited warranty (see your dealer for details), plus free 24-hour Roadside Assistance and Courtesy Transportation. Call 1-800-762-4900 for more product information and dealer locations. Bonneville®

Always wear safety belts, even with airbags.


PONTIAC.
WE ARE DRIVING EXCITEMENT

TO PROVE THE NEW JENN-AIR WALL OVENS HAVE LARGER INTERIORS, WE CONSULTED THIS PANEL OF EXPERTS.

There's big news at Jenn-Air. Because our new wall ovens now offer you the largest interior cooking space of any 24" and 27" combined radiant/convection ovens.

These Jenn-Air wall ovens offer fast, even, three-rack baking and fit cooking and baking pans that some other ovens can't. Turkeys, rib roasts and other oversized items are no problem in our ovens, which are up to 25 percent larger than some other wall ovens.

The new Jenn-Air wall ovens — with more room and greater baking flexibility, you don't need an expert to tell you that anyone who owns one is one smart cookie. For a brochure showing the Jenn-Air line and the name of your nearest dealer call 1-800-JENN-AIR.

JENN-AIR

THE SIGN OF A GREAT COOK®.

Jenn-Air
Wall Ovens

Geographica

Iraq Imperils Marshes, a Way of Life

Iraq's intensified campaign to drain its southern wetlands threatens the survival of the Madan, or Marsh Arabs, who have inhabited the area where the Tigris and Euphrates Rivers meet (map) for at least 5,000 years (GEOGRAPHIC, April 1976).

SHYAM BHATIA, THE OBSERVER

NGS CARTOGRAPHIC DIVISION

The Madan, who number more than 50,000, are Shiite Muslims living in reed houses and subsisting on fish, rice, and water buffalo. Some, such as this group manning an antiaircraft gun (above), have joined rebels opposing Iraq's President Saddam Hussein, a Sunni Muslim. His government, citing agricultural plans from the 1950s, has constructed canals, dams, and levees to divert river water in what it says is an effort to reclaim salt-encrusted land for agriculture. Outside observers like Andrew Whitley, director of Human Rights Watch/Middle East, call that claim "laughable."

Satellite images suggest that 40 percent of the marshes had dried out by last summer. And the Iraqi Army has moved in to arrest dissident Madan. Some Madan have fled to cities, thousands of others to Iran. "The free people who were sustained for millennia by the sweet waters between the Tigris and the Euphrates are on the verge of disappearing," says Max van der Stoel, a United Nations human rights investigator. "Without the marshes, there can be no Marsh Arabs."

The drainage has also destroyed wildlife habitat. Once common creatures, from wild boars to ibis, are rare. Says Derek Scott, a British wildlife consultant, "All wildlife dependent on extensive marshes is now under serious threat."

Paleo Point—Surprise in a Box

One of the oldest artifacts ever found in Central America, a chert point dating from 11,200 to 8,000 years ago (right, at bottom), came to light by sheer happenstance, illustrating the role of serendipity in science.

BIRGE BRINKERS

Peter Dunham, an archaeologist at Cleveland State University, has been surveying the mountains of Belize for Classic Maya ruins (A.D. 250-900), funded by the National Geographic Society. His base camp lies on the farm of British expatriate Don Owen-Lewis, who found the point while gardening about 15 years ago. Without mentioning it to anyone, Owen-Lewis stowed the object in a box with other artifacts. Last summer he showed the box to project geologist Dan Gall. Gall and Dunham recognized the point at once as ancient and important.

The point's large groove, or flute, is characteristic of spear or dart heads from North America dating between 11,200 and 10,500 years old (cast at top). Its flared, or fishtail, base suggests points found in South America (cast at center), dated 10,000 to 8,000 years ago. The 1.5-inch-long Belize point represents a remarkable melding of the two styles and is one of only a handful of such points from Central America. Fastened to a shaft, it may have been hurled with an atlatl, or spear-thrower.

"We've had our base camp on the farm since 1983," says Dunham with a laugh, "and this pre-Maya object of tremendous scientific value had been gathering dust in a box there the whole time."

I can't believe
they gave my promotion
to Kaminsky.

Let him have it, I don't
want all that
responsibility anyway.

He could use the
extra money, a good hair weave
isn't cheap.

And a window office only means
he'll have to watch
the rest of us leave at five.

Besides, everyone in management develops a nervous tick eventually.

And with a reserved parking space, the boss always knows when you're late.

I can't believe they gave my promotion to Kaminsky.

THIS IS REFRESHMENT

"We need to take care of the forest and the things that live here."

"Out here, you understand that the forest is more than just trees. And that caring for the wildlife that lives here is important. To all of us. My company, Georgia-Pacific, believes that. And we're doing something about it. One way

is with a plan we've developed to protect the Red Cockaded Woodpecker. We're finding nesting sites, then creating safe areas around them. Areas we'll leave undisturbed. Just to make sure the birds will always have a place to live and thrive. That makes me feel good about the work I do. And about the company I work for." Carlton White, Forest Specialist. Georgia-Pacific

Geographica

Face of Gold Tells a Priceless Story

She was only 20 years old when she passed into eternity, her mummified body wrapped in fine linen and flower garlands. Her gold-leaf mask with glass eyes and lapis lazuli brows covered the head and shoulders; a breastplate was decorated with scenes from the Book of the Dead. The mummy was laid on a bed of flowers in a heavy wood coffin and placed in a rock-cut chamber at Faiyum Oasis in Egypt's Western Desert.

There it remained until archaeologist C. Wilfred Griggs of Brigham Young University discovered what he calls "the best preserved, most complete burial from this late pre-Christian era." Hieroglyphs identify the young woman as the daughter of a high priest; carbon dating places the burial about 220 B.C. The mummy of a child lay at the foot of the coffin.

When the woman lived, religious practices in Egypt were changing, influenced by contact with other Mediterranean peoples. But the inscriptions and drawings on the mask, breastplate, and coffin reflect beliefs in physical resurrection and a ritual passage to life in the afterworld. "Pure old-time Egyptian religion was doing well on the eve of the Christian era, thank you," Griggs says, "even here outside the Nile Valley." DNA studies should reveal the relationship between the woman and child and their ethnicity. The mummy will soon have an honored place in Cairo's Egyptian Museum.

ALAN D. ST. JOHN (BELOW): C. WILFRED GRIGGS

Navajo Wildlife Refuge Grows in Desert Wetland

Amid the stark landscape of the Colorado Plateau in east-central Arizona, a small area near Winslow appears like a mirage: a spring-fed wetland where birds, from hawks and harriers to migratory waterfowl, come to drink. There the Navajo Nation has created its first wildlife refuge.

The very notion of "setting aside" a specific place as a refuge is alien to the Navajo way of looking at the world as a unified whole, admits Mike Tremble, coordinator of the Navajo Natural Heritage Program, founded with help from the Nature Conservancy. But ranching and development plans are impinging on the 27,540-square-mile reservation.

The 640-acre refuge at Hugo Meadows protects a *ciénega*, a place where groundwater bubbles to the surface. Cattle-grazing leases already have been terminated, and fences will be strung to keep out strays. Nonnative plants will be eradicated.

Oregon Fights to Save a Rediscovered Butterfly

Scientists had barely identified the Fender's blue butterfly in 1931 before it vanished from sight. Now, thanks to an Oregon State University entomologist who spotted a single colony in 1989, the rare butterfly finally may be protected.

"Every biologist hopes to find a long-lost species," says Paul Hammond, who observed the iridescent insect in Oregon's McDonald State Forest. A survey turned up ten colonies of Fender's blues, all in the Willamette Valley. "All together, there are about 4,000. That's a pretty small number for an insect."

The butterfly, *Icaricia icarioides fenderi*, feeds on spurred lupine (left) and on Kincaid's lupine, which grows only in the valley and is a candidate for endangered status. Experts hope to establish preserves to keep the insect and its ecosystem alive.

The insect's rediscovery delighted 88-year-old Ralph Macy, the retired biologist who first identified the butterfly. He named it for Kenneth Fender, a letter carrier who, as a boy, was inspired by Macy's butterfly collection to become an expert on local beetles.

—Boris Weintraub

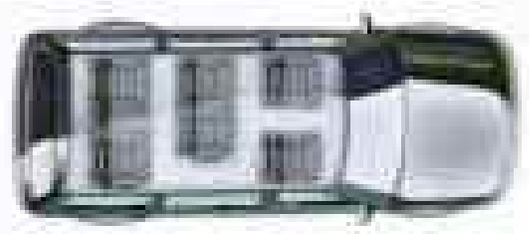
National Geographic, April 1994

MERCURY VILLAGER It's true that the competition may not be all that excited about the overwhelming success of the Mercury Villager.

After all, it *is* the only front-wheel-drive, V-6 powered minivan that gives you the smooth, quiet ride, comfort and easy handling of a Mercury.

Our competitors would breathe a lot easier if you didn't know about Villager's innovative sliding rear seat that easily moves forward to provide extra cargo space. Or

Villager's innovative sliding rear seat moves forward in seconds for extra cargo space. Its removable middle seat provides even more cargo space.

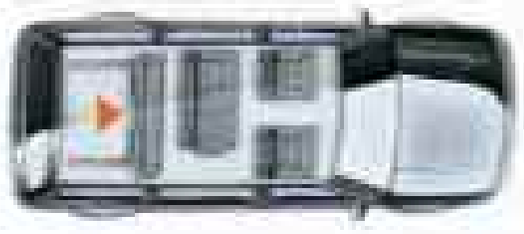


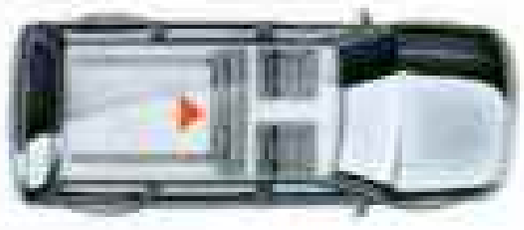
Our Competitors To Turn This

LINCOLN-MERCURY DIVISION Ford Buckle up—together we can save lives. *Driver side air bag is supplement safety belt. Always wear your safety belt

about Villager's standard driver-side air bag* and four-wheel anti-lock brakes, available power moonroof and keyless entry system. The kind of amenities that separate a Mercury minivan from an ordinary minivan.

So if you want to know more about the Mercury Villager, we suggest you take it for a test drive or call 1 800 446-8888. And pay no attention to that gentleman in the lower right-hand corner.





MERCURY

ALL THIS AND THE QUALITY OF A MERCURY.

Would Be Happy Page For You.

er
er
ns
ark
She
de it
ectly
that I
ld not
board
plane
n it de-
rred. "I
t care if
slaugh-
having
gery," she
ld coldly.
not hold-
this plane
anyone."
rcraft beyond
we stormed
of the termi-
We were no
ger three col-
gues trying to
ch a plane. We
with a mission.
n Madge quickly
round and raced
ap and keys to a
warded the red-eye
or Detroit. I arrived
ried in the direction
ing against the clock
morning in time to
hter, Emma, awaken
ap. She opened her eyes
oked at me as if I were a
character from her dream.

Forum

Special Water Issue, November 1993

Your Special Edition was fascinating. Where do you find people who can slog through swamps, operate rubber rafts, and fly small airplanes—and also write? But there was little mention of the increasing effect of population on the environment.

JOSEPH A. PERRY
Minneapolis, Minnesota

You covered virtually every method of procuring freshwater except rainwater catchment from roofs for domestic use. Before deep wells became common in the arid Southwest, many people relied on cisterns filled from roof runoff. These are still very common in arid parts of Australia.

JOEL GLANZBERG
Fairview, New Mexico

Radioactive waste is the most insidious and dangerous water pollutant. We are accumulating radioactive waste in leaking pools beside nuclear power plants all around this country and the world.

ENRIQUE G. PETROVICH
Pompano Beach, Florida

A community that reuses water should be looked at as forward thinking and not as radical. We engineers can make water potable, but only society can make it palatable.

JOHN L. MIDDELKOOP
Schenectady, New York

Southern California, which is a microcosm of the rest of the world when it comes to water—with floods, droughts, pollution, and cleanup—is reclaiming wastewater. Yucaipa Water District at the foot of our mountains recently completed a tertiary-treatment plant that allows wastewater to be reintroduced into local aquifers. Irvine has a dual system, with tertiary-treated water supplied by a separate pipe for irrigation and lawn watering. As the special issue makes clear, there is no new water—it has all been recycled. It's time we got used to it.

MARSHALL D. COLLINS
Crestline, California

Concerning freshwater supplies, short streams along a narrow coastal range from Alaska to Washington State feed into a coastal current and create one of the largest freshwater systems in North America. Comparable to the annual discharge of the Mississippi River, this enormous flow, about 523 billion gallons a day, results from high precipitation, up to 27 feet a year. It is very important to Alaska's fisheries. Alaska Governor Walter Hickel once suggested tapping some rivers and constructing an underwater pipeline to carry some of this water to California to ease drought conditions.

THOMAS C. ROYER
Institute of Marine Science
University of Alaska
Fairbanks, Alaska

The section on California left the impression that Santa Clarita is home to water wars, unplanned development, and anti-environment activities. In fact, it is a balanced, self-contained community that survived serious drought because of its well-managed water supply and community cooperation in conservation. Our company has spent years testing state-of-the-art subsurface irrigation systems; we distribute handbooks to new home buyers describing drought-tolerant landscaping, and we are inaugurating the valley's first reclaimed-water program to irrigate public landscaping. With a healthy underground water supply replenished by rain, with long-range planning and common-sense use of water by this development community and residents, the valley has the water to meet its needs.

THOMAS L. LEE, *Chairman*
Newhall Land and Farming Company
Valencia, California

Regarding the hydroelectric project at James Bay, Quebec, the Cree have voiced their opposition to the Great Whale project, but, like the Inuit, they have been involved in the process. As a matter of principle, the Cree are not opposed to development. This is reflected by the 17 agreements they have negotiated with Hydro-Québec and others. Hydro development has brought them substantial benefits, including employment opportunities and business contracts worth some 160 million dollars for construction, forestry, distribution of petroleum products, and a successful airline, Air Creebec. Hydropower developments have existed in Quebec for more than a century, and we have always been very sensitive to their environmental and social impact. Our record speaks for itself.

RICHARD DROUIN, *Chairman*
Hydro-Québec
Montreal, Quebec

Your James Bay article states that Manitoba has "a palpable itch to develop the Gods, Hayes, and Seal [Rivers]." Manitoba Hydro's plans for development to the year 2027 do not mention any of these rivers. The Manitoba government has been actively promoting environmentally sound and sustainable economic development of our natural resources. In August 1992 Manitoba declared the

RAIN GEAR.

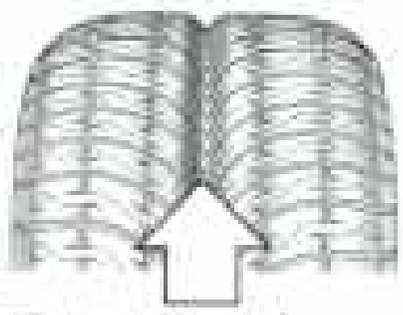
Water, water everywhere. The slippery kind. That's when you'll sure be glad you've got Goodyear's all-season Aquatred.® Because Aquatred has an advanced deep-groove AquaChannel™ that sweeps water away at more than a gallon a second. Leaving you feeling secure and in control of the situation.

So gear up for inclement weather. With Aquatred.

Only from Goodyear.

60000

A 60,000-mile limited treadlife warranty. Ask for details.



☐ AquaChannel sweeps water away at more than a gallon a second.

☐ Unique Goodyear compound adds to the Aquatred's superb road grabbing wet traction.

☐ The AquaChannel design is now used in Goodyear's Formula One racing rain tire.

THE BEST TIRES IN THE WORLD HAVE GOODYEAR WRITTEN ALL OVER THEM.

Seal River a Heritage River to protect its natural and native spiritual values.

ALBERT DRIEDGER
Minister of Natural Resources
Winnipeg, Manitoba

Although the absolute costs of the James Bay project are devastating, how do they compare with the costs—environmental, social, and otherwise—of generating the same power by other means or not at all. As long as we are trying to support five billion people on the planet, even the best resource-management decisions will have undesirable effects.

TIMOTHY D. BURKHARDT
Freshwater Foundation
Wayzata, Minnesota

Under the photograph of Baton Rouge (pages 102-103) you refer to the Mississippi River south of the city as "a region dubbed Cancer Alley by skeptical residents." In reality medical studies show that with the exception of lung cancer the incidence of cancer in this region is lower than the national average for common forms of cancer. The higher lung-cancer rate is strongly suspected to be linked to the higher rate of smoking.

KEITH KELLY
Baton Rouge, Louisiana

The manufacturing and drilling activities in Louisiana that contribute to pollution of the Mississippi River generate products that make lives across the U. S. more comfortable and convenient. And the companies involved are owned by stockholders all over the nation. As you folks around the country criticize us, consider this: Are you willing to pay the *true* cost of the products that make your lives more pleasant?

PAM KASTER, *President*
Citizens for a Clean Environment
Baton Rouge, Louisiana

When I received your Special Edition on water, I knew it could only bring bad news. Indeed it was as bad as expected, but it was presented in a way that gives me hope. Understanding and facing problems is a huge step toward their solutions.

MARTHA H. GRAMMAR
Bedford, Texas

Lake Superior

I spent the first half of my life in Calumet, Michigan, on the Keweenaw Peninsula, almost within walking distance of Lake Superior (December 1993), but with only a trace of appreciation for its rugged splendor. Now, 25 years after leaving, I discover that author Noel Grove provides additional insight into why Superior exercises its magnetism on my soul. Its furious November storms and midsummer sunsets have a religious quality unmatched by anything man-made.

MARTIN BACHER
Brentwood, Tennessee

The photograph on pages 92-3 makes Sault Ste. Marie look like a small run-down city and makes Saultites look as though they neglect their homes, when the exact opposite is true. The Soo is one of the most beautiful places in Ontario. Better pictures could be made along the boardwalk, park, or the locks. Incidentally, the lock on the Ontario side has been closed for six years.

AARON ERICKSON
Sault Ste. Marie, Ontario

I am at a loss to understand how you have made Superior "the world's biggest freshwater lake"—an honor traditionally accorded to Lake Baikal, which holds some 20 percent of the world's freshwater. While Russia has given up much of its historic glory, it seems that Lake Baikal should not be stripped of its time-honored preeminence.

JOHN P. MACMEEKEN
Oakland, California

Biggest in this case refers to surface area. Baikal covers less than half the surface area of Superior, although its volume is four times greater.

St. Petersburg

The wonderful piece on St. Petersburg touched me deeply because I was able to spend a few days there with my 12-year-old son last July. We arrived after a week in Krasnodar near the Black Sea—Cossack territory—and we were quite unprepared for the sophistication and beauty of the city.

WAYNE SHEPHERD
Chicago, Illinois

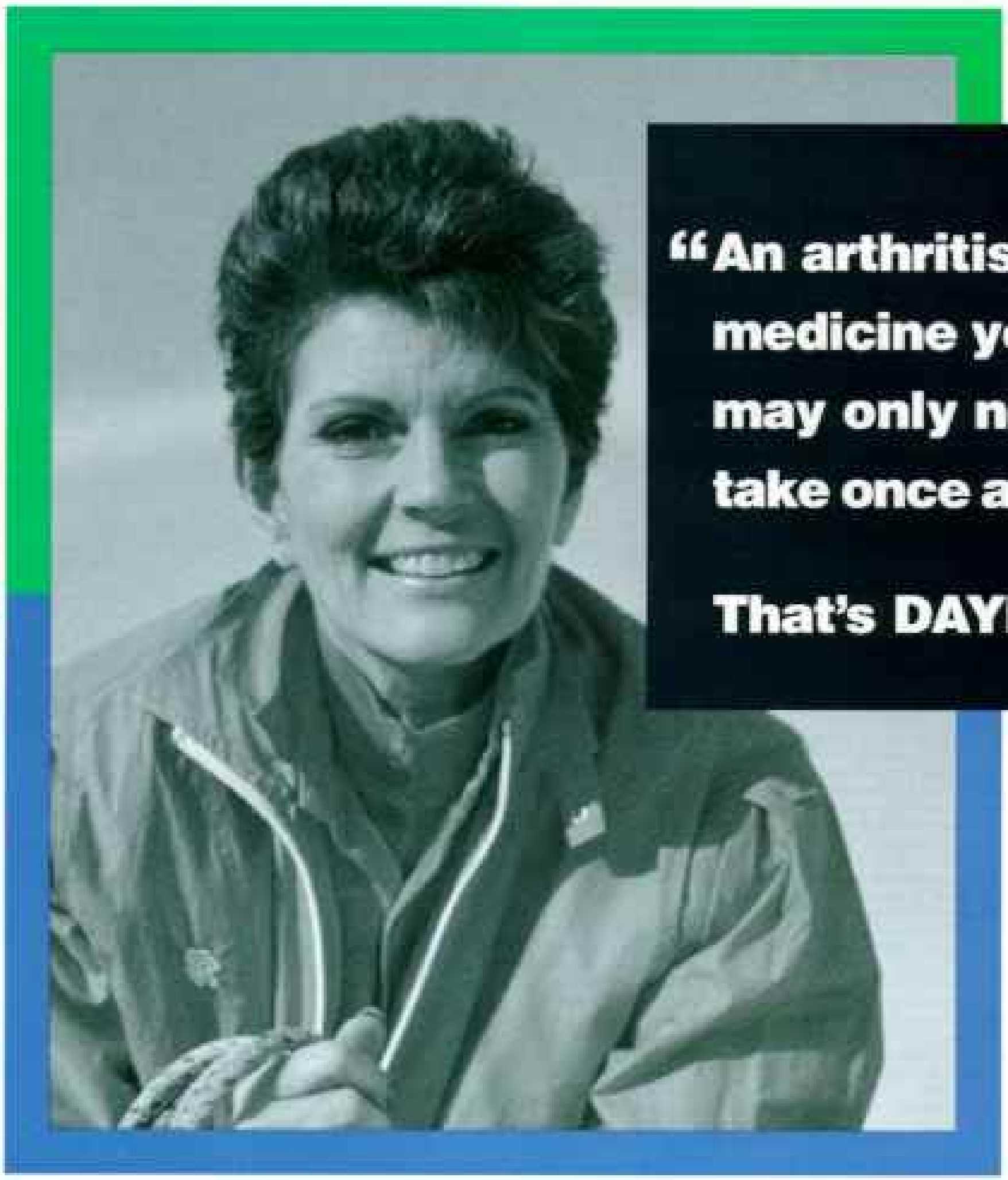
Italy is written on the face of St. Petersburg. Indeed when Tsar Peter envisioned the great city, he called in architects and artists from Italy.

MICHAEL SUOZZI
San Diego, California

To call Gregory Efimovich—known to history by the nickname Rasputin—a "fanatic monk" creates the impression that he represented some current in the Orthodox Church, a lunatic fringe. He did not. Early in life he resided for two years as a guest at the Russian monastery on Mount Athos in Greece, but he was a self-appointed holy man. His dissolute way of life was in no way holy, much less monastic.

BROTHER ISAAC
St. Michael's Skete
Canones, New Mexico

Letters should be addressed to FORUM, National Geographic Magazine, Box 37448, Washington, D. C. 20013-7448, and should include the sender's address and telephone number. Not all letters can be used. Those that are will often be edited and excerpted.



Ask your doctor about DAYPRO® (oxaprozin), an arthritis medicine from Searle.

While there is no cure for arthritis, your doctor can prescribe DAYPRO, which may relieve the pain and swelling associated with arthritis. DAYPRO is available by prescription only. DAYPRO is not recommended for pregnant or nursing women. DAYPRO should not be used if you are allergic to aspirin or any other arthritis medicines. DAYPRO can cause serious side effects, including stomach ulcers and intestinal bleeding. If you have any stomach or intestinal problems or if you have ever had high blood pressure, heart, liver or kidney problems, be sure to tell your doctor. The most common side effects associated with the use of DAYPRO can include abdominal pain, constipation, diarrhea, stomach upset, nausea, and skin rash.

Please see adjacent page for additional important information.

SEARLE

BRIEF SUMMARY - DAYPRO® (oxaprozin) 600-mg caplets

CONTRAINDICATIONS: Hypersensitivity to oxaprozin or any of its components or in individuals with the complete or partial syndrome of nasal polyps, angioedema, and bronchospastic reactivity to aspirin or other nonsteroidal anti-inflammatory drugs (NSAIDs). Severe and occasionally fatal asthmatic and anaphylactic reactions have been reported in patients receiving NSAIDs, and there have been rare reports of anaphylaxis in patients taking oxaprozin.

WARNINGS: RISK OF GASTROINTESTINAL (GI) ULCERATION, BLEEDING, AND PERFORATION WITH NONSTEROIDAL ANTI-INFLAMMATORY DRUG THERAPY: Serious gastrointestinal toxicity, such as bleeding, ulceration, and perforation, can occur at any time, with or without warning symptoms, in patients treated with NSAIDs. Although minor upper gastrointestinal problems, such as dyspepsia, are common, and usually develop early in therapy, physicians should remain alert for ulceration and bleeding in patients treated chronically with NSAIDs, even in the absence of previous GI tract symptoms. In patients observed in clinical trials for several months to 2 years, symptomatic upper GI ulcers, gross bleeding, or perforation appear to occur in approximately 1% of patients treated for 3 to 6 months, and in about 2% to 4% of patients treated for 1 year. Physicians should inform patients about the signs and/or symptoms of serious GI toxicity and what steps to take if they occur. Patients at risk for developing peptic ulceration and bleeding are those with a prior history of serious GI events, alcoholism, smoking, or other factors known to be associated with peptic ulcer disease. Elderly or debilitated patients seem to tolerate ulceration or bleeding less well than other individuals, and most spontaneous reports of fatal GI events are in these populations. Studies to date are inconclusive concerning the relative risk of various NSAIDs in causing such reactions. High doses of any NSAID probably carry a greater risk of these reactions, and substantial benefit should be anticipated to patients prior to prescribing maximal doses of Daypro.

PRECAUTIONS: General: ***Hepatic effects:*** As with other NSAIDs, borderline elevations of one or more liver tests may occur in up to 15% of patients. These abnormalities may progress, remain essentially unchanged, or resolve with continued therapy. The SGPT (ALT) test is probably the most sensitive indicator of liver dysfunction. Meaningful (3 times the upper limit of normal) elevations of SGOT (AST) occurred in controlled clinical trials of Daypro in just under 1% of patients. A patient with symptoms and/or signs suggesting liver dysfunction or in whom an abnormal liver test has occurred should be evaluated for evidence of the development of more severe hepatic reaction while on therapy with this drug. Severe hepatic reactions including jaundice have been reported with Daypro, and there may be a risk of fatal hepatitis with oxaprozin, such as has been seen with other NSAIDs. Although such reactions are rare, if abnormal liver tests persist or worsen, clinical signs and symptoms consistent with liver disease develop, or systemic manifestations occur (eosinophilia, rash, fever), Daypro should be discontinued. Well-compensated hepatic cirrhosis does not appear to alter the disposition of unbound oxaprozin, so dosage adjustment is not necessary. However, the primary route of elimination of oxaprozin is hepatic metabolism, so caution should be observed in patients with severe hepatic dysfunction. ***Renal effects:*** Acute interstitial nephritis, hematuria, and proteinuria have been reported with Daypro as with other NSAIDs. Long-term administration of some NSAIDs to animals has resulted in renal papillary necrosis and other abnormal renal pathology. This was not observed with oxaprozin, but the clinical significance of this difference is unknown. A second form of renal toxicity has been seen in patients with preexisting conditions leading to a reduction in renal blood flow, where the renal prostaglandins have a supportive role in the maintenance of renal perfusion. In these patients administration of an NSAID may cause a dose-dependent reduction in prostaglandin formation and may precipitate overt renal decompensation. Patients at greatest risk of this reaction are those with previously impaired renal function, heart failure, or liver dysfunction, those taking diuretics, and the elderly. Discontinuation of NSAID therapy is often followed by recovery to the pretreatment state. Those patients at high risk who chronically take oxaprozin should have renal function monitored if they have signs or symptoms that may be consistent with mild azotemia, such as malaise, fatigue, or loss of appetite. As with all NSAID therapy, patients may occasionally develop some elevation of serum creatinine and BUN levels without any signs or symptoms. The pharmacokinetics of oxaprozin may be significantly altered in patients with renal insufficiency or in patients who are undergoing hemodialysis. Such patients should be started on doses of 600 mg/day, with cautious dosage increases if the desired effect is not obtained. Oxaprozin is not dialyzed because of its high degree of protein binding. Like other NSAIDs, Daypro may worsen fluid retention by the kidneys in patients with uncompensated cardiac failure due to its effect on prostaglandins. It should be used with caution in patients with a history of hypertension, cardiac decompensation, in patients on chronic diuretic therapy, or in those with other conditions predisposing to fluid retention. ***Photosensitivity:*** Oxaprozin has been associated with rash and/or mild photosensitivity in dermatologic testing. An increased incidence of rash on sun-exposed skin was seen in some patients in the clinical trials. ***Recommended laboratory testing:*** Because serious GI tract ulceration and bleeding can occur without warning symptoms, physicians should follow chronically treated patients for the signs and symptoms of ulceration and bleeding and should inform them of the importance of this follow-up (see *Warnings*). Anemia may occur in patients receiving oxaprozin or other NSAIDs. This may be due to fluid retention, gastrointestinal blood loss, or an incompletely described effect upon erythropoiesis. Patients on long-term treatment with Daypro should have their hemoglobin or hematocrit values determined at appropriate intervals as determined by the clinical situation. Oxaprozin, like other NSAIDs, can affect platelet aggregation and prolong bleeding time. Daypro should be used with caution in patients with underlying hemostatic defects or in those who are undergoing surgical procedures where a high degree of hemostasis is needed. **Information for patients:** Daypro, like other drugs of its class, nonsteroidal anti-inflammatory drugs (NSAIDs), is not free of side effects. The side effects of these drugs can cause discomfort and, rarely, serious side effects, such as gastrointestinal bleeding, which may result in hospitalization and even fatal outcomes. NSAIDs are often essential agents in the management of arthritis, but they may also be commonly employed for conditions that are less serious. Physicians may wish to discuss with their patients the potential risks (see *Warnings, Precautions,* and *Adverse Reactions*) and likely benefits of Daypro treatment, particularly in less-serious conditions where treatment without Daypro may represent an acceptable alternative to both the patient and the physician. Patients receiving Daypro may benefit from physician instruction in the symptoms of the more common or serious gastrointestinal, renal, hepatic, hematologic, and dermatologic adverse effects. **Laboratory test interactions:** False-positive urine drug screening tests for benzodiazepines have been reported in patients taking Daypro. This is due to cross-reactivity. Confirmatory testing is recommended when such screening test results are positive. **Drug interactions:** *Aspirin:* Concomitant administration of Daypro and aspirin is not recommended because oxaprozin displaces salicylates from plasma protein binding sites. Coadministration would be expected to increase the risk of salicylate toxicity. *Oral anticoagulants:* The anticoagulant effects of warfarin were not affected by the coadministration of 1200 mg/day of Daypro. Nevertheless, caution should be exercised when adding any drug that affects platelet function to the regimen of patients receiving oral anticoagulants. *H_2 receptor antagonists:* The total body clearance of oxaprozin was reduced by 20% in subjects who concurrently received therapeutic doses of cimetidine or ranitidine; no other pharmacokinetic parameter was affected. A change of clearance of this magnitude lies within the range of normal variation and is unlikely to produce a clinically detectable difference in the outcome of therapy. *Beta-blockers:* Subjects receiving 1200 mg Daypro qd with 100 mg metoprolol bid exhibited statistically significant but transient increases in sitting and standing blood pressures after 14 days. Therefore, as with all NSAIDs, routine blood pressure monitoring should be considered in these patients when starting Daypro therapy. *Other drugs:* The coadministration of oxaprozin and antacids, acetaminophen, or conjugated estrogens resulted in no statistically significant changes in pharmacokinetic parameters in single- and/or multiple-dose studies. The interaction of oxaprozin with lithium and cardiac glycosides has not been studied. **Carcinogenesis, mutagenesis, impairment of fertility:** In oncogenicity studies, oxaprozin administration for 2 years was associated with the exacerbation of liver neoplasms (hepatic adenomas and carcinomas) in male CD mice, but not in female CD mice or rats. The significance of this species-specific finding to man is unknown. Oxaprozin did not display mutagenic potential. Results from the Ames test, forward mutation in yeast and Chinese hamster ovary (CHO) cells, DNA repair testing in CHO cells, micronucleus testing in mouse bone marrow, chromosomal aberration testing in human lymphocytes, and cell transformation testing in mouse fibroblast all showed no evidence of genetic toxicity or cell-transforming ability. Oxaprozin administration was not associated with impairment of fertility in male and female rats at oral doses up to 200 mg/kg/day (1180 mg/m²), the usual human dose is 17 mg/kg/day (625 mg/m²). However, testicular degeneration was observed in beagle dogs treated with 37.5 to 150 mg/kg/day (750 to 3000 mg/m²) of oxaprozin for 6 months, or 37.5 mg/kg/day for 42 days, a finding not confirmed in other species. The clinical relevance of this finding is not known. **Pregnancy:** Teratogenic Effects—Pregnancy Category C. There are no adequate or well-controlled studies in pregnant women. Teratology studies with oxaprozin were performed in mice, rats, and rabbits. In mice and rats, no drug-related developmental abnormalities were observed at 50 to 200 mg/kg/day of oxaprozin (225 to 900 mg/m²). However, in rabbits, infrequent malformed fetuses were observed in dams treated with 7.5 to 30 mg/kg/day of oxaprozin (the usual human dosage range). Oxaprozin should be used during pregnancy only if the potential benefits justify the potential risks to the fetus. **Labor and delivery:** The effect of oxaprozin in pregnant women is unknown. NSAIDs are known to delay parturition, to accelerate closure of the fetal ductus arteriosus, and to be associated with dystocia. Oxaprozin is known to have caused decreases in pup survival in rat studies. Accordingly, the use of oxaprozin during late pregnancy should be avoided. **Nursing mothers:** Studies of oxaprozin excretion in human milk have not been conducted; however, oxaprozin was found in the milk of lactating rats. Since the effects of oxaprozin on infants are not known, caution should be exercised if oxaprozin is administered to nursing women. **Pediatric use:** Safety and effectiveness of Daypro in children have not been established. **Geriatric use:** No adjustment of the dose of Daypro is necessary in the elderly for pharmacokinetic reasons, although many elderly may need to receive a reduced dose because of low body weight or disorders associated with aging. No significant differences in the pharmacokinetic profile for oxaprozin were seen in studies in the healthy elderly. Although selected elderly patients in controlled clinical trials tolerated Daypro as well as younger patients, caution should be exercised in treating the elderly, and extra care should be taken when choosing a dose. As with any NSAID, the elderly are likely to tolerate adverse reactions less well than younger patients.

ADVERSE REACTIONS: The most frequently reported adverse reactions were related to the gastrointestinal tract. They were nausea (8%) and dyspepsia (8%).

INCIDENCE GREATER THAN 1%: In clinical trials the following adverse reactions occurred at an incidence greater than 1% and are probably related to treatment. Reactions occurring in 3% to 9% of patients treated with Daypro are indicated by an asterisk(*); those reactions occurring in less than 3% of patients are unmarked. Abdominal pain/distress, anorexia, constipation*, diarrhea*, dyspepsia*, flatulence, nausea*, vomiting, CNS inhibition (depression, sedation, somnolence, or confusion), disturbance of sleep, rash*, tinnitus, dysuria or frequency. **INCIDENCE LESS THAN 1%: Probable causal relationship:** The following adverse reactions were reported in clinical trials or from worldwide marketing experience at an incidence of less than 1%. Those reactions reported only from worldwide marketing experience are in *italics*. The probability of a causal relationship exists between the drug and these adverse reactions: Anaphylaxis, edema, blood pressure changes, peptic ulceration and/or GI bleeding (see *Warnings*), liver function abnormalities including *hepatitis* (see *Precautions*), stomatitis, hemorrhoidal or rectal bleeding, anemia, thrombocytopenia, leukopenia, ecchymoses, weight gain, weight loss, weakness, malaise, symptoms of upper respiratory tract infection, pruritus, urticaria, photosensitivity, *exfoliative dermatitis, erythema multiforme, Stevens-Johnson syndrome, toxic epidermal necrolysis*, blurred vision, conjunctivitis, *acute interstitial nephritis*, hematuria, renal insufficiency, acute renal failure, decreased menstrual flow. **Causal relationship unknown:** The following adverse reactions occurred at an incidence of less than 1% in clinical trials, or were suggested from marketing experience, under circumstances where a causal relationship could not be definitely established. They are listed as alerting information for the physician: Palpitations, alteration in taste, sinusitis, pulmonary infections, alopecia, hearing decrease, increase in menstrual flow.

DRUG ABUSE AND DEPENDENCE: Daypro is a non-narcotic drug. Usually reliable animal studies have indicated that Daypro has no known addiction potential in humans.

OVERDOSAGE: No patient experienced either an accidental or intentional overdosage of Daypro in the clinical trials of the drug. Symptoms following acute overdose with other NSAIDs are usually limited to lethargy, drowsiness, nausea, vomiting, and epigastric pain and are generally reversible with supportive care. Gastrointestinal bleeding and coma have occurred following NSAID overdose. Hypertension, acute renal failure, and respiratory depression are rare. Patients should be managed by symptomatic and supportive care following an NSAID overdose. There are no specific antidotes. Gut decontamination may be indicated in patients seen within 4 hours of ingestion with symptoms or following a large overdose (5 to 10 times the usual dose). This should be accomplished via emesis and/or activated charcoal (60 to 100 g in adults, 1 to 2 g/kg in children) with an osmotic cathartic. Forced diuresis, alkalization of the urine, or hemoperfusion would probably not be useful due to the high degree of protein binding of oxaprozin.

See package insert for complete prescribing information.

1/7/94 - P93SA8967V

Address medical inquiries to:
G.D. Searle & Co.
Medical & Scientific Information Department
4901 Searle Parkway
Skokie IL 60077

A94DA9062T-4

SEARLE

Box 5110
Chicago, IL 60680-5110

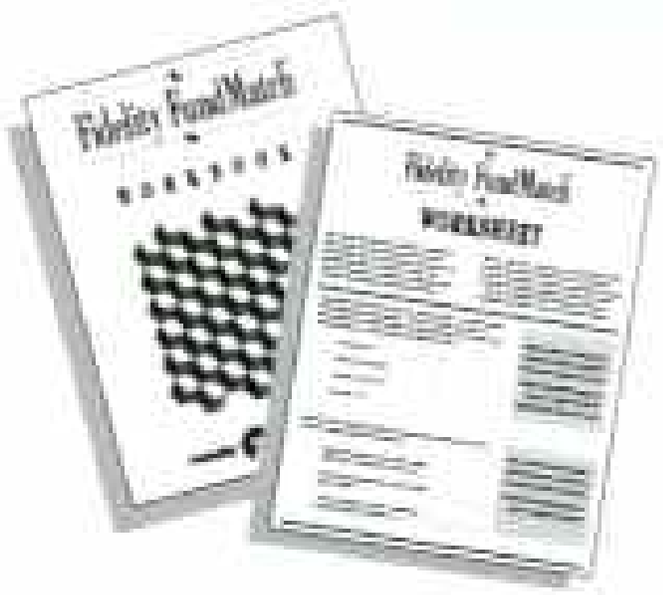
"How Do I Know Which Mutual Funds May Be Right For Me?"

Presenting Fidelity FundMatch℠

Fidelity's do-it-yourself program helps you build a diversified portfolio to match your needs.

Our FundMatch Kit Has Everything You Need To Start

You'll receive an easy-to-use workbook that helps you understand the importance of diversification. The accompanying worksheet takes your input on your time horizon and risk profile to help you choose an investment mix that matches your own needs.



Fidelity's Asset Manager Funds Make Diversification Simple

Fidelity's Asset Manager funds provide a way you can take advantage of the benefits of diversification – with **no sales charge.**

Each of these funds allocates your investment among a broad mix of domestic and foreign stocks, bonds and short-term instruments. This flexible approach allows each fund to take advantage of a wide variety of investment options in pursuit of the highest possible returns, but with reduced risk through its broad diversification.

Start your investment in one of Fidelity's Asset Manager funds with just $2,500, or $500 for an IRA. The FundMatch kit can help you choose the Fidelity Asset Manager fund that may best meet your needs.

Our best retirement offer ever – Fidelity's No-Load, No-Fee IRA. Take advantage of more Fidelity stock funds *with no sales charge* for your retirement investments. And we make it easy to transfer your assets to Fidelity. Just call for details.

Call 24 Hours For Your FREE Worksheet and Workbook

1-800-547-8558

Fidelity Investments®

2r

YOU'RE NOT ASKING FOR

When you bring your car in for service, you want to be treated with courtesy.

Be taken care of promptly.

Have your car fixed right the first time.

That's what Quality Care at Ford and Lincoln-Mercury dealers is all about.

It's treating you as if our success depends on making you satisfied.

Because it does.

We're not promising you the moon. Just trying to give you the best service on earth.

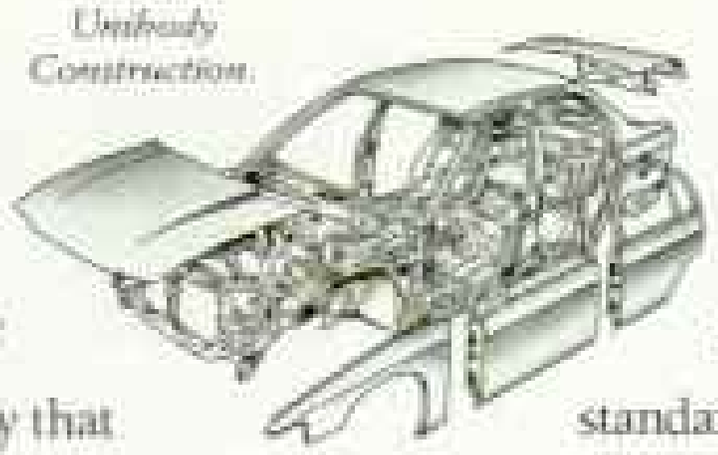
FORD
MERCURY
LINCOLN
QUALITY CARE
Where the Quality Continues®

A Little Plastic Packaging Can Help Prevent Bruising.

It's some of the most important packaging your kids can wear. Because plastic helmets and pads and other sports equipment play a vital role in helping to protect against bumps and bruises. • But plastic isn't just for fun and games. Plastic wraps and trays help keep food fresh and prevent spoilage. Tamper-evident seals help keep medicines protected. Foam cartons protect eggs from premature scrambling. • And because plastic is strong, thin and lightweight, it provides a lot of protection without a lot of additional, heavy packaging. • To learn more, just call 1-800-777-9500, and the American Plastics Council will send you a free booklet. • And see how a little plastic is having a positive impact in places far beyond the football field.

American Plastics Council

PLASTIC MAKES IT POSSIBLE™



Unibody Construction.

Some cars may offer more. Some cars may cost less. But only with Corolla do you get the unwavering dedication to quality that comes with its Toyota heritage.

If quiet is considered a measure of quality in a car, it's no wonder Corolla has acquired a reputation as the strong, silent type. Its unibody construction not only improves rigidity and reduces weight but it also helps minimize noise and vibration. Corolla's quiet ride and smoothness are enhanced even further by strategically placed sound insulation (sheets of asphalt and steel covered with a layer of heat-hardened resin) and a liquid-filled engine mount.

Liquid-Filled Engine Mount

Three-Layer Sound Insulation

Available Anti-lock Brakes

Driver- and passenger-side air bags* are standard equipment as are ventilated front disc brakes with available Anti-lock Brake System (ABS). Corolla's air bag system even has gold-plated electrical connectors. Not just to impress, but for longer life and greater corrosion resistance.

*Dual Air Bags**

You Can't Buy A More Impressive Car For Less.

The goal was to make the best possible car at an affordable price. The result was Corolla. And for over twenty-five years it has been a benchmark of quality in America. That's impressive.

Call 1-800-GO-TOYOTA for a brochure and the location of your nearest Toyota Dealer.

Gold-Plated Electrical Connectors

TOYOTA Corolla

"I love what you do for me."

*Always use your seatbelt. Driver and passenger side air bags are a Supplemental Restraint System (SRS). Buckle Up! Do it for those who love you. ©1993 Toyota Motor Sales, U.S.A., Inc.

The World's First 4x4 With An Air Bag.

It would be difficult to talk about Jeep Grand Cherokee Limited without discussing its remarkable strength and capability.

After all, Grand Cherokee offers an available 5.2 litre V8, plus standard four-wheel anti-lock brakes, an advanced four-wheel drive system, as well as side-guard door beams. But perhaps the most remarkable feature of Grand Cherokee is the one that we hope you never use–a driver's side air bag.* Grand Cherokee is the world's first 4x4 to come equipped with a driver's side air bag–and it's standard on every Grand Cherokee model.

With such a wide array of standard features, it's easy to see why Jeep Grand Cherokee is at the top of its class. But then, getting to the top is nothing new to Jeep.

For more information, please call 1-800-JEEP-EAGLE.

There's Only One Jeep.®

A Division of the Chrysler Corporation.

*Always wear your seat belt.

Jeep is a registered trademark of Chrysler Corporation.

On Television

Diving for Treasures in a Living Sea

Interactive communicator, the Caribbean reef squid displays colorful patterns to suit each occasion. Here one models the leisure look as it hovers at rest. When the need arises, special organs called chromatophores expand into disks of color in the skin—"body language" that flushes signals to other squid, enemies, and prey.

Underwater filmmakers Howard and Michele Hall found a trove of such marine life in reefs, sandbanks, and prairies of sea grass. Their work "Jewels of the Caribbean Sea" is a National Geographic Special.

In light-splashed waters corals spawn, dolphins cavort, sea turtles hunt. A tiger grouper pulls up to a reef "cleaning station," and tiny gobies range over the fish—even in its mouth and gills—to eat parasites and dead tissue. Scientists suspect that these miniature maintenance workers are also welcomed for the tactile pleasure they give.

To capture such fleeting moments, Howard Hall, with a grant from the Society, adapted a diving system known as a rebreather. The device is bubble free, enabling the diver to blend into the background without disturbing the animals.

Threatened by pollution and overfishing, reef life may find relief as sport divers, attracted in growing numbers, realize the importance of protecting these hidden treasures.

"Jewels of the Caribbean Sea" will be shown on PBS, Wednesday, April 13, 8 p.m. ET.

Diving for Answers to a Controversial Wreck

May 7, 1915: The British steamship *Lusitania* neared the end of a voyage from New York to Liverpool. One of the world's largest and most opulent liners, it carried 1,265 passengers, 189 of them Americans, and a crew of 694. On that spring day a single torpedo fired from a German U-boat struck on the starboard side. A second explosion quickly sounded. Within 18 minutes the vessel went down, bow first, at the cost of nearly 1,200 lives.

Why did the ship sink so quickly? What caused the second, fatal explosion? Was the liner, as Germany claimed, secretly transporting munitions that ignited on impact?

To probe the mystery, EXPLORER's "Last Voyage of the *Lusitania*" examines the ship whose loss hastened United States entry into World War I. (See also the article on pages 68-85.) Leading the quest is oceanographer Robert Ballard. He most recently took viewers to Iron Bottom Sound at the World War II battle site of Guadalcanal.

Ballard deployed the two-person mini-submarine *Delta* (below) as well as remote-controlled vehicles with high-resolution cameras to reach the wreck, which lies in 295 feet of water. High-frequency sonar scanned the hull, creating a three-dimensional computer image of the great vessel.

One goal was to locate a gaping hole reported by earlier divers, which would support the theory of a munitions explosion. The team's eyes in the sea found no such hole.

"Last Voyage of the Lusitania" airs Sunday, April 10, 9 p.m. ET, on TBS Superstation and is a May selection of the National Geographic Video Club.

HOWARD HALL (TOP); JONATHAN BLAIR

Someday you're going to retire.

Someday soon.

It's going to cost more than you think.

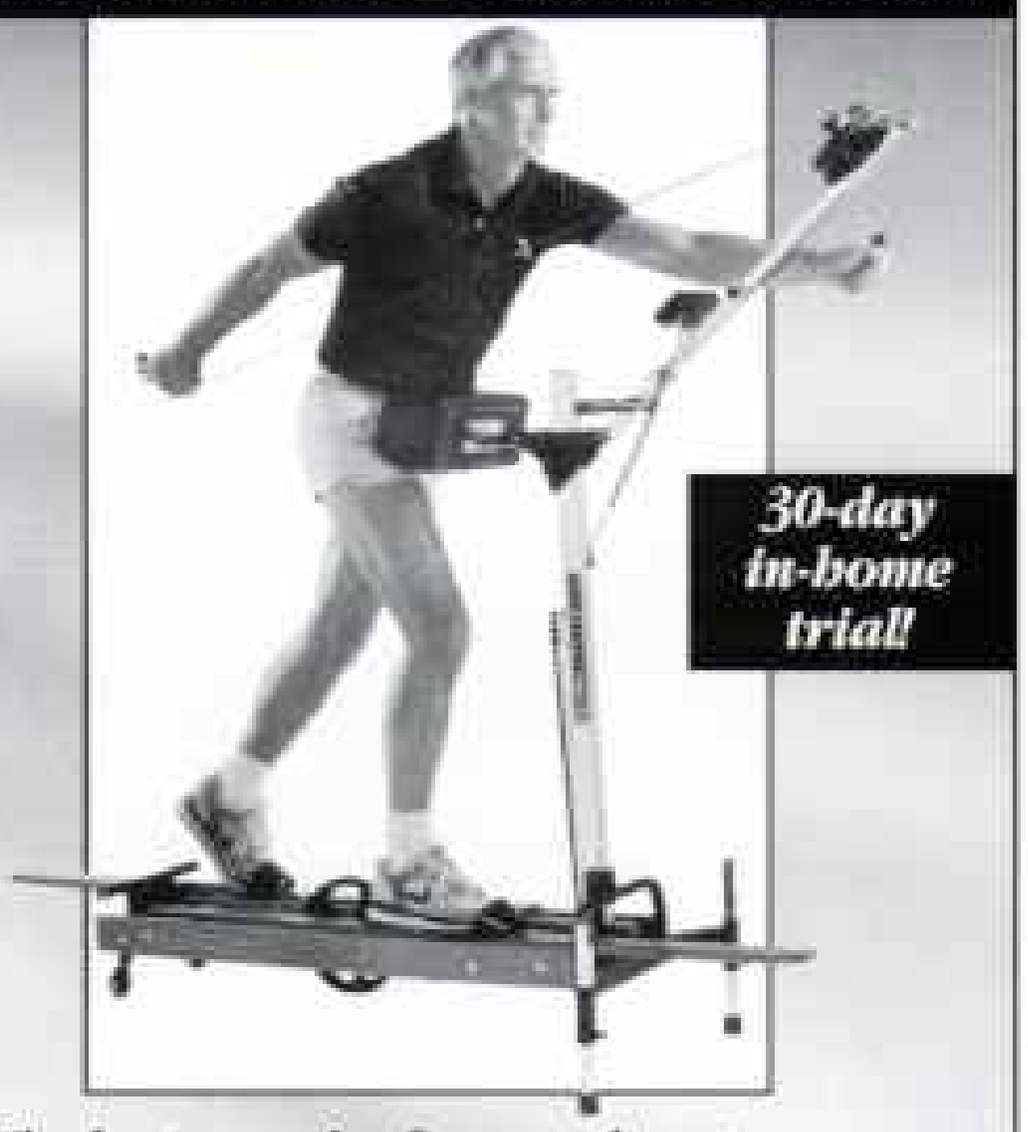
Odds on winning the lottery are still
12,913,583 to 1.

Intelligent planning. That's the real ticket to financial security. We can help you devise a plan that leaves little to chance.

Peace of Mind. It comes with every piece of the Rock.®

ThePrudential®

Get your blood pressure on track...with NordicTrack.



The best exercise for your heart.

You've heard medical experts advise that exercise reduces the risk of heart disease, by lowering your blood pressure and cholesterol levels. Problem is, how do you find the best workout?

Study after study shows that a NordicTrack® exerciser more effectively increases the performance of your heart and lungs than ordinary lower-body exercisers.

So in just 20 minutes, 3 times a week you'll get the most effective cardiovascular workout. And enjoy more energy and stamina, too.

Proven to reduce high blood pressure.

Research shows that NordicTrack users lowered their blood pressure an average of 12%. That alone is enough to reduce your risk of heart disease.

Doctors know it's less stressful on your body.

There's a reason why over 11,000 doctors are NordicTrack owners. They know our patented flywheel and one-way clutch system ensures a jarless motion that's less stressful on the back, knees, ankles and feet.

Thanks to a NordicTrack workout, they can stay with the exercise program that's essential for their heart.

Call today...prescribe the best exercise for your heart!

1-800-441-7891

Ext. 245D4

Call or write for a FREE Video and Brochure!

Write to: NordicTrack, Dept. 245D4, 104 Peavey Road, Chaska, MN 55318

NordicTrack

A CML Company

"The World's Best Aerobic Exerciser"

OWN A PIECE OF AMERICAN HISTORY

ORIGINAL MINT CONDITION
SAINT-GAUDENS DOUBLE EAGLE $599.

The Saint-Gaudens Double Eagle is an outstanding tangible asset investment. Now you can own one of these investment-grade, mint-condition coins for $599.

BUY WITH CONFIDENCE

Blanchard and Company is the nation's largest retailer of classic American coins. The only rare coins we sell are independently graded and certified by the Professional Coin Grading Service and Numismatic Guaranty Corporation. We will meet or beat any competitor's currently advertised prices, subject only to the availability of the coins and verification of the competitor's offer.

TO ORDER: **1-800-880-4653, ext. 728** TOLL FREE

BLANCHARD

AMERICA'S RARE COIN & PRECIOUS METALS FIRM

110 Veterans Blvd. • P.O. Box 61740 • New Orleans, LA 70161

An Academic Alternative

Kindergarten through Grade 8

You can bring a classic, comprehensive home instruction program to your child. Your home is your classroom; you are the teacher. Developed by certified teachers at our outstanding independent school, Calvert courses provide detailed, step-by-step instruction so that teaching experience is not required.

All materials are included and you may begin at any time. Coursework readily accepted by other schools; transcripts provided. Assistance from our certified Advisory Teachers is optional. Join over 350,000 student users since 1906. Fully accredited. Nonprofit. Write, call, or fax for free information.

Calvert School

Dept. N94A, 105 Tuscany Road
Baltimore, Maryland 21210
(410)243-6030 fax (410)366-0674

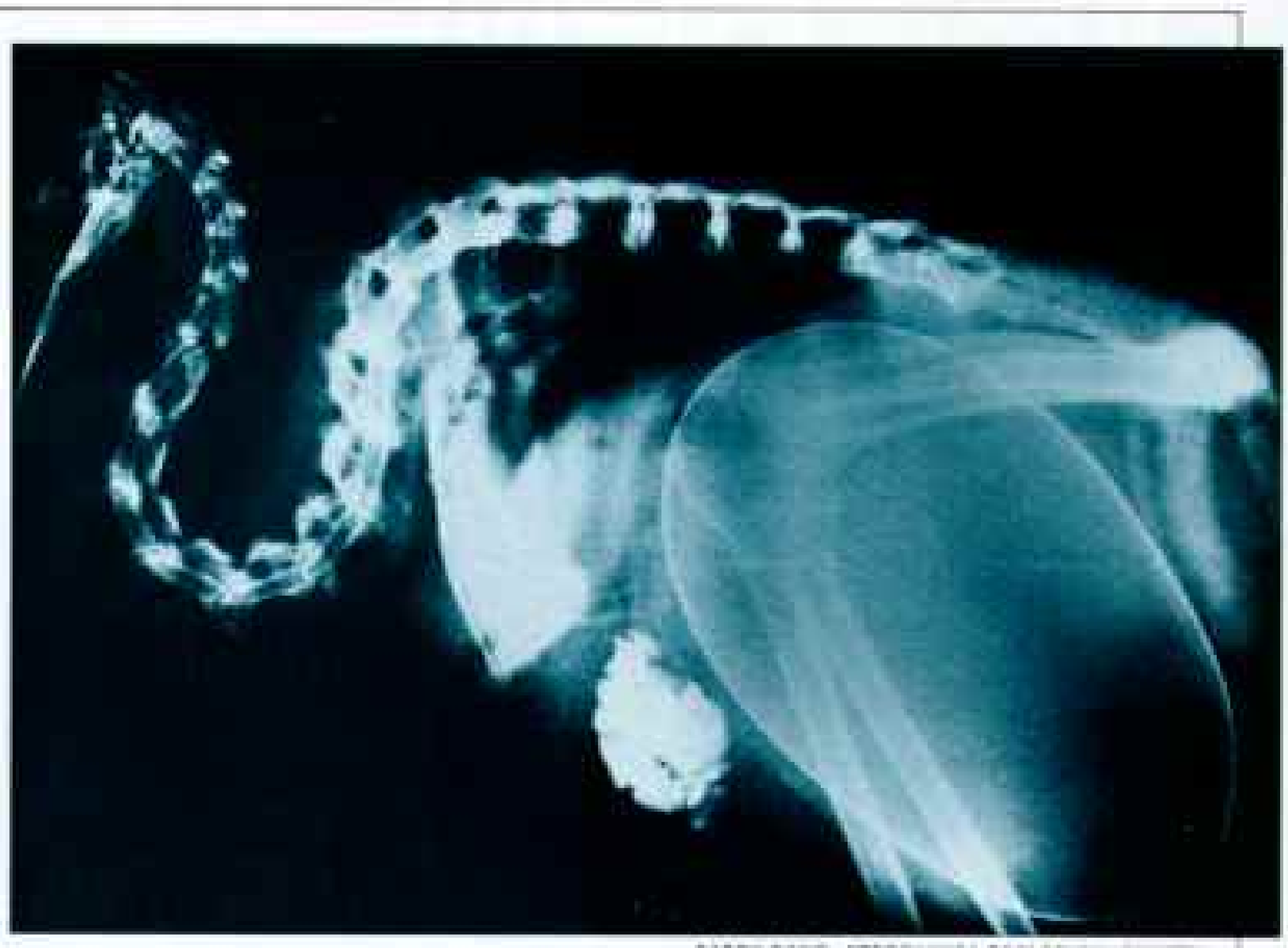
Established 1897

Earth Almanac

Whopper of an Egg Is the Kiwi's Burden

Any mother-to-be stressed out by the ordeal of pregnancy should consider the kiwi's plight. This six-pound female brown kiwi must carry a one-pound egg (X ray, right)—one of the largest egg-to-body ratios of any bird.

ROD MORRIS



BARRY ROWE, OTOROHANGA ZOOLOGICAL SOCIETY

Bizarre birds, kiwis exist only in New Zealand. Studying brown kiwis in North Island's Waitangi Forest, researchers Barbara and Michael Taborsky found that an egg develops for 34 days before being laid—a record for birds. After the female contributes a second jumbo grade A to the clutch, the male begins incubation duty, which only he performs. The male is tied to the nest for about 90 days—another superlative—until the chicks hatch. The eggs are 60 percent yolk, which sustains the huge chicks.

The kiwi, a national symbol, is endangered. In the past, few natural predators threatened kiwis, and they evolved into flightless, nocturnal ground dwellers. But they are defenseless against alien species—especially dogs—brought ashore by European settlers. The Taborskys found that in 1987 a stray German shepherd killed 500 of Waitangi's kiwis within two months.

Crop-infesting Bugs Hear a Giant Sucking Sound

One pesticide after another has been banned, and some cagey bugs are now immune to those still legal. Moreover, "insecticides can eliminate beneficial insects too," says entomologist Ed Show (left), with an alternative he has invented—the Bug Vac.

The farm-scale vacuum cleaner with powerful fans has been bought by more than 40 California growers, who drive the modified tractors through their strawberries. It works four rows at once, sucking up lygus bugs and other pests. Some beneficial insects, such as ladybugs, also die, "but not nearly as many as are wiped out by a series of chemical sprays," says Show.

Although the machines won't work on all bugs, they have been adapted for use on leafhoppers in vineyards and on Colorado potato beetles. One variation even sucks unwanted prairie dogs out of their burrows and dumps them unharmed into a holding tank.

RICHARD STEVEN STREET

National Geographic, April 1994

LeSabre Clearcoat Gloss. Another highly polished example of Buick quality.

Increased protection against the sun's harmful UV light.
Against water spots. Against fading. Even acid rain.
LeSabre Clearcoat Gloss protection. When it comes to quality,
Buick puts a fine gloss on it. To learn more, call 1-800-4A-BUICK.

BUICK
The New Symbol For Quality
In America.

TOM SEAVER

Gardener, Baseball Hall-of-Famer

Gardening is an important part of my life. I'm often out in my garden by seven.

I love the smell in the air, the early morning light.

My wife Nancy gave me a bronze plaque.

It says "He who plants a garden plants happiness." That's the way I feel.

I use Miracle-Gro to make everything in my garden look its best.

I learned that secret back when I was a rookie gardener.

Tom Seaver

Earth Almanac

Dead as East Germany, a Car Is Quietly Buried

Ugly duckling of a car and the butt of countless jokes, the Trabant—made in former East Germany—has made its final exit. But thousands remain as abandoned eyesores, and a campaign to get them off the street is under way.

Three years ago the last Trabant—number 3,096,099—rolled off an assembly line. Derided in the West as the "little stinker," the Trabant was seen as a symbol of the futility and ineptitude of the East German regime. One wisecrack: Why does a Trabant need a rear-window defroster? To keep your hands warm when you push it.

One model's earsplitting two-stroke engine—the type once used in lawn mowers—created clouds of pollution. It took 45 seconds for the 26-horsepower car to go from a standing start to 62 miles an hour. The body was partly made of wool sandwiched between plastic.

Some 700,000 Trabants still travel German roads. Many others, like this heap in Dresden, are inert (above right). Dead Trabants are collected at 187 sites and carted to several plants. Reusable parts are stripped, and the plastic is shredded.

DIRK FRACCHIA, CONTRASTO, SABA

One plan would have recycled the chips into products such as park benches, but it proved infeasible.

It's the end of the line for the vehicle voted "car of the year" in 1989 by thousands of East Germans who drove Trabants west to freedom.

Tiny Assassin Foils Maine Caribou Comeback

Hidden perils can thwart efforts to restore wildlife. Such was the case with the woodland caribou, a subspecies that once roamed the Maine woods. A few survive in the West and in Canada, but they vanished from Maine in 1908, felled largely by hunting and logging.

In 1963 the state tried to bring back the caribou, but the test animals died out. A private group tried again from 1986 to 1990. Brought from Newfoundland, 22 woodland caribou were bred in Maine and gave birth to 43 calves. A total of 32 caribou were eventually released to the wild over two years.

All died. Bears killed some, but others died from a brain worm carried by white-tailed deer, which had moved into the caribou's former range. "To deer, the parasite is totally benign," says Mark McCollough, a biologist who led the project. But to the caribou's return, it proved a fatal flaw.

JEFF LEPORE, PHOTO RESEARCHERS

In Search of the First Flowering Plant

Barely a millimeter tall, this fossilized male flower bloomed about 95 million years ago near what is now the Chesapeake Bay. Although it is one of the oldest flowers yet photographed, the very first flowering plants may be more than twice as old, some botanists believe.

PETER R. CRANE, FIELD MUSEUM

The earliest seed plants had no flowers, and most spread pollen by wind. Then came the flower bearers, angiosperms like this one, luring insect pollinators. Some 230,000 species now exist, compared with about 770 non-flowering varieties.

What did the first flowering plants look like? "If we can answer that, maybe we can understand why they became so successful," says Harvard botanist Michael Donoghue. Researchers had suspected that the earliest ones resembled woody shrubs like magnolia. Now some think paleoherbs—ancient semiaquatic plants like water lilies—bore the seeds of this botanical revolution.

—JOHN L. ELLIOT

Sometimes even having two doctors in the house isn't enough.

Browning Sterner's parents are doctors. And when they found out he had cerebral palsy, they came to Easter Seals for help. They knew that even with 28 years in the medical profession between them, Easter Seals had the experience they really needed. With a 75-year history of helping people with disabilities, Easter Seals had the right resources and facilities to help Browning. Today, he's just the active 5-year-old he should be. Proof that helping people make the most of their abilities is what Easter Seals is all about. And that a 75-year track record is pretty hard to beat. *Give Ability A Chance.*

THERE'S NO PLACE LIKE HONG KONG

In Hong Kong, you can feast on a nine course Chinese dinner amid the splendour of the world's largest floating seafood restaurant. Or experience the fascinating spectacle of an open-air performance of Chinese opera. Fortune hunt in a Hollywood Road antique shop stocked with the treasures of a dozen dynasties. Or a store offering the latest in high tech wizardry in Kowloon's Tsim Sha Tsui. And at the end of every day, slip back into the luxury of some of the best hotels in the world. Just be sure that when you're here, you give yourself enough time to take in all there is to see and do in Hong Kong. There's no place like it.

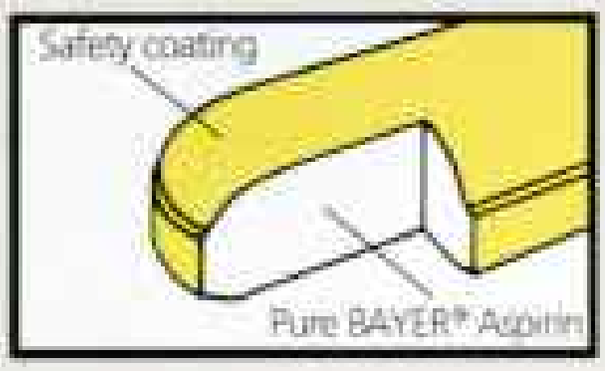
HONG KONG

For more information, please contact:
The Hong Kong Tourist Association, P.O. Box 7220,
Itasca, Illinois 60143-7220. Tel: 1-800-282-HKTA.

THE BAYER FACTS: ASPIRIN

BAYER ENTERIC ASPIRIN. IF YOUR DOCTOR RECOMMENDS A COATED ASPIRIN, MAKE SURE IT'S WEARING THE RIGHT COAT.

Safety-coated on the outside, Genuine BAYER® Aspirin on the inside.



The makers of BAYER have developed an amazing coating that actually prevents the aspirin from dissolving until after it leaves your stomach. Then it's gently absorbed into your system. Because the aspirin doesn't dissolve in your stomach, it's gentler than even buffered aspirin. You'll find this protective safety coating on BAYER Enteric Aspirin. It's designed especially for those on an aspirin regimen.

A name you know.
BAYER Enteric is the only safety-coated aspirin that contains Genuine BAYER Aspirin. Maybe that's why so many doctors on a personal aspirin regimen choose BAYER Enteric Aspirin for themselves. After all, if you're on an aspirin regimen, shouldn't your safety-coated aspirin be one of top quality?

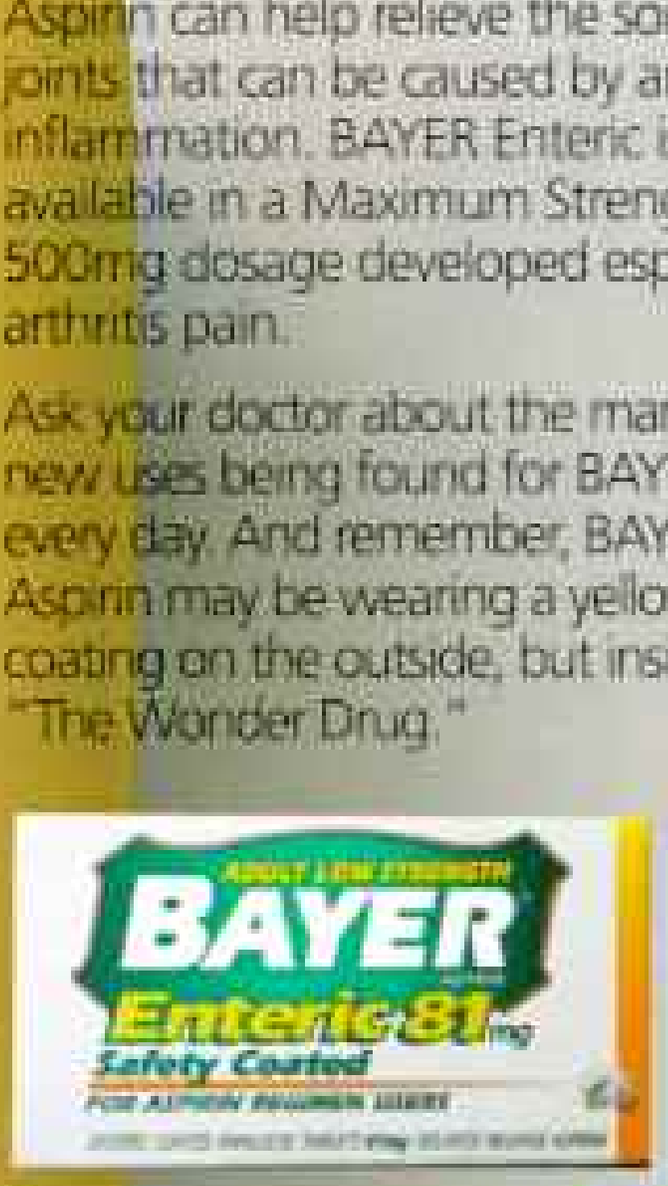
Life preserver.
BAYER Enteric Aspirin could help save your life. Ask your doctor. Because today, many doctors are recommending enteric aspirin to help prevent a second heart attack, along with a regimen of exercise and diet.

BAYER Enteric Aspirin comes in 325mg and the low dose 81mg. Ask your doctor which dosage is right for you.

BAYER

A helping hand for arthritis Inflammation.
Doctors often prescribe an aspirin regimen for people who suffer from arthritis. In addition to minor arthritis pain, when taken regularly, BAYER Enteric Aspirin can help relieve the sore, swollen joints that can be caused by arthritis inflammation. BAYER Enteric is now available in a Maximum Strength 500mg dosage developed especially for arthritis pain.

Ask your doctor about the many other new uses being found for BAYER Aspirin every day. And remember, BAYER Enteric Aspirin may be wearing a yellow safety-coating on the outside, but inside it's still "The Wonder Drug."



Read and follow label directions.
If pain persists for more than 10 days, or redness is present, consult a physician immediately.

THE WONDER DRUG THAT WORKS WONDERS.™

On Assignment

JOHN STANMEYER, NGS STAFF

A bear hug begins a bear hunt for freelance photographer SARAH LEEN, about to accompany Russian biologists to a wildlife preserve in Kamchatka to photograph bears emerging from hibernation. The helicopter copilot didn't speak English but understood her gesture of thanks for transport across the roadless region. "You couldn't shoot a story in a place like this without tremendous help," she says.

Born in Wisconsin, Sarah grew up in an Army family, moving "all over the Midwest." While an art student at the University of Missouri, she became interested in photography. After graduating with a journalism degree, she began her career as a NATIONAL GEOGRAPHIC intern; she covered Uganda for the July 1980 issue. She has also photographed California's Central Valley, the Canada-U. S. border, and Lake Baikal for the magazine.

Working in Siberia is like time travel, Sarah says. "It's grubby. I'd get excited when I could wash my hair in some little stream. Still, I'd love to go back. I like a place where you can't count on the light going on when you flip a switch."

When National Geographic field technician KEITH MOOREHEAD is on assignment, though, you can count on the light. As a member of the Society's photo equipment shop, he specializes in designing and building underwater lighting and protective camera housings for diving photographers. "Whatever they need," he declares, "we'll figure out a way to do it."

JONATHAN BLAIR

Off the coast of Ireland Keith adjusts a light on the camera-laden hull of the robot *Jason* (left), featured in this month's *Lusitania* article. Keith has also mounted remote-controlled cameras and lighting outside airplanes, submarines, and "even on the fin of a shark," he says. "That one's called the crittercam."

Keith's first job at the Geographic, 17 years ago, was fixing photocopiers. He learned a lot after his transfer to the photo equipment shop. "I had never touched a camera before," says the Memphis native. Now he—and his tool kit—follow cameras all over the world.

NATIONAL GEOGRAPHIC (ISSN 0027-9358) IS PUBLISHED MONTHLY BY THE NATIONAL GEOGRAPHIC SOCIETY, 1145 17TH ST. N.W., WASHINGTON, D. C. 20036. $21.00 A YEAR, $3.95 A COPY. SECOND-CLASS POSTAGE PAID AT WASHINGTON, D. C., AND ELSEWHERE. POSTMASTER: SEND ADDRESS CHANGES TO NATIONAL GEOGRAPHIC, P.O. BOX 2174, WASHINGTON, D. C. 20013.

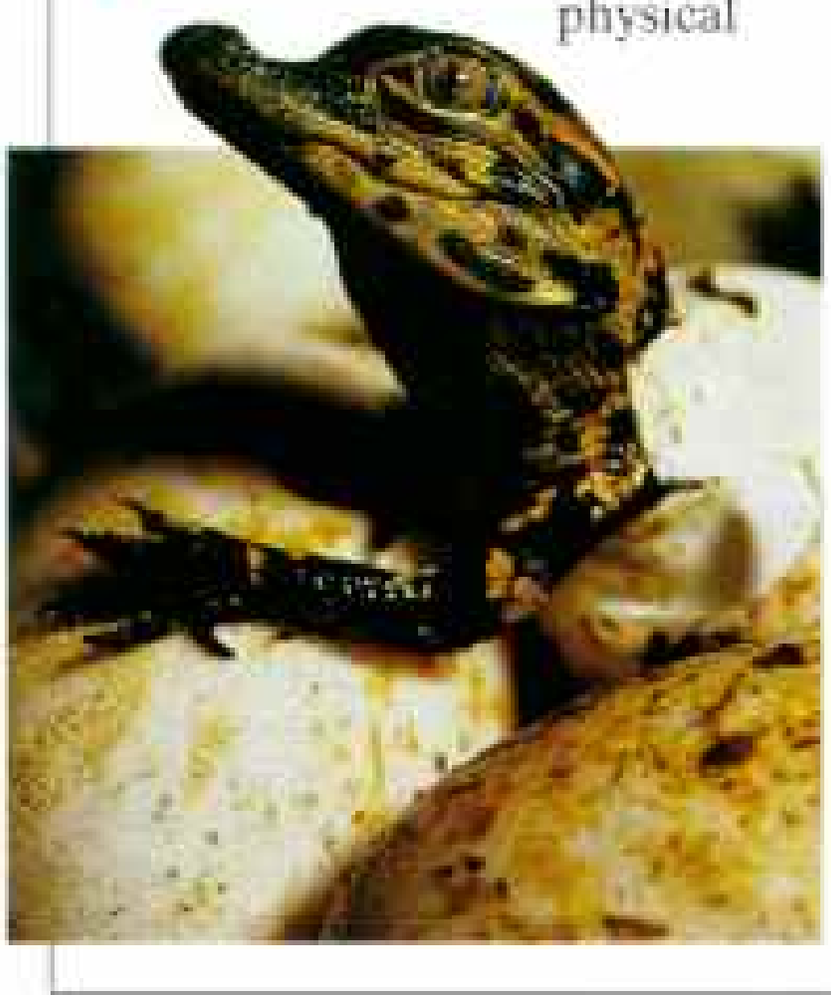
Geoguide

ALL BY CHRIS JOHNS

RIDING AN AIRBOAT WITH HIS FATHER, FIVE-YEAR-OLD KENT CYPRESS (LEFT) SKIMS ACROSS SOUTH FLORIDA WATERS JUST OUTSIDE EVERGLADES NATIONAL PARK. AN EIGHT-INCH-LONG ALLIGATOR (LOWER LEFT) SQUEEZES FROM THE CONFINES OF ITS EGG FOR A FIRST LOOK AT THE WORLD. THE BILL OF A ROSEATE SPOONBILL (BELOW) SNAGS FISH, INSECTS, AND CRABS IN THE EVERGLADES' SHALLOW WATERS.

The Everglades

- Florida's southern tip, which includes Everglades National Park, has a tropical climate even though the state lies north of the tropics. Which U. S. state is found largely within the tropics—between 23½° north and 23½° south latitude?
- In what way is the Everglades healthier—or less healthy—today than it was a hundred years ago? Fifty years ago?
- Humans have changed the physical characteristics of the Everglades by diverting its freshwater. More than 1,400 miles of canals and levees cut through the region. Why has the water been diverted? What else has been changed by the decrease in water flow?
- Some two million people live in the area shown on the map on pages 10-11. Where are most of these people clustered? Why have they tended to settle there and not elsewhere?
- The Everglades is referred to as a "biologically diverse treasure" on page 17. What does that mean? Scientists want to protect biological diversity. One reason is that some plants and animals might hold answers to finding cures for human diseases. What are other reasons for protecting biological diversity?
- Why is the melaleuca tree called the "Everglades Terminator"? Where did melaleuca come from? Why was it brought to Florida? Was its introduction a success? Why or why not?



USE THE GEOGUIDE PAGE ALONG WITH THE ARTICLE "THE EVERGLADES: DYING FOR HELP" IN THIS ISSUE TO HELP CAPTURE THE INTEREST OF YOUNG READERS AND STIMULATE DISCUSSION WITH THEM. GEOGUIDE IS PUBLISHED FOUR TIMES A YEAR.

Even Predators Are Prey To Changes In Geography.

Even the most powerful alligator is no match for a swamp going dry. In fact, animals all over the world are facing extinction because of changes in their natural habitats.

In order to help these animals, you have to thoroughly understand geography – in the sense of how systems and lives interact. Delta Air Lines is committed to geography in every sense, with over 4,900 flights to over 300 cities every day.* What's more, we sponsor the National Geographic Geoguide on the facing page, to help teach our children how change affects the Earth and the life on it.

DELTA AIR LINES

In partnership with National Geographic

*Based on systemwide flights and cities served by Delta and the Delta Connection. Delta Connection flights operate with Delta flight numbers 5000–5999 and 7000–7999. The educational Geoguide page is brought to you through the cooperative efforts of Delta Air Lines, Inc. and the National Geographic Society Geography Education Program. © 1994 Delta Air Lines, Inc.