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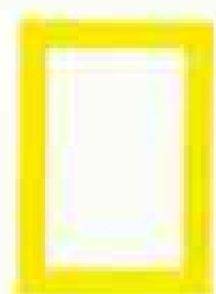

NATIONAL GEOGRAPHIC

OCTOBER 1992

Our Disappearing Wetlands

By John G. Mitchell
Photographs by Raymond Gehman and Jim Richardson

Rich and complex ecosystems, wetlands reduce water pollution, alleviate flooding, and provide critical wildlife habitat. Yet the U. S. loses 300,000 acres of this natural resource each year.

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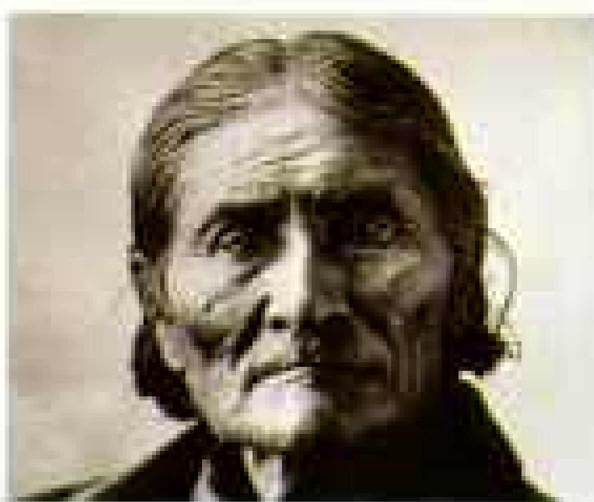
Geronimo

By David Roberts
Photographs by Bruce Dale



This charismatic Apache leader fought the relentless advance of settlers and entered history. A map supplement illustrates key sites in the cultural heritage of the Southwest.

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Hard Harvest on the Bering Sea

By Bryan Hodgson
Photographs by Natalie Fobes

In a brutal struggle with the elements, Americans and Russians reap the wealth of the waters off their shores. Now other nations seeking a larger share of the catch threaten the fishery.

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Deep-Sea Geysers of the Atlantic

Text by Peter A. Rona

Diving two and a half miles to the Mid-Atlantic Ridge, a U. S.-Russian expedition investigates mineral-rich hot springs, home to eyeless shrimp and source of the first pure gold found in the deep.

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The Bolshevik Revolution

By Dusko Doder
Photographs by Peter Essick

Lenin's Bolsheviks dreamed of creating the ideal society, but the communism born of their 1917 revolution proved as vulnerable to human imperfection as did the rule of the tsars.

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COVER: Mirrored by his wetland habitat, a bullfrog floats in a Massachusetts pond. Photograph by Mark Wilson, WILDSHOT.

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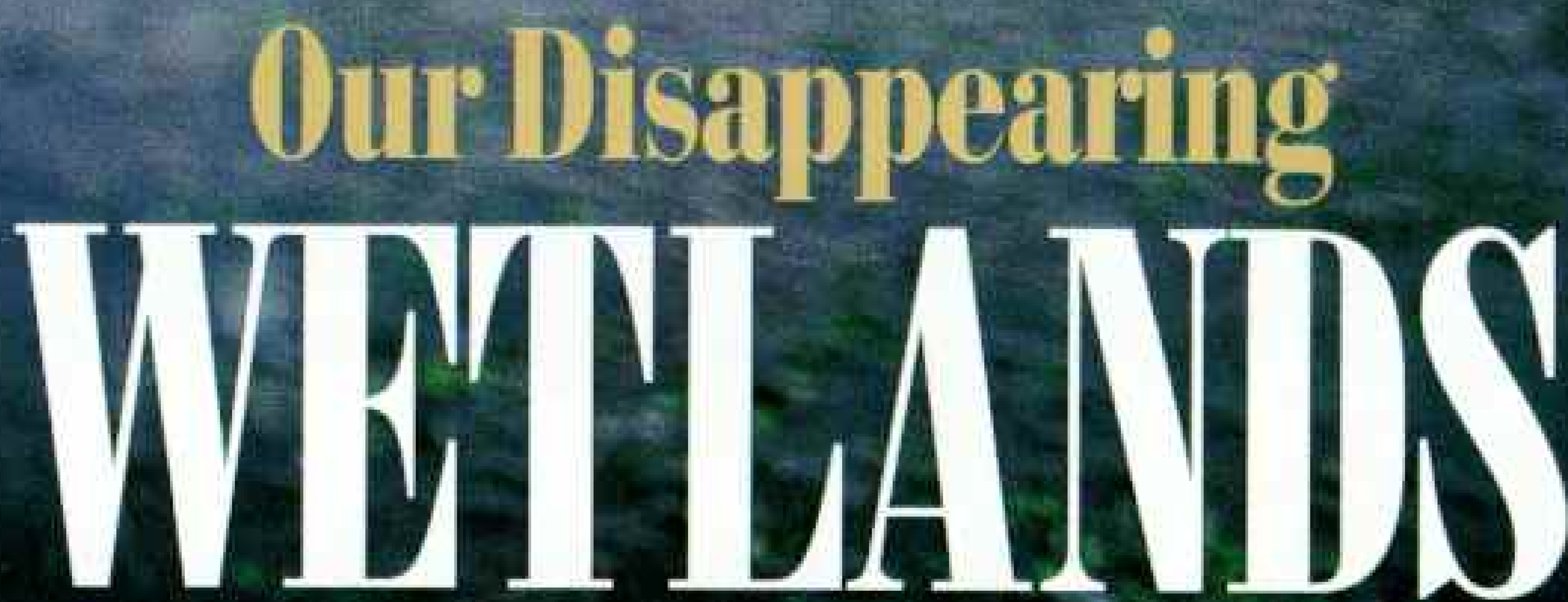


Our Disappearing WETLANDS

Life begins in a marsh for Canada geese in Minnesota. Long dismissed as noxious, unprofitable places, wetlands are now prized as one of the richest ecosystems on earth. And yet their destruction continues.

By JOHN G. MITCHELL

Photographs by

RAYMOND GEHMAN and JIM RICHARDSON WEST LIGHT

JIM RICHARDSON

LIQUID RICHES

As nature intended, spring runoff soaks a cypress swamp in Missouri's

JOHN AND KAREN HOLLINGSWORTH

Mingo National Wildlife Refuge. Drained and logged in the 1920s, the restored wetlands welcome back river otters and bald eagles.

WET AND WILD

Places of plenty, wetlands in the United States provide critical habitat for 150 kinds of birds and 200 kinds of fish. They also harbor a third of the country's endangered or threatened species of plants and animals. Nutrient-rich waters in a Mississippi Delta salt marsh draw a flotilla of white pelicans. In a Lake Erie marsh, a Blanding's turtle seems to blossom amid water buttercups. And what's a wetland without frogs? Croaking loudly, wood frogs spill eggs along a Maryland creek.

ANNIE GRIFFITHS BELT (LEFT); GLENN DAVIS (TOP); GEORGE GRALL

WETLANDS DOWN THE DRAIN

Mud puddles and mess are left behind when developers "improve" wetlands. Water gushes from an Illinois swamp being drained for crops, while a dragline bucket (above) did the dirty work on a boat channel in a Minnesota bog. A bulldozer left its mark on an Illinois cypress swamp (right) scraped away for a pond. Laws have slowed wetland loss, but 300,000 acres still vanish annually.

ALL BY JIM RICHARDSON

JOHN WHITMAN DAVIS was out behind his clapboard farmhouse when I found him on a raw, windy, winter-into-spring sort of morning. He was working up logs for the wood-burning furnace that heats his place. A self-described Swamp Yankee, Davis is the proprietor of some 400 acres of woodland, pasture, and tidal marsh in the small, shorefront community of Pawcatuck, Connecticut. He runs 40 head of shorthorn beef cattle, raises vegetables for the local market, cultivates the old-fashioned way, with horses, and shuns the use of herbicides to keep down the weeds.

What about fertilizers, I wanted to know. "Don't need much," he said. "Got cows."

We went down through his woods to the edge of the marsh, soft brown this time of year, *Spartina* cordgrass mostly, some oak snags on the other side, some common reeds tucked in around the upper end, and, at the other, a peekaboo slice of the sea aglint under yellow sky.

"My ancestors been farming here—haying this marsh—for almost 350 years," Davis said. The early ones had always been drawn to the marshes, the Meadowes, as some were called. The lush grasses of soggy places provided the settlers with forage for their livestock, mulch for their gardens, bedding for their homes. Map the spread of colonial settlement on the forested coastal plain of North America and you are tracing an American quest for wild hay.

"The deeds call this here the Continental Marsh," said Davis, "because back in Revolutionary War days we were a provision farm for the Continental Army. The marsh fed our cows and pigs, and we supplied salt pork, salt beef, butter, cheese to what the British called the pirates—we called 'em privateers—out of Stonington Harbor. And we've been haying and pasturing this marsh, easy, though, ever since."

So what was the secret? How did he have his marsh and use it too?

"You don't upset old mother nature," he said. "You work with her. It's Swamp Yankee common sense. Don't drain the marsh. Don't fill it. Don't dig it up. Don't rut it up. Don't dam it and don't flood it. That's how you do it right."

"I smell the ocean in my hay," says Connecticut farmer John Whitman Davis, whose family has been harvesting the same tidal salt marsh since before the Revolutionary War. The glow of marina lights across the Pawcatuck River constantly reminds Davis of the urban squeeze put on coastal wetlands. "No sir, our marsh will not be developed," he vows. "You don't kick mother nature in the shins."

Standing with Whit Davis that morning at Pawcatuck, I let my mind wander along the coast and over the hills to all the other places where the quest for grass had gone astray, had slowly turned into a grab for something else—for dry land, for row crops, for homes and businesses, for reservoirs and roads and drilling pads and shopping malls and airports. When Davises scythed *Spartina* grass for George Washington's musketeers, some 220 million acres of wetlands sparkled across the lands we

JOHN G. MITCHELL, a former field editor for *Audubon*, is author of *Dispatches From the Deep Woods* and *The Man Who Would Dam the Amazon*.

would one day call the lower forty-eight. Now only a fraction over a hundred million of those acres remain intact. Even that residual could suffer further erosion if guidelines controlling the filling of wetlands are significantly weakened by the federal government, one of the environmental issues in this year's presidential campaign.

Draining and filling of wetlands got serious after Uncle Sam, with the Swamp Land Acts of the mid-19th century, made it official policy to encourage reclamation in order that "wastelands" might soon bear the fruits of sustained agriculture. Ever since, conversion of wetlands to

RAYMOND GEHMAN

croplands has been the leading cause of depletion—an irony to ponder here at the edge of Davis's unwasted mowing ground. Of course, residential and commercial development has also contributed to the loss. As has mining. And energy projects. And water development schemes. And chemical contamination.

Over the years the greatest losses among coastal wetlands have occurred along the Gulf shores of Florida, Louisiana, and Texas. In freshwater places the swamps and riverine bottomlands of the Mississippi Valley and the Southeast have taken the heaviest hits. Among states, the big losers on a percentage basis have been California, with only 9 percent of its historic wetlands remaining, Ohio, with 10 percent,

and Iowa, with 11 percent. Next are Indiana and Missouri, with 13 percent of their colonial wetlands base.

More than half of Connecticut's coastal wetlands are gone. Two-thirds of the prairie potholes—those sparkling waterfowl factories of the northern prairies—are gone. Half the fabled Florida Everglades is gone. Much of the marshland around the Chesapeake Bay is gone. In California the San Joaquin Delta's natural function as an estuary is greatly diminished. Despite all manner of new programs and regulations instituted since the 1970s to save what remains of this vital national resource, the record of success has not been outstanding. In a report to Congress last year the U. S. Fish and Wildlife Service announced that between the mid-1970s and mid-1980s the nation suffered a net loss of some 2.6 million acres of wetlands. That's 4,000 square miles, an area twice the size of Delaware.

BOTH BY RAYMOND GEHMAN

"On average," the report noted, "the lower 48 states have lost over 60 acres of wetlands for every hour between the 1780s and the 1980s."

It suddenly occurred to me that morning in Pawcatuck that 60 acres is not much larger than Whit Davis's salt marsh.

Does it really matter all that much that America has lost two Delawares' worth of wetlands in a decade? After all, what good were these miasmal places, apart from providing hay? And what value, if any, adheres to the acres remaining? There are a substantial number of Americans who raise these questions, wondering why the good wet earth should not be put to a higher and drier use.

Only scraps of marsh have survived the waves of development at Groton Long Point, on the Connecticut coast. Protected by stringent regulations since 1969, the state's tidal wetlands, which purify water entering Long Island Sound, face further shrinkage as sea level rises.

Yet what could be more useful than biological productivity? Wetlands are producers of life, some being equal in output to a same-size chunk of tropical rain forest. Wetlands lock up large amounts of carbon—especially in the form of peat—thereby preventing it from entering the atmosphere as carbon dioxide, the principal culprit in global warming. Wetlands provide feeding, spawning, and nursery grounds for more than half the saltwater fin- and shellfish harvested annually in the U. S. and for most of our freshwater gamefish as well. They are habitat for a third of the country's resident bird species, more than half of its migratory ones, and for one out of three plants and animals currently listed on the federal registry of endangered and threatened species.

So? says the utilitarian who eats no fish, eschews bird-watching, scoffs at the concept of biological diversity, and views global warming as an elitist scam. *What about people?*

What about water? People need water. Clean water. Wetlands absorb and filter pollutants that would otherwise degrade lakes, rivers,

reservoirs, and aquifers. People need protection from too much water in the wrong places at the wrong times. Coastal wetlands buffer the impact of storm tides on populated uplands; inland marshes sponge up runoff, reducing flood crests downstream. Wetlands stabilize shorelines and riverbanks. They are the glue that holds the land together.

The word "wetlands" is a relative newcomer to the language, an invention of the age of ecology. Most people used to be content to speak of marshes and swamps and let it go at that without even knowing the difference—the difference being that a marsh is a wet place with herbaceous vegetation, while a swamp is a wet place dominated by shrubs and trees. And since there are so many different kinds of each, it behooved some unsung wordsmith to come up with a handle that would carry them all—bogs, sloughs, floodplains, estuarine marshes, to cite just a few (map, pages 18-20). So what did we get for that handle? Wetlands.

My plan for examining the plight and the promise of our nation's wetlands was linear. I would have a look around Whit Davis's precincts, check out the regulatory scene in Washington, D. C., and then light out for a couple of territories where the resource was at highest risk: likely a riverine swamp in Georgia and a patch of prairie in North Dakota with a few relict potholes still in place. And somewhere too, probably in California, I would have to look into the issue of restoration and mitigation, whereby all the king's bulldozers and all the king's men are supposed to put wetlands together again.

Orphaned from its natural surroundings, a cypress dome is reduced to serving as a storm drain for one of the large citrus farms that have moved into southern Florida. Such remnant wetlands still support wildlife, but scientists wonder for how long.

In Connecticut, I discovered that hardly a season can go by that a tidal marsh or inland swamp isn't figuring in some kind of municipal donnybrook, the landowner on the one hand wanting to put a piece of his wetland to a drier use, and, on the other, a regulatory agency wanting him not to. At the time of my visit with Whit Davis, for example, the town of Stonington (of which Pawcatuck is a part) was reviewing an application to develop a 71-lot subdivision abutting, and in places overlapping, a red maple swamp. The swamp drains directly into the town's water-supply reservoir. Town officials told me that earlier versions of the application, projecting a higher density of development, were rejected because of fears that subdivision roads across the swamp would cause an unacceptable loss of wetlands functions and that some of the development's septic systems might contaminate the town water supply.

Developers figuring to rearrange wetlands face considerable obstacles in a state such as Connecticut, which imposes its own regulatory

Dust flies where weeks earlier geese and ducks took wing on M & T Staten Ranch in California's Central Valley. To nurture the soil and to host migrant birds, managers flood fields from August to May. Then tractors arrive to plant corn.

constraints to supplement the federal ones. In most cases the state regulations are enforced by local municipal boards known as inland wetlands commissions—"inland" because coastal matters are strictly under state and federal jurisdictions. And all these regulatory layers tend to give developers an incurable itch.

"There's too much damn government, that's the truth of it," says Daniel Cosgrove, a selectman in the town of Branford, just a few hops down the Connecticut shore from Stonington. While being a selectman may make Cosgrove a part of government, he is better known as the founding father of Cosgrove Construction Company, which specializes in earthmoving contracts for airports, commercial developments, and other large projects frequently positioned next to, or heretofore on top of, marshes and swamps. "You can't deal with it all," he says. "All these laws do is hold you up. Sure, there's merit in that noble purpose that brought about the law in the first place, but then there's only abuse by those who enforce it."

The federal government's principal weapon for protecting wetlands is Section 404 of the Clean Water Act, which prohibits the filling, without a

BOTH BY RAYMOND GEHMAN

permit, of any portion of the waters of the United States. Wetlands are included in those "waters." Under the law, the U. S. Army Corps of Engineers functions as the permitting agency, while the Environmental Protection Agency (EPA) is authorized to promulgate guidelines and, if need be, exercise its veto power over a corps decision. Other regulations and programs affecting wetlands are administered by other federal agencies, such as the U. S. Fish and Wildlife Service and the Soil Conservation Service, and more than 20 states have, like Connecticut, strung up statutory safety nets for their wetlands as well. To provide some measure of consistency in the implementation of all these efforts and to reduce the effect of sending too many mixed signals to landowners, the government in 1989 issued its "Federal Manual for Identifying and Delineating Jurisdictional Wetlands." The manual defined the hydrologic, vegetation, and soil characteristics that qualify a site as a wetland subject to federal regulatory protection.

It wasn't very long, however, before the manual came under sharp attack. Pro-development and agricultural interests argued that its scope was too inclusive; that it delineated as *(Continued on page 24)*

Better than nothing, an irrigation canal makes a wetland for mallards on a Central Valley ranch. Once a floodplain, the valley was drained for agriculture. In the 1940s some 40 million waterfowl wintered here. Today: five million.

THE WORTH OF WETLANDS

Ranging from moist prairie depressions of less than an acre to flooded Florida grasslands stretching for hundreds of square miles, wetlands appear in every region and climate of the U. S. Rivaling tropical rain forests in productivity, wetlands have been comparably exploited and diminished by development. In the past 200 years more than half the wetlands in the lower 48 states have been drained, paved, filled, or otherwise lost—most to agriculture.

A 1991 government proposal to change the standards for identifying wetlands could shrink the totals further, eliminating protection for as much as half the remaining 103 million acres of bogs, swamps, and marshes. The question presses: Can the nation afford to lose any more of a prime natural resource? Wildlife and fish habitat, flood control, clean water, beauty—these are the virtues of wetlands.

ALASKA

HAWAII

Wetlands (general)

Northern bogs

Prairie potholes

Cypress swamps

Southern riverine bottomlands

Coastal marshes

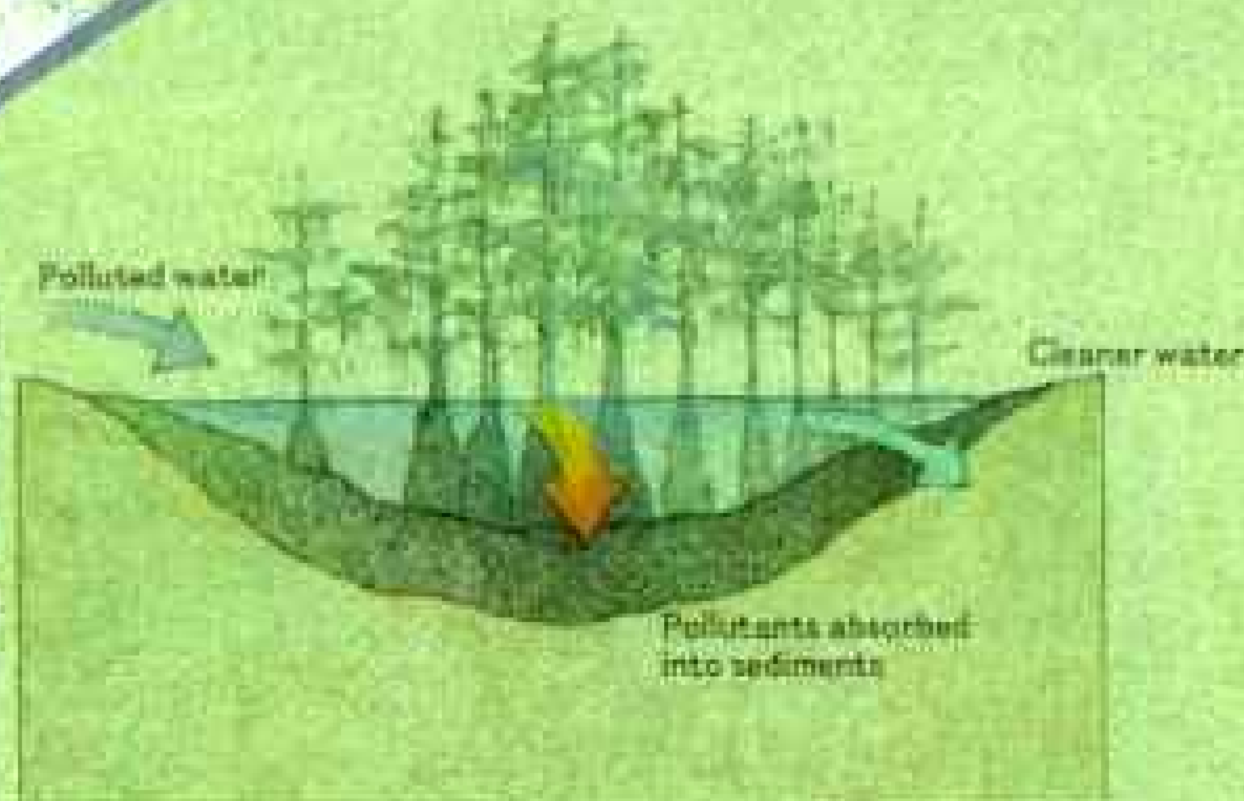
National wildlife refuge (N.W.R.)

Larger wetland areas on map often consist of a high density of small wetlands intermixed with uplands.

Scale varies in this perspective.

NGS CARTOGRAPHIC DIVISION

Hawaii's 52,000 acres of wetlands shelter four endangered bird species.

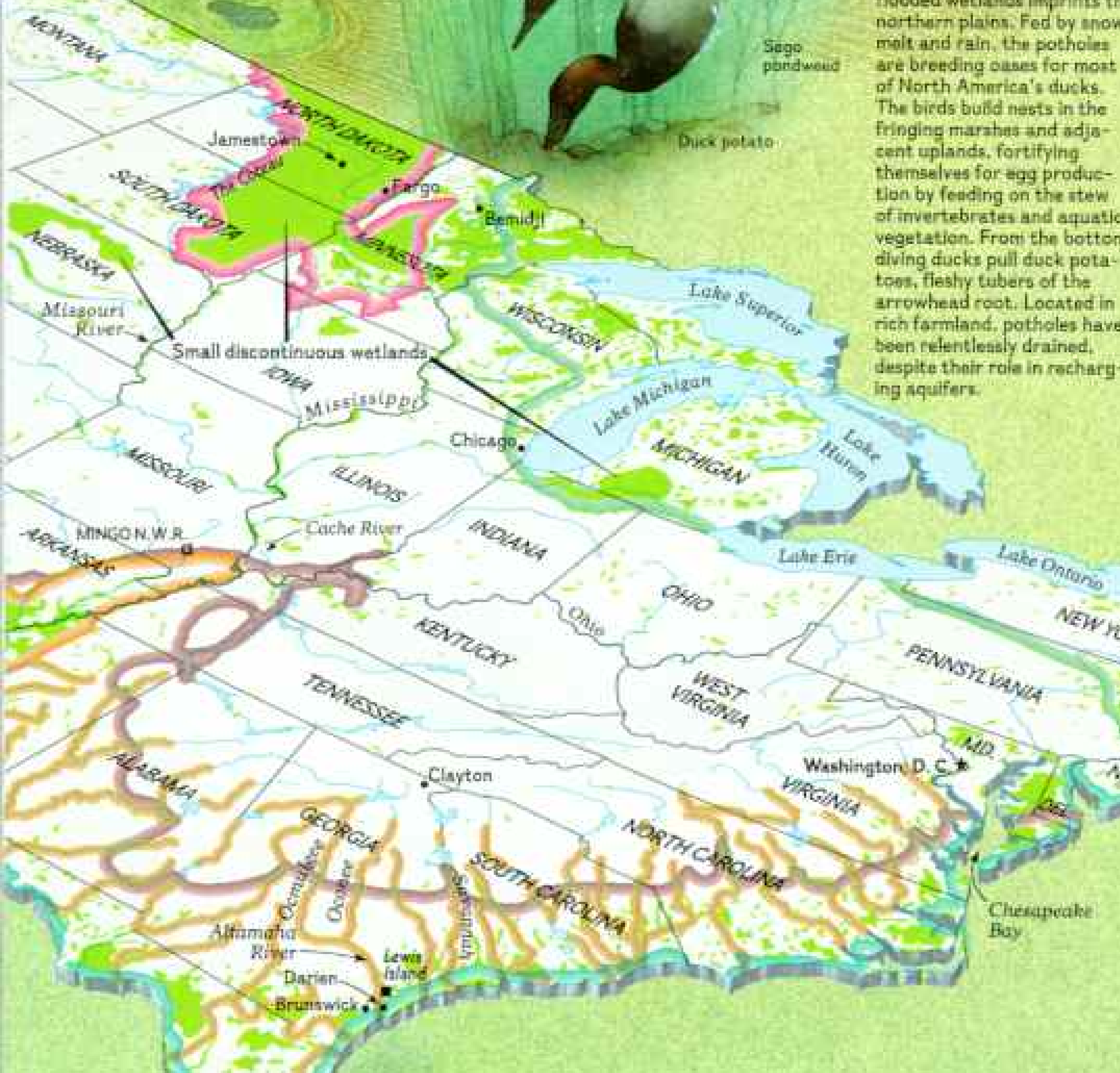


Cypress Domes

Natural purifiers, cypress domes—small swamps with tall cypress trees at the center—act to eliminate wastes carried in water. Fed domestic sewage, cypress domes remove most of the harmful nitrates and phosphates, binding them up in mud and tree roots. Scientists caution that wetlands, vital as pollution traps, could suffer from overloads of contaminants.

Prairie Potholes

Scooped out by glaciers, a mosaic of shallow, seasonally flooded wetlands imprints the northern plains. Fed by snow-melt and rain, the potholes are breeding oases for most of North America's ducks. The birds build nests in the fringing marshes and adjacent uplands, fortifying themselves for egg production by feeding on the stew of invertebrates and aquatic vegetation. From the bottom, diving ducks pull duck potatoes, fleshy tubers of the arrowhead root. Located in rich farmland, potholes have been relentlessly drained, despite their role in recharging aquifers.

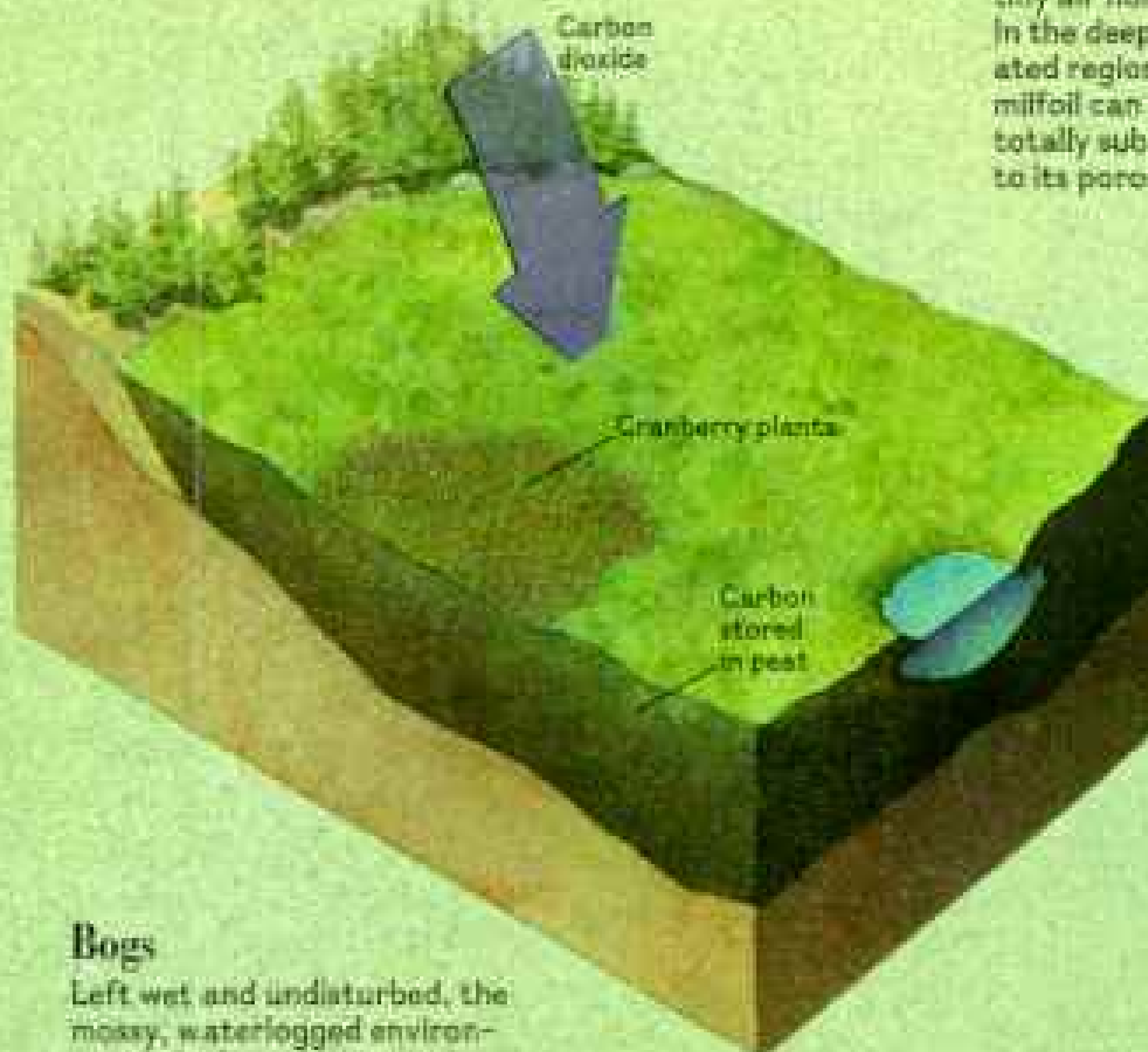


Coastal Marshes

Energized by a daily pulse of nutrients from tides, coastal salt marshes provide habitat for two-thirds of the commercial fin- and shellfish harvested in the U. S. At high tide shellfish pursue an abundant supply of algae and cordgrass detritus or scavenge for invertebrates. The spotted sea trout and many other species come to the marsh to spawn, and young fish use it as a nursery.

Wetland Plants

To survive in the flooded conditions of a freshwater marsh, wetland plants take in oxygen in specialized ways. The spongy feel of a cattail leaf testifies to a dense network of air spaces through which oxygen reaches the roots. The flat leaves of the water lily are riddled with tiny air holes on their tops. In the deeper, less oxygenated regions, the water milfoil can grow while totally submerged, thanks to its porous roots.



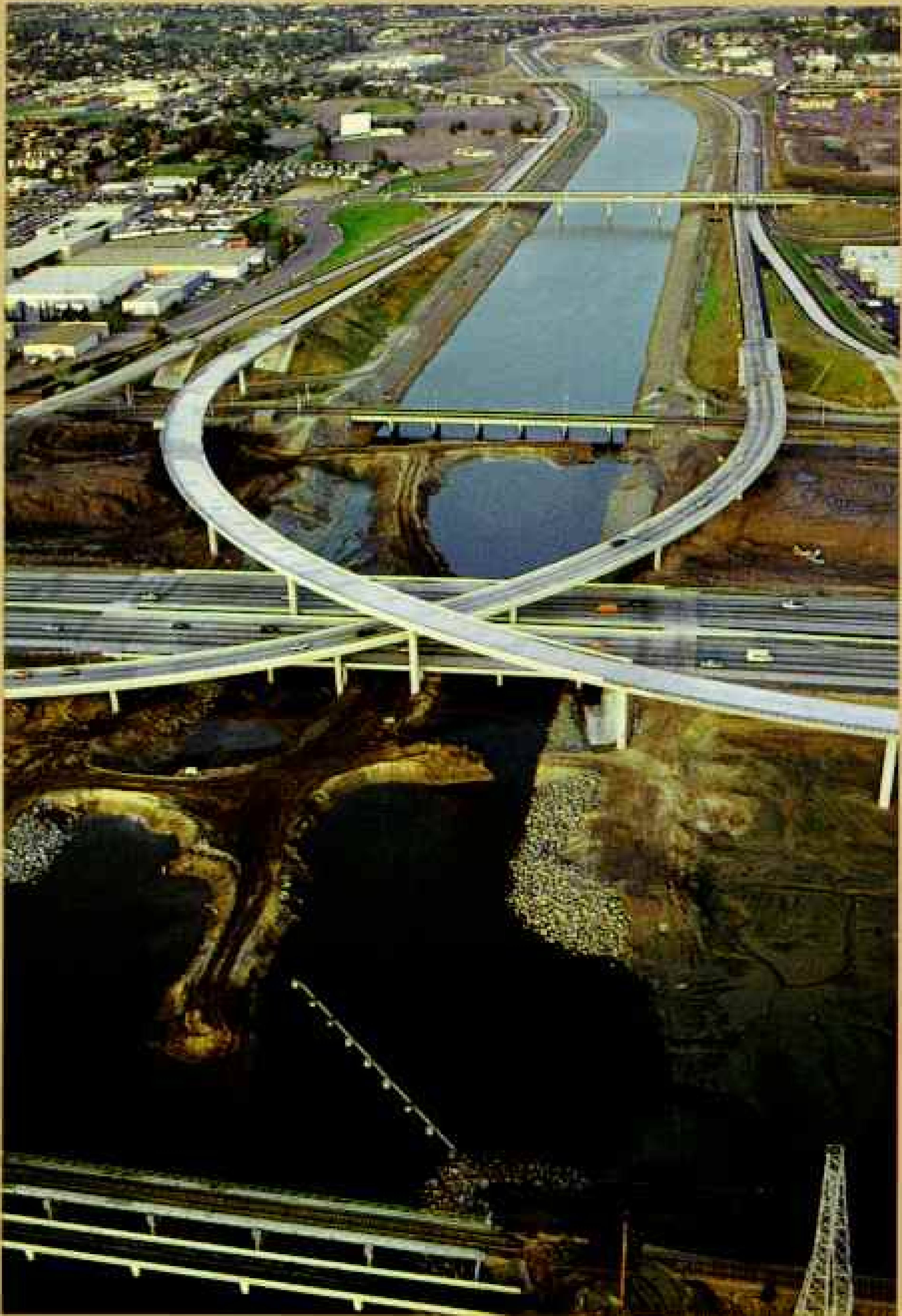
Riverine Bottomlands

Flourishing amid river meanders, floodplain forests serve as reservoirs during times of high water. Instead of rushing downstream, flood water pools behind natural levees and in sloughs and oxbows, and is then slowly released. Thick woody vegetation traps sediment and slows the river's speed. Silver maple and cottonwood dominate northern floodplains; along the sluggish southern rivers tupelo and bald cypress stand out.

PAINTING BY GREG HARLIN

Bogs

Left wet and undisturbed, the mossy, waterlogged environment of a bog plays a vital role in regulating climate. By storing carbon in the form of decaying plant material, bogs reduce the amount of carbon dioxide released into the atmosphere. Found in damp, cool places, these low-energy wetlands feature carpets of sphagnum moss mixed with shrubs, cotton grass, and stunted spruce. In the fall wild cranberries are ripe for harvest.



ANNIE GRIFFITHS BELT (LEFT); RAYMOND GEHMAN

MARSHES WILD AND TAMED

Nature's blueprint is still followed on the lower Savannah River in Georgia, where waterways scrawl across fertile estuarine marsh (left). Human designs invade Sweetwater Marsh near San Diego. Highway ramps and a flood-control channel disrupt the natural flow of water.

(Continued from page 17) "wet" lands that were dry for most of the year. The administration considered these complaints and, in August 1991, proposed new criteria that would sharply reduce protection for a wide variety of wetlands areas. Critics of the proposed changes countered that the revisions, if adopted, would deregulate half the remaining wetlands in the lower 48 states—some 50 million acres all told—including many of the South's bottomland hardwood swamps, more than a third of the potholes in North Dakota, most of the high coastal marshes in California, and even a quarter of Everglades National Park.

BOTH BY RAYMOND GEHMAN

That was how it was being played when I went to Washington, D. C. There was talk of an effort to get the delineation debate out of the political arena and into the hands of the National Academy of Sciences. But it was clear that both the White House Domestic Policy Council's Interagency Task Force on Wetlands and Vice President Dan Quayle's Council on Competitiveness remained eager to revamp wetlands protection—one way or another—in a style more acceptable to farming, homebuilding, property-rights, and mining advocates.

One way, of course, was the legislative route through Capitol Hill, but bills already introduced to accomplish that goal didn't seem to be going anywhere. Another way was to return to the Corps of Engineers' 1987 criteria for defining wetlands. Still another was through initiatives out of the Domestic Policy Council's Task Force—actions designed to weaken the role of the EPA and the U. S. Fish and Wildlife Service, while giving the corps a freer hand in administering wetlands regulations.

It is a puzzlement to me why the corps should need a freer hand. Apparently it already has one. In an official corps summary of "average annual regulatory statistics," I found that of some 90,000 projects under the corps's jurisdiction, 80,000 were placed in a category that required "little or no individual review." And of the 10,000 applications that *were* put through the full regulatory process, only 6 percent were denied by the corps. All this, plus the fact that Section 404 of the Clean Water Act now regulates only the filling of wetlands, not the draining of them, helps explain why, despite an avowed national policy of tolerating "no net loss" of wetlands, America continues to lose them even now at the rate of some 300,000 acres a year.

THE HEADWATERS of the Altamaha River rise in the hills of the Georgia Piedmont, in the precincts of Athens and Atlanta, and roll down the long valleys of the Oconee and Ocmulgee to a confluence near Lumber City; from there the main stem flows southeasterly to the ocean at Darien. The Altamaha drains a quarter of the state. Each second it pushes more than a hundred thousand gallons of water into the Atlantic Ocean. There are no dams on the main stem. Shad and sturgeon and herring spawn in the Altamaha, and its vast waterways nurture their young. There are shrimp offshore sufficient to support a commercial fishery valued at 20 million dollars a year.

None of these good things—the dollars, the shrimp, the sturgeon, the sweet water—would be here were it not for the fact that the Altamaha, for much of its way to the sea, preens itself upon the nutritious sloughs and terraces of a scraggly, labyrinthine bottomland swamp.

The undisputed scholar-of-the-house in matters pertaining to southeastern bottomland hardwood swamps is Charles H. Wharton, a tall, soft-spoken research associate from the Institute of Ecology at the University of Georgia. Wharton is passionately fond of swamps and cannot get enough of wading around in them. So, when I reached him by phone at his home in Clayton, it didn't take a whole lot of coaxing to get him to agree to an expedition to one of his wadable haunts.

We went out of Darien by outboard motorboat, courtesy of the Georgia Department of Natural Resources. Beyond the I-95 bridge we followed the river past giant cut-grass marshes, past river cypress and tupelo and magnolia. The naturalist William Bartram had come this way by canoe in 1773, noting the riparian species and saluting especially the "Magnolian groves." Even then the plantation people had started to convert the delta marshes to rice cultivation, but timbering on a scale to justify a Lumber City wouldn't get under way for a century.

"The big conversion threat here," Wharton said, "is logging and pine plantations—tree-farm monocultures—after they've taken the hardwoods out." By "here" Wharton meant generally upriver. In the particular here, all the land on our starboard side was Georgia's, some 18,000 protected acres composing the Altamaha State Waterfowl Management Area. Wharton said: "We'll need protection for more than this. These river swamps are the last great wildernesses in the whole Southeast."

The same swamps also happen to be prized by the timber companies that own so many of them. Along the Altamaha, Georgia-Pacific, ITT Rayonier, and Union Camp are the largest corporate landowners. Union Camp, for example, owns big acreage on the river just beyond where Wharton was taking me. John Godbee, an environmental specialist with the company, told me Union Camp was not converting its bottomlands to

Stressed to the max, the Tijuana River estuary (facing page) suffers from its urban locale: Sewage, trash, and street runoff wash in from Tijuana and San Diego suburbs.

Sand from trampled dunes clogs tidal channels. Yet somehow the marsh persists.

To replace lost wetlands and restore habitat for the endangered clapper rail, biologists plant cordgrass (above) on terrain excavated from dredge dumps in Sweetwater Marsh. After seven years, still no birds.

WETLANDS REBORN

Precious waters mirror a passing of dowitchers in a new addition to the

RAYMOND GEHMAN

Sacramento River National Wildlife Refuge in California. Some 14,000 acres of the former Llano Seco ranch will be restored to marsh.

pine farms, because the sites were best suited to hardwoods. "Our market requirements call for increasing amounts of hardwood in the pulp mix," Godbee said. "That's what you need to make the kinds of papers that go into magazines like NATIONAL GEOGRAPHIC."

As for Union Camp's coping with federal wetlands regulations, which do not prohibit logging operations per se but could, in some situations, limit building roads for access to the logging sites, Godbee said: "We have to be very careful, as a nation, that we don't arbitrarily place wetlands values above everything else. That's not good science, and it's not good environmental policy."

RAYMOND GEHMAN

Now, with Wharton on the river, I was heading for Lewis Island, lying at the upper end of the state holdings. The island was the gem of the Altamaha, he had told me, the finest example of the gum-cypress type of bottomland forest, the wettest kind, flooded periodically when high tides in the delta backed up the river. Much of the island had been timbered many years ago, but there were still some huge bald cypresses remaining where the skidding crews had not had the proper cable access to get the logs out.

Wharton recalled bringing Governor Jimmy Carter to the island in the early seventies and Carter's being awestruck by the ancient trees, shaking his head, saying firmly, "They'll not cut *these*."

They didn't. The Nature Conservancy soon purchased the island from Georgia-Pacific and passed the ownership on to the state.

And now we were on the island ourselves, thrashing through a lush understory of red bay and sabal palm. Wharton, clad in black sombrero and chest-high waders, seemed to skip on birds' feet across the mud of shallow pools. I wallowed. Fall too far behind and he would fetch me up with a warbling, high-pitched barbaric yawp—his rebel yell, I called it. Not that at all, he insisted—his coon hunter's cry.

In the two hours we had to poke around before the river started backing up to test our waders, we saw perhaps two dozen surviving old-growth cypresses, lofty ones, neck-craners, bases so big around that Wharton couldn't resist putting a tape measure to them. And the winner? Seventeen feet and four inches, circumference. How old? "About 1,300 years," he said.

The river was rising. We saluted the cypress, sloshed back to the boat, and headed downstream.

In the evening, in Brunswick, Christi Lambert of the Nature Conservancy spread out some of the maps and aerial photographs and satellite imagery sheets that she has been using to support the Conservancy's effort to have the Altamaha River basin designated a bioreserve of global

Enough is enough, said Gary Zahm of the U. S. Fish and Wildlife Service, who helped stop the conversion of waterfowl ponds to drainage pools at Kesterson refuge in California's Central Valley. Poisoned with selenium leached from farmland, such pools killed scores of birds.

significance. The study area embraces nearly a million acres. Lambert's greatest challenge lies in striking cooperative partnerships with all the private landowners up and down the river, including the large timber companies, and working with them to find ways to protect the corridor's environmental treasures.

Saving the Altamaha is important to Georgians. Over the years a number of strategies have been advanced to accomplish that goal—proposals to designate the waterway as a scenic and recreational river, even as a national river park. "There's never been a national river park," said Wharton. "The Altamaha could be the first."

With so many ideas for saving the river, did he think it might be possible to pull off at least one of them?

Wharton stood under his sombrero, staring down at the map while we waited for his answer. Watching him, you knew his mind was wandering up the river somewhere, under the giant cypresses maybe, or wading out behind the tupelo gums, because after a long while he said, "We got to."

JOEL SARTORE

Stem by stem a salt marsh appears in the San Jacinto River estuary near Houston. Volunteers, including Natalie O'Neill of the Galveston Bay Foundation, joined to plant cordgrass and restore fish habitat on a polluted, chewed-up piece of Gulf Coast.

SOME NOTES on a poke into Pothole Country, North Dakota. Interstate 94 takes you west out of Fargo across the Drift Prairie, aiming for Jamestown and the Missouri Coteau. Wheat, barley, oats, sunflowers, not much corn, none of it up yet. Sodbuster territory. Scratch that. Swampbuster territory.

The Coteau. A long, low, undulant plateau paralleling the Missouri River; where the last of the glaciers dumped a top load of sediment, and stone and ice settled in, pocking the land with thousands of water-filled holes. The best of what's left of its kind in the U.S.A.; a relict of the prairie pothole region, 300,000 square miles of it stretching from Iowa and Minnesota to the high plains of Alberta. A place, it is said, where the gods forgot their handkerchiefs the day they decided to have a good cry.

And what are these potholes good for, apart from watering the prairie grasses and recharging the aquifers some farmers draw on to irrigate their crops? Mostly they are good for birds. Good for 140 resident and migratory species. Good for avocets and willets, rails and gulls, terns and pelicans, godwits and plovers. Good for mallards, pintails, teal, canvasbacks, redheads, wigeon, scaup. Good enough to be known as the most productive duck breeding area in the world. Good enough so that ducks banded in North Dakota have turned up in 46 states, 10 Canadian provinces, and 23 countries around the world. But nowhere are there as many ducks as there used to be. In North Dakota the acreage planted to wheat has nearly doubled since the 1960s. The acreage of glacier-planted potholes has shrunk by more than half.

SWEET SWAMP WATER

Greener and cleaner are the waters
of an Illinois cypress swamp where

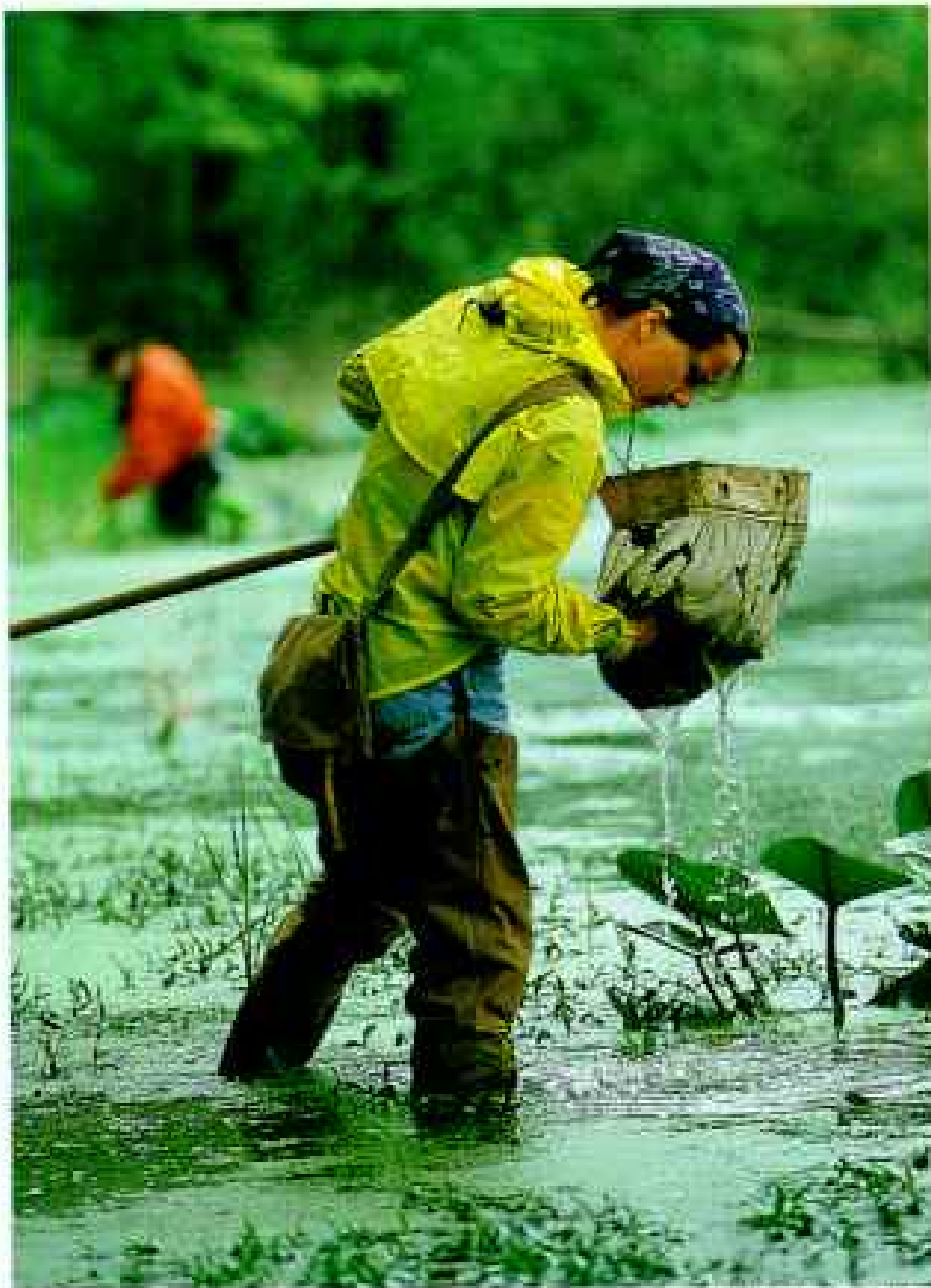
DUCKWEED PHOTOGRAPHED FROM INSIDE A PARTLY SUBMERGED AQUARIUM. JIM RICHARDSON

duckweed grows. The tiny plants filter out pollutants that invade the wetland from nearby fields. And, as the name implies, ducks love the stuff.

Swamp rat Anice Corzine high-steps across some of the 209 knees on a cypress in the Cache River basin

I call on Bruce Barbour, manager of the National Audubon Society's Alkali Lake Sanctuary north of Jamestown. Half an hour cruising the farm-to-market roads in his pickup is enough to see what's troubling him. Small, shallow dips in the landscape—hardly potholes to my untrained eye—have been systematically drained and converted to cropland. Why not, goes the grass-roots sentiment, when these little basins aren't even deep enough to launch a duck.

"But when you drain the shallow wetlands," says Barbour, "you're taking away the duck's cafeteria." He points to a quarter-acre swale, pooled water no more than a foot deep, at the edge of plowed field. "That kind of little depression is the first to thaw in the spring," he says, "the first to get the food chain stirring. It's precisely what our waterfowl need at nesting time."



BOTH BY JIM RICHARDSON

of Illinois (right). "I counted them when the pond went dry," says the former TV repairman, who led the fight to end drainage of this wetland. In a nearby marsh a graduate student's net drips water-bug soup, a daily special in the food web.

ON ANOTHER DAY I drive through the Coteau with George Swanson, who has been a biologist with the U. S. Fish and Wildlife Service's Northern Prairie Wildlife Research Center at Jamestown since 1966. Ducks and potholes are his beat. "You have to look at the prairie a long time to see what's really going on here," he says as we explore the pothole country. And what's going on in these shallow basins that are barely "wet"? Not a whole lot right now; it's still too early in the year. But give the sun a little elbowroom and the seasons another shift, and this pothole will be bursting with protein: macroinvertebrates hatching out of their long winter's sleep—midge larvae and snails and fairy shrimp starting to stir up the food chain. In the spring, animal protein is essential for dabbling ducks such as mallards if the hens are to produce good clutches of eggs and if the ducklings are to survive those first crucial weeks before they are able to fly.

North Dakota suffers from drought. Drought, poor drainage, and soil erosion. Among the erodibles, the real comer is sunflowers. Sunflowers for that bottle of low-cholesterol oil up there on the supermarket shelf. Sunflower cultivation requires a heavy use of insecticides. Insecticides get into the potholes and poison the protein. Sediments from tilled fields also drain into the potholes. As the drought lowers the water level and the sediments pile up in the potholes, cattails begin to choke up the marsh. Dense cattails are bad news for ducks but good cover for blackbirds. And what do blackbirds do in Dakota? "Blackbirds," says Swanson, "are death on sunflower seeds."

The climate can be harsh in North Dakota; astringent, you might say. It suits the temperament of the place, especially when the issue is potholes or water diversions.

Dr. Gary L. Pearson, Jamestown veterinarian. Used to be Gary L. Pearson of the U. S. Fish and Wildlife Service until a water controversy

AGE, 850 YRS.
209 KNEES

called the Garrison Diversion swept his job right out from under him. The word had gotten back to Capitol Hill that Pearson was too outspoken about how an increase in irrigated acreage in eastern North Dakota would surely result in a decrease in pothole habitat.

"There is no way," Pearson tells me one evening in Jamestown, "no way at all that one can be effective saving wetlands in North Dakota and still be popular." Pearson does not try to be popular. People here still remember what he once put in print: That some farmers who had idled up to 30 percent of their land under a certain farm subsidy program "used the extra time not needed for farming those acres to drain more wetlands, thus not only compounding future overproduction but also increasing the acreage they will be paid not to plant when this overproduction necessitates another cropland retirement program." And he made no new friends when he described wheat farming as the largest industry in North Dakota. "Paying farmers not to plant wheat," he continued, "is the second largest industry."

The second largest industry may be slipping. In 1985 Congress passed a farm bill with a provision that by and by came to be known as Swampbuster. Why it became that is unclear, because the measure doesn't bust any swamps; it just busts the farmers who want to have their subsidies and drain wetlands too. In effect, Swampbuster says to the farmer: Look, if you still want to go ahead and drain that wetland on your property, so be it. We're not stopping you. We're just saying that the taxpayer isn't going to pay for it. So, if you want to keep your federal price-support payments and your loan and disaster insurance programs and the like, then leave those wetlands alone. . . .

The administration of Swampbuster, however, may leave something to be desired. According to one study by the National Wildlife Federation, some county agricultural agencies in pothole country were found to be extremely lenient in the enforcement of Swampbuster regulations.

Some day, some century, a shallow lake near Bemidji, Minnesota, will disappear. The process creeps along as sedgy mats—no more than 50 strides across—dislodge from shore and blow about the lake, filling it with decaying vegetation. Shrubby bog plants growing on a carpet of moss will eventually cover the lake, creating a fresh expanse of peatland. For now, the floating mats give excellent nesting cover for black terns and ring-necked ducks.

Near Jamestown, I look up a farmer with little use for wetlands that are barely wet for most of the year. Men so disposed are not hard to find in Stutsman County. This farmer's name is Lawrence Kropp. He works several thousand acres with his brother and his oldest son, John. Wheat, barley, sunflowers, a bit of pasture. We are out behind some bins where Kropp and a hired hand have been loading grain into the hold of a big truck. We stand at the edge of a great sweep of planted fields. Kropp says, not without a trace of pride, "We have probably drained a higher percentage of our land than any other farm in Stutsman County. Did it all before Swampbuster. Why, if you'd have come here 40 years ago, half our land would have been classified wetlands. The government did all the engineering. They advised us how to drain the

land. They wanted us to do it." The frown passing over his face turns suddenly into an ironic smile. "Now all those same bureaucrats, they're within five years of retirement. Now they're out here telling us to put all the water back." It is, of course, a little joke, for no one can tell Kropp to put the water back since the taking away was perfectly legal. Still, the idea of the government's interfering with the use of private property bothers him.

Kropp says: "People are getting fed up with all these regulations. I don't go into Chicago and tell them how to run their show. Why should

JIM RICHARDSON

city people get to come out here and tell me how to run mine? What these people don't seem to realize is that the land they say we should take out of production is the same land that gives them cheap food."

IT HAS BEEN SAID that if California were an independent nation apart from the United States, its economy would rank eighth largest in the world. One out of nine Americans now resides in the Golden State, and population growth continues at the rate of 500,000 people a year. Despite the recession, the pressure for development remains intense in two regions: along the shore from Santa Barbara to Imperial Beach and in the Central Valley, which stretches along the

The fitting image of a duck (far right) defines a prairie pothole in spring farmland in Minnesota. By the time summer ripens, some 22 million ducks — half the continent's population — will have flown to the dwindling pothole regions of the U. S. and Canada to feast on protein-rich fairy shrimp (above right) and other aquatic organisms. On the fringe of a pothole fenced off from foxes and minks, mallard eggs will hatch safely.

sundown side of the Sierra Nevada some 400 miles from Redding to Bakersfield. It is a great place for crops and condominiums but not so great for wetlands. Of nearly five million acres of marshes that once speckled the valley floor, only 5 percent remain, and even these are parched for water. Of the 30 coastal marshes still in place between Point Conception and the Mexican border, all but eight, in one form or another, have been cut off from the full flushing action of the tides.

For a bureaucracy that must deal with all kinds of environmental problems, many of them much closer to the psyches and pocketbooks of constituents than saving marshes could ever be, the California Resources Agency and its top gun, Douglas Wheeler, seem mighty committed to holding the line against further losses. Trouble is, some of those other problems keep getting in the way. Like water supply and water quality.

Scattered among the surviving marshes of the Central Valley are some

ALL BY JIM RICHARDSON

20 federal and state wildlife refuges, winter havens for many of the shorebirds and waterfowl that ply the Pacific flyway. Historically, many of these refuge marshes received a seasonal supply of water when mountain rivers, swollen by snowmelt, flooded the valley floor. But now, with irrigated farms and swollen cities tapping the riverine pipelines, most refuges receive their water only when there is a surplus (which there hasn't been through six years of drought), or when the water has already been used for irrigation upstream.

More often than not the wastewater reaching the marshes is tainted with salts or trace elements such as selenium, a leachate resembling sulfur that becomes more concentrated as it moves up the food chain. Some years ago, the selenium buildup got so bad at the Kesterson National Wildlife Refuge that massive die-offs of migratory birds occurred, and incoming waterfowl had to be frightened off with explosives lest they

NORTHERN SPRING

Unflappable Canada geese wait out a March snowfall at the marsh

JAMIE RUGGLES

where they will nest, only a few wingbeats from downtown Winnipeg, Manitoba. Canada holds nearly a quarter of the world's wetlands.

land in the tainted pools. Those pools have since been drained and filled.

At his office in Sacramento, Douglas Wheeler told me that problems like this one just won't go away. "The agricultural drainage problem in the Central Valley is so severe," he said, "that the federal study that followed the Kesterson revelations recommended that 70,000 acres of agricultural land simply be retired from irrigation as the only solution. We just don't have the technology or the money to purify water that has been contaminated to that extent. And that water if not contained or properly disposed of—and there is no proper way to dispose of it—will contaminate the entire aquifer."

Burning issues of water rights and habitat occupy stewards of fragile wetlands in Kansas. To provide open water for birds, managers of Quivira National Wildlife Refuge torch their marshes every few springs. A six-year drought plus a water shortage due to irrigation turned Cheyenne Bottoms into a desert where crayfish didn't stand a chance. Rains and a 1992 state ruling upholding the wetlands' right to water promise to revive the vast inland marsh.

ABOUT THE TIME that Connecticut Yankees were sharpening their scythes in the marshes of Pawcatuck, the Spanish planted a colony at San Diego Bay. In those days the bay was ringed with mud flats and salt marshes, punctuated here and there with the mouth of a freshwater river or stream. It was a splendid place for all kinds of creatures. Then the gringos arrived, and by and by San Diego embraced its bay in the crushing arms of a supercity. But there was a catch. As the gringos would discover, you can't have your supercity and untrammeled nature too.

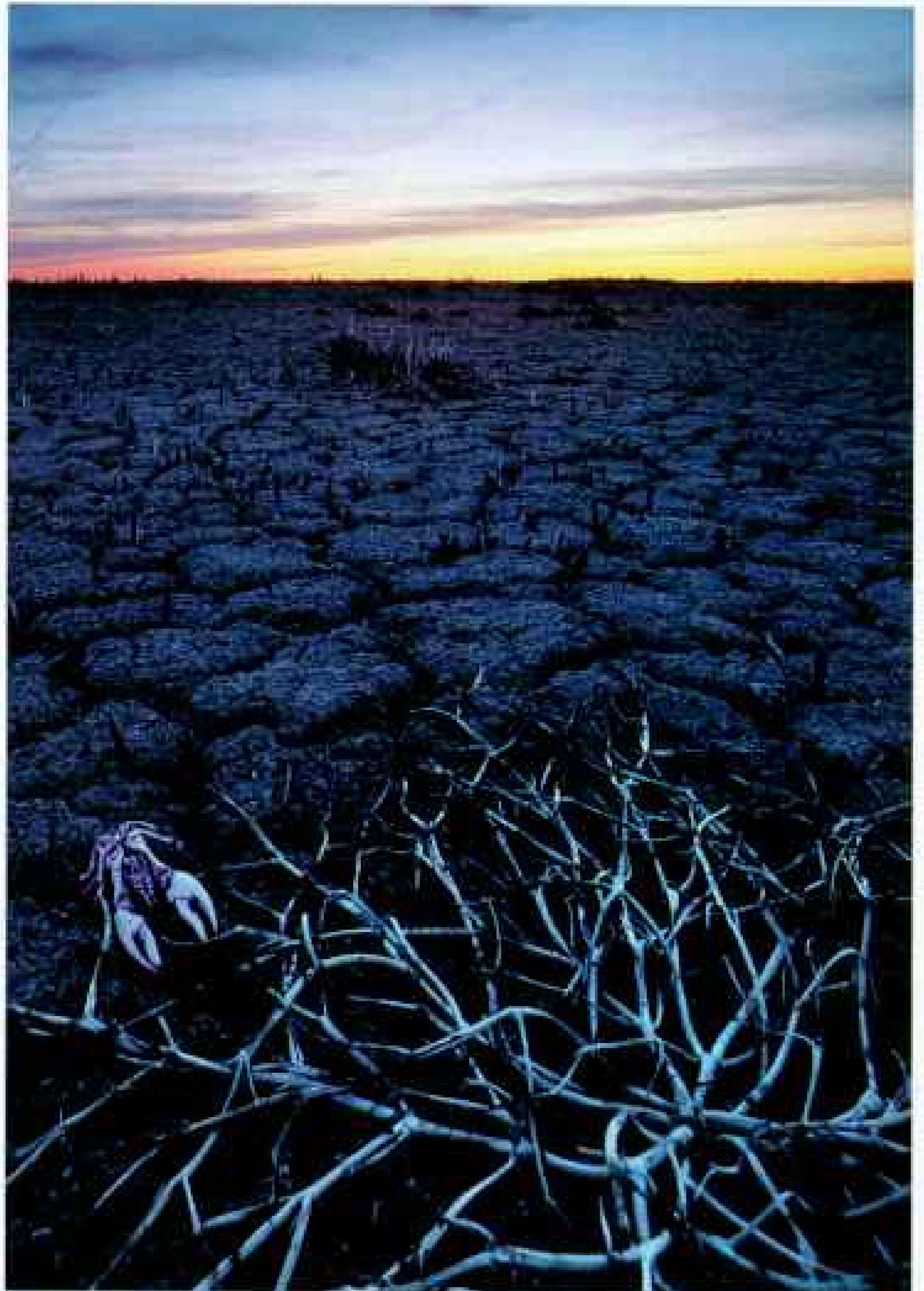
I had come to San Diego because there are people nowadays, here and across the country, who say that you *can* have the best of both worlds, the artificial and the natural, side by side. All you have to do is use your science and technology to move the natural things, like marshes, out of the city's path and put them where they won't get in people's way. Bury a marsh today, then build a new one to replace it tomorrow. The name of the game is mitigation. It sounds intriguing, but does it *work?*

Joy B. Zedler is one scientist who has some doubts about mitigation, though as a true professional she's reserving judgment until all the facts are in, and that could take many years. Zedler is chief ecologist at the Pacific Estuarine Research Laboratory, headquartered at San Diego State University. For the past five years she has directed the monitoring of a wetlands mitigation project at Chula Vista, on the waterfront of San Diego Bay.

By 1987 the area had already been pretty much worked over by draglines and bulldozers, with a big dredge-spoil deposit covering the mud flats on the bayside and Interstate Freeway 5, paralleling an abandoned track of the Santa Fe Railroad, dropped like a concrete curtain along what used to be the upland shore. Even so, there were still a few light-footed clapper rails hanging on in a cordgrass marsh at Paradise Creek, and California least terns trying to mitigate the loss of their habitat. The rail does not nest well without cordgrass; besides providing good cover against predators, the tall grass serves as a kind of elevator shaft for the

nest, which rides up and down with the tides. The least tern is a shore nester but forages in wetlands. Both birds are listed by the state and federal governments as endangered.

Then the California Department of Transportation decided it needed a new interchange on Interstate Freeway 5, and the Army Corps of Engineers—the sometime savior of wetlands under the Clean Water Act—thought it would be all right if Chula Vista—concerned that the threat of some future flood would lower the value of real estate upstream—put a new flood-control channel through a surviving salt marsh near the mouth of the Sweetwater River.



BOTH BY JIM RICHARDSON

Citing the presence of endangered species, the Sierra Club and the League for Coastal Protection filed suit in federal court. The court mandated the transfer of 316 acres to the U. S. Fish and Wildlife Service for the creation of the Sweetwater Marsh National Wildlife Refuge. And it directed that new, tough criteria be applied to a mitigation effort, such that a degraded wetland known as the Connector Marsh might be restored to provide functional habitat for the clapper rail, the least tern, and a patchy, low-growing plant called the salt marsh bird's beak (also endangered). Enter Zedler and the Estuarine Research Lab: to track the results, to see if the restoration might possibly succeed.

Zedler and I met one morning beside the bay and walked north up the old Santa Fe line—rust on the rails—toward Paradise Creek. Ahead, we could see a great slab of raw earth where the interchange was going in, and the tall, yellow crane of a dredge poking up from the ditch where the river would flow, and, running up beside the tracks here, the raw, skimpy, constructed contours of the Connector Marsh.

"I don't know of another restoration project for which success is so hard to achieve," Zedler said. She had already supplied me with her latest report on the site; the wistful note in her voice simply emphasized the findings. After five years the project is still far from reaching its goals: The cordgrass biomass remains insufficient for proper cover and nesting habitat, and the site's nutrient retention is poor in comparison to a control plot up on Paradise Creek.

"We can never fully assess all the variables," she told me. "If we allow all our natural wetlands to be replaced by man-made ones, I guarantee you that we will lose biodiversity. We cannot possibly census

SANDPIPER HEAVEN

Single-minded, western sandpipers rest on mud flats in Grays Harbor

JOHN MARSHALL

National Wildlife Refuge in Washington. Once targeted as an industrial site, the basin hosts half a million shorebirds on their way to Alaska.

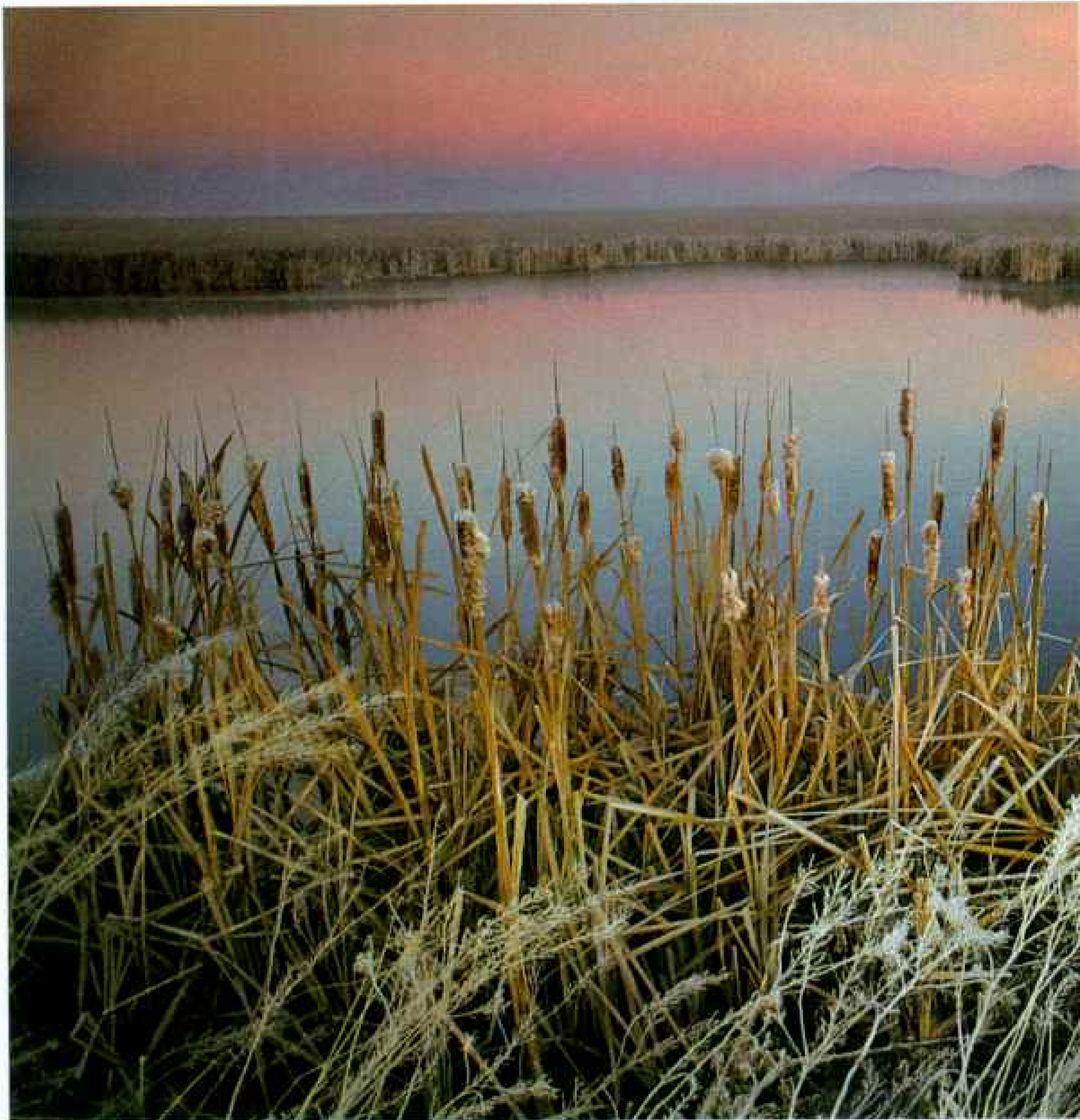
The stage is set. Soon a distant cry will break the frosty stillness of a marsh in the Lower Klamath basin of California. Wild birds will then flood the sky, drawn to a sanctuary wet and priceless.

everything that was there to know later how much of it we've been able to bring back."

What bothers Zedler as much as anything about wetlands mitigation and restoration is the idea that quantity can be used as a substitute for quality. A restoration turns out to be only half as good as it should be? No problem, say the sponsors. We'll just restore twice as much. "So I ask people like that," she said, " 'Look. If you had an original Van Gogh, would you swap it for two copies just because they would cover twice the wall space?' "

Now we were beyond the flood-control channel, getting on toward that little patch of marshland at Paradise Creek. We flushed a pair of pintails, a lonely egret, a great blue heron protesting our intrusion with a raucous croak. But no clapper rails, not a single one.

We talked about restoration projects in other parts of the country, in other kinds of wetlands systems—as in the prairie pothole region—where



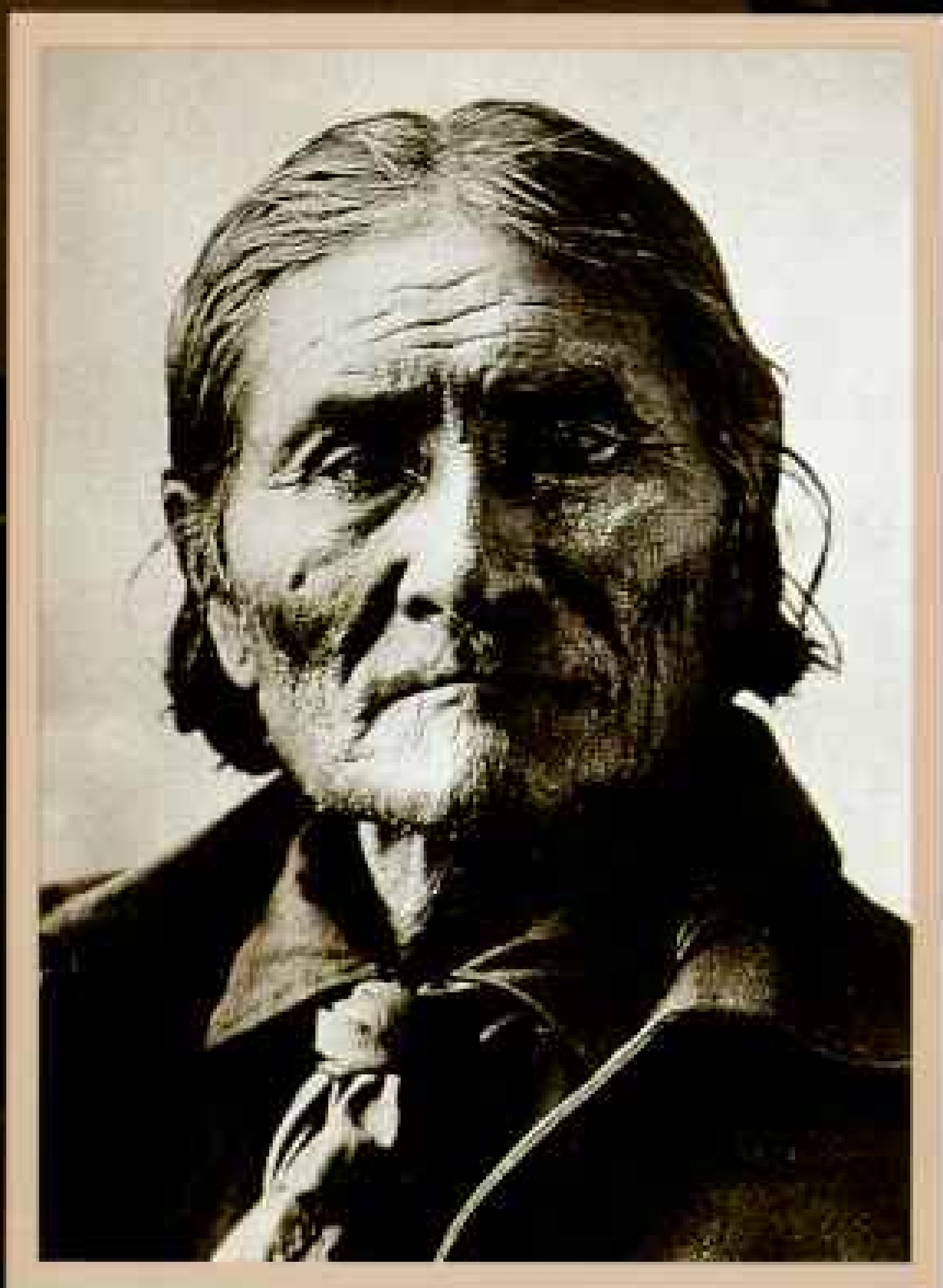
success did not seem so elusive as it did here on the Pacific coast. "I'm not suggesting that all wetlands restorations are doomed to failure," she said. "But I do want to make the distinction between restoration for its own sake versus mitigation in the regulatory context, where restoration simply becomes a license to destroy habitat somewhere else."

When we got back to our cars near the highway, I asked Zedler if she thought California might have a lesson to share with the rest of the nation. "Sure," she said. "The lesson is: Don't do what we did. Don't wait until it's too late. It's going to be incredibly expensive to try to turn back the clock when you've lost 91 percent of your wetlands acreage and species are threatened with extinction."

For a moment then, I thought about asking her what particular species she had in mind, apart from the tern and the rail and the bird's beak. But I didn't. I figured that the three in peril already were about three more than you'd ever need for enough. □

Geronimo

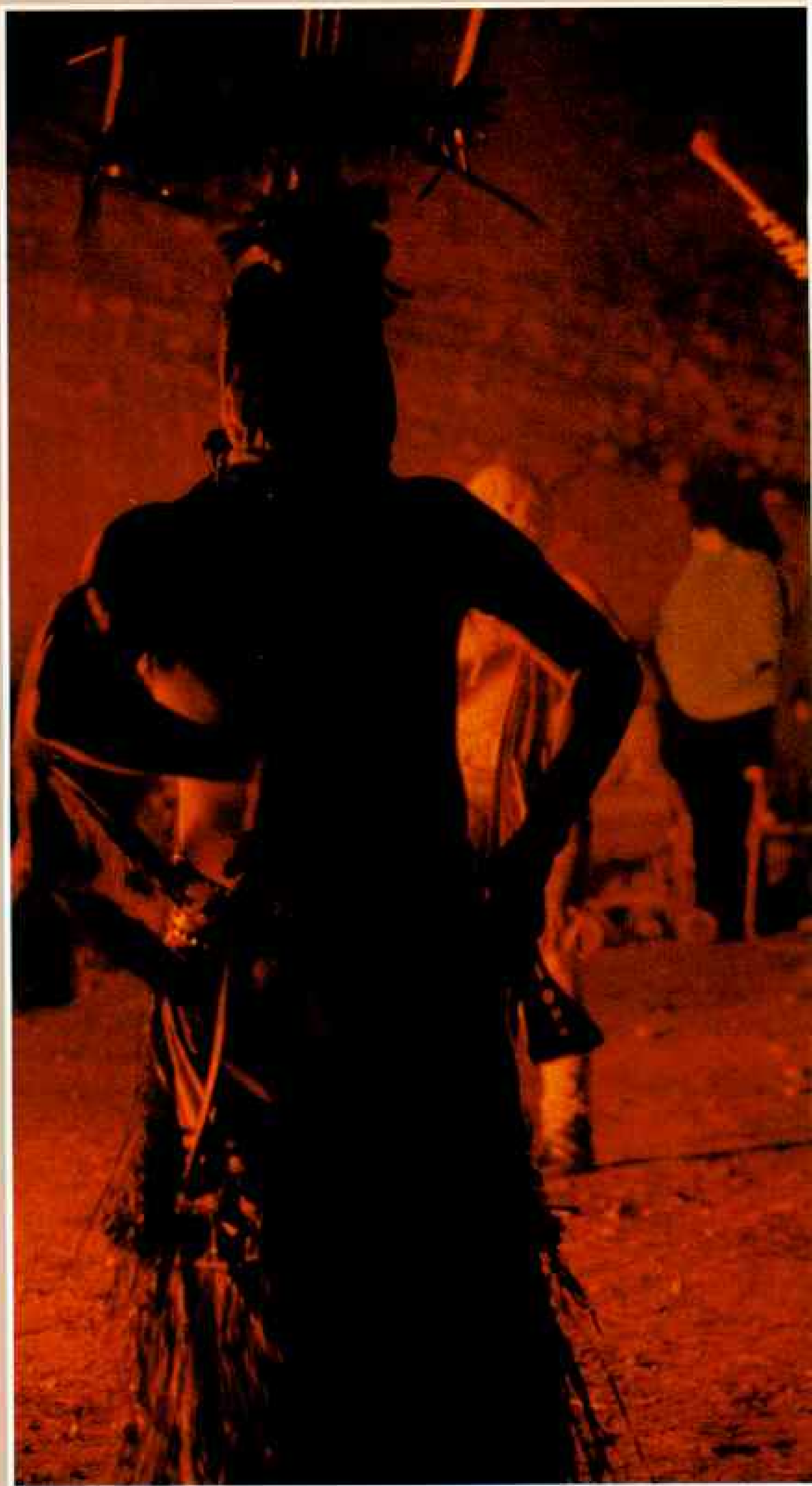
By DAVID ROBERTS Photographs by BRUCE DALE
NATIONAL GEOGRAPHIC PHOTOGRAPHER

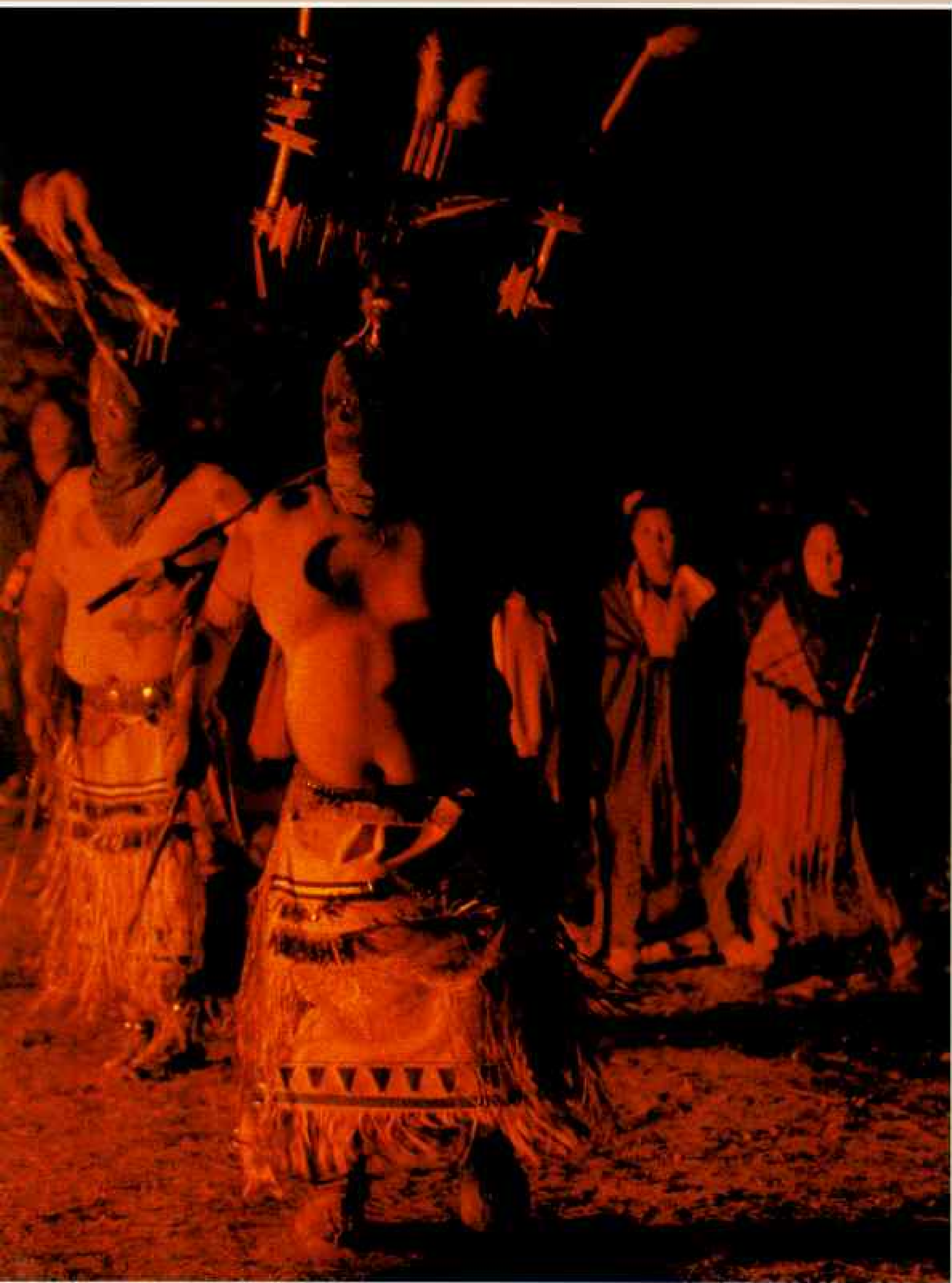


BURTON DEVERE COLLECTION, ROSE TREE INN, TOMBSTONE, ARIZONA

His fierce eyes dimmed by age and imprisonment, the Apache warrior in 1898 longed for the Southwest mountain homeland he had fought so furiously to keep.

Coaxing strength from the earth, dancers in Mescalero, New Mexico, enact the Dance of the Mountain Spirits, centerpiece of the Chiricahua Apache's rich ceremonial life. Geronimo took part in such rituals as a medicine man, wielding the magical powers he believed came to him after a devastating tragedy. While on a trading mission in Mexico, his mother, wife, and three children were massacred by Mexican soldiers. He returned home, numb, to burn his dwelling and the toys of his children. A voice called out "Goyahkla" —his Apache name— "No gun can ever kill you." Armed with this belief, he vented his rage in bloody raids against Mexicans, once repeatedly attacking soldiers with his knife despite a hail of bullets. The soldiers cried out "Geronimo," perhaps a plea to St. Jerome, and the name stuck.





A. FRANK RANDALL

His face a grim mask, Geronimo was about 60 when he posed for this 1884 photograph, first known image of the man whose exploits riveted the nation. After keeping peace with Anglo-Americans for years, Geronimo took to the warpath in 1861, when the U. S. Army seized Cochise, an Apache chief, and hanged members of his family. Then, Geronimo recalled, "the Indians agreed not to be friendly with the white man any more."

Infuriated Apache swarmed a stagecoach in Arizona, where a memorial honors one of those slain. A shell found nearby recalls that bloody era.

"CRUELLER FEATURES were never cut," a journalist wrote of Geronimo in 1886. "The nose is broad and heavy, the forehead low and wrinkled, the chin full and strong, the eyes like two bits of obsidian with a light behind them. The mouth is the most noticeable feature—a sharp, straight, thin-lipped gash of generous length and without one softening curve."

Even today feelings are rarely neutral about this last great Indian leader to stand against the tide of Manifest Destiny that pushed United States land claims steadily west.

By 1881 the Sioux and Cheyenne, who had massacred Custer's army at Little Bighorn, had been defeated and pacified. Crazy Horse was dead, bayoneted by a soldier as he resisted arrest. A prisoner at Fort Randall, Sitting Bull was giving interviews to newspapers. Chief Joseph of the Nez Perce had given up; now his people were dying of malaria in Oklahoma.

Only the four bands of Chiricahua Apache remained free, sweeping at will across southern Arizona and New Mexico. The Chiricahua had many great leaders, chiefs such as Cochise, Mangas Coloradas, Delgadito, and Victorio. By 1881 all four were dead. Yet for five more years, a single charismatic warrior—Geronimo—spearheaded an impossible resistance. At the end Geronimo's group amounted to only 16 warriors, 12 women, and 6 children. Against them were deployed 5,000 U. S. troops, or one-quarter of the entire

Army, and perhaps 3,000 Mexican soldiers. Because he held out the longest and fought against such daunting odds, Geronimo became the most famous Apache of all.

During several seasons scattered over four years, I have traveled across the Southwest, seeking out the key places in the fate of Geronimo's people. Because the Apache were nomadic, the former homeland of the Chiricahua bears only insubstantial traces of their passage. My search for Geronimo's Southwest thus became a private, intuitive journey, all the more powerful for the muteness of the landscape, a majestic sweep of stony mountains, pine forests, and empty desert.

Geronimo was never a chief but rather a medicine man, a seer, and a leader in battle. Chiefs turned to him for the wisdom that came to him in sudden visions. Geronimo had little of the stoic nobility that anchored Cochise. Instead, Geronimo was a master manipulator, an opportunist. He schemed constantly, fretted over the unknown, worried about what he could not control. He was naturally distrustful, a trait that Mexican and U. S. betrayals reinforced. He had a huge intellectual curiosity and constantly puzzled over matters that he could not comprehend. Yet he was also a pragmatist.

He was a talker—not an orator of eloquence but a spokesman, a debater, a thrasher-out of ideas. With either revolver or rifle, he was one of the best Chiricahua marksmen. He liked a good drunk, either on *tiswin*, the Apache corn

beer, or on whiskey he got from traders. During his long life he had nine wives and numerous children.

What made Geronimo such a canny leader? His fearlessness in battle, his apparent divination of distant events, and his sharp intelligence all gave his counsel deep authority. And his refusal to give in when faced with hopeless odds inspired others.

There had never been that many Apache to begin with—perhaps 6,000 to 8,000 in the 1860s. Although all were referred to by whites as Apache, they lived in many separate, often mutually antagonistic bands. Indeed, the Army's success in pacifying most of them depended on enlisting warriors from one band to track and fight against those of another.

Sometime around 1823, Geronimo was born near the three forks at the headwaters of the Gila River, in what is today western New Mexico but was then still Mexican territory. For Geronimo, as for every Apache, his birthplace was important: When in his wanderings he came to this spot again, he would roll on the ground to the four directions.

That river junction lies in the heart of the Gila Wilderness, not far from the 13th-century Gila Cliff Dwellings of the Mogollon people. The Apache often camped near this site.

On a warm, breezy day in May, I hiked up the middle fork of the Gila, wading the stream where it meandered across my path. The banks were lined with giant sycamores and cottonwoods. The mottled canyon walls shone ruddy in the sun. Soon I came to a hot spring that trickled from gray bedrock, filling pools deep enough to wallow in. I dipped a finger into water almost too hot to touch. To know that almost certainly as a boy Geronimo had played at this hot spring gave me a visceral sense of connection.

By his family he was named Goyahkla, which is usually taken to mean "one who yawns." It was the Mexicans who began calling him Geronimo, perhaps for St. Jerome. The name came from a battle in which Goyahkla repeatedly ran through a hail of bullets to kill soldiers with his knife. When they saw the Indian warrior coming toward them, they began to yell out in desperation, "Geronimo!"

DAVID ROBERTS last wrote for the NATIONAL GEOGRAPHIC on Mali's Dogon people (October 1990). His book on Geronimo will be published in 1993 by Simon and Schuster.

THE PIVOTAL EVENT of Geronimo's life occurred in the northern Chihuahua town of Janos. Today Janos is a mere truck-stop crossroads, 35 miles south of the New Mexico bootheel, but it was once an important Spanish fort. By the early 1850s, when few of the Chiricahua had ever seen any White Eyes (as they called the Anglo-Americans), they had endured two centuries of bloodshed by Spaniards and Mexicans. The latter, having failed to achieve a stable peace with the Apache, had embarked on a policy of genocide, signaled in 1837 by the state of Chihuahua offering a bounty on Apache scalps.

Around 1850, the citizens of Janos made a peace offer inviting the Chiricahua to trade. While the Apache men bartered hides and furs in town, the women and children camped on the outskirts. One day a roving platoon of Mexican troops from the neighboring state of Sonora came upon the camp. They killed 25 women and children at once and captured 50 or 60 more, whom they later sold into slavery.

Geronimo came back from town to discover the dead bodies of his mother, his young wife, and his three children. "There were no lights in camp, so without being noticed I silently turned away and stood by the river," he told an interviewer more than half a century later. "How long I stood there I do not know. . . ."

In the middle of the night the band retreated northward, leaving their dead in the field. "I stood until all had passed, hardly knowing what I would do—I had no weapon, nor did I hardly wish to fight, neither did I contemplate recovering the bodies of my loved ones, for that was forbidden [by the chief, for reasons of safety]. I did not pray, nor did I resolve to do anything in particular, for I had no purpose left. I finally followed the tribe silently, keeping just within hearing distance of the soft noise of the feet of the retreating Apaches."

For the rest of his life Geronimo hated all Mexicans. He killed them whenever he could, without pity. Though the number almost defies credibility, the governor of Sonora claimed in 1886 that in the last five months of Geronimo's wild career, his band of 16 warriors slaughtered some 500 to 600 Mexicans.

It was shortly after the debacle at Janos that Geronimo received his Power. According to one Apache who had been a boy at the time, Geronimo was alone, mourning his family, his head bowed as he sat weeping, when he heard a voice call his name four times—four being

Fort Apache Indian Reservation (White Mountain Ind. Res.)
FORT APACHE
Globe
SAN CARLOS AGENCY
San Carlos Indian Reservation
FORT THOMAS
Clifton
Duncan
Mt. Graham
FORT GRANT
Tucson
Willcox
APACHE PASS
FORT BOWIE
COCHISE STRONGHOLD
CHIRICAHUA NAT. MON.
Chiricahua Indian Reservation (1872-1876)
Chiricahua Mts.
Tombstone
Dragoon Mts.
FORT HUACHUCA
Douglas
SKELETON CANYON
ARIZONA
NEW MEXICO
GILA CLIFF DWELLINGS NAT. MON.
Silver City
WARM SPRINGS AGENCY (OJO CALIENTE)
BUTTERFIELD STAGE ROUTE
Lordsburg
Deming
SOUTHERN PACIFIC RR
El Paso
TEXAS
Mescalero Indian Reservation
Mescalero
WESTERN APACHE
CHIRICAHUA APACHE
MESCALERO APACHE
U. S.
MEXICO
Fronteras
CAÑON DE LOS EMBUDOS
Janos
Bavispe
Arizpe
Nacozari
Sierra Madre Occidental
SONORA
CHIHUAHUA
Casas Grandes
Galeana
UNITED STATES
Ft. Sill
Mt. Vernon Barracks
Ft. Marion
Ft. Pickens
Geronimo surrenders 1886
AREA ENLARGED

■ Fort
□ Point of interest

MILES

NGS CARTOGRAPHIC DIVISION

1. Geronimo is born about 1823 near the headwaters of the Gila River.
2. Geronimo's mother, wife, and three children are slaughtered by Mexican troops in 1850.
3. Agent John Clum springs an ambush in 1877—the only time Geronimo is captured. Clum's successor releases him.
4. Mexican troops ambush an Apache trading party in 1882, killing 20 and capturing 35—including another of Geronimo's wives.
5. To avenge Casas Grandes, Geronimo leads an attack on a patrol of Mexican troops, killing 22.
6. Led by Apache scouts, Gen. George Crook in 1883 penetrates Geronimo's mountain stronghold. Geronimo agrees to join other tribe members on the San Carlos Indian Reservation.
7. Geronimo tries farming on the Fort Apache Reservation in 1884-85, until disputes cause him and his men to bolt in fear of reprisals.
8. At a prearranged meeting in March 1886, Geronimo agrees to surrender to General Crook but later flees.
9. Pursued by 5,000 U. S. troops, Geronimo and his band surrender to Gen. Nelson Miles in September 1886.
10. Geronimo and his warriors are shipped to Fort Pickens, Florida; others, including his family, are held at Fort Marion. After a stretch at Mount Vernon, Alabama, the Chiricahua are moved to Fort Sill, Oklahoma, in 1894. Most are released in 1913, four years after Geronimo's death.

Geronimo's Southwest

This thorny wilderness was home to nomadic Apache, including Geronimo's Chiricahua band, long before the Spanish laid their claim. Born about 1823, Geronimo roamed the headwaters of the Gila River (right) as a boy, learning to hunt and raid. After the U. S.-Mexico border was drawn in 1848, a parade of miners and settlers crowded the Apache. War broke out in 1861, launching a cycle of death and retaliation that did not end until 1886, when Geronimo surrendered.

Geronimo's bloodlines lead to Mescalero, New Mexico, where most Chiricahua settled after their release from Fort Sill, Oklahoma. His spirit surely lives in grandson Robert Geronimo (right), who has fought countless brawls defending the family name. "Everybody wants to say he fought Geronimo," sighs the 61-year-old former rodeo cowboy. "I guess I'm just takin' after the footsteps." His sister Ouida Miller (above) still gets hate mail about her famous grandfather, whose essential integrity and devotion to his family are little-known aspects of his character. "I wish I had known him," she says.

the Apache sacred number—then deliver this message: "No gun can ever kill you. I will take the bullets from the guns of the Mexicans, so they will have nothing but powder. And I will guide your arrows." From that day on, Geronimo believed that he could not die by a bullet, and his bravery in battle was based on that assumption.

IN THE 1850s the White Eyes began to drift across the Chiricahua homeland. At first the Apache believed they could live in peace with these interlopers. Cochise even allowed the Butterfield Stage to send coaches through Apache Pass, where a vital spring lay.

But in February 1861 a hotheaded lieutenant named George Bascom, fresh out of West Point, called Cochise into his camp near Apache Pass to accuse the Chiricahua chief of stealing cattle and abducting a 12-year-old boy from a ranch 80 miles away. Cochise denied the allegations, but Bascom, who had surrounded his tent with soldiers, declared that he would hold Cochise hostage against the return of the livestock and the boy.

In an instant the chief pulled out his knife, cut a slit through the wall of the tent, and dashed to safety through a barrage of fire. Bascom took Cochise's six companions prisoner: his wife, two children, brother, and two nephews. Cochise captured several whites of his own to trade as hostages. Negotiations failed, and Cochise murdered and mutilated his victims. U. S. troops later hanged the chief's

adult male relatives. This treatment of the greatest Chiricahua chief set the Apache as bitterly against the White Eyes as they had stood for decades against the Mexicans.

The next year soldiers captured the crucial spring at Apache Pass and built Fort Bowie, which became the headquarters of the campaign against the Chiricahua. The ruins of the fort have been preserved as a national historic site. When I visited, the decaying adobe walls had been recently capped with a preservative lime plaster that made them look oddly prehistoric. The old fort cemetery is overgrown with grasses and mesquite, but the spring still flows in a shadowy cranny.

By the next decade the federal government had concluded that reservations were the solution to the "Indian question." In 1872 a reservation was established for the Chiricahua in southeast Arizona. The tract was well chosen, for it centered on the people's homeland. The agent, Tom Jeffords, was a former stage superintendent remarkable for his sympathy toward the Apache—the only white man Cochise ever befriended. Four years later, fearing that the Chiricahua had too much freedom, the government fired Jeffords and ordered that the Indians be moved to San Carlos, homeland of the Western Apache, their sometime enemy. This was an arbitrarily chosen spot, supposed by the Washington bureaucrats to be a good place for Indians to live.

The new agent for the Apache was John Clum. Only 24 years old, he was honest and

To become a woman: 14-year-old Connie Rae Rice (left) gathers herself for the traditional Apache puberty ceremony. In an elaborate 12-day rite of passage, she will become the embodiment of White Painted Woman, Apache symbol of fertility and longevity.

Robed in buckskin and blessed by a medicine woman (lower right), the girl performs a series of chores and rituals—many of them conducted at a ceremonial tepee (right) symbolizing her new life. During the event she is also showered with gifts and song,

and given instruction, in Apache, in the duties and privileges of a woman.

This custom has passed unchanged from Geronimo's day, when Naiche—who succeeded his father, Cochise, as a chief of the Chiricahua—painted the ceremony on buckskin (above). As a medicine man, Geronimo celebrated the ritual, which the Chiricahua scrupulously observed even in time of war and captivity.

Believing "it takes an Apache to catch an Apache," the U. S. Army hired scouts to track "hostiles" through the mazelike Chiricahua Mountains, where an Apache pictograph remains. Using standard tactics here, wrote an officer, was "like chasing deer with a brass band."

courageous but also smug and overbearing. (The Apache nicknamed him "Turkey Gobbler" for his strutting.) Clum marched to Fort Bowie, where he managed to persuade nearly a third of the Chiricahua to move to San Carlos, but Geronimo fled in the night with some 700 men, women, and children who refused to give up their freedom.

Gen. George Crook, a wise and humane officer, realized that the Apache were far too volatile and too independent for the Army to disarm them en masse. Instead he instituted a compromise: The Apache had to wear brass ID tags and submit to a daily head count with the issue of rations, but they were allowed to camp and hunt more or less where they pleased. To leave the reservation was thus no difficult task. Yet the Arizona citizens howled that the "renegades" were being coddled and fed by the government through the lean winter months, only to repay their treatment by raiding and murdering each summer. It was an uneasy truce.

In the spring of 1877 Clum marched to Ojo Caliente in New Mexico to force the Warm Springs Apache—close allies of Cochise's Chiricahua—to move to San Carlos. For centuries the Warm Springs Apache had considered Ojo Caliente a sacred place. The V-notched gorge that its waters cut through

the hills to the east made it a natural fortress. All around was an abundance of wild fruit, nuts, and game.

On learning that Geronimo was in the area, Clum sent a messenger with a request for a parley. Meanwhile, ensconced at the Warm Springs Agency, Clum hid 80 armed men inside the commissary. Geronimo arrived on horseback with a band of Chiricahua.

Clum left a manuscript sketch of his ambush and a memoir celebrating it. On a bright day in May, with a copy of each in hand, I walked among the ruins and reconstructed the affair in my head.

Here on the porch of the main building, as Clum told it, stood the cocky agent, his hand an inch from the handle of his Colt .45. There sat Geronimo on horseback, backed by a hundred Apache, his thumb an inch from the hammer of his .50-caliber Springfield rifle. The two men traded ominous threats. Fifty yards to the south, on Clum's signal, the commissary doors burst open, and Clum's men dashed out to surround the Chiricahua. Twenty-three rifles were trained on the leaders, the rest on their people; even so, Geronimo came within an eyelash of raising his rifle and firing. Instead he surrendered.

Clum welded irons onto Geronimo's ankles and carried him in a wagon to San Carlos as part of a dolorous procession of Chiricahua prisoners, among whom a smallpox epidemic was breaking out. For two months Geronimo was held a prisoner in irons, expecting to be put to death. To hang the Apache leader was indeed Clum's hope, but he could not win approval of that measure from authorities in Tucson. In a fit of temper the agent resigned, and Clum's successor set Geronimo free.

In his memoirs Clum later crowed over his deed: "Thus was accomplished the first and only *bonafide capture* of GERONIMO THE RENEGADE." But, like Bascom's affront to Cochise, Clum's treatment of Geronimo was to have far-reaching consequences.

OVER THE NEXT FOUR YEARS Geronimo, now past 50 and already an old man by Apache standards, took advantage of the loose reservation regime, leaving whenever he felt like it. Sometimes the warrior thought it possible for White Eyes and the Apache to live on the same land. And sometimes he was sure that was impossible.

During his months at large, Geronimo traveled all over his homeland. The mountains in particular were congenial terrain, for among their cliffs and gorges an Apache felt all but invulnerable. Here too dwelt the Mountain Spirits, divine beings who cured illness and protected the Chiricahua from their enemies.

When Geronimo was still a young man, in the 1850s, the Chiricahua ranged across a territory that they believed their god, Ussen, had given them. It comprised southeastern Arizona, southwestern New Mexico, and large tracts of northern Mexico along the spine of the Sierra Madre. Army officers who tried to trail Indians through this wilderness called it the most difficult terrain in North America. The

scarcity of water, the steep and jumbled mountain ranges, the cactus and thorny scrub that tore at their clothing, the rattlesnakes underfoot—into this wasteland white men ventured with a deep apprehension.

But the Apache had mastered this land. They knew every spring and seep for hundreds of miles in all directions; they thought nothing of riding or running 75 to 100 miles in a day; they could jog up mountains where soldiers thrashed and stumbled; they could make themselves invisible in a field of shallow grass or along the bank of an arroyo; and they could travel so lightly as to leave a trail too faint for any but another Apache to follow. In a desert where white men starved, they flourished on mesquite beans, agave hearts, saguaro and cholla fruit, juniper berries, and piñon nuts.

In the 1880s, with the White Eyes becoming more numerous, Geronimo and his band moved across the border into the Sierra Madre, where the Chiricahua felt a sublime security. It was here, deep in the mountains, that Juh—Geronimo's lifelong friend and one of the finest military strategists the Chiricahua ever knew—received a vision sent by Ussen. Out of a thin cloud of blue smoke seen across a chasm, thousands of soldiers in blue uniforms marched into an evanescent cave. Juh's warriors saw the vision too. A medicine man explained: "Ussen sent the vision to warn us that we will be defeated, and perhaps all killed by the government. Their strength in numbers, with their more powerful weapons, will make us indeed . . . the Dead. Eventually they will exterminate us."

DETERMINED to crush Geronimo's band for good, General Crook embarked in May 1883 on the boldest Apache campaign ever undertaken by U. S. troops. With 327 men—more than half of them scouts from other bands—Crook marched deep into the Sierra Madre, guided by a White Mountain Apache who had traveled with Geronimo.

Geronimo was far to the east in Chihuahua at the time, seizing Mexicans to trade for captured Chiricahua. According to Jason Betzinez, a young Apache who was there, one night at dinner Geronimo suddenly dropped his knife. His Power—which sometimes came in a sudden flash—had spoken.

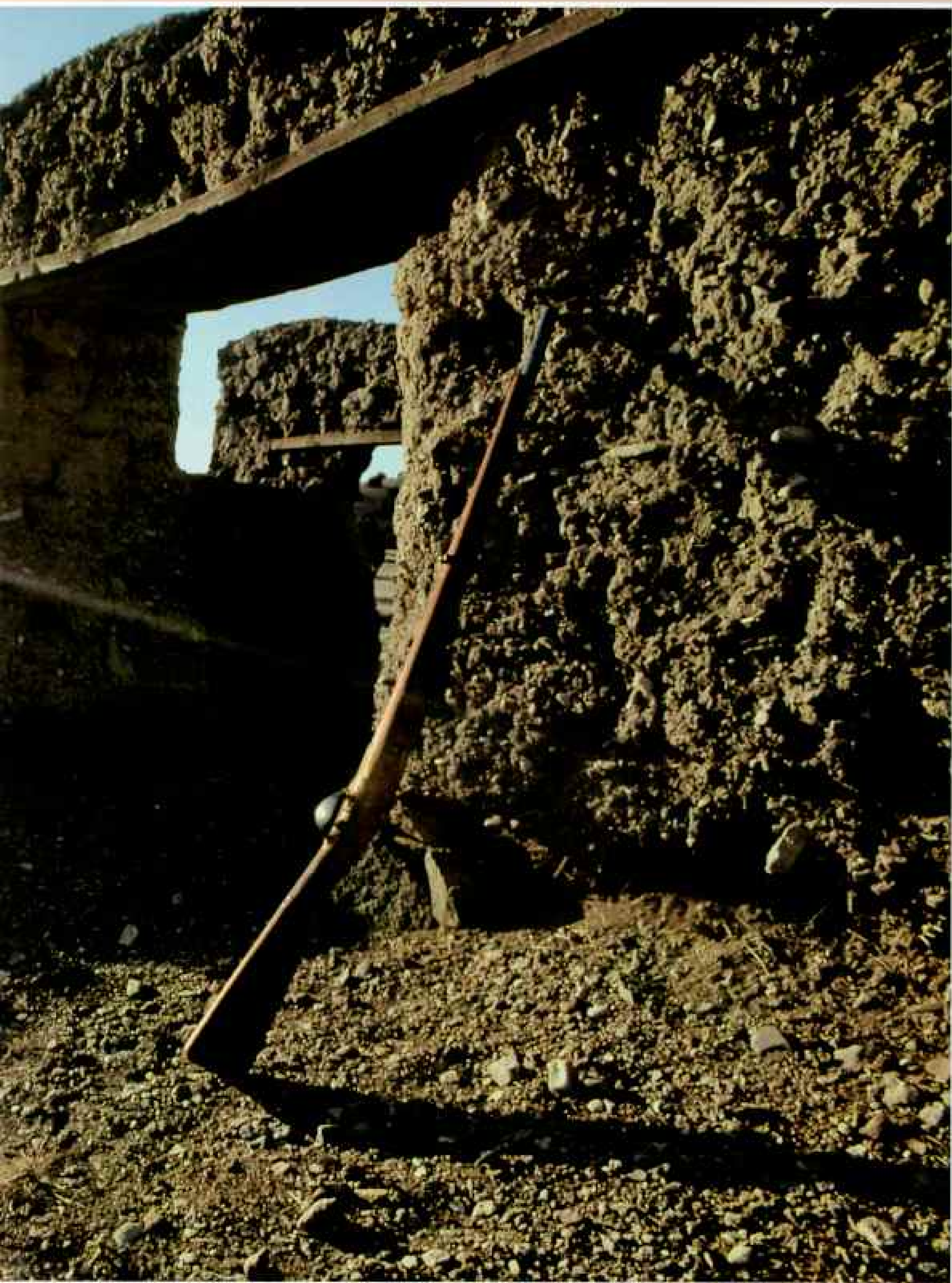
"Men," he burst out, "our people whom we left at our base camp are now in the hands of U. S. troops! *(Continued on page 65)*

ARIZONA HISTORICAL SOCIETY

On the run in Mexico, Geronimo and his dwindling band holed up in the Sierra Madre, raiding with a vengeance that lives on in the spine-tingling tales told vaqueros (above) by their grandfathers. But the Army was closing in. In January 1886, a patrol led by Apache scouts overran his camp—collecting souvenirs (opposite), but missing Geronimo. In March, Gen. George Crook (left, at far right) met the fugitive, who had agreed to surrender. Two nights later he changed his mind, fleeing with 38 followers.

Cunning as a coyote, Geronimo was captured only once—at the Warm Springs Agency, now in ruins, where Indian agent John Clum summoned the Apache and his followers on April 21, 1877. Clum was determined to move the band from Warm Springs, where they lived as hunters and raiders, to San Carlos, a reservation where Apache bands were being taught to farm. "We thought they wanted a council," Geronimo later explained—but Clum had laid a trap.

At his signal an armed force burst from hiding and surrounded the Indians. Geronimo had no choice but to hand over his rifle (right) and ride to San Carlos in irons. He was later released, but without his gun; Clum kept it as a souvenir.



FORT BOWIE NATIONAL HISTORIC SITE

After surrendering in 1886, Geronimo and his followers—now prisoners of war—were quickly spirited out of Arizona, where whites were seething for revenge. "We were honor bound," wrote Gen. Nelson Miles, "not to give them up to a mob." The Apache were gawked at in every whistle-stop between Texas and Fort Pickens, Florida (left), where they would begin their imprisonment. A glimpse of the notorious Geronimo, in center foreground, was the ultimate prize. On his right is Naiche, the band's chief, who fought alongside his elder, more charismatic friend in many battles.

What shall we do?" In fact, at about the same time, Crook's advance guard of Apache had attacked a Chiricahua camp, killed nine or ten old men and women, and captured five children.

Geronimo's band dashed back to the stronghold, where they saw Crook with his young captives. Other bands came in, and for several days the Chiricahua camped on the surrounding ridges, looking down on the intruders.

Crook's penetration of the Apache mountain stronghold had a devastating psychological impact on the Apache. Yet what happened next in the Sierra Madre has never been entirely clear. Despite his strong force, Crook was outnumbered, running short on rations, and extremely vulnerable.

After waiting five days, Geronimo and his band, feigning friendship, joined the other fugitive bands in Crook's camp. They joked and sported with Crook's White Mountain Apache scouts. The Chiricahua began a victory dance and invited the scouts to dance with the Chiricahua women. Geronimo's plan was to surround the scouts and shoot them all as they danced. But Crook's chief of scouts, an old mountain man named Al Sieber, refused to let the White Mountain Apache dance with the Chiricahua—whether on principle or because he sniffed a trap, nobody knows.

The ambush foiled, Geronimo and other leaders agreed to parley with Crook. Some Chiricahua then headed north with the soldiers to go into the San Carlos Reservation. Others promised to do so after gathering up their people. Geronimo stayed out for another nine months, but in late winter he too came in.

In November 1989, with a friend and his four-wheel-drive truck, I attempted to locate the place on the upper Bavispe River where the general had confronted Geronimo. On the fifth day, navigating by a copy of Crook's own manuscript map, we reached a remote bend of the river that fit the description and climbed to the top of a mesa that may have been the site of the Chiricahua camp.

The beauty of the inner Sierra Madre astounded me: Hills covered with swaying grama grass; scattered oaks and junipers giving way, as we climbed, to ponderosa pine; in the distance, stately cottonwoods ranged along the blue thread of the Bavispe, tributary canyons dwindling away in labyrinths of hidden cliffs.

As a boy in the 1880s James Kaywaykla, a

Warm Springs Apache, had camped in this stronghold. Seventy years later he remembered that paradise: "In that place we lived a few weeks as those who have gone to the Happy Place must. Again we hunted, feasted, and danced about fires. . . . For the first time within my memory we lived as Apaches had before the coming of White Eyes."

MORE THAN ANY OTHER DEED, Crook's daring thrust into the Sierra Madre turned the tide of the war. Most of the Apache, now weary and demoralized, would never again break out from the reservation. In his parley with Crook, Geronimo had insisted that he had always wanted to live at peace with the White Eyes. Now, in 1884, he made a sincere effort to do just that. With several other bands, under the watchful eye of Lt. Britton Davis, he settled down on Turkey Creek on the White Mountain Reservation.

On Turkey Creek, for once, there seemed to be goodwill and enlightened leadership on both sides. The government had decided that the Chiricahua ought to become farmers, and most of the Apache were willing to try. But even the Apache themselves could not recognize the violence done to their way of life by trying to turn from nomads into agrarians.

Authorized by the tribal council, I made my own visit to Turkey Creek on a gray November day with the threat of winter in the air. Along the streambed, pools had frozen over. I walked past fallow fields of sunflowers and plots where spoiled squashes were scattered over the stiff ground. The tall pines—the very ones Geronimo had walked beneath—swayed in the breeze. Wild turkey feathers fluttered in the weeds.

I paused in a clearing beside an abandoned cabin, built by the Apache perhaps 70 years ago. No one lives there now, but I could see why the grassy valley beneath the tall pines had appealed to Geronimo's people.

Geronimo stuck it out for a year on the reservation, as the whole Southwest prayed that the Apache hostilities were finally over. But tensions were mounting on Turkey Creek. The government had forbidden two Apache practices that had long been accepted: brewing and getting drunk on tiswin, and beating their wives. Things came to a head in May 1885. Several chiefs held a big tiswin drunk, then confronted Davis the next day, daring him to throw them in jail. Meanwhile, Geronimo was for some reason told by informants that Davis planned to arrest and hang him. On May 17 Geronimo left the reservation with 145 Chiricahua men, women, and children.

The tale of Geronimo's last 15 months on the loose has an epic sweep in its own right. As U. S. soldiers vainly chased the Apache all over the Southwest, the newspapers of Arizona and New Mexico waxed hysterical: "Geronimo and His Band of Murderous Braves Still at Large"; "Blood of Innocent Victims Crying to Heaven for Vengeance." On their initial dash to Mexico the fugitives left 17 White Eyes dead. Often the victims had been mutilated. Tales spread that Geronimo occasionally killed babies by tossing them in the air and catching them on his knife.

American soldiers had killed their own share of Apache babies, their rationale being that "Nits make lice." And in 1863, after killing the great chief Mangas Coloradas, soldiers had cut off his head and boiled it. In the Apache view, a man was condemned to range through the afterlife in the bodily condition that existed at his death, so there was an obligation to exact vengeance from White Eyes who killed and maimed Indians.

Moreover, to prepare for battle Apache boys learned to endure excruciating tests of self-inflicted pain and not to fear death. The most hideous punishment an Apache warrior could imagine was to be locked up in a cage—which was just how the White Eyes treated their victims.

In the last years of his freedom, Geronimo killed ranchers and settlers chiefly because he needed ammunition, food, and horses, and that was the easiest way to get them. The savagery of the torture he sometimes inflicted was retribution for the horrors others had suffered—his mother, his first wife, and three of his children among them. Yet decades later, in his old age, Geronimo would wake in the night "groaning with remorse" for the young children he had killed.

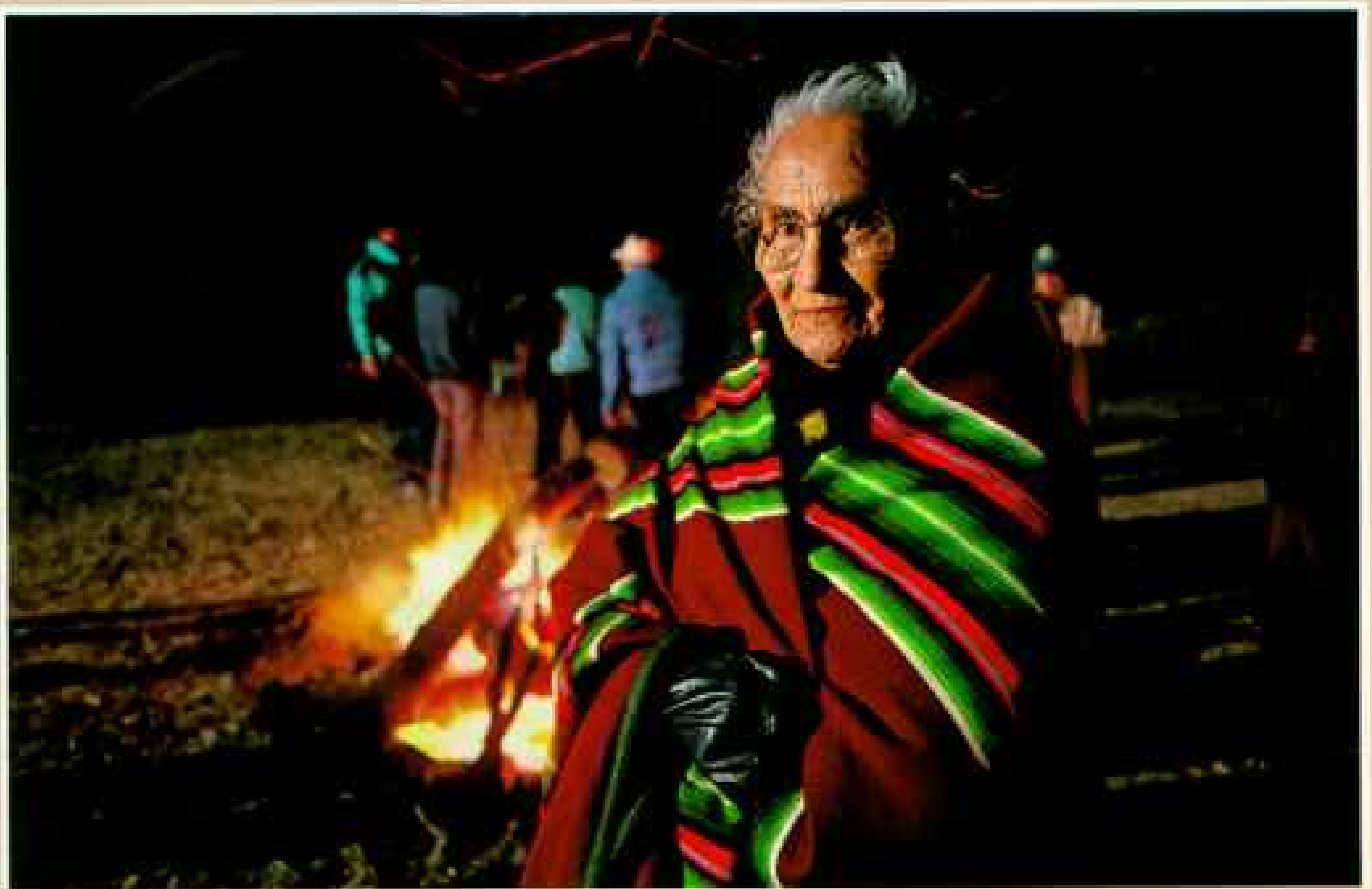
AS THE ARMY pursued Geronimo's band, the fugitives divided into small groups and scattered. Troop after troop doggedly followed them, only to lose the trails on rocks or in streambeds. After making a coordinated thrust, several columns of soldiers thought they had Geronimo cornered in Mexico; but at that moment he blithely crossed back into the U. S., then rode all the way north

Billed as the Tiger of the Human Race, Geronimo earned a small fortune making public appearances while a prisoner. At a 1905 exhibition, thousands packed the grandstands to watch Geronimo (above, in top hat) perform "the last buffalo hunt" from a moving automobile. Few knew that Geronimo, no Plains Indian, had never hunted bison or worn a headdress (below). He also did a brisk business in autographs and bows and arrows. "The old gentleman is pretty high priced," said an onlooker, "but then he is the only Geronimo."

PAWNEE BILL'S HISTORIC WILD WEST

GERONIMO

FORT SILL MUSEUM ARCHIVES (TOP); CIRCUS WORLD MUSEUM, BARABOO, WISCONSIN



Lit by a stalking moon, the Dragoon Mountains of Arizona have a hold on the Chiricahua that time cannot diminish. "When we first visited in 1986, I felt I'd been here before," says Mildred Cleghorn (left), who was born a prisoner at Fort Sill, Oklahoma, and now lives in the nearby town of Apache. A small parcel of the Chiricahua homeland, confiscated in 1877, was recently returned to the Apache tribe.

These mountains also pulled at Geronimo until the end, which came in 1909, four years before his band was released. "My heart is no longer bad," he had pleaded to President Roosevelt in 1905. "Let me die in my own country, an old man who has been punished enough." Knowing Geronimo's rampage was far from forgiven, Roosevelt refused.

to the White Mountain Reservation, seized one of his wives, his three-year-old daughter, and another woman from under the noses of the patrolling guards, and escaped without leaving a trace.

Yet the Chiricahua were wearying of their fugitive life. Only a few weeks later one of their fiercest chiefs, Nana, lame and near 80 years old, agreed to return to the reservation along with a number of women, including one of Geronimo's wives. In March, Geronimo, intending to surrender, met Crook at the Cañon de los Embudos just south of the border. In two days of negotiations Geronimo aired his decades of grievances.

"I think I am a good man," he told Crook the first day, "but in the papers all over the world they say I am a bad man; but it is a bad thing to say so about me. I never do wrong without a cause. . . . There is one God looking down on us all. We are all children of the one God. God is listening to me. The sun, the darkness, the winds, are all listening to what we now say."

Crook was unyielding. "You must make up your own mind whether you will stay out on the warpath or surrender unconditionally. If you stay out, I'll keep after you and kill the last one, if it takes fifty years."

The next day, in a more subdued mood, Geronimo shook hands with Crook and uttered the famous words of his submission: "Do with me what you please. I surrender. Once I moved about like the wind. Now I surrender to you and that is all."

BUT IT WASN'T ALL. Crook started for Fort Bowie, leaving a lieutenant to bring in the still armed Apache warriors. That night, however, a bootlegger sold the Indians whiskey and told Geronimo that he would be hanged as soon as he crossed the border. Still drunk in the morning, the Indians moved only a few miles north, and that night, as the compass of his distrust veered once more, Geronimo fled south with a small group of followers.

So began the last phase of the Chiricahua resistance. Worn out by his efforts and fed up with criticism from Washington, General Crook resigned his post. He was replaced by Nelson A. Miles, a vainglorious general with presidential aspirations who had compiled a strong record fighting the Sioux and Nez Perce. But Miles's five-month campaign to

hunt down the last 34 Chiricahua was an exercise in futility.

By the end of August 1886 the fugitives were desperate to see their families and relatives again. They sent two women into a Mexican town to test the possibility of surrender. Soon thereafter, a courageous lieutenant named Charles Gatewood went with two Apache scouts into Geronimo's camp on the Bavispe River. Gatewood played his trump card, telling Geronimo that his people had already been sent by train to Florida. The news stunned the fugitives.

On September 4, 1886, Geronimo met Miles in Skeleton Canyon, in the Peloncillos just west of the Arizona-New Mexico line. "This is the fourth time I have surrendered," the warrior said. "And I think it is the last time," replied the general.

GERONIMO SURRENDERED in the belief that he was to be reunited within five days with his family, that his "sins" would be forgiven, and that his people would eventually be settled on a reservation in Arizona. But Miles had lied. Few of them would ever see their homeland again.

For their intransigent resistance the Chiricahua were punished as no other U. S. Indians had been. All of them, even women and children, ultimately served nearly 30 years as prisoners of war, first in Florida and Alabama, then at Fort Sill in Oklahoma. In 1913 space was made for the Chiricahua at the Mescalero Reservation in south-central New Mexico. About two-thirds of the survivors moved to the Mescalero site, while the others stayed near Fort Sill. In those two locations their descendants live today.

Last spring I spent a day on the Mescalero Reservation with Ouida Miller, Geronimo's granddaughter. A warm and sympathetic woman of 66, she has guarded her knowledge of the great warrior all her life. "We still get letters of hatred from people in Arizona," she says. "They say that their great-grandfather was killed by Geronimo."

In 1905 Geronimo pleaded with President Theodore Roosevelt to send his people back to Arizona. "It is my land," Geronimo wrote, "my home, my father's land, to which I now ask to be allowed to return. I want to spend my last days there, and be buried among those mountains. If this could be I might die in peace, feeling that my people, placed in their native homes, would increase in numbers, rather than diminish as at present, and that our name would not become extinct."

President Roosevelt turned down the appeal on the grounds that in Arizona antagonism against the Apache still ran too high. "That is all I can say, Geronimo," he replied, "except that I am sorry, and have no feeling against you."

Geronimo's fear that his people might become extinct was no rhetorical flourish. In their prime the Chiricahua had numbered no more than 1,200. By the time they were freed, they had dwindled to 265. Today, because of dispersal over the subsequent decades and intermarriage with other bands, it is impossible to number the Chiricahua.

Last fall I visited the final surrender site in Skeleton Canyon. It lies in a tranquil clearing at the junction of two creeks. Tall sycamores shade the ground where Miles laid down symbolic stones, moving them about to illustrate his promises about the Apache future.

Only three or four old ranches lie along the 15-mile length of Skeleton Canyon. From the surrender site I hiked a long way upstream, rounding one idyllic bend after another. I saw no one else all day. I wondered, not for the first time, why it had proved impossible to find a place in all this empty magnificence for fewer than a thousand Apache—the population of such tiny Arizona towns as Duncan or Morenci.

According to those closest to him, Geronimo for the rest of his life bitterly regretted having surrendered to Miles. He wished instead that he had stayed in the Sierra Madre with his warriors, fighting it out to the last man.

On a winter night in 1909, riding home from the town of Lawton, Oklahoma, Geronimo fell off his horse and lay in a ditch till morning. About 85 years old, he succumbed to pneumonia four days later. On his deathbed Geronimo spoke the names of his warriors who had stayed loyal to the end.

The Apache cemetery at Fort Sill, on a serene bench of land above a branch of Cache Creek, contains some 300 graves. At the center lies Geronimo's: a collection of brown granite stones cemented into a small pyramid, topped by a carved stone eagle, whose vandalized head has been replaced by a crude replica in concrete. From Geronimo's grave, identical white headstones range in precise rows and columns. Each stone has a number code on the

FORT SILL MUSEUM ARCHIVES

The old warrior spent his last days signing autographs and gardening with his family at Fort Sill. Yet one prison visitor saw a different Geronimo, when he peeled off his shirt to reveal some 50 scars. "Putting a pebble in a bullet wound he would make a noise like a gun, then take the pebble out and throw it on the ground," the man reported. "'Bullets cannot kill me!' he shouted."

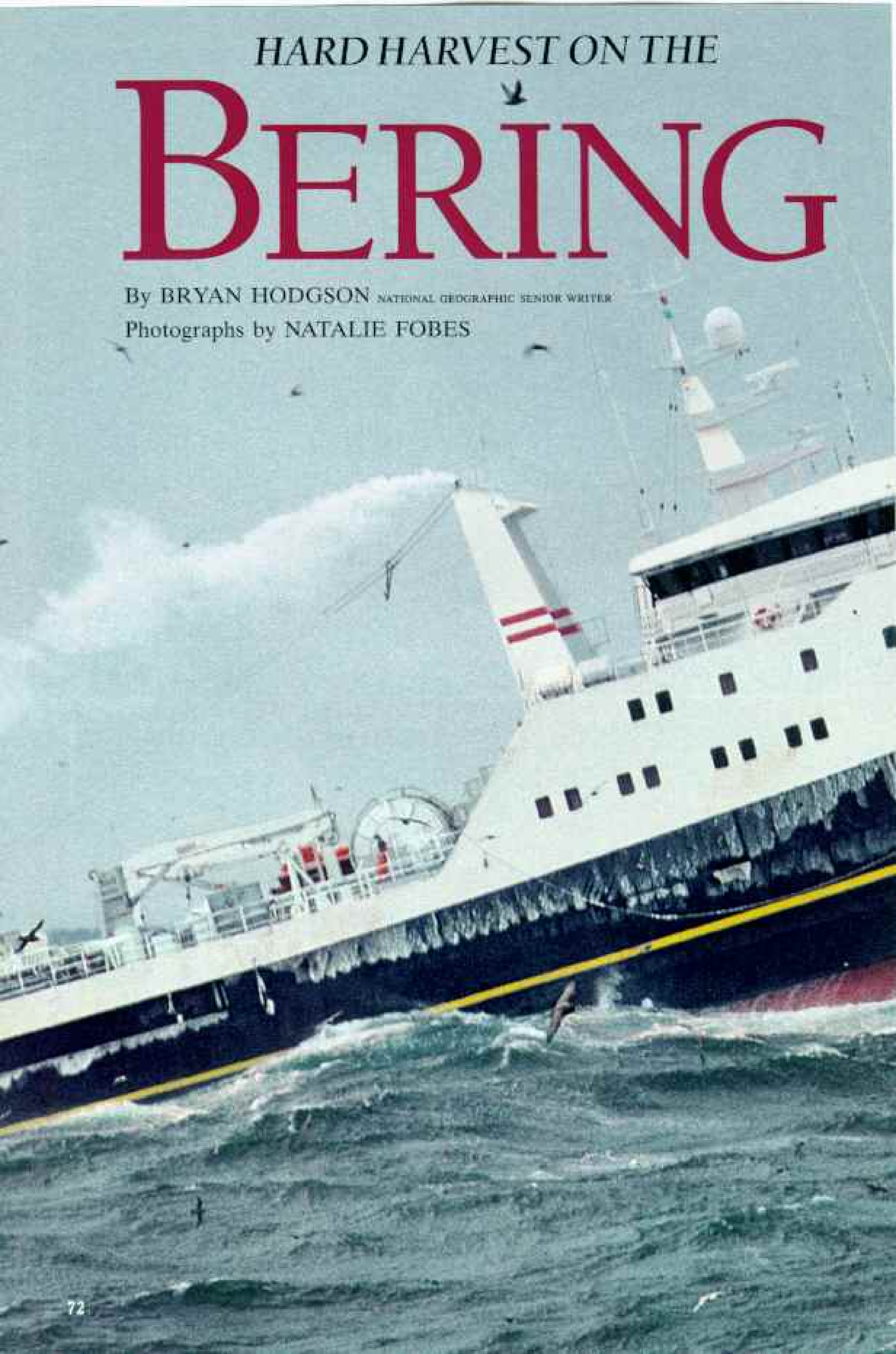
back, such as "SW5055"—the echo of the brass number tags the Apache were issued in the 1870s at San Carlos.

Geronimo and Miles had met once more, at the Omaha Exposition in 1898 where several prominent Apache were exhibited like trophies. Trembling with anger, the old warrior demanded that the general account for his lies in Skeleton Canyon.

Miles gave no real explanation. Geronimo pleaded with him, "I have been away from Arizona now twelve years. The acorns and piñon nuts, the quail and the wild turkey, the giant cactus and the palo verdes—they all miss me. They wonder where I've gone. They want me to come back."

Miles replied, "A very beautiful thought, Geronimo. Quite poetic. But the men and women who live in Arizona, they do not miss you. . . . The acorns and piñon nuts, the quail and the wild turkey, the giant cactus and the palo verde trees—they will have to get along as best they can—without you."

As I wandered across the Southwest, pausing among the piñons, Geronimo's words came to me often. And sometimes, if I stood long enough in the silence, the landscape began to brim with their meaning. □



HARD HARVEST ON THE BERING

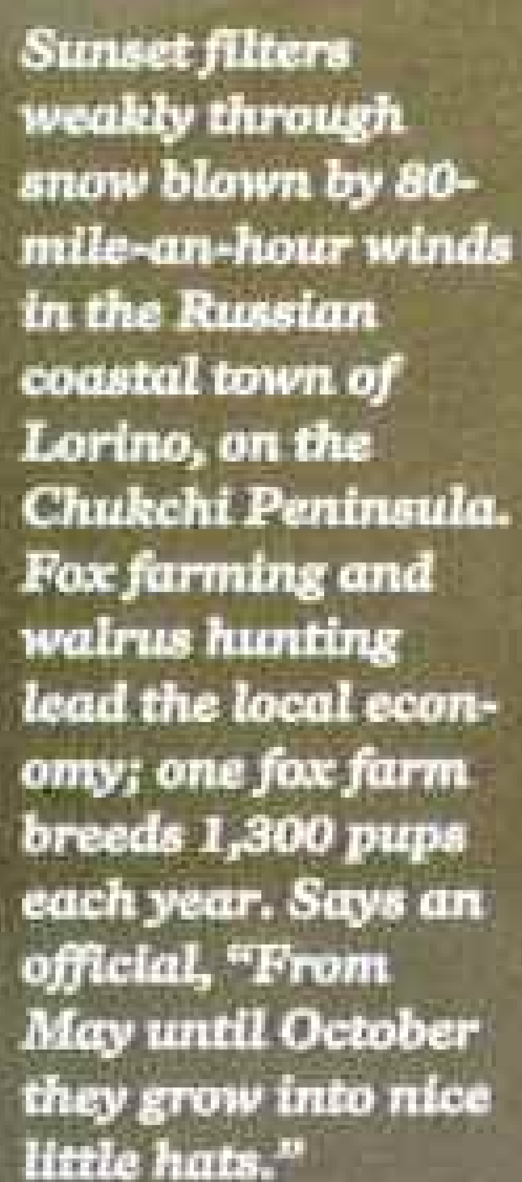
By BRYAN HODGSON NATIONAL GEOGRAPHIC SENIOR WRITER
Photographs by NATALIE FOBES

SEA

Toying with a 286-foot factory trawler, waves punish man and machine risking all to harvest this sea at world's end.

"To eat, we whale," says LeRoy Kulukhon, 58, captain of a walrus-skin whaling boat on Alaska's St. Lawrence Island. "We used to dry most of it, make jerky. We'd dig into the permafrost to store some. Now we've got freezers. All year long we have jerky, whale steak, and whale burgers."

After a successful hunt, Kulukhon smokes a peace pipe, "for the whale."



Sunset filters weakly through snow blown by 80-mile-an-hour winds in the Russian coastal town of Lorino, on the Chukchi Peninsula. Fox farming and walrus hunting lead the local economy; one fox farm breeds 1,300 pups each year. Says an official, "From May until October they grow into nice little hats."

A JANUARY STORM hurls 50-knot winds at the trawler *Saga Sea* as we wallow in freezing darkness on the Bering Sea, about 50 miles north of the Aleutian Islands. On deck snow swirls around brilliant sodium-vapor lamps as a huge green-and-orange net comes slithering up the stern ramp, bloated like some sea monster with more than 120 tons of walleye pollock.

The *Saga Sea* is something of a sea monster herself, a 304-foot, 58-million-dollar factory ship equipped to catch and digest some 550 tons of fish a day. In her belly scores of men and women work round the clock, serving ferocious machines that behead the fish at blinding speed, slicing off fillets and grinding leftovers into fish meal.

Tonight we're also on a gourmet quest. Billions of pollock are migrating from the Bering's 12,000-foot-deep Aleutian Basin toward shallower spawning grounds on Alaska's outer continental shelf (map, pages 80-81). Their delicate pink roe sacs are worth about five dollars a pound. Each must be plucked carefully by hand. If all goes well, we'll return to Dutch Harbor with some 400 tons of frozen roe, worth four million dollars.

We're not alone in this high-tech feeding frenzy. Radar shows 20 vessels nearby, part of an American fishing armada that takes three billion dollars' worth of pollock and other bottom fish from the Bering each year.

On the darkened bridge, Capt. Kurt van Brero peers at a color monitor that shows an incredible picture: thousands of digital blips, each representing a fish, swimming slowly into the two-acre maw of our newly launched trawl net. I suddenly realize that it took five *billion* blips like this to make up last year's five-million-ton pollock harvest, the largest single-species catch in the world.

"There's still a lot of fish," he says. "But in five years I've seen the pollock biomass reduced by half. I hate to think we may be fishing ourselves out of business."

It's an old dilemma in this storm-tossed sea: How to harvest a wealth of marine life without destroying it. The Bering's 885,000 square miles of frigid, nutrient-rich waters lie between Alaska and the Russian Far East, bounded on the south by Alaska's Aleutian chain and escaping northward through the Bering Strait to the Arctic Ocean.

I'd boarded the *Saga Sea* as part of a

Waves coming aboard aft pound workers on the American factory trawler Saga Sea (above) as they haul a loaded fishnet up the stern ramp. Some 120 tons are netted at a time, mostly walleye pollock (right). Belowdecks (left), where fish are cleaned and flash frozen, a crew hoses off while roe sacs pass by on a conveyer.

A teeming sea reveals its riches

Half covered with ice in winter and often packing 20-foot waves, the Bering Sea is among the world's most productive. Some 300 species of fish thrive in the nutrient-rich waters. Walleye pollock, more than half of all Bering bottom fish, are harvested here in the world's largest single-species fishery.

Marine mammals have suffered huge population drops due to hunting and, some experts believe, reduced food supplies. Trawlers from the U. S., Russia, Japan, and other nations take millions of tons of fish a year—but changing pollock and herring levels have also been linked to solar cycles and resulting water-temperature fluctuations. U. S. factory trawlers and land-based plants have waged legal wars for the past three years over their right to process Bering Sea pollock. New proposals to guarantee shore processors up to 45 percent of the catch have prompted lawsuits from factory-ship owners.

nine-month exploration of the Bering by ship, plane, helicopter, and Eskimo skin boat. I'd crossed the Bering Strait, camped amid walrus hunters on the eastern shores of Russia, visited the remotest islands of the Aleutian chain, and talked to scores of scientists, fishermen, and native leaders from Seattle, Washington, to Fairbanks, Alaska, to Vladivostok in the then Soviet Union.

I'd quickly learned that working on that sea, or simply surviving around its edges, means a life of hardship and isolation, an unceasing struggle with nature for sustenance or profits. The weak seldom prosper. The strong don't always win.

Russian fur traders were first to cash in on the Bering's ecosystem in the mid-18th century, seeking sea otter and seal skins for trade with China and Europe. Within a hundred years industrial hunters from around the world devastated the populations of sea otters, fur seals, and whales. Now an international battle was raging over the pollock, a form of codfish that only a few years ago was considered unworthy of American attention.

Most of the Bering Sea lies within 200-nautical-mile exclusive economic zones claimed by the United States and Russia, which limit their combined pollock catch to about 2.5 million tons a year. But there's a

Volcano active since 1964
Fish and shellfish processing plant
Native people
Bathymetry in fathoms

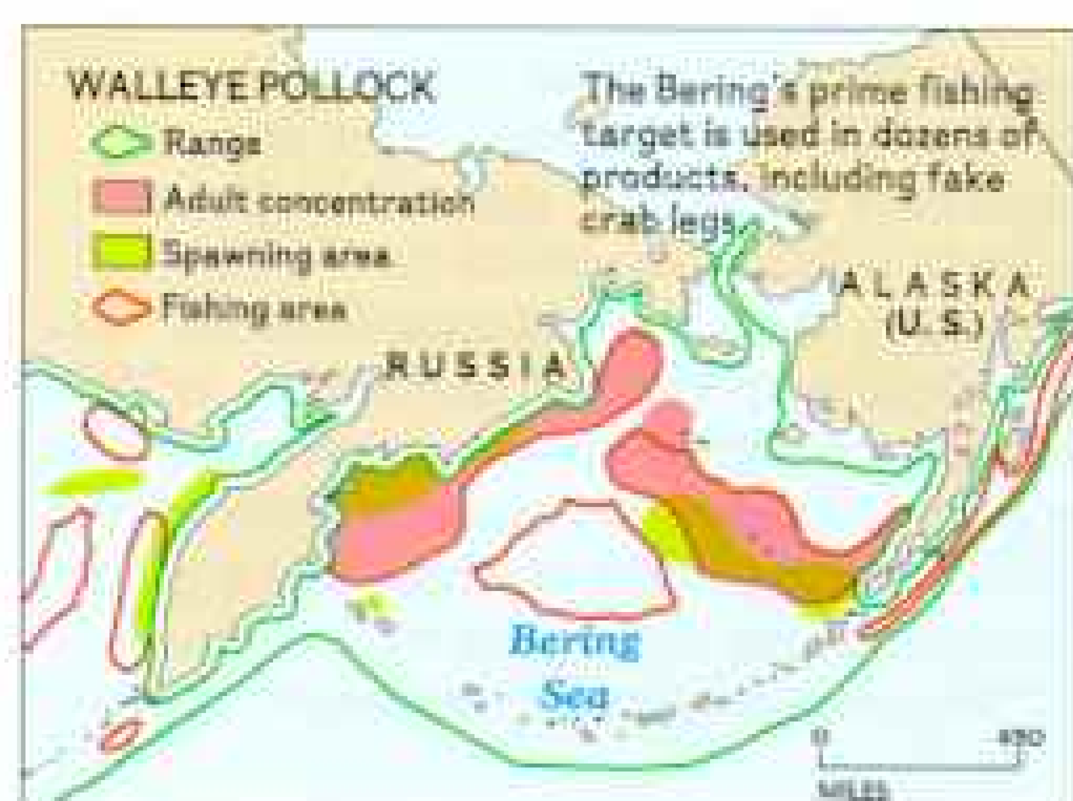
SIBERIA: Traditional fishing, sea mammal hunting, and reindeer breeding continue near the coast; Soviet-style collectivism persists.

DONUT HOLE: Trawlers from Japan, China, South Korea, and Poland crowd into a region of deep international waters surrounded by U. S. and Russian 200-nautical-mile exclusive economic zones.

STELLER SEA LIONS
Range
Rookery
Major area of decline
Minor area of decline

Commercial fishing of their food supply may have caused a reported 63 percent drop in population in the past two decades.

ALEUTIAN ISLANDS: Deep nutrient-laden currents well upward in this region, nourishing surface life.



Battles over prime resting spots consume Steller sea lions' time on Alaska's Round Island (below). Far to the northwest, elbow room is no problem for the 1,000 people on icebound St. Lawrence Island (right). Just 50 miles from the Russian mainland, the island's Yupik inhabitants are a short hop from their ancestral homeland via chartered plane.

"donut hole" of international waters in the middle of the sea; here unregulated fishing fleets of Japan, China, South Korea, and Poland have caught as much as 1.3 million tons—an added burden that Russian and American scientists say may severely deplete the pollock population.

What's more, much of the "international" catch comes from illegal raids into the more productive American zone. Such depredations have caused a 24 percent decline in pollock catches throughout the Bering, according to the U. S. National Marine Fisheries Service (NMFS). And since the 1970s commercial fishing may have contributed to a reported 63 percent population crash among pollock-eating Steller sea lions, and similar declines among seabirds as well.

"Nonterritorial waters represent only 8 percent of the Bering Sea, while fish stocks there are primarily from U. S. and Russian zones," said Vjacheslav K. Zilanov, deputy director of the Ministry of Fisheries, in Moscow. "We believe that the United States and Russia should develop a specific conservation regimen for shared stocks of Bering Sea fish. Third countries should observe these regulations."

This international tempest seems mild compared with the economic typhoon that threatens to overwhelm the booming fishing industry at home. The *Saga Sea* and 60 other factory trawlers, based in Seattle and financed largely by foreign investors, took 87 percent of the 1990 U. S. pollock quota. That drew howls of protest from operators of the scores of smaller Alaska-based boats that delivered their catch to Japanese-owned

shore-based factories at Dutch Harbor and Kodiak. The combined fleets had the capacity to catch double the annual quota.

"The Bering Sea fishery is a success story that got too successful," said Bert Larkins, of the Alaska Factory Trawler Association in Seattle. "We have a billion-dollar investment in 60 trawlers—10 more than we really need. We could catch the entire annual quota in a 20-week season."

Mr. Larkins is a former National Marine Fisheries Service regional director. One of his old colleagues, William Aron, director of the NMFS Alaska Fisheries Science Center in Seattle, explained the industry's extraordinary success.

"Since 1980 the groundfish industry in U. S. waters has gone from a million to three billion dollars a year," he told me. "That includes bottom-dwelling fish like cod, turbot, and sole, as well as pollock.

"The story goes back to the Magnuson Fishery Conservation Act of 1976, which banned unlicensed foreign vessels from fishing in American waters. Crabs were then the main resource for U. S. fishermen. Crab sold for a dollar a pound. Groundfish were selling for five cents a pound or less.

"By 1978-79 the crab population appeared headed for collapse—probably the result of overfishing. A few American ships converted to trawling. They would catch fish and sell them 'over the side' to Japanese and Russian ships—meaning that they would not even take their nets out of the water, but transfer them to foreign ships directly and take new nets in their place. That's how the U. S. got into the pollock business.

"But as the price of fish goes up, more and more American-flagged boats are being built. We need to control that before the politics of investment and boat ownership prevent rational management of the resource."

Assigned by law to advise the U. S. Department of Commerce in such matters is the North Pacific Fishery Management Council, which includes representatives from industry groups and state and federal agencies. In Anchorage I listened to intense debates that seemed like a hopeless tangle of nets and lines.

Investors in the *Saga Sea* and other factory trawlers denounced proposed regulations allotting up to 45 percent of the annual pollock quota to the rival smaller boats.

Trawlermen protested a decision to halt fishing for pollock, cod, sole, and sablefish whenever the boats hauled in an excessive "bycatch" of other regulated species such as snow crabs and halibut.

Crabbers spoke against a trawling technique called "hard on bottom," which some boats use. Nets plow along the seabed, taking whatever is there. "We now lose two to five million crabs a year to this," said Arni Thomson of the Alaska Crab Coalition.

Robert D. Alverson, of the Fishing Vessel Owners' Association in Seattle, blames much controversy on ignorance. "We have a three-billion-dollar industry and no science dollars," he said. "It's like trying to look at the sea bottom through a straw."

MOST of the fishing industry's contrary forces reach critical mass at Dutch Harbor on Unalaska Island in the Aleutians, famed for the rigor of its weather and the vigorous nightlife of its waterfront bars. My 800-mile flight from Anchorage ended with a landing in violent crosswinds, a few moments ahead of a blizzard that isolated the island for three days.

Here was a world dedicated to seafood. Dirt roads were lined with crab pots—500-pound steel-and-wire cages used to capture 300 million pounds of snow crabs each year. Dozens of boats ranging from 90 to 200 feet were tied up side by side with small trawlers that served four huge fish-processing plants. Sleek factory trawlers came to off-load frozen product and hasten to sea again. In the roadstead a dozen rusty Japanese "tramper" refrigerator ships awaited cargoes from all.

"There's big money here now—it's becoming a mini-Seattle," said Lynn Fitch, director of the local television station. She came to Dutch Harbor with her husband in 1980, when a king crab harvest of 130 million pounds was creating instant wealth for many fishermen. When overfishing dropped the harvest to almost zero within three years, the Fitches decided to stay.

"Now we have the pollock boom," Lynn said. "I hope this one lasts awhile." Later, I learned, the family retreated to the mainland, fearful that the chaos of development would lead to the deterioration of the community and the collapse of property values.

Among the custodians of Dutch Harbor's new prosperity is F. Gregory Baker, general manager of Westward Seafood Company. The prosperity will last only if the U. S. Department of Commerce authorizes the formal allocation of fish quotas to the smaller boats that bring their catch to shoreside factories, he told me.

He showed me around the company's new 50-million-dollar processing plant, which is owned by the Taiyo Fishing Company of Japan. Its batteries of stainless-steel machines are designed to reduce 800 tons of pollock each day into 160 tons of *surimi*, an almost flavorless fish product made by grinding fish fillets to paste, washing it repeatedly so that only protein solids remain, then reducing it to a somewhat rubbery texture by adding sugar and sorbitol gelling agent.

"The Japanese use it to make fish cakes called *kamaboko*, but you might recognize it if you've eaten any fake crab legs or lobster tails lately," Mr. Baker said.

Everything the shore-based plants can do, the sleek factory trawlers can do as well, with very similar machinery, the difference being that they can follow the fish all over the Bering Sea, and the world if necessary.

The industry's technology makes the old dilemma even more pressing: How much high-tech fishing can the ecosystem withstand?

IN AN INDUSTRY TORN by dissension, there's one thing everyone agrees on: The Bering Sea is one of the most dangerous fisheries in the world. Each year 25 to 30 people die in shipboard accidents, many of them on small boats capsized by

ANDREW HAVILAND

From a skin boat, a St. Lawrence Islander harpoons a bowhead whale. An explosive tip kills it. Local harpooners are well trained, with good reason: The Alaska Eskimo Whaling Commission allowed the island just six harpoon hits this year. Three strikes failed, so only three whales were harvested.

A Russian Orthodox church and a satellite dish take aim at the heavens from opposite ends of town on the Pribilof island of St. Paul (above). Father Michael Lestenkof (below) continues a Russian Yuletide tradition in which children visit homes with a twirling star, bringing the Christ child's light to each family.

90-mile-an-hour winds and 20-foot waves.

"We fly 300 to 350 search-and-rescue cases a year," I was told by Capt. Mont J. Smith, then commander of the Coast Guard air station at Kodiak. "It can get very intense. Last year we heard screams on high-frequency radio from a boat that was capsizing in Unimak Pass. We had to listen to the tape three times before we could understand the location. We got there four hours later and found only one body in a partially zipped survival suit."

Death rates are expected to diminish, thanks to the Commercial Fishing Industry Vessel Safety Act of 1988, which requires that each ship carry life rafts and EPIRB (emergency position-indicating radio beacon) transmitters that automatically relay the vessel's name and location via satellite to rescue agencies. It also requires that each crew member be provided with a "Gumby suit," as the heavy neoprene survival suits are called.

"These suits have kept people alive for 12 days in water so cold it can paralyze you in minutes," Captain Smith said. "It was the Wives Association that pushed for them, not the fishermen. They were tired of hubby not coming home. We owe them a lot."

Danger is part of the environment for pilots like Lt. Comdr. W. C. Kessenich and Lt. Randy L. Moseng, who fly the Coast Guard's Sikorsky H-3 rescue helicopters through some of the worst weather in the world. "I'm a risk manager, not a risk taker," Commander Kessenich said, as we flew in pitch darkness along the Kodiak coast on a training flight using night vision goggles. "I have the option of turning down a rescue flight if the weather's unflyable, or if the victim has access to care or shelter. But if the victim's in the water, we'll push it pretty hard."

Sometimes that's very hard indeed. The goggles reveal a ghostly green world, full of shoals and precipitous cliffs. Quietly Commander Kessenich pointed out one of them. "We lost a helicopter there on a night rescue," he said. "There were no survivors."

Fishery patrols also occupy Coast Guard time. Six C-130 Hercules transports from Kodiak provide daily intelligence for two 378-foot cutters and two smaller boats covering three million square miles of the Bering Sea and northern Pacific. Recently the patrols led to the arrest of 12 foreign boats in U. S. waters—including two Russian trawlers.

"I've seen 80 foreign boats lined up at the U. S. boundary, waiting for darkness," C-130 skipper Lt. Geoff Funk told me as we headed toward Attu Island on a perfect flying day. It can be the "boring Bering" on uneventful ten-hour patrols. "But when you're flying low in bad weather," he said, "ice can form within 30 seconds on the wings and ruin the airfoil. If you get through a winter without scaring yourself, you're pretty lucky."

FOR YEARS I HAD DREAMED of traveling the Aleutians, this remote chain of islands flung like fallen asteroids in a 1,100-mile arc across the sea. They turned out to have more of a neighborhood feeling than I'd expected. At the U. S. Naval Air Station on Adak, halfway down the chain, P-3 Orion antisubmarine planes take off on constant patrols. There I found a suburban village of 5,000 people, complete with a McDonald's, a shopping mall, and modern housing for spouses and children accompanying servicemen on two-year tours.

At Shemya Air Force Base, near the islands' western tip, the "official" wind sock

Frozen foods dangle conveniently outside apartment windows in Provideniya, a Siberian seaport of 5,000 just 50 miles from U. S. waters. But not all necessities are so handy here. "It is very difficult to work," laments physician Tatiyana Ataukai Barzova in the nearby village of Sireniki, plagued by shortages of medicines. "Sometimes we even have to turn away first-aid cases."

is a heavy chunk of wood dangling on a chain. "We have two seasons here—winter and fog," said weather station chief Master Sgt. Jeff Fries. "In spring and summer we get warm subtropical air that condenses when it hits the Bering's 45-degree water. That produces 2,000 to 3,000 feet of dense fog, which persists until autumn. In winter we get low pressure systems moving east from Siberia—a major one every 48 to 72 hours, with minimum 50-knot winds. When it blows 70 knots, that wooden wind sock is no joke."

Weather is one of the few things not labeled top secret at Shemya, where Air Force RC-135 jets fly electronic and photographic missions to monitor Russian intercontinental missile tests. The missiles are launched from sites in central Asia and land on or near the Kamchatka Peninsula.

Attu Island, the westernmost of the Aleutians, is one of the bleaker ends of the earth. Its only inhabitants are 22 Coast Guardsmen whose lonely task is to maintain a loran station that broadcasts navigational signals for ships and aircraft.

Attu is strewn with ruins of World War II U. S. military buildings, collapsing amid a forest of bare utility poles that look like melancholy totem poles of a lost tribe. On May 11, 1943, two tribes from opposite sides of the Pacific met here in mortal combat, when some 16,000 U. S. troops stormed ashore at Massacre Bay to displace Japanese invaders. In 18 days of savage fighting, 549 Americans and 2,350 Japanese were killed.

With Coast Guard navigator Dave Kinney, an amateur historian, I drove to a windswept hilltop to see a titanium starburst monument left by Japanese pilgrims in memory of their own. In this loneliest of places, it was difficult to shed a feeling of emptiness and woe.

WHEN THE JAPANESE invaded, a third tribe became victims too. Almost 900 Aleut villagers were evacuated by U. S. forces from their homes in the Aleutians and the Pribilof Islands to a life of squalor in abandoned fish canneries near Juneau. A hundred of them died before they were allowed to return to their shattered homes in 1945. For their travail they received some $35 each in compensation for "personal loss." Not until 1988 did Congress try to rectify this war debt with payments of $12,000 each to survivors.

In Aleut history such suffering was not unprecedented. They had fared worse under the rule of the Russian-American Company, which ran the tsars' fur-hunting empire in the Aleutian Islands and Gulf of Alaska until the U. S. purchased the territory from the Russian government for $7,200,000 in 1867.

"It's been said that before the Russians came in 1741, there were 15,000 natives in the Aleutian Islands and Kodiak area," said Rick Knecht, chief archaeologist for the Kodiak Area Native Association. "We believe there were more. But we know that by 1840 there were only 1,500 left on Kodiak."

Many were massacred by the Russians, who suffered some casualties themselves,

Dr. Knecht told me. "Also, smallpox and other diseases wiped out whole communities. Starvation killed many because the Russians insisted that men hunt for furs, not for food."

Recently archaeologists discovered that tectonic forces and the melting of ancient glaciers have gradually raised shoreline terraces. "Now we find old habitation sites 40 to 100 feet high on Kodiak, on Prince William Sound, and along the Aleutian Islands," Dr. Knecht said. "There are tens of thousands of sites, indicating at least 5,000 years of occupancy."

Today about 2,000 Aleuts live in the Aleutian and Pribilof Islands. On St. George and St. Paul, 600 miles west of Kodiak, they share their volcanic habitat with some 900,000 fur seals, who arrive each spring to engage in what may be the noisiest—and is certainly the smelliest—mating game on earth.

"The Russian-American Company brought us here to hunt seals around 1787," St. Paul city manager Larry Merculieff told me. "After the Russians left, commercial hunters from outside almost destroyed the stock. In 1911 the U. S. government took

"One season I worked alone, but I wasn't lonely," says ornithologist Nikolai Konyukhov, in Sireniki, checking eggs for sounds of hatching chicks. The Muscovite studies 100,000 crested auklets (opposite) that nest in nearby cliffs (above). They daily cross 80 miles of open sea—and the Russia-U. S. border—to feed in the plankton-rich Anadyr Current.

over management of the seal harvest by international treaty. We hunted for the government, and the stocks were rehabilitated.

"We thought we'd be independent in 1983, when the government pulled out and turned the harvest over to us. We made a $500,000 profit in the first season. But in 1985 animal-rights groups pressured Congress to end sealing. Now the Marine Mammal Protection Act requires that when we hunt we take only the meat and destroy the skins."

Although fur seals were listed as depleted in 1988, with a population only 35 to 40 percent of historic peak levels, most scientists agree that hunting of some 16,000 subadult males a year did not influence birthrates.

To replace sealing with other ocean-related industry, federal agencies have spent a hundred million dollars on breakwaters and port facilities at St. Paul and St. George. Japanese investors have built fish-and-crab processing plants where fishermen can bring their catch, saving a 36-hour trip to Dutch Harbor.

For some islanders it's not enough. "We built this harbor to make our people fishermen, not just cannery workers," said Ron Philemonoff, chief executive of the native-owned TDX Corporation. "But we can't get financing for boats. Are we going to be just a gas station for the fleet, with a few seven-dollar-an-hour jobs—right in the middle of a multimillion-dollar fishery? We are asking the government for an 8 percent direct allocation of the Bering fish resource. We need guaranteed access to fish."

By now it occurred to me that perhaps man is the Bering Sea mammal that has suffered mismanagement most of all.

ONE NOTABLE FEAT of mismanagement on the Bering Sea began in 1948, when the Soviet Union closed the Bering Strait and turned its eastern border into a Cold War barricade. In 1988 the strait became a two-way street again, thanks to two Nome businessmen, real estate broker Jim Stimpfle and air service operator Jim Rowe, who persuaded Soviet leaders to allow private U. S. aircraft to fly across the strait.* Today, Rowe's Bering Air service makes 100 to 150 charter flights a year to Provideniya, capital of the Chukchi Peninsula.

"We used to take rubles for Russian passengers—even though we couldn't spend them," Rowe told me. "Friendship—that's why I stick with this. Many of our passengers are Eskimos, visiting relatives they haven't seen for 50 years."

In Nome I boarded a Bering Air Piper Navajo for the 240-mile flight to Provideniya. Sergei Frolov, a young Soviet marine architect, had invited NATIONAL GEOGRAPHIC to join the first stage of a two-year expedition in which he and an international crew planned to sail skin boats called umiaks from the Chukchi Peninsula to visit native communities in Alaska, Canada, and Greenland.

There were difficulties, I discovered on arriving. Expedition members had been delayed by problems with Soviet entry visas. And high winds would delay our trip by water to the expedition's launching site at Sireniki, an ancient Eskimo village 30 miles away. What was the plan?

"The plan is, we're stuck," said Sergei.

That gave me a chance to explore Provideniya. It looked like a city that had made war on itself and lost. Its largely Russian population trudged unpaved roads and lived in drab prefabricated apartment buildings beneath a pall of coal smoke belching from power and heating plants. Food stores were almost empty.

I was glad at last to help launch Sergei's 30-foot umiak in the blighted harbor and emerge into a sparkling seascape, where walruses surfaced to observe our passage and white seabirds startled by our motor poured like waterfalls from mist-shrouded cliffs.

We arrived at Sireniki on the crest of a breaking wave. A dozen hip-booted villagers hauled us up the gray pebble beach. Beyond stood an industrial-looking complex of two-storied apartment houses and a battery of cages, where some 5,000 blue foxes paced restlessly, awaiting walrus and seal meat provided by brigades of Eskimo hunters. The foxes would in time yield their fur for hats and coats.

One of the hunters, Timofiey Panaygie, invited me to his home, where his wife, Roza, served dried walrus meat seasoned with pungent seal oil. "Before, we hunted *aupik*, the Greenland whale," he told me. "Americans and other foreigners came with ships and killed them all. Now to feed the foxes we kill 400 walruses and 200 seals a year."

*See "Air Bridge to Siberia," in the October 1988 NATIONAL GEOGRAPHIC.

The catch of the day draws a beach crowd in Sireniki, where seafaring Yupik Eskimos haul in 400 walruses each year. Tusks are sent to a carving collective, while some of the meat feeds foxes at a state-run fur farm. The skins are sometimes used to build traditional lightweight umiaks for ocean hunting.

However regimented the hunt, traditions still survive. That evening I watched as villagers crowded to the beach to welcome hunters returning with a bull walrus lashed to the side of their umiak. They hauled the 2,000-pound sea giant ashore, its 20-inch tusks jutting skyward. In a slow-moving ritual, men dismembered it with hatchets on a blanket of its own skin. Women with knives carved off glittering red delicacies. Afterward, a child fed pebbles to the severed head.

While hunting and fox farming are important, reindeer herding is the region's major industry. Some 500,000 animals roam the area, tended by native Chukchi who lived as nomads until the government combined settlements into collectives and moved an entire Chukchi community to Sireniki.

One day, while visiting the cluster of *yarangas*, or tents, of Reindeer Brigade No. 3, I watched Ivan Rultytagin engage in a distinctly nontraditional activity. From his tractor he unloaded cartons filled with American blue jeans, T-shirts, sweat pants, cosmetics, and battery-powered cassette players. Herders arrived from outlying brigades to buy these luxury goods with rubles.

The real medium of exchange is reindeer horn. Korean men believe swallowing powdered antlers improves sexual powers—a belief so strong that the bone dust, mixed with reindeer blood plasma, sells for more than $150 an ounce in Seoul. An informal system allows the collectives' management to ship the antlers to Eskimo partners in Alaska. Korean agents pay for them in dollars. American partners buy consumer goods unobtainable in Russia and ship them to the herders.

"We have many rubles," a herder told me. "There is nothing in our own stores to buy."

SOMEHOW IT SEEMED that the need for such convoluted economic strategies had paralyzed and shamed the very soul of Russia. But the soul survived in unexpected places. One day while hiking along coastal cliffs amid a fragrance of sage, I found the shack of ornithologist Nikolai Konyukhov. For nine years he has studied the crested auklet, *(Continued on page 100)*

HOME ON THE TUNDRA

Screaming winds and blustery snows of tundra winter mark the rugged face of Chukchi herder Fyodor Eleneut of Yanrakynnot, a coastal Siberian village of 450. Tough and independent, seminomadic Chukchi in groups of about a dozen roam the tundra for a month at a time, following their herds of reindeer to patches of moss and lichens. Reindeer skins keep man and beast warm, while two-way radios keep herders in touch with the village. With most herds under state control, some Chukchi are now pushing for private ownership.

Boisterous play breaks up a lasso lesson (left), where boys learn to catch reindeer the Chukchi way. Stripped down inside a reindeer-skin tent's tightly sealed inner chamber, or polog (below), grandmother and grandson share a story.

After killing a yearling in the traditional manner—with a single stab in the heart—leader Anatoli Tevlyagirgin (above) helps skin the carcass. Though conditions are harsh most Chukchi herders prefer the freedom of the tundra to village routine.

Tundra trade brings in American goods—and puzzled looks—to herders studying the contents of the latest shipment. Dried reindeer horn, sold as an aphrodisiac in Korea and Japan, gives Chukchi herders barter power in their efforts to satisfy a growing appetite for imports such as blue jeans, T-shirts, and tape players.

(Continued from page 93) a tiny, orange-beaked creature that is one of the most dedicated international commuters in the world.

Each day, Nikolai told me, some 100,000 of the birds fly from Sireniki to U. S. waters off St. Lawrence Island, where they dive as deep as 130 feet to feed on zooplankton—a round trip of 160 miles.

At sunset we witnessed their return, an endless swarm of small black silhouettes, swirling, gabbling, squeaking, wings sounding like the wind as they circled the rookery for more than an hour. Gradually they landed and vanished into deep crevices in rocks, voices still echoing like subterranean spirits.

Spirits of another kind also dwell on the Bering coast, silent, nameless. They live at Whale Alley, on Yttygran Island, where a sweeping arc of giant whale skulls faces the sea, jawbones planted deeply in the pebble strand by unknown hunters centuries ago as a monument to the thousands of great whales that passed by on migration each year.

I traveled there by boat with Vasily Yattelen, a 47-year-old Eskimo who works as a diesel mechanic on the Dawn of Communism State Farm at Novoye Chaplino. Whale Alley is his birthplace, he told me, and it is important for him to come here occasionally and leave a small offering of food.

As we sailed back to the mainland, I could see dozens of whale spouts glittering against the setting sun. But they were the modest exhalations of gray whales and belugas. The giants seldom come nowadays.

I RETURNED TO PROVIDENIYA to discover that the Chukchi Peninsula's notorious fog had turned the airport into a sort of Russian purgatory, filled with lost souls camping wretchedly on their luggage. Such fogs are known to last for days, and I was due to meet some of the Soviet Union's top marine scientists in Vladivostok, headquarters of the Pacific Research Institute of Fisheries and Oceanography (TINRO).

Salvation was mine on the waterfront when a huge freighter, the *Vitus Bering*, loomed through the mist. Its name was a good omen—Bering, a Dane commissioned

by the tsar, was the first to sail east from Asia to discover America. The *Vitus Bering* was bound for Vladivostok. My visa was in order, the KGB was willing, and Capt. Vladimir Voytovich welcomed me aboard.

Voytovich is 56, a captain for 22 years with the Far East Shipping Company. His is the first of a new type of 500-foot icebreaking ship equipped with two helicopters that deliver cargo to remote coastal villages.

His regular route takes him north through the Bering Strait and into the Arctic Ocean to Chaun Bay. It is one of the world's most demanding sailing chores, the captain told me. Savage storms create massive drifts of ice that grind down from the North Pole, closing northern waters to conventional shipping for all but two or three months a year.

"There are more comfortable oceans, but I prefer sailing where the weather keeps you busy," he said, offering me strong tea spiked with rose hips. "To be a seaman, it is necessary to be romantic. It is also useful to have good luck." As we sailed out of the mists into sunlight on a dancing sea, coursing southwestward across the Gulf of Anadyr and then along the coast of Kamchatka, I reflected on the fatal lack of luck that attended the historic voyage of Captain Bering.

He sailed from the Kamchatka port of Petropavlovsk on June 4, 1741, with conflicting guidance from mapmakers as to where the continent of America might be. After six weeks of zigzagging, during which his ship, *St. Peter*, became separated from a second vessel, *St. Paul*, he logged his first landfall at Mount St. Elias, Alaska, on July 17.

His return voyage was a nightmare that stirs sympathy in anyone who sails the Bering Sea today. "Although . . . we should still spend some time in examining the discovered American coast, yet we find this to be dangerous because of the violent autumn storms and continuous heavy fogs," his sailing master, Sofron Khitrov, wrote on August 10.

September and October were worse. "Terrific storm . . . Frightful squalls . . . Heavy sea running," the assistant navigator reported, almost unable to write because of painful scurvy, which would kill 32 of the crew. At last, on November 5, they sighted the Commander Islands off Kamchatka's coast, where storms drove the ship ashore. Bering died of scurvy on December 8. Not until the following August did the survivors return to Petropavlovsk in a vessel built from the wreckage of the old.

When the *Vitus Bering* arrived at Vladivostok, I found a sad codicil to the old explorer's fatal voyage. Hidden among other bones and fossils at TINRO's marine museum was a huge mammalian skull, one of the few remaining bits of evidence that an animal called the Steller sea cow ever existed.

This sirenian, weighing as much as 8,000 pounds, was discovered by a Bavarian scientist, Georg Wilhelm Steller, who accompanied Bering. The naturalist left the only description ever written of the sea cow.

"These animals love shallow and sandy places along the seashore, but they spend their time . . . about the mouths of the gullies and brooks, the rushing fresh water of which always attracts them in herds," he wrote.

"They keep the half-grown young in front of them when pasturing, and are very careful to guard them in the rear and on the sides when traveling. . . . With the rising tide they come in so close to the shore that not only did I on many occasions prod them with a pole or a spear, but sometimes even stroked their back with my hand."

So easy were they to capture, and so tasty their flesh, that they were exterminated by 1768—only 27 years later—by Russian hunters. Like most of man's depredations, this was committed in ignorance, with a naive belief that nature's resources are inexhaustible.

Today, TINRO's scientists have joined a worldwide effort to convince fishery experts and conservationists that current methods of ecosystem management are almost as naive.

"We can say that nobody in the world yet understands processes in ocean basins," I was told by Oleg A. Bulatov, deputy director of the TINRO science laboratories. "For seven years, we have studied not only exploited species, such as pollock, but unexploited species as well, such as lantern fish, sculpin, sharks, and skate.

"Our preliminary results estimate the fish biomass in the Bering at 30 million tons, almost 75 percent in the American zone. But we do not know which species increase when another species is reduced by fishing.

"Managers on both sides often base their conclusions on very weak data regarding such complex factors as primary productivity of phytoplankton and the roles played by bacteria, protozoans, and benthic organisms."

THAT LEFT ME with more questions than answers. I put some of them to Bill Aron at NMFS. "Animals are better oceanographers than we are," he told me. "For instance, the Steller sea lion population collapse started at a time when there was a vast increase in pollock, their principal food. Why? We don't know. But they are telling us something is happening."

Today sea lions are helping to report their own activities by way of radios and instrument packages glued to their fur in a multimillion-dollar government study.

"The radios transmit data to satellites," said Tom Loughlin, of the NMFS Marine Mammal Laboratory. "We've learned that in the breeding season they go 20 to 25 miles offshore to feed. Their dives last about two minutes, at depths between 65 and 330 feet.

"The next step will be to monitor fishing within a 20-mile radius of a rookery, to see what effect it has on population trends."

To learn more, I visited Alaska Department of Fish and Game biologist Lloyd Lowry, director of the Steller Sea Lion Recovery Team.

"We are finding that adult females are poorly nourished, so what is happening near the rookeries may be critical," he said. "Fishing on spawning shoals of pollock could be particularly damaging, because the high-calorie roe-bearing fish are a preferred food for the sea lions late in pregnancy. If they don't get the right food at the right time, it may be that they spontaneously abort."

Neither Loughlin nor Lowry believes that number crunching—juggling fishing statistics and population estimates—provides enough information for management. "You must have a conceptual model of each creature's relationship to all the other creatures and to the whole," Dr. Lowry said.

"Remember, the North Pacific was changed greatly by whaling. Large whales were very abundant, numbering in the tens of thousands. When they disappeared, millions of tons of food was freed up for pollock, herring, and salmon. Did that create an artificially high biomass of forage fishes? What kind of ecosystem did we start with?"

Fisheries managers will soon have more information to work with thanks to a new policy of placing some 600 NMFS observers on fishing vessels, at a cost of seven to eight million dollars to the industry, to monitor the catch and bycatch and gather biological data.

Enforcement of rules will be strengthened. "Up to now, all we've required is that fishermen throw the bycatch back," said Russ Nelson, manager of the observer program. "Now we have a 'penalty box' system for excessive bycatch. Penalties range from a warning to boat seizure. It doesn't bother the careful ones. Dirty fishing is just a habit. Clean fishing is a skill."

Living doll, nine-month-old Lorianne Koonooka waits as her elders launch a whale hunt from the beach on St. Lawrence Island. Cushioned by modern amenities, residents of the Bering Sea's largest island still ride the waves in walrus-skin umiaks of their ancestors.

CLEAN IS A RELATIVE TERM in the bowels of a factory trawler. During my voyage on the *Saga Sea*, I had toured the belowdecks plant with foreman Heidi Nabinger. We entered a charnel house whose whining machines depended on the machine-like labor of four human "drivers," who fed fish at a rate of 130 a minute into a conveyor. I saw the pollock dangling heads up, mouths agape, six abreast, in serried ranks that swayed in unison, an eerie chorus line of death.

"It's tough work," Heidi said. "I tell seasick people, 'You gotta get out of bed. That's the *worst* place to be.' "

Workers are paid in shares, she told me. Earnings depend on production. Top workers can make as much as $20,000 during a two-month contract. It sounded very much a part of the American dream: Work hard, earn a stake, change your life.

We returned to Dutch Harbor in a roseate dawn, and the Bering Sea was a mirror reflecting cherubic clouds. It was difficult to believe that it was the same ocean that had devoured at least 20 lives the previous year, broken a score of boats, and scattered plans and hopes ruthlessly on savage winds.

Working on this cruel sea has always demanded a special kind of strength and flexibility, I had learned. But now there was a new requirement. Only knowledge could banish that nightmare component of the American dream: the part that puts all other dreams at risk when people work too hard, too blindly, and too well. □

DEEP-SEA GEYSERS

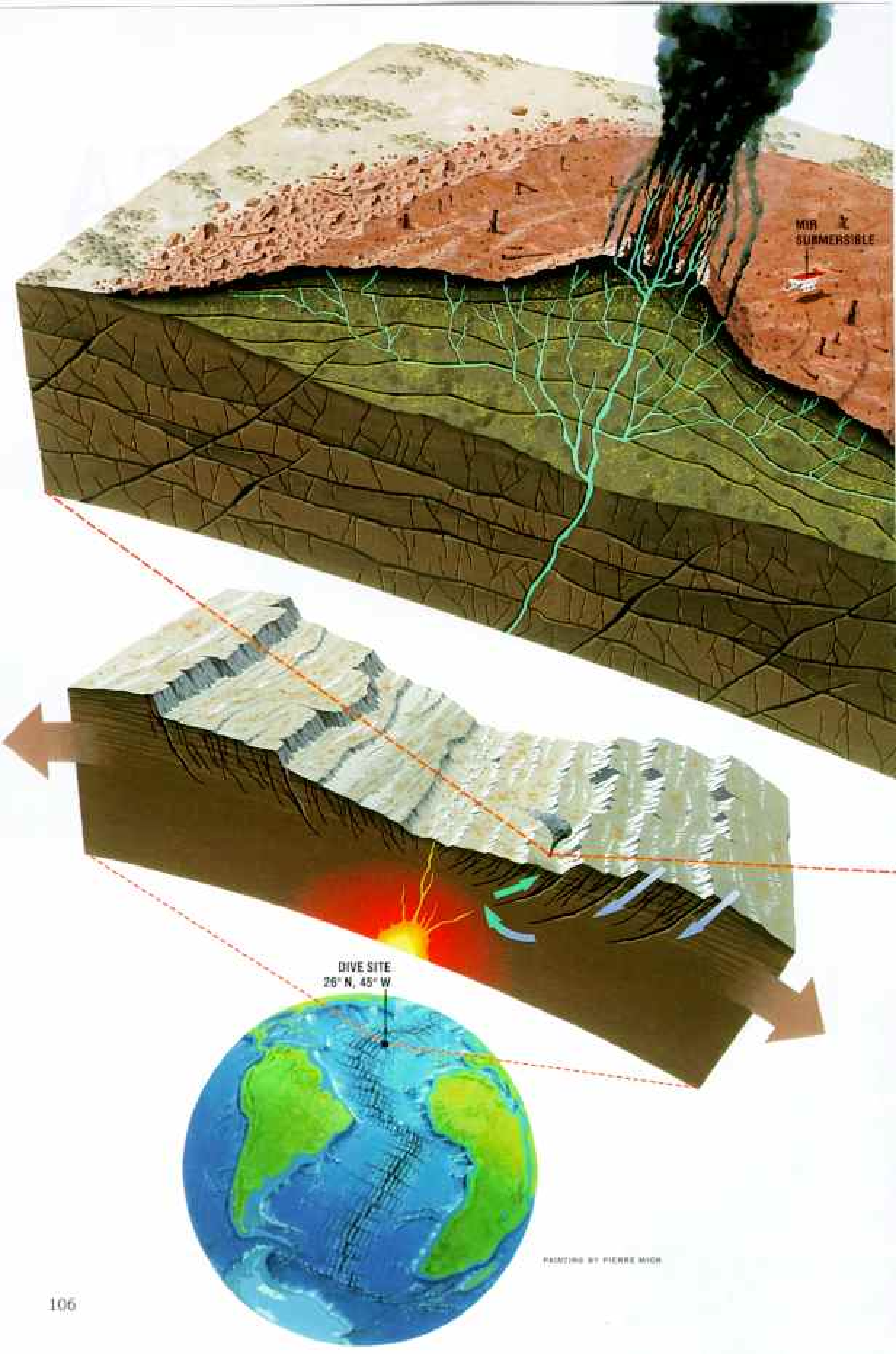
OF THE ATLANTIC

ANATOLY SAGALEVITCH, P. P. SHIRSHOV INSTITUTE OF OCEANOLOGY (LEFT); EMORY KRISTOF, NGS

By PETER A. RONA

Billowing black clouds erupt before us. Only a few feet and the acrylic portholes on our *Mir 1* submersible (above) separate me and my Russian companions from a blasting, 650°F inferno. We catch our breath as our pilot, oceanographer Anatoly Sagalevitch, braces the craft against a mineral deposit, maneuvering to keep us from being sucked into the roiling geyser. Cramped inside the advanced-technology submersible are Sagalevitch, geologist Yuri Bogdanov, and myself, a geophysicist who has spent three decades exploring the deep-ocean floor. We let out a cheer, having at last reached our target.

We are 1,800 miles east of Miami and two-and-a-half miles down, in a valley cleaving the Mid-Atlantic Ridge, where superheated water bursts through the seafloor. Since 1975, when the United States and the Soviet Union agreed to undertake joint studies of the oceans, we've seen nothing as spectacular as these spewing black smokers and the life around them.


MIR
SUBMERSIBLE
DIVE SITE
26° N, 45° W
PAINTING BY PIERRE MION

Bulging mound of metallic minerals, the geyser field we had come to see (above) merely hints at the colossal forces at work beneath the ocean floor.

As crustal plates separate (left), molten rock from the earth's interior wells up between them. Then it flows onto the ocean bottom, creating new crust that cracks and slips to form mid-ocean ridges circling the globe.

Cold dense seawater penetrates the cracks, which may extend miles deep. Heated near the magma, the water expands and, carrying gases and metals leached from the rocks, it discharges as hot springs. In ten million years as much water as the oceans now hold passes through such systems, altering the water's chemistry and leading to the release of carbon dioxide into the atmosphere.

Approaching the geyser field, we scanned the pale sediment and dark volcanic rocks of the undersea desert. We were elated when a color-splashed oasis came into view. Red, yellow, and green—bright chunks of minerals—marked the Astrodome-size mound with its jetting geysers.

Over much of the mound we saw places where warm water seeped up and, meeting cold water, shimmered like heat waves on desert sand.

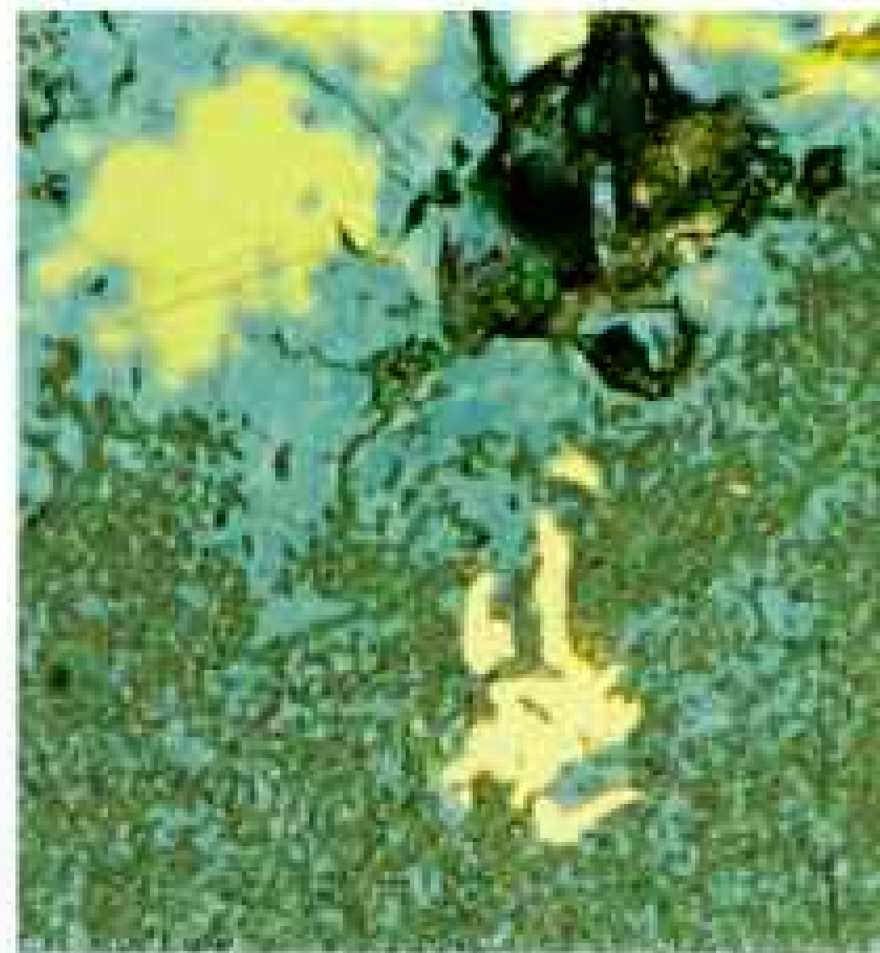
Scientists were astonished in 1985 when a team I led discovered this field of hot springs, the first seen in the Atlantic. Such springs were then thought to occur only in the Pacific—the world's most volcanically active ocean basin—where they had been found in 1977 near the Galápagos Islands. Today these fields are believed to exist in mid-ocean ridges worldwide.

Ascending the mound, we entered a bluish-white fog of minerals wafting from vents in its side. In minutes we reached the mighty black smokers at the summit.

The mound itself resembles deposits on land, called massive sulfides, that are mined for copper, zinc, silver, and gold. Earlier we had spotted the sparkle of pyrite, or fool's gold, but later examination of the mineral sample under a microscope also revealed the real thing (right). Finding grains of pure gold in such hot-spring deposits disproves the long-held belief that gold becomes concentrated only on land.

MILTON SMITH, UNIVERSITY OF WASHINGTON

A time exposure of a black smoker at another field, made with an ultrasensitive camera, reveals yet another unknown: Metal-rich hot springs emit a distinct infrared glow (above).



MARK HANNINGTON, GEOLOGICAL SURVEY OF CANADA

PETER A. RONA, NOAA (ABOVE); EMORY KRISTOF

Something moves in the path of our floodlights. Thousands—perhaps millions—of shrimp (left) swarm around the black smoker chimneys and feed on bacteria growing near the hot water. Spots on their backs reflect our lights.

I first encountered these odd eyeless shrimp during the 1985 expedition. My colleague Austin Williams and I named the new species *Rimicaris exoculata,* or "dweller in the rift without eyes." We were intrigued: How could a blind shrimp feed safely near the scalding springs?

I sent specimens of the two-inch-long shrimp to biologist Cindy Lee Van Dover at Woods Hole Oceanographic Institution. She discovered that part of the shrimp's back between the dark protruding gill chambers (bottom right) contains a chemical present in the eyes of other animals.

The crustacean cannot "see" with this reflective patch, but the organ serves as a modified light sensor. There remained one further question: In the blackness of the deep ocean, how could the shrimp find its way around?

Researchers hypothesize that the shrimp's unique "eye" picks up a dim source of light—the infrared glow from the black smokers. If true, the relationship between the sensor and the glow may have two functions: to help the shrimp find the black smokers and the microorganisms surrounding them and to prevent it from getting too close to the heat.

Our adventure continues not far from a cluster of mineral chimneys about ten feet high (bottom left). The sediment is sanctuary to a mysterious creature the size of a silver dollar that looks like a Chinese checker board (above). It may be related to *Paleodictyon nodosum,* a fossil invertebrate preserved in rocks between 70 million and 340 million years old that were uplifted from ancient seafloor and exposed in the mountains of central Europe and Wales.

Other hot springs are yet to be discovered on submerged volcanic mountain ranges across the globe. More than remote curiosities, these geysers no doubt support a deep-ocean ecosystem where new and ancient life-forms propagate.

Indeed, these may be the places where life began. □

EXPERIMENT THAT FAILED

THE BOLSHEVIK

REVOLUTION

True believers still, Russian communists gather in St. Petersburg to uphold their utopian dream. It was here in 1917 that Lenin and his followers wrested control of a revolution and began a social experiment that engulfed much of Eurasia for most of a century.

BY DUSKO DODER

PHOTOGRAPHS BY PETER ESSICK

LENIN MUSEUM ARCHIVE, MOSCOW

During an attempt to hijack Russia's revolution, Bolsheviks disperse under fire on July 4, 1917, in Petrograd's Nevsky Prospekt. Succeeding three months later, they eventually rallied under the hammer and sickle (right), symbol of a forced marriage of worker and peasant.

OUTSIDE THE LENIN MUSEUM in Moscow, I kept running into women and children asking for money. After the tenth such encounter, I gave a ten-ruble note—worth about eight cents—to one of the beggar boys at the crowded subway entrance. It was a mistake.

Suddenly I was trapped by three other boys who aggressively tugged at my sleeves, a tone of despair in their voices. "Mister, we are hungry," one of them said in Russian, holding out a dirty little hand. "Please?" I gave ten rubles to each one in the trio and, feeling embarrassed and sorry for boys so close in age to one of my own, hurried on to Red Square.

Commuters swarmed across the square, busy on their way to and from the heart of Moscow. I stood among them, watching the scene. Bedraggled, desperate figures sold old communist flags, Red Army uniforms, and cigarettes. A column of Hare Krishnas with shaved heads, dressed in their saffron robes and beating their drums, pushed through the milling crowd. Bits of torn newspapers and empty drink cans were scattered across the pavement. Where once there were slogans and posters paying obeisance to Marx, Engels, and Lenin, banners now promoted holidays in the Canary Islands for the few Russians with enough money for travel. And a new slogan had taken the place of an old one celebrating the Bolshevik Revolution. "Freedom Works," it said.

The Red Square of 1992 was something of a shock, for I had lived as a foreign correspondent in the Soviet Union periodically from the late 1960s through the 1980s, at the height of that nation's power. In those days Red Square was all spit and polish, a clean and orderly expanse of cobblestone where people spoke in hushed voices and policemen snapped warnings at the foreign tourist who dropped a cigarette too close to Lenin's Mausoleum. On festive days out came the tanks and missiles and flags in a show of might, as row upon row of Red Army troops, 25 abreast, marched in perfect unison, making their own thunder

with their boots. All of the empire's certainty and authority seemed concentrated on such occasions, giving the impression of permanence and stability.

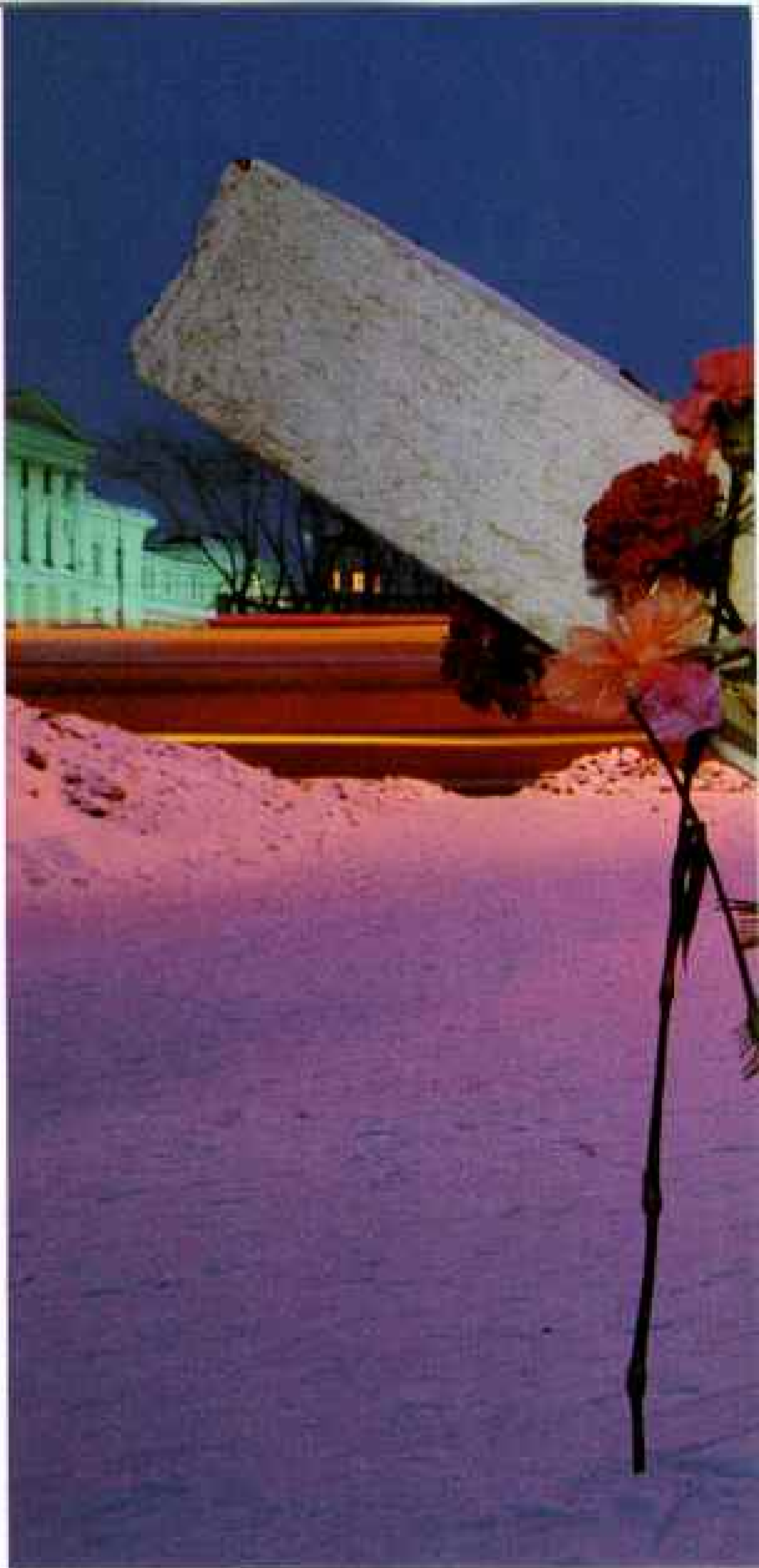
But now, just 75 years after a tiny group of Bolsheviks led by Lenin—born Vladimir Ilyich Ulyanov—seized power on October 25, 1917, the Bolshevik dream was as dead as Lenin himself, the man enshrined on Red Square. (Dates in this article follow the Julian calendar until February 1, 1918, when the Gregorian calendar came into use.) Lenin's creation, the Soviet Union, which sprawled over two continents and sent its tendrils as far afield as Angola and Cuba, Syria and Vietnam, Ethiopia and Afghanistan, was finished and fragmented. His vision, of a just and decent society in which no one was exploited, had evaporated.

"When are they going to take him away from here?" a young man mocked, talking with a matchstick between his teeth as we watched the changing of the guard outside the old Bolshevik's tomb, a shining granite building the color of rhubarb.

"Not very soon," said someone near me in the crowd.

"Soon, very soon," another shot back.

With communism dead, people felt free to speak this way, even about their old god.



IT STRUCK ME that these times were in many ways similar to 1917, the year Lenin's Bolsheviks set themselves the goal of "overthrowing the world" and creating the perfect social system. Now as then, a huge empire was collapsing, there was chaos in the streets, the economy was in turmoil, military discipline was dissolving, there was civil war around the edges of the country. The government was weak, begging the world for help.

Just before the Russian Empire disintegrated in 1917, the people were demoralized and cold, looking for a savior. Millions of troops were strung out along the frontier to the west, fighting Germans and Austro-Hungarians, while food riots plagued the old capital of Petrograd (St. Petersburg). Faced with the prospect of Russia's collapse and under pressure from revolutionary groups, Tsar Nicholas II abdicated his throne on March 2, 1917; after his brother, Michael, refused the crown, a provisional government stepped in.

"All around treason and cowardice and deception," he wrote in his diary. Three centuries of rule by the Romanov family had ended. From that moment Lenin's goal was to overthrow the provisional government and replace it with Bolshevik rule.

Lenin had grand visions for his country. He embraced Marxism in 1889, convinced that it would lead a backward Russia into the

DUSKO DODER, a free-lance writer based in Belgrade, has worked as a Moscow correspondent for the *Washington Post*. He reported on Albania's transition from communism in the July 1992 issue of NATIONAL GEOGRAPHIC. PETER ESSICK is a frequent contributor, whose photographs illustrated "Under the Spell of the Trobriand Islands," also in the July issue.

HISTORICAL PICTURES/STOCK MONTAGE

A threat to Bolshevism while alive, the tsarevich, Alexis Romanov, endures as a cult figure. A makeshift memorial in Yekaterinburg (above) marks the spot where the 13-year-old boy, his parents—Tsar Nicholas II and Alexandra—and sisters were killed on July 17, 1918. Some insist Alexis and his youngest sister, Anastasia, seen in 1914 with their family (left), survived the regicide. Historians now believe—though it was long denied—that Lenin ordered the massacre to avert revival of the monarchy.

There at the creation, Karl Rianni remembers vividly the near-bloodless Bolshevik coup of October 1917.

Communications were "seized without firing a shot," says the 99-year-old World War II veteran, Lenin's telegraph officer.

modern world. As the new century began, he and other activists joined the Russian Social Democratic Labor Party, which split into two factions, the Menshevik (meaning "minority") and Bolshevik ("majority"). Lenin headed the Bolsheviks. There were no more than 10,000 active members, but this small conspiratorial group was disciplined and committed, and they would use any force necessary to achieve power.

They intended to create a paradise on earth, where there was no injustice, where each worker was a master in his factory, where private property was forbidden, where each citizen would share the wealth equally.

STATE CENTRAL ARCHIVE OF FILM AND PHOTOGRAPHIC DOCUMENTS, MOSCOW

Lenin addresses workers and soldiers in 1920, at a time when the distinction between the two was being systematically blurred. Beside the podium, at right, is Leon Trotsky, whose grand plan to militarize Russian industry helped give rise to the epithet "Trotskyism."

"It was all a big lie," said Vitold Ryllo, an imposing fellow with a flowing black beard and long hair whom I met in Moscow. Like others who had joined the Communist Party as youths, Ryllo soon became disillusioned by the communist system and its corruption and quietly turned his back on society. Quitting his job, he retreated into a private world, taking his pleasure in the small delights of cooking, photography, and his cat.

From my own years in the Soviet Union, I knew that the realities of life under communism—the shortages, the privations, the shoddy workmanship, the endless queues—were a constant feature. Of course this was in marked contrast to the perfect society Lenin and the Bolsheviks envisioned.

Women bore the brunt of communism's failures. They did not have the freedom Lenin anticipated. The state required most people to work. For a woman not to do so was a crime in the old Soviet Union, and "social parasites" could be punished by prison.

A schoolteacher named Katya described how she felt "permanently exhausted" from keeping house, working full-time, standing in line for food, worrying over the children. "I was stretched beyond my limits."

The state provided child-care centers, but "the nurseries were dreadful," Katya told me. "My girls were always getting sick. The women who looked after them didn't care."

At home there were few, if any, modern appliances. And women like Katya spent hours standing in line for scarce goods each day. "It was humiliating. The shop-girl would ignore you. There was nothing you could do. They couldn't lose their jobs. And everyone knew they kept the best for themselves, to exchange for something else. Meat for stockings. That was the way the system ran—*nalevo*—under the table."

"Perhaps the best times were in the family, around the kitchen table," recalled another woman, named Valya. "There was tea, dark Russian bread, vodka. It was the center of the home, the only place you could really let go, away from the harshness of life outside."

Under the old system the best things were kept for the top party officials, who had black ZIL limousines, private health clinics, resorts, and food rations. The discrepancy between Lenin's vision and the reality of daily life was obscured for years by the pressure of events—the forced industrialization, World War II, and reconstruction following the war. In 1961 the party predicted, in a published plan, that

Shifting empires

1914 Western extent of Russian Empire

1918 Bolshevik-controlled territory (August)

1991 Soviet territory (August)

Political boundaries are as of August 1991.

Barents Sea
Norwegian Sea
North Sea
Baltic Sea
Vorkuta
Archangel
SWEDEN
NORWAY
FINLAND
DENMARK
RUSSIA
Ural Mountains
ESTONIA
Leningrad (St. Petersburg)
LATVIA
LITHUANIA
RUSSIA
GERMANY
Berlin
Moscow
Sverdlovsk (Yekaterinburg)
Chelyabinsk
Minsk
BYELORUSSIA
Warsaw
POLAND
Novomoskovsk
Magnitogorsk
SOVIET UNION
CZECHOSLOVAKIA
AUSTRIA
Kiev
KAZAKHSTAN
HUNGARY
UKRAINE
MOLDOVA
ROMANIA
Odessa
Aral Sea
YUGOSLAVIA
Tashkent
Sevastopol
UZBEKISTAN
ITALY
BULGARIA
ALBANIA
Black Sea
Caspian Sea
GEORGIA
GREECE
AZERBAIJAN
ARMENIA
Baku
TURKMENISTAN
TURKEY
IRAN
IRAN
AFGHANISTAN
Mediterranean Sea
SYRIA
LEBANON
IRAQ
ISRAEL
LIBYA

Rise of the SOVIET STATE

The realm of the tsars extended from Poland to the Pacific in February 1917, when, during the worst war the world had yet known, the Russian monarchy toppled after popular uprisings. Virtually overnight the empire imploded, as a welter of democratic-leaning parties struggled with Lenin's Bolsheviks for command of the Russian heartland.

After seizing control in October 1917, the Bolsheviks, to consolidate power at home, needed first to extricate themselves from World War I. They relinquished claims to the Ukrainian, Baltic, and Polish territories of the tsarist empire in a separate peace with Germany signed at Brest-Litovsk. In the treaties following Germany's defeat by the Allies, Bolshevik Russia regained Ukraine and Byelorussia. Then it won the civil war against the White armies, re-exerted control over Central Asia, and in 1922 gave birth to the Union of Soviet Socialist Republics.

Millions of peasants died in the 1930s during Joseph Stalin's brutal collectivization of agriculture. Shipped to Siberia and Kazakhstan, millions more served as colonial fodder for the vast Soviet east. In a secret pact with Hitler, Stalin regained the Baltics in 1940. After helping defeat the Nazis in World War II, the Soviet Union retained large areas of eastern Poland; next it gained hegemony over the nominally independent countries of Eastern Europe.

By 1948 the Soviet empire exceeded in size and power anything the tsars might have dreamed of.

Electrical engineer and power plant builder Alla Shister reminisces over a 1918 picture of herself in the Young Communist League. Despite five years in Stalin's gulags, she long held to her Bolshevik ideals. Hundreds of factories built during Stalin's first five-year plan, like the tractor plant (right) at Chelyabinsk, relied as much on women as on men.

the Soviet Union would have the world's highest living standard by 1980, overtaking the United States. But when that year came and went, the Soviet Union still limped along, burdened by lavish military spending, corruption in high places, and a stagnant economy.

In 1982 I asked a reform-minded official what happened to the party's goal of surpassing the U. S. by 1980.

"They are burning those reports," he said.

THE BOLSHEVIK DREAM finally ended with Mikhail Gorbachev's program of *glasnost*, or openness, which allowed citizens to speak freely for the first time in decades. All the carefully constructed "truths" began to unravel, and there was no turning back. Gorbachev's era passed. Russia's President, Boris Yeltsin, outlawed the Communist Party by signing a few pieces of paper. The Bolshevik heirs surrendered without a shot.

By 1992 every day brought new revelations, new changes, new stories upsetting all the old beliefs. Capitalism was good. Religion too. Lenin was no longer a god. Now he was a monster, a tyrant, a villain.

On April 21, the eve of Lenin's birthday, I read an article by one of Yeltsin's chief lieutenants, who described how Lenin ordered the mass execution of those who opposed his Bolshevik program in 1918. This story, from archives previously kept secret, proved to Russians what the outside world suspected all along, that Lenin himself ordered thousands of peasants hanged "so that the people see it."

What was one to believe now? I put this question to one of the few living people who knew and worked with Lenin, a 99-year-old named Karl G. Rianni. An Estonian drafted into the Russian Navy in 1914, Rianni was there when the Bolsheviks seized the Winter Palace at Petrograd and changed the course of history.

Rianni, a tall man with a composed and exacting manner, dismissed my blunt queries about Lenin's flaws. He pretended not to hear. How could a man of his years consider that the greatest event of his life had been a mistake, a waste of time?

So I encouraged him to talk about the October Revolution. His eyes lit up, and his voice took on the strength of conviction, and I sat back to listen: "Lenin had a general plan. The Baltic Fleet sailors and the Petrograd workers were to play the key role in seizing control of the city. We had to take key government buildings, the Peter and Paul Fortress, all bridges, the telegraph and telephone communications," Rianni said, pausing for a sip of tea.

Later, when it was clear that the provisional government could not endure, Lenin called on Rianni and the other Bolsheviks to storm the Winter Palace, Prime Minister Alexander Kerensky's headquarters.

"A tall iron fence surrounded the palace. One of the gates had not been locked. We saw this and opened the gate wide," Rianni continued, spreading his arms. "Like a wave of black lava, we moved into the palace, followed by workers and soldiers. There was no

resistance, none at all. They surrendered their weapons. We arrested the members of the provisional government."

Rianni's granddaughter, a beautiful young woman with red hair, came in with a tray of cookies, interrupting the old man's story. "Get away, woman!" he shouted. "We're doing serious business here!" She left the tray for us, and Rianni finished his tale: "I never met anyone like Lenin," he told me, describing the old leader as sharp, incisive, brilliant, kind, and fair. I left the old hero surrounded by a lifetime of gifts, citations, plaques, and medals, and went out into a swirling April snow.

PEOPLE LIKE RIANNI could live in the past. Many others seemed to be drifting in some sort of daze, relieved to be free of the Bolshevik legacy, yet groping to understand what had really happened to them over the past century. I also had the impression that this uncertainty was part of a larger struggle between two age-old forces of Russian geography: the pull of Europe on the one side and of Asia on the other.

"Deep in the soul of every Russian is the idea that, after a terrible travail, a wise tsar is going to come to lead us to a new Jerusalem," said Valery Bazhanov, an industrial supervisor in Yekaterinburg. It was in this city that agents of the Soviet government executed Tsar Nicholas II and his family in July 1918.

With the old tsars gone and communism dead, people are yearning for something to believe in. Religion, which Marx called the "opium of the people," is now a comfort to many.

Walking with a friend through Moscow at Easter time, we were stopped in our tracks by a new sign.

"Look at that," she said, directing my attention to a banner fluttering in the chill breeze of the Russian spring.

"Khristos Voskrese," it declared in swooping old Cyrillic letters. Christ Is Risen.

The Easter banner, my friend said, hung exactly where an old poster—Glory to the Communist Party of the Soviet Union—had been. Daily I heard Russian Orthodox priests

on radio and television, reminding the faithful how to prepare foods for the holiday feast. Those who wished to worship in the traditional way needed reminders, because the years of religious repression had left blank spots.

For most of this century the Lenin cult replaced the Russian Orthodox faith as the main source of legitimacy of the Kremlin masters who expanded the empire and turned it into the world's other nuclear superpower. Millions of pilgrims had flocked to the shrine of the new god, waiting hours to glimpse Lenin's embalmed, waxlike body under glass. Now the crowds shun the old shrine in favor of the GUM department store.

FOR ALL THE BLOODSHED and pain the Bolsheviks brought to the former Soviet Union, it must be said that they prepared for social and economic changes as if for war. They also waged a successful campaign against illiteracy in a society only recently freed from serfdom; they built power plants and brought electricity to the most remote parts of the country; they undertook massive industrialization and gave free medical care. In the beginning, at least, it seemed as if the Bolsheviks could really change the world.

"It may be hard for you to understand," Alla B. Shister explained to me, "but my

Home of true criminals today, Yekaterinburg Prison was once filled with anti-collectivist peasants—many Ukrainian—of whom it was said: "Not one of them was guilty of anything; but they belonged to a class that was guilty of everything." The one who put them there, Joseph Stalin, is seen in a mug shot from 1913.

LENIN MUSEUM ARCHIVE

family believed in the revolution. Lenin was for us a sacred name."

I sat with Alla through a long afternoon in Moscow, listening to her story of hope and loss, which began in 1918. She was a girl of 15 in Tashkent, now the capital of Uzbekistan, and the country was plunged into civil war. Red armies battled White armies across the land. Alla joined the Young Communist League and fought throughout Soviet Central Asia, beside her father, mother, and brother.

For Alla and others who were lucky enough to survive those years of turmoil, the civil war seemed like a triumph of justice over evil, the beginning of a bright new age in which the Soviet Union would lead the modern world.

Alla put the Communist Party before anything else in life. When Lenin pronounced the slogan "Study, study, study!" that is just what Alla did, choosing electrical engineering because she had read another of Lenin's sayings: "Communism equals Soviet power plus the electrification of the whole country." She joined the Communist Party, graduated from a Moscow institute, and married Rafael Y. Grinberg, a scientist who was then a secretary to a Politburo member.

But it didn't last. Grinberg ran afoul of Joseph Stalin, another Politburo member in the 1920s. "My husband would come home and start talking about Stalin as a dishonest and tyrannical man. I couldn't listen. We argued. I believed in Stalin. I left Rafael."

She went east to build power plants. "I was never so happy in my life," she said, recalling how she became the nation's first "shock" engineer (an honorific for dedicated leadership) in charge of the crash construction of a plant, at Stalinogorsk, which is now Novomoskovsk. "I slept two or three hours a day, and I worked two shifts daily with my workers. We were determined to finish the project ahead of schedule. We did."

Alla also met her second husband there, the local Communist Party secretary, Ion S. Yenov. "He loved Stalin and believed in him," she recalled, smiling at the memory. "We were so happy. We thought alike."

Like all true believers, Alla was oblivious to

Forest of no return, the Bykovnya woods of Kiev bear homemade memorials to some of the thousands of victims

buried here during Stalin's consolidation of power in the 1930s. An estimated 20 million died during Stalin's regime.

the glaring human sacrifices exacted by the regime. Millions of people died in the famine of 1921-22, intensified by civil war. And Stalin's collectivization campaign of the 1930s, when he consolidated peasant holdings and forced citizens to work on collective farms, led to another famine of staggering proportions centered in Ukraine and southern Russia. Seven million died.

More were to die in Stalin's Great Terror of 1935-38. In that campaign, at least five million people perished in forced labor camps. It was their punishment for what Stalin considered "counterrevolutionary activities." Alla's first husband, Grinberg, became a victim. Arrested in 1935, he was shot in prison. Her second husband, Yenov, disappeared into a mental institution. And Alla herself was arrested and sent to a series of labor camps. After years of exile, she gained release only in 1942.

By then, of course, Alla knew the promise of the revolution had failed. She even spoke of the "two phases" of her life as if they were disconnected. As a Bolshevik, she had hope and optimism, thinking the world was made of wax that could be molded, providing you put a little heat here, a bit of pressure there. In her second life, the one she lives now, the themes were merely resignation and survival.

Her apartment was almost barren, furnished with a few belongings that gave the place a transient look, as if she had just moved in. As I was leaving, Alla let me in on a little secret. "You know," she said, smiling quizzically, "my name is not Alla, but Ella."

I asked what she meant.

"When I was being released from a labor camp near Vorkuta, the officials wrote down my name as Alla. They said there was no such name as Ella in Russian. I insisted they change it. They said I'd have to stay for some time while they completed the new papers. I told them Alla was a fine name," she recalled.

And so Ella became Alla.

One of the great crimes of the Bolshevik Revolution was its residue of self-debasement. It dissolved families, crushed careers, and broke the spirit, leaving people like Alla with

nothing. How would it feel to realize that virtually everything you believed was false, that all the old faiths were suddenly wrong?

Until Gorbachev's era of glasnost, citizens dared not openly question the party line. The system would not tolerate it. Few other modern nations have done more to suppress ideological competition or distort history.

I remember reading my son's history textbook—he attended a Russian school in the early 1980s—and discovering that the Soviet Union was without a leader from the time of Lenin's death in 1924 until Leonid Brezhnev came to power in 1964. The explanation was simple: Stalin, who took power in 1924, was transformed into a nonperson by Nikita Khrushchev. Khrushchev himself suffered the same fate when he was suddenly replaced by Brezhnev in 1964. History books were frequently rewritten, with all references to the disgraced leaders eliminated, while their images were obliterated from photographs and films.

Soviet legacy, virtually free day care (below) is offered to working mothers at a steelworks in Magnitogorsk. Women's rights were extolled in principle but eroded in practice, and communism failed to deliver equality at the top: Only one woman ever sat on the Politburo.

At a "wedding palace" in Moscow, couples still tie the knot in Soviet fashion.

And now it seemed as if Russian history was being recast again. People like Evgeny L. Chernikov, who once fervently served the Lenin cult, were rapidly backing away from it.

"I thought that life in the Soviet Union was the best," said Chernikov, a 61-year-old Muscovite who was formerly a leading official of the Higher Party School of the Central Committee. Chernikov freely admits his surprise at having seen how well people lived in the West, and to see him you might conclude that he is a Western businessman, in his white shirt and gray pinstripe suit.

I asked him if the Bolsheviks achieved anything positive.

"What could that be?" Chernikov asked. "We have lost our past, our history, our religion, our moral values."

Despite the inequalities and privations under communism, there was a safety net. Everyone was guaranteed the basics—a job, housing, food, health care.

All that disappeared when the system collapsed in 1991. I found homeless people on the streets of Moscow and St. Petersburg. The factories and the farms seemed to be on hold, producing little. Food was scarce and priced beyond the reach of average Russians. People were living at the edge of poverty, fearful of eviction, the declining ruble, and the soaring rents.

"There's no money for kitchen parties and long conversations," Vitold Ryllo lamented. "People simply have to struggle to keep themselves afloat."

But at least the Russians were joking about it, combining the mindless communist slogans of yesteryear into the self-mocking quips for today: "Lenin said Russia stood at the edge of the precipice—now we have taken a great leap forward."

Even though the new Russian government was hoping to create a viable market economy, it looked as if seven decades of communism had left few citizens with a realistic sense of the commercial rules that govern capitalist countries.

I found thousands of people in the streets,

selling possessions—from rebottled vodka to KGB identity booklets. But these were not goods they had produced. The creation of productive enterprises was painfully slow, hampered by old habits.

"Everything is up for sale in Russia," a friend told me.

The few who had something valuable to sell for foreign currency were doing well—they were the Russians who could afford to take vacations abroad.

Muscovite Roy Medvedev, a former dissident, is such a person. He charges a set fee for interviews with the foreign journalists passing through the city. "I've switched to the market economy," my old friend explained when I called him.

ALL THE OLD CERTAINTIES were gone for Zina Popova, who owed her good apartment, nice clothes, and decent schooling to the Communist Party. Zina was never a party member, but she got all the accoutrements through family connections. Her late mother, Maria, was an old Bolshevik, a heroine who earned the name Anka Pulemyotchitsa (Anka the Machine Gunner) by gunning down waves of White Army soldiers in the civil war.

But Zina gave me the impression that, like other legends from the Bolshevik Revolution, the stories of her mother had been inflated for propaganda purposes.

"That hero stuff was a millstone around her neck," Zina confided. "Mama told me she knew nothing about Lenin and Marxism when she joined the revolutionaries. They were spurred by hunger. My mother believed in the myth of the October Revolution but only for a few years. Then there was no exit. She put in her time, like most of the others."

Casting about Zina's apartment, which she had inherited from her celebrated mother, I saw photographs and posters of a pretty woman with fair skin, a wide brow, and black hair. There was also evidence of the comfortable life-style they enjoyed, vacationing at Stalin's former dacha on the Black Sea, school pictures of his daughter, Svetlana, and other children of famous communists. True to the Soviet elite, Zina had willingly lived a double life, publicly maintaining the fiction of socialist equality while living in private luxury.

But now people like Zina, who had gained so much under the old system, had the most to lose. With the party banished, all her perks had vanished. Prices were out of control, rubles virtually worthless.

Fruits of a dead—but still unburied—ideology, empty stores and lack of choices testify to the economic failure of the "workers paradise." A Spartan existence faces those living in the collective monotony of apartments in Novosibirsk (above) and elsewhere—yet shortages of even such basic necessities are so acute that whole Soviet armies remain stranded abroad.

The uncertainty put Sergei I. Smirnov very much on edge. "Democracy!" he scoffed, darting through traffic in his battered taxi. "I remember the Brezhnev years as the golden age. I knew that I'd be able to buy my own car and have a little dacha. I saved 20,000 rubles

Still singing the same old songs, diehard communist Aleksei Rybin teaches Bolshevik folk songs to members of the now defunct young Pioneers. A guard at Stalin's dacha in the 1930s, the 84-year-old represents a vocal minority who continue to believe they did "good work."

for retirement. The pension now is 900 rubles a month, but one kilo of salami costs about 500 rubles. How do we live?"

For the moment it seemed that this society was trapped in a majestic apathy, a caricature of its old promise—more unfair, more hopeless, more pathetic, more unchangeable than it had ever been.

Yet there is cause for hope. "The Russians are capable of enduring a great deal," a friend told me as winter slipped into the spring of 1992. Conditions were hard, but the Russians had survived another winter, despite the dire predictions that they would not.

And there was a burst of creative energy among younger Russians, who seemed less haunted by the ghosts of Lenin and Stalin than were their elders. The new kids were interested in music and money and selling you things. They were thinking for themselves, freely speaking their own minds instead of spouting the old party rhetoric.

Vladimir Chursin, a young painter who heads the Artists' Union in Yekaterinburg, was experimenting with new styles and trying to find a way to market them. When I met him, he had abandoned socialist realism, with its muscle-bound factory heroes and belching smokestacks. He was instead churning out nudes—nothing but nude women—a bourgeois subject discouraged for the past 75 years. There would be difficult times ahead for him, but at least Vladimir was trying something different.

And despite the turmoil around its edges, Mother Russia survived at the center, the largest nation on earth, blessed with enormous natural resources. There had been an unprecedented transfer of power, from one tsar to another, Gorbachev to Yeltsin. They didn't lock Gorbachev up, and they let him travel. And he could even criticize the government without getting shot. Perhaps the old pattern has been broken. □

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tional room and comfort. And to help keep you secure, Crown Victoria offers a standard driver and available right-front passenger air bag supplemental restraint system. Air bags, in conjunction with properly worn safety belts, are one of the most effective restraint systems available.

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Geographica

GREG DAVIS, TIME MAGAZINE

Peace Revives Hope of Preserving Angkor

Ravaged by jungle vegetation and rainwater, defaced by lichens and bat droppings, looted by thieves, the monumental Cambodian temple complex at Angkor may yet endure.

That, at least, is the hope of Cambodian officials and foreign experts mapping a program to preserve the hundreds of monuments—from simple shrines to grandiose temples like 12th-century Angkor Wat (above and right)—in northern Cambodia (NATIONAL GEOGRAPHIC, May 1982).

An uneasy peace has returned to Cambodia's killing fields, and teams from France, Japan, Poland, Hungary, and the World Monuments Fund are joining specialists from India—who have been working at Angkor Wat since 1986—in planning Angkor's future. UNESCO, which is expected to add Angkor to its World Heritage List in December, is coordinating the effort.

"This will take patience, and lots of money," warns Henri Lopes, a UNESCO assistant director general.

Ouk Chea, Cambodia's director of conservation of historic monuments, agrees and admits his nation lacks the money and the expertise.

MICHAEL S. YAMASHITA

"My job is to prepare a list of projects, like a menu," he says. "International assistance is necessary."

Braving mine fields left from the days of civil war and facing a paucity of tourist amenities, some 50 people a day now visit Angkor. "Peace has made access easier," says Richard Engelhardt, UNESCO representative for Cambodia. "But thieves have better access too."

Thieves steal the statues or lop off the heads for sale on the black market. "If this continues, how many works of art will be left at Angkor?" pleads Pich Keo, head of the National Museum of Phnom Penh.

A Mile-a-Minute Weed Strangles the Landscape

What grows quickly, sends out barbs that cling to other vegetation like Velcro, blocks out the sun, and may someday cross the nation?

It's mile-a-minute vine.

Like kudzu, the scourge of the South (GEOGRAPHIC, July 1990), mile-a-minute vine—*Polygonum perfoliatum*—infiltrated United States soil from Japan. It first turned up in the late 1930s in holly shipped to a York County, Pennsylvania, nurseryman, who let it go to seed. Within ten years the import ruled most of the nursery and staked a claim to the surrounding fields.

Mile-a-minute vine now sprawls across Pennsylvania and has invaded Maryland, Delaware, New Jersey, West Virginia, Virginia, and the District of Columbia.

Ann Rhoads, botany chairman at the University of Pennsylvania's Morris Arboretum, says the vine grows especially well along eroded riverbanks, in floodplains, and on roadsides. "An individual vine may be up to 25 feet long," she says. "But they grow in such a mass and get so tangled up, it's hard to tell one vine from another."

Canon Endangered Species Series – Featured in National Geographic since 1981

WILDLIFE AS CANON SEES IT

Blue Whale
Genus: *Balaenoptera*
Species: *musculus*
Adult size: Length, 20 – 33 m
Adult weight: To 190,000 kg or more
Habitat: Polar to tropical seas
Surviving number: Estimated at 10,000
Photographed by Barrie Rokeach

The power of two feeding blue whales creates spectacular swirls in Pacific waters as seen from 300 meters above. Because of its sheer size, the majestic blue whale became the prime target of whalers, and was close to extinction by the 1960s. The last whales are now protected, but with their sparse populations scattered throughout the vast seas, it is still unknown if so few can fully recover. To save endangered species, it is essential to protect their habitats and understand the vital role of each species within the earth's ecosystems. Photography, both as a scientific research tool and as a means of communication, can help promote a greater awareness and understanding of the blue whale and our entire wildlife heritage.

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Geographica

Dolphins Ride a Wave, Save on Energy Costs

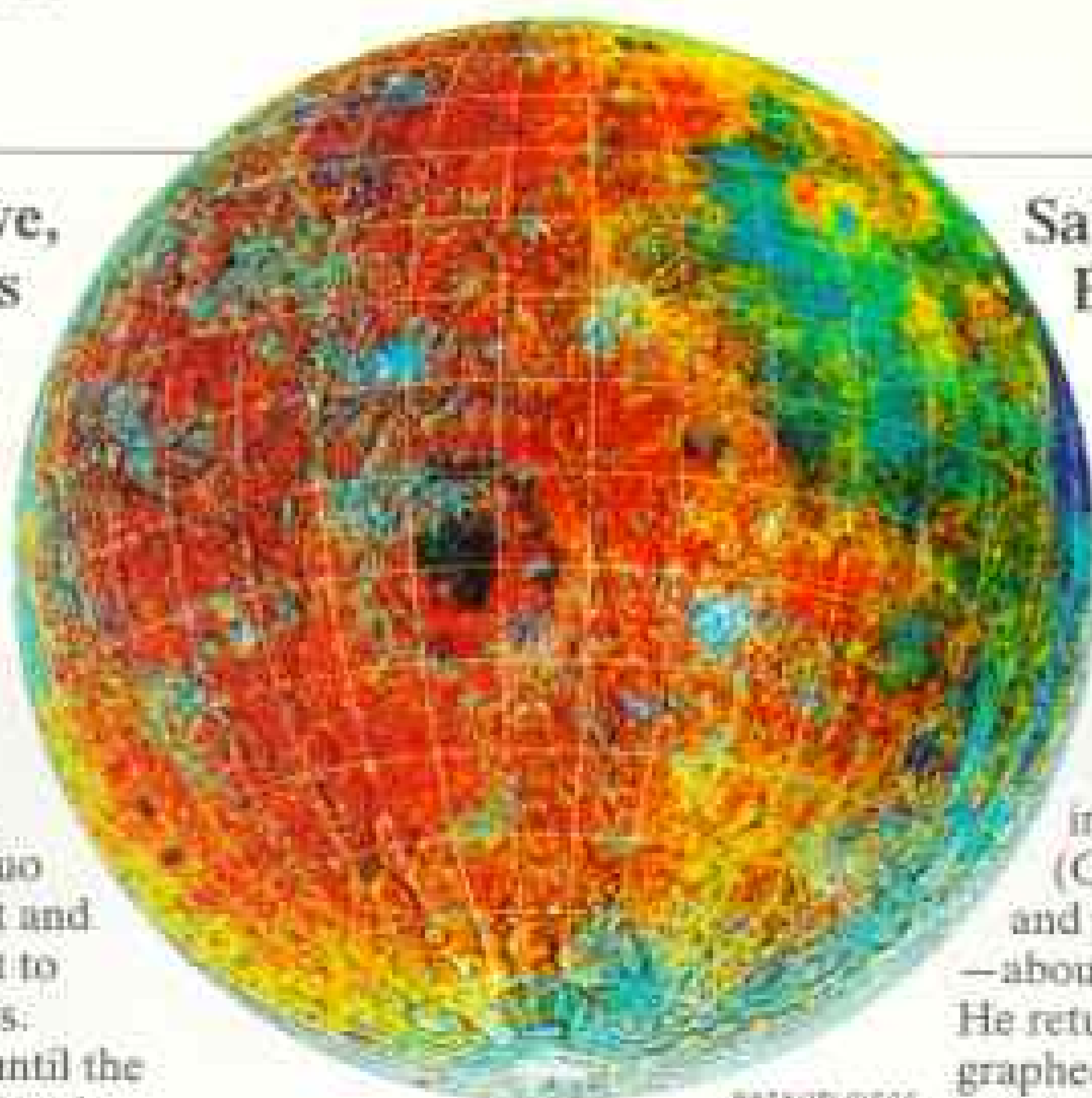
The U. S. Navy wanted to find out how much energy dolphins expend while swimming. The answer: as little as possible.

Terrie Williams and her Hawaii-based team of researchers trained a pair of bottlenose dolphins to swim alongside a boat, fitted the duo with monitors to record heart and breathing rates, and went out to Oahu's Kaneohe Bay for tests.

The pair swam amidships until the boat had nearly doubled its speed. Then they shifted to the stern wake and rode the wave, like bicyclists drafting behind a truck. "No amount of coaxing could get them to move," Williams says.

Their average heart and breathing rates in the stern wake matched the rates for the lower speed, she marvels: "They were going twice as fast with little change in energy costs."

DAVID DOUBILET



NASA/JPL/USGS

Is This Our First Look Under the Moon's Crust?

On a warm-up lap around earth and the sun to pick up speed before "slingshotting" off to Jupiter, the Galileo spacecraft has transmitted images that offer scientists what may be their first peek at rocks from beneath the moon's crust.

Pointing at the far side of the moon on a December 1990 flyby, Galileo's camera detected an unusually high abundance of iron-bearing minerals in an area called the South Pole-Aitken basin (yellow at bottom left in this false-color image). When a meteoroid struck the moon, creating the 1,200-mile-wide depression, it may have churned up iron-rich rocks from more than 55 miles below the moon's surface, says James W. Head III of Brown University, a member of the Galileo imaging team.

Galileo, now on its second and final lap around earth and sun, will pay a return visit to the moon in December. It will begin exploring Jupiter in late 1995.

Sale of Panda's Pelt Brings Prison Terms

Deeply in debt and desperately seeking a way out, Wu Hui Yuan of Shanghai decided to buy, then resell, a giant panda's pelt. His decision will cost him 12 years in a Chinese prison.

Wu went to Sichuan Province, home of the giant panda (GEOGRAPHIC, March 1986), and paid two men 30,000 yuan —about $5,500—for a panda skin. He returned home, had it photographed, and, with the help of his associate Wang Shu He, lured a buyer to Shanghai's Peace Hotel. But when the buyer turned over 200,000 yuan, police swooped in and arrested both Wu and Wang. For his help Wang will spend eight years in prison.

Giant pandas, which number only 1,000 or so in the wild, are at risk of extinction; Chinese poachers and traffickers face the death penalty if they are caught. Still, more than 200 people have been arrested for illegal dealings in panda skins.

GEORGE B. SCHALLER

Stuart Parkins of the World Wide Fund for Nature says that demand for the exotic pelts is strongest in Taiwan but exists also in Japan and Hong Kong. The going price is about $10,000.

Just because you have kids doesn't mean you have to drive a bus.

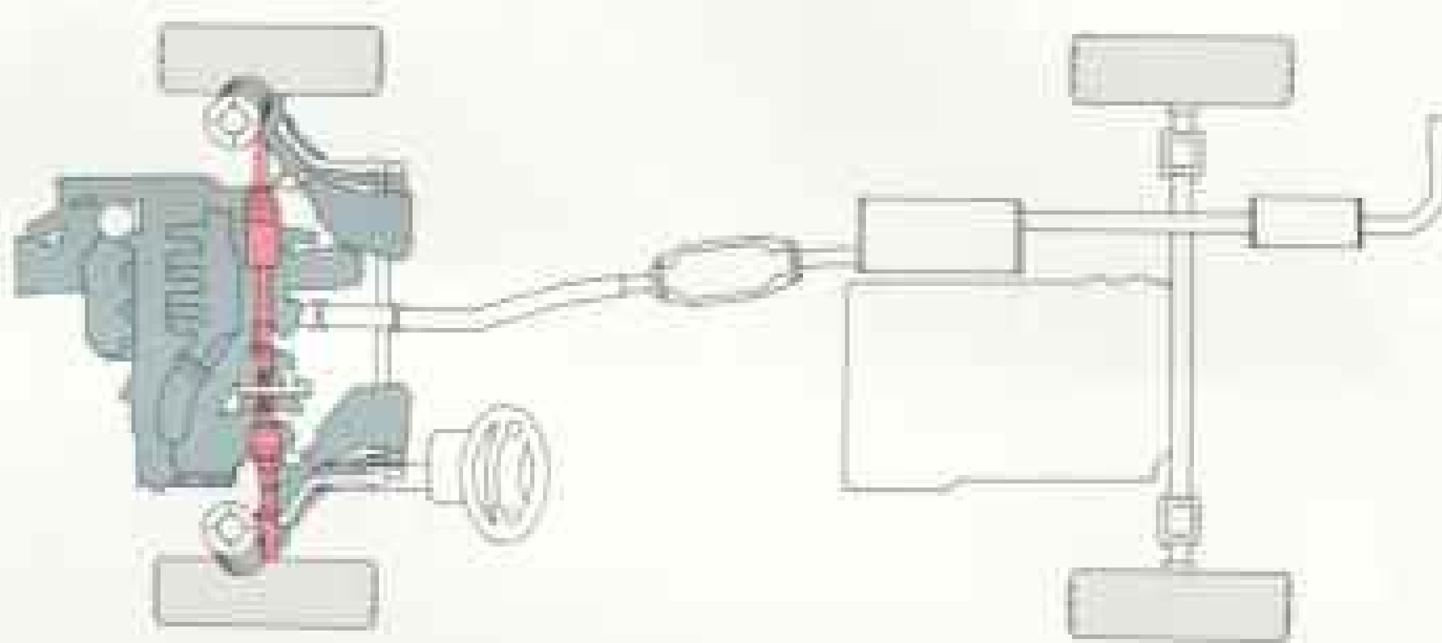
You are part of a generation that has been raised and fed on 0-60 times, horsepower and

skid pad results. And yet for some inexplicable reason,

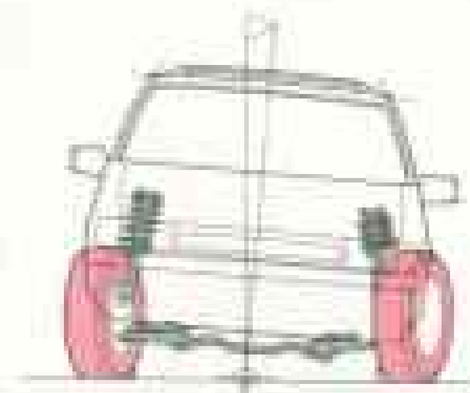
the moment you have kids, car companies expect you to settle for some oversized, ungainly minivan that's about as much fun to drive as a bus.

Well, at Nissan, we believe that parents have enough sacrifices to make. The pleasure of driving shouldn't be one of them. Which is why we designed the new *Nissan® Quest™* to be as much fun to drive as the sedan you now own.

Slip behind the wheel of the *Nissan Quest* and you immediately notice an absence of the swaying motion minivans are known for. A front stabilizer



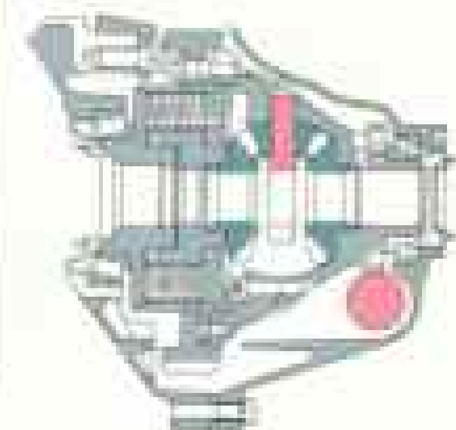
bar keeps it level during cornering or lane changes. And



an independent front suspension allows each front wheel to react independently to the road surface for exceptional traction.

This uncanny feeling that you're driving a sedan is further enhanced by a sophisticated front-wheel drive, and power rack-and-pinion steering that offers you a quicker, more precise steering response.

If you think the *Nissan Quest* has an appetite for curves, however, you'll find it's positively famished when it comes to hills. A 3.0 liter



V6 overhead cam engine delivers an impressive 151 hp and 174 ft./lbs. of torque.

No other minivan has more standard horsepower or torque.* Period. And it's the only import brand minivan to combine both V6 power and front-wheel drive.

Nissan Motor Corporation in U.S.A.

*The Nissan Quest is one of the few minivans to meet 1993 Federal passenger-car safety standards.***

❶ *It comes with front and rear energy-absorbing 5 mph bumpers.*

❷ *Pillar/roof reinforcements help increase body rigidity.*

❸ *Looking back on it, we decided to include a rear window washer/wiper.*

❹ *Did we mention that the Nissan Quest comes with three body guards? Steel side door guard beams provide added protection in case of a side impact.*

❺ *Several ingenious crumple zones have been designed into the Nissan Quest to help absorb crash energy.*

㉑ *High-strength steel body panels add crash energy absorption capability.*

⑳ *Sophisticated power assisted brakes provide quick, sure stopping action.*

⑲ *We even included a cargo net to help prevent large items from falling out when the tailgate is open.*

⑱ *A center high-mount rear stop lamp enhances brake light visibility.*

⑰ *3-point seat belts may be conveniently found in outside positions in second and third row seats.*

⑯ *We've placed the gas tank in front of the rear axle to help protect it from damage in a rear-end collision.*

*Smart people always read the fine print. And they always wear their seat belts. *Base model comparison. **GXE model. ***Optional on XE model, standard on*

❻ *Adjustable head restraints can be found in the outside positions of all seats.*

❼ *To us, concerns about safety are automatic, which is why we've included front automatic motorized shoulder belts.*

❽ *Even the steering column is designed to collapse in case of a frontal collision.*

❾ *Buckling creases have been designed into the hood to help prevent it from intruding into the passenger compartment in a frontal collision.*

The minivan that feels like a car.

❿ *Front cornering lamps provide added side-view illumination when turning at night.*

⓯ *A child safety lock has been wisely included on the sliding side door.*

⓮ *An optional 4-wheel anti-lock braking system is also available.*

⓭ *An advanced shift interlock system prevents the transmission from being engaged without first applying the brakes.*

⓬ *Power rack-and-pinion steering delivers precise control and excellent road feel.*

⓫ *Halogen headlamps enhance nighttime illumination.*

A day filled with temper tantrums, water balloon fights and potty training, could give anyone jagged nerves,

which is why everything inside the luxurious interior is designed to soothe and pamper.

Your fingertips settle on a steering wheel graced with fine leather.** Your eyes are greeted by an array of easy-to-read analog instruments. And your ears are lulled by an AM/FM audio cassette system offering

impressive fidelity.

Cruise control*** and an optional sunroof† are available so you can concentrate on the scenery instead of the speedometer.

Attention to ergonomics is so complete that the

controls to the power windows, door locks and mirrors are thoughtfully nestled close at hand in the driver's-side door.***

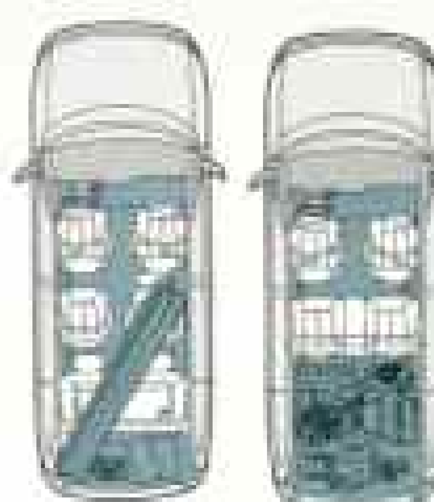
Of course, we have every intention of spoiling your

children as well.

A second row of luxurious captain's chairs† has been provided to keep your children from squirming.

To keep them thoroughly entertained, you'll discover the second row even has its own set† of air conditioning controls, headphone

jacks and remote audio controls.



And since we are all aware of how much kids enjoy playing musical chairs, you should know our QUEST TRAC™ Flexible Seating System can be reconfigured up to twenty-four different ways.††

The new Nissan *Quest* offers better handling and more luxurious comfort than you'd ever expect to find in a minivan. In fact, it will make you feel like you are

driving a car.

That is, until one of the kids in the back seat throws another temper tantrum.

GXE. †Optional on GXE model. ††Excluding models with privacy glass, which is not allowed on passenger cars. †††GXE with optional 2nd-row captain's chairs.

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For additional information, please call 1-800-NISSAN-3, ext. 122.

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Geographica

IZUMI SHIMADA (ABOVE AND TOP RIGHT)

Tombs Yield Gold, Artifacts—and Bones

For 14 years Izumi Shimada of Harvard's Peabody Museum probed Peru's northern coast for traces of the Sicán, who ruled there from A.D. 900 to 1100. Last year he struck gold—literally—with the discovery of two elite Sicán tombs. One held nine skeletons, mostly young women, and three levels of funerary offerings (left). In the other lay the remains of a nobleman and a breathtaking array of artifacts.

A gold mask hid the nobleman's head, and four layers of beads covered his chest. Six pairs of gold ear spools, a pair of gilded gloves, and a staff with gold ornaments surrounded him, along with six crowns, nearly 400 bronze implements, and 400 shells—in all, perhaps 1.2 tons of offerings. Two women, one of them wearing a gold armband (detail above), and two children joined him on his journey to the afterlife.

Shimada believes that the Sicán developed metalworking skills for which later conquerors—the Chimú and the Inca—improperly get credit.

Off California, Even the Islands Are Moving

It's bad enough that the earth is always shifting beneath the California mainland. Now we find that the Golden State's Channel Islands are moving around too.

Kristine M. Larson of the University of Colorado, who has been tracking the islands by satellite for five years, says several offshore faults—all linked to the San Andreas system but running in a number of directions—wrinkle the Pacific Ocean floor.

The faults' varied directions make the islands move differently relative to the shore (map, right). The island of San Clemente, off San Diego, trudges northwest, following the pattern of most southern and central California faults, which run northwest to southeast. But Santa Cruz is heading northeastward toward Santa Barbara.

There's no cause for worry, though. The northern Channel Islands are closing the gap between them and the coast at a steady-as-she-goes average of only five millimeters a year; movement along the San Andreas Fault is about 33 millimeters a year in central California. At their current pace, Larson calculates, it will take the northern islands 10 to 15 million years to strike the coast.

—Boris Weintraub

COMPUTER-GENERATED IMAGE BY DYNAMIC GRAPHICS, INC., ALAMEDA, CALIFORNIA

Forum

Lake Baikal

Your portrait of this huge inland sea (June 1992) will inspire many to visit. To give an update: The health of the endemic *nerpa,* the Baikal seal, has become so tenuous that activists are calling for a halt to annual hunts until a census can be completed. A decree before the Russian Parliament would allow the Baikalsk pulp mill to continue polluting the lake. The fishing and tourism industries are severely jeopardized. Only through international efforts, such as designation as a UNESCO World Heritage Site, can this unique lake be saved.

DAVID BROWER and GARY COOK
Baikal Watch Project
San Francisco, California

This comprehensive and perceptive article erroneously implied a linkage between the great age of the rift basin and the number of unique endemic organisms. Evolution is generally slow, but sometimes it is astonishingly rapid. An obvious case, the endemic seal has become distinct only since the Ice Age. Most organisms in the lake were killed when it froze to a great depth during glaciation. An evolutionary explosion occurred when the ice melted and the present habitats developed, providing opportunity for adaptive radiation of the few survivors or the early immigrants. By 1923 V. C. Dorogostaisky had documented and interpreted the rapid evolution in Lake Baikal, a good 15 years ahead of other scientists. His daughter Eugenia and I recently provided English translations of his work.

HERMAN S. FOREST
Department of Biology, SUNY
Geneseo, New York

The article says the Baikal seal, or *nerpa,* is the only species of seal that lives in fresh water year-round. You forgot the *norppa,* which lives in Lake Saimaa in eastern Finland. *Phoca hispida saimaensis* [a subspecies of the saltwater ringed seal] almost became extinct, but since being listed as endangered it has reached 150 animals.

WOLLU SALOKORPI
Helsinki, Finland

Your article brings back childhood memories of 50 years ago when tens of thousands of Latvians—husbands, wives, children—were separated by force and sent in boxcars toward the Baikal area. Few reached the destination alive. I recall the words whispered secretly so often: "We hear that your uncle (or neighbor) is sick (dead) somewhere near Lake Baikal."

GUNARS REIMANIS
Corning, New York

Sunset Boulevard

When we, as technical publications specialists, recently attended a seminar at UCLA about the effective use of graphics, we took your article with us to learn about the area. The map on pages 48-9, showing the Sunset Boulevard neighborhoods, proved an exceptionally useful guide. We took it to our instructor, who displayed it as an example of graphic information at its finest: informative, accurate, useful, and attractive.

JEFF GAGLIARDI
LYNDA EDGINGTON
Boulder, Colorado

Some nostalgic additions: For many years both sides of the boulevard in central Hollywood were lined with beautiful old pepper trees. In Beverly Hills the boulevard was divided by a bridle path down the middle. There movie personalities like Hobart Bosworth—a big star in silent pictures—occasionally could be seen riding horses. Motorists would honk, and he would tip his hat. In earlier days, Tom Mix would sometimes break into a brief full gallop to thrill visitors.

RANSOM P. HALL
Sanford, North Carolina

Thank you for including gays and lesbians in the community of humans you document in "Sunset Boulevard."

FERDI BUSINGER
Anacortes, Washington

America is bombarded daily with the widening chasm between the rich and poor. We receive a media overdose of AIDS, drugs, and "love for sale," which are rotting out the very heart of this land. They are not issues to be ignored. But we do not believe that they are issues to be covered in our NATIONAL GEOGRAPHIC.

RAY AND LOYE-JANE MCPEEK
Sevierville, Tennessee

Cuttyhunk

Wonderful article. My brother Blair and I used to journey often from Nonquitt, Massachusetts, across Buzzards Bay to those Elizabeth Islands. Such beautiful Indian names. Let's roll them all out: Cuttyhunk, Penikese, Nashawena, Pasque, Naushon, Nonamesset, Uncatena, and Weepecket. Don't forget to swim at Quicks Hole between Nashawena and Pasque.

E. BROOKE LEE, JR.
Chevy Chase, Maryland

Did number 6 bell buoy drift off station during a heavy northeaster? Your chart on page 121 has the New Bedford ferry passing north of number 6. If I

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remember right, even-numbered buoys are passed to starboard when entering harbor from seaward.

WILLIAM NELSON
Watsonville, California

Correct, captain. Buoy 6 drifted only on our map.

The Palestinians

You accept the claim (page 92) that today's Palestinians are descendants of people who migrated to the southeast Mediterranean coast 5,000 years ago. Yet when the Romans first conquered the Jewish kingdom, they found only Jews. The majority of today's Palestinians are descendants of Arabs who migrated after 1840 mainly from Egypt and Syria. Even the family name of the first Palestinian Prime Minister of Jordan bears this out: Masri means "Egyptian."

ZALMAN GAIBEL
Chicago, Illinois

The area's population has always been diverse. Palestinians today trace their ancestry to ancient inhabitants, from the Canaanites to successive immigrants and invaders, including seventh-century Muslims from Arabia, as well as later migrants.

The article was quite exhaustive in its description of the unnatural and often brutal circumstances imposed on the West Bank and Gaza Strip. In this age of growing recognition of self-determination by peoples in the Baltics, Balkans, and Central Asia, the question of Palestinian self-determination begs for attention. Once the Palestinians take their position as equals in the community of nations, they will be better able to contribute to the development of world culture.

NABIL KHOURY
Birmingham, Michigan

What you show as Palestine (map, page 94) is only a portion of what was left of that land after Trans-Jordan was carved out of it in 1922. Our perception of the conflict is warped by that omission. Jordan is an Arab state with a large population of Palestinians and is part of what was historic Palestine. Why doesn't that qualify as a homeland? Hanan Ashrawi is quoted as having made the imaginative leap to a "two-state" solution. It seems she is asking for Palestine to be divided into *three* states, not two.

OSCAR WALD
Chicago, Illinois

My wife and I were involved with Palestinian refugee camps right after the first Arab-Israeli war. We thought your article was objective. The rise of moderate Palestinian leaders must be acknowledged by Israelis who want peace. The six million Palestinians can make enormous contributions to both peace and development in a new Middle East.

CHANNING B. RICHARDSON
Clinton, New York

Bikini's Nuclear Graveyard

Two days before receiving my copy of the June issue, I began receiving calls from old shipmates. Then I saw the breathtaking picture of my old home and ship, the U.S. submarine *Pilotfish.* After 45 years to see her again! I was chief pharmacist mate on this submarine. Our old crew has a reunion planned for September in Indianapolis. Your picture will inspire us all and may help in locating some lost shipmates. Incidentally, at what depth is she lying? I hope it is about 200 feet; she was always comfortable at 200 feet.

ROBERT KROTZER
Mt. Clemens, Michigan

The keel of the venerable sub, which was present in Tokyo Bay for Japan's surrender, rests at 175 feet.

The idea of preserving the wrecks at Bikini is ironic. It was originally intended that both the *Saratoga* and the *New York* would become war memorials. The radioactive effects of the atomic tests were so much greater than anticipated that the *New York* was sunk instead. After the Baker test the "Sara" went down gracefully, settling into a shallow grave. The 200-foot-long canyon in her aft flight deck may have resulted from collapse after she sank, since pictures taken right after the Baker explosion show no such damage.

PAUL A. MILLER
Milton, Wisconsin

I attended Operation Crossroads as scientific consultant to the secretary of war. The fascinating article by John L. Eliot prompts a question: Would not the best marine memorial be a field laboratory for education and science, with a diving park secondary? Who knows what these relics may reveal 50 years from now.

JACK DE MENT
Portland, Oregon

I read the account with tears in my eyes. In the early 1940s my family and I stood on the deck of the U.S.S. *Carteret* during her commissioning in Long Beach, California, as my eldest brother, John Lee Hunter, took command. After transporting troops and surviving torpedo attacks, the ship was ordered to Bikini for the Able-Baker tests. She was undamaged, and captain and crew were ordered back aboard. Then after additional radiation tests, the ship was declared highly radioactive, and personnel were evacuated. Some years later, Captain Hunter died of malignant cancers of the brain and lungs.

JEANNETTE HUNTER PAYNE
Riverside, California

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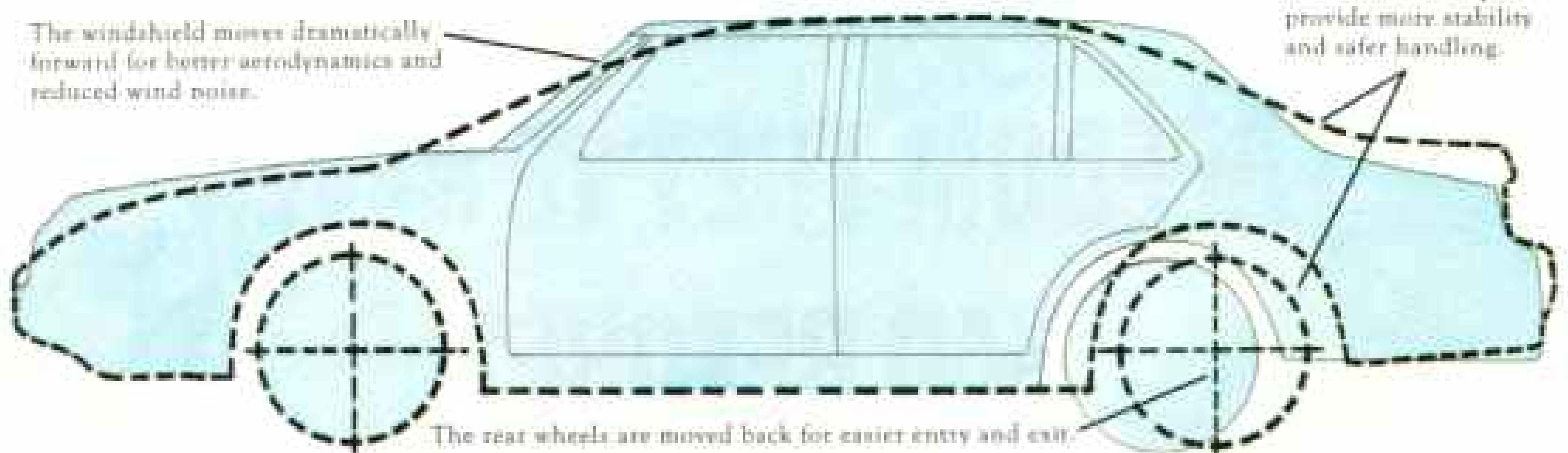

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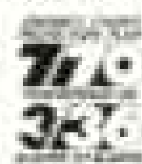

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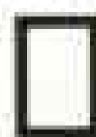

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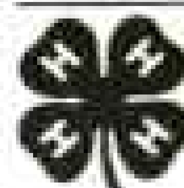

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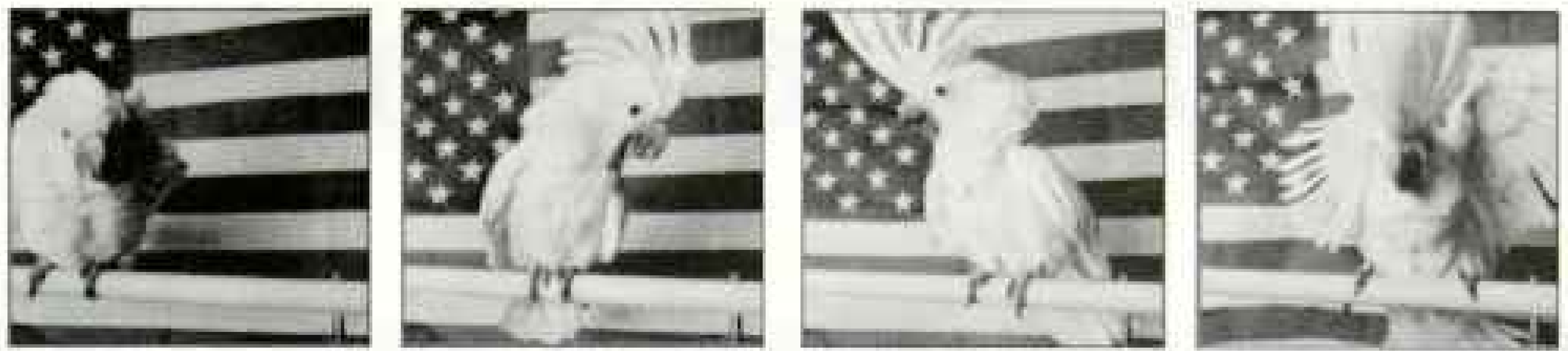

4 OUT OF 5 EXOTIC BIRDS RECOMMEND: BUY AMERICAN

Forced on a journey from the wilds of Africa, Asia and Latin America to the local pet stores of the United States, an average of four out of five exotic birds die. Some die when hunters hack open their nests with machetes. Others die when smugglers gag and bind the birds, then stuff them in wheel wells and engine compartments. Still others die in cramped crates aboard international airlines bound for America.

Thousands of these birds are lost each year — parrots, toucans, and other highly intelligent, beautiful and often endangered animals.

When You Buy American, You Help Save Exotic Birds

If you're one of many Americans who wants an exotic bird as a pet, there's a responsible option: make sure your next bird has been bred in captivity here in the U.S. You'll be helping the world's most precious birds survive, and you'll also get a better bird. American captive-bred birds are healthier and better adapted to life as pets. Many wild birds do not become tame and can destroy furniture and injure humans.

... And You Protect Yourself From Disease

Wild birds carry more diseases. For example, "parrot fever" (psittacosis), a flu-like illness, can be fatal to humans if not detected. For nearly two decades, wild parrot imports were banned to help control the spread of this disease. The Centers for Disease Control estimate that 70 percent of all reported cases come from pet birds.

Ask Questions — And Expect Answers

Before buying an exotic bird, ask if the pet store has a policy of selling only captive-bred birds. Ask for documentation that the bird is captive-bred. If the store cannot prove that the birds were born and raised in the U.S., go to another store. Captive-bred birds are now widely available.

If you would like more information on ways to protect wild birds, please call or write us: Defenders of Wildlife, 1244 19th Street, NW Washington, DC, 20036 202/659-9510.

WILD BIRDS BELONG IN THE RAINFOREST, NOT THE SHOPPING MALL

On Television

RON AND VALERIE TAYLOR, BRUCE COLEMAN, INC.

Do Sharks Deserve Their Bad Reputation?

"The jaws closed around his torso. . . . The fish bit down, and the last thing Hooper saw before he died was the eye gazing at him through a cloud of his own blood."

Peter Benchley's *Jaws* helped fix the public's image of the shark as a ruthless, man-eating feeding machine. In fact, a person has a greater chance of being attacked by a pig or struck by lightning than being bitten by a shark.

"People fear sharks because they feel they're unpredictable. Yet the more we know of them, the more predictable they become," says Michael deGruy. His new film for National Geographic EXPLORER, "Shark Encounters," co-produced with his wife, Mimi Armstrong, airs on TBS SuperStation as part of an evening of programming dedicated to sharks—in all their diversity.

These misunderstood animals range from the 7-inch dwarf dogshark to the 50-foot whale shark, the largest fish in the sea (above). More than 350 species share an ancestry going back 400 million years—long before dinosaurs walked the earth—and display a variety of temperaments.

MARK DELL'AQUILA

What makes a shark a shark? Among other features, it has a cartilaginous skeleton lighter than bone, and skin covered with toothlike scales called denticles. Besides the five senses that humans possess, sharks are equipped with ampullae of Lorenzini, electro-receptors so sensitive that they can detect fields as weak as five-billionths of a volt per centimeter.

DeGruy is sensitive to the bad press sharks have received. In contrast he tells of one bonnethead shark who gently rubbed against him as she gave birth to her pup.

But for Michael the high point of years of shark-watching came in being the first human to swim with the extremely rare megamouth, a plankton-eating, deepwater species discovered only in 1976 and never studied alive. When a fisherman caught one in his net off San Clemente, California, Michael and Mimi filmed the first close-ups of a live megamouth (left). Deserving of its name, the 16-footer has a mouth three feet wide—large enough to swallow a man whole. Recalls Michael, "He didn't object in the least as I stroked his huge, soft jaws."

"Shark Encounters" airs October 4 on EXPLORER, TBS SuperStation, 9 p.m. ET.

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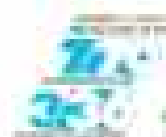

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Earth Almanac

WENDY SHATTIL AND BOB ROZINSKI

A Wartime Arsenal Goes Back to Nature

A former chemical weapons factory seems like the wrong place to create a national wildlife refuge. But that is happening at Rocky Mountain Arsenal, just minutes from downtown Denver (above).

During World War II and the Korean War, the U. S. Army produced deadly chemicals in a three-square-mile area here. The hazardous wastes were poured into nearby depressions. From the 1950s until 1982, Shell Chemical Company used the facility to make herbicides and pesticides. Yet the 27-square-mile arsenal, off-limits to most humans, attracted more than 230 animal species, from mule deer to prairie dogs.

Now the Army and Shell are treating groundwater. The process could take 30 years and cost a hundred million dollars. Amazingly, contamination levels in wildlife sampled here have proved lower than in populations studied elsewhere.

DALE MIQUELLE

Hard Times Put Siberian Tigers Out in the Cold

Like so many things in Russia, the world's largest cats—up to 800 pounds—are falling victim to that nation's shattered economy. About 500 Siberian tigers, most of the world's wild population, are at risk in their mountainous home north of Vladivostok. Government funds for wildlife protection have been slashed. Loggers hired by South Korea and Japan have clear-cut woods that shelter the cats. And poachers stalk them—even within the 1,314-square-mile Sikhote-Alin Biosphere Reserve.

"Local officials are strapped for cash and are pressured to sell anything from fish to forest, including tiger habitat," says ecologist Howard Quigley, here checking the fit of a radio collar on a sedated tiger.

With grants from the National Geographic Society and the National Fish and Wildlife Foundation, Quigley and co-investigator Maurice Hornocker are part of a three-year U. S.-Russian project to determine how much territory each tiger needs and to gather data on tiger prey, such as wild boar and elk. Quigley adds, "The Russians don't have our equipment and tranquilizers, but they are very good scientists."

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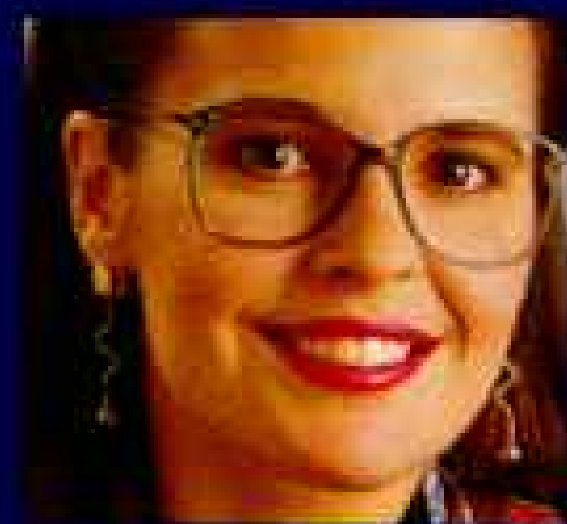

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Earth Almanac

Bluefin Tuna: Too Good to Live?

One of the world's largest fish, the bluefin tuna (right) is also one of the tastiest, at least to the Japanese. They find the fatty flesh irresistible, especially in its raw form—as sashimi and sushi—and consume some 20,000 tons a year. That's more than half the world's catch. A 715-pounder air-freighted to Japan was recently auctioned for $90,000 in a Tokyo market.

The number of adult bluefin in the western Atlantic has dropped by 90 percent since 1970, to around 22,000 fish, according to the International Commission for the Conservation of Atlantic Tunas. In 1991 it cut fishing quotas there by 10 percent. The United States and Japan believe that quotas should be halved, but Canada disagrees.

"If quotas aren't cut more, as a last resort we will seek suspension of international trade in Atlantic bluefin," says Carl Safina, director of the National Audubon Society's Living Oceans Program. "It's like the last buffalo hunt. We aren't letting enough juveniles grow up to breed and rebuild the population."

DAVID DOUBILET

In Alaska, Portrait of a Duck in Trouble

The only spectacled eiders Alaska hunters are likely to see this year are the ones on their federal duck stamps.

Actually, the species is seldom hunted, and then mainly by Eskimos. That's a good thing, because its numbers have plummeted by 94 percent since 1971. Most spectacled eiders nest on western Alaska's Yukon Delta National Wildlife Refuge, where 50,000 to 70,000 pairs were counted some 20 years ago. Recently only 2,700 nesting pairs were found there. Biologists have not ascertained the cause of the decline, but the U. S. Fish and Wildlife Service has proposed that the species be listed as threatened.

By coincidence, a painting of the bird had already been chosen for the 1992-93 duck stamp, which all duck hunters must purchase. Each year 1.4 million stamps are sold; the profits have saved more than four million acres of wetlands since 1934.

A Honey of a Project, Benin's Killer Bees

Notorious in reputation, African honeybees (also known as killer bees) are bringing environmental protection and economic gain to the West African nation of Benin. Villagers earn extra income harvesting honey, while the bees pollinate saplings, helping to regenerate the forest.

In a project funded by Catholic Relief Services, novice beekeepers (right) receive training in apiculture from Frenchman Alain Ratié and Swiss Karin Ostertag. The two purchase the honey for $1.15 a pound, then process and sell it in six Benin cities. A beekeeper can earn $400 a year, double the average family income.

Mellowed by human contact, the bees can still turn mean. One agitated swarm chased and stung Ostertag repeatedly as she ran for cover.

Ratié and Ostertag have started a tree nursery and—with the help of pollinating honeybees—reforested 124 acres devastated by slash-and-burn agriculture. Holding a 50-year lease on their land, the couple plan to stay for life.

—John L. Eliot

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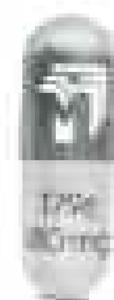

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On Assignment

By Bering Sea standards, photographer NATALIE FOBES was enjoying beach weather—a balmy 10°F—at a hot springs spa near the Siberian town of Lorino. Even as ice crystals clung to her clothes, Natalie ducked into an ice shelter (right), where she bravely donned a bathing suit for a dip. "That was a nice day for February," says Natalie. "On bad days it was minus 35°F with a 70-knot wind. When it blows like that, the smart people stay indoors—everyone except photographers."

BARBARA SKINNER

Venturing out, she protected her film from freezing by keeping it at hand, in her mittens. A 110-knot wind battered a trawler she was on. "I was in the galley hanging on to a pillar, with my legs out from under me." Another time, while crossing the Russian tundra, she was knocked unconscious when her vehicle slammed into a hole.

Siberia is a far cry from her Iowa childhood. Her years at Ohio University gave no hint of future high adventure either: "I worked two jobs—as a waitress and a deli manager—to get money for cameras and college." The effort paid off. Natalie became an award-winning journalist, first at the *Cincinnati Enquirer* and later at the *Seattle Times*. While at the *Times*, she braved the frigid ocean to do a series on Pacific salmon, which led to a GEOGRAPHIC article on the subject (July 1990). She also covered the Alaska oil spill for us (January 1990).

But don't dub her Natalie of the North. "I'm looking forward to an assignment where it's warm and sunny and they have flush toilets."

"Getting down and dirty" was how RAYMOND GEHMAN approached his assignment to photograph U. S. wetlands. In Florida's Corkscrew Swamp Sanctuary that meant sloshing through waist-deep waters and enduring heavy doses of heat and bugs. "You pull on your waders every morning, knowing you're going to get wet and muddy anyway. You just jump in," says Raymond.

JOEL RHYMER

Feeling comfortable in the outdoors comes easy to the Virginia native, who worked the wilderness beat at the *Missoulian* in Montana and the *Virginian-Pilot* in Norfolk. Now a contract photographer for the Society, Raymond made his debut with the February article on Eastern wildlife.

Sharing the honors on wetlands, Denver-based free-lancer JIM RICHARDSON, here on a soggy perch at the headwaters of the Colorado River in Rocky Mountain National Park, says, "I like to show how natural systems work. It started when I was a boy scientist on a Kansas farm—I'd scoop gunk off the bottom of a pond and go to my microscope to study all the creatures." The veteran journalist honed his style at Topeka's *Capital-Journal* and the *Denver Post*. Water issues have dominated Jim's GEOGRAPHIC assignments: Great Salt Lake (June 1985), the Colorado River (June 1991), and a forthcoming story on groundwater in the High Plains. "I've spent so much time in water," Jim says, "that friends think I have webbed feet."

JIM RICHARDSON

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