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Sanctuary

U.S. National Wildlife Refuges

Muted summer sunshine warms thousands of walrus bulls in Alaska's Togiak National Wildlife Refuge, a remote outlier among more than 500 federal refuges nationwide. Founded on principles of putting wildlife first, the world's most extensive sanctuary system is under scrutiny in the national debate about use of federal lands.

TENTH LIFE FOR A BIG CAT

Ringworm plagues a Florida panther on its namesake refuge in the state's Big Cypress Swamp. One of only 30 to 50 of these cats left in the wild, this breeding male — radio collared and closely monitored — is highly

JOEL SARTORE WITH CATHERINE DEER

susceptible to the skin fungus, the result of an immune system deficiency probably brought on by inbreeding. Several endangered species would have vanished by now if not for habitat and gene pools preserved by refuges.

DESERT PRIMEVAL

The vast empty of Arizona's Sonoran Desert supports a tough array of plant and animal survivors within Cabeza Prieta National Wildlife Refuge (NWR), the largest wilderness refuge in the lower 48 states. "We have all

our species intact," says Bob Schumacher, manager of its 1,300 square miles, acquired in 1939 to preserve desert bighorn sheep range. "We're managing whole ecosystems with a staff of only six."

BY DOUGLAS H. CHADWICK

PHOTOGRAPHS BY JOEL SARTORE

GUNS OF AUTUMN

Decoys hide North Dakota goose hunters on a farm next to Upper Souris NWR. One of several uses deemed compatible with wildlife, hunting is permitted on more than half the nation's refuges.

This Florida day was never going to make it into a winter vacation brochure. The sky looked like slag metal. A heavy wind out of the north had the palm trees bent sideways and was rolling big waves down the lagoon at the Indian River's mouth. As soon as the boat nosed away from the dock near the town of Sebastian, spray began to surge head high over the decks. Halfway across I was shivering and trying to grip the rail with numb fingers as the craft slammed from crest to trough. Then, not far ahead, appeared a refuge—a refuge in every sense of the word. A 2.5-acre tangle of mangroves anchored on a silty bar, Pelican Island lay sheltered from the wind by a curve of the far shore. The mangrove

branches were thick with brown pelicans, white ibises, egrets, and herons. Flotillas of white pelicans drifted through the calm waters on the lee side. Roseate spoonbills sometimes come here in the evening to roost as well, like sparks off the sunset. And each spring, the island is crowded with the colonies of a dozen different species, from double-crested cormorants to endangered wood storks.

As evening light seeped under the storm clouds, flocks kept arriving in greater numbers, wheeling round the mangroves, forcing others to shift their perches until the whole island became a blur of wings and ancient cries. I turned to look one last time and saw a great hive where life would weather the dark hours and then, once again, arise and go forth to wake up the world.

In 1903, as market hunters supplying plumes to the fashion trade raked Florida's breeding colonies with gunfire, President Theodore Roosevelt asked an assistant, "Is there any law that will prevent me from declaring Pelican Island a federal bird reservation?" No. "Very well, then I so declare it."

That marked the beginning of what would become the most comprehensive network for nature protection in this country or anywhere in the world: the National Wildlife Refuge System. Overseen by the Fish and Wildlife Service of the U.S. Department of the Interior, this is the only array of federal lands and waters set aside primarily for the benefit of wild creatures. There are more than 500 wildlife refuges at the moment, including at least one in every state and several in overseas possessions from Puerto Rico to American Samoa's Rose Atoll in the South Pacific, and new units are being added each year.

With nearly 90 million acres inside refuge boundaries and another 3.3 million on lands set aside specifically for waterfowl or managed in cooperation with state agencies to protect key habitats, the National Wildlife Refuge System covers close to 4 percent of the surface area of the United States. It is larger than our National Park System, just as spectacular in many ways, and possibly more varied. Yet it remains one of the least understood parts of our federal domain. As Paul Tritaik, Pelican Island's manager and captain of our wet but

LAST SPACES
Suburbs surround salt ponds beside San Diego Bay, where black skimmers (left) and other species nest. Waterfowl and shorebirds throng the ponds and feed in adjacent mudflats and eelgrass beds. These wetlands may become part of the new San Diego NWR, preserving a key wintering spot on the Pacific flyway. Open spaces not soon claimed for wildlife are unlikely to last, warns wildlife biologist Cathy Osugi. "This is all that's left."

DOUG CHADWICK, a Montana-based wildlife biologist, is the author of several books, including *The Company We Keep*, a National Geographic book about endangered species to be released this fall. The book was photographed by JOEL SARTORE, who also collaborated with Doug on the article "Dead or Alive: The Endangered Species Act" in the March 1995 issue.

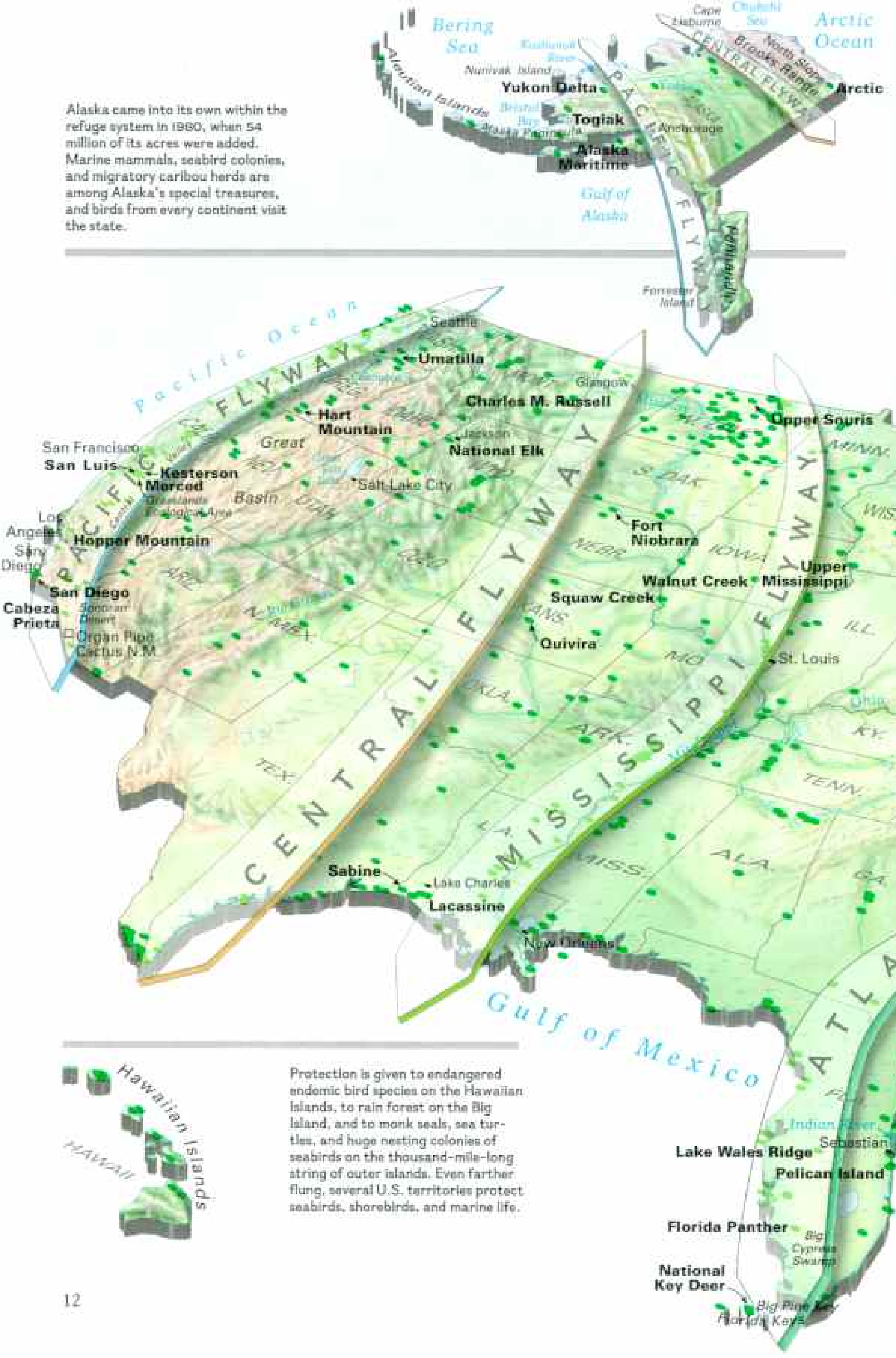
sturdy boat, put it, "A few refuges see a lot of use, but the system as a whole is America's best kept secret."

Hoping to become better acquainted myself, I looped around the system like a bird on a migration binge. Not far from Pelican Island, I found one of the newest additions, a sanctuary set aside primarily for plants—Lake Wales Ridge National Wildlife Refuge (NWR), protecting a unique scrub ecosystem. I wandered on, from the orchid-filigreed swamps of Florida Panther NWR to the stony puffin rookeries of Petit Manan NWR off Maine's foggy coast, from the heights of Oregon's Hart Mountain, in the arid Great Basin, to the marshy flatlands of Quivira NWR in the Kansas prairie, and on to 1,200-acre John Heinz refuge, squeezed between Philadelphia International Airport and the city's towering skyscrapers.

At most of the reserves that I visited, I met dedicated employees working overtime, often with help from local citizens, to safeguard a home for native plants and animals. But I also found places that made me ask: Refuge from what? Sanctuary for whom? Over the years Congress has allowed so many different uses of this public land that some critics fear parts of the system have become too public. Grazed, farmed, drilled, logged, contaminated, and open to various kinds of motorized recreation, many refuges now seem in danger of becoming like every other realm where wild creatures give way before the needs of humans.

CABEZA PRIETA NWR in southwestern Arizona has seen both extremes—the pure and the pounded. Set aside in 1939 to protect big game, such as desert bighorn sheep and the now endangered Sonoran pronghorn, it ended *(Continued on page 16)*

Alaska came into its own within the refuge system in 1980, when 54 million of its acres were added. Marine mammals, seabird colonies, and migratory caribou herds are among Alaska's special treasures, and birds from every continent visit the state.



Protection is given to endangered endemic bird species on the Hawaiian Islands, to rain forest on the Big Island, and to monk seals, sea turtles, and huge nesting colonies of seabirds on the thousand-mile-long string of outer islands. Even farther flung, several U.S. territories protect seabirds, shorebirds, and marine life.

A confederacy of wildlife

Theodore Roosevelt might well grin to see the brood of federal refuges hatched since he set aside Florida's Pelican Island in 1903. Early growth concentrated on waterfowl flyways and nesting grounds, then went on to span the nation and protect other wildlife. Now serious challenges face the U.S. Fish and Wildlife Service, stewards of 92.3 million acres—more than that under the National Park Service. With slim budgets, managers struggle to oversee more than 500 refuges while reconciling conflicts arising from secondary uses—from hiking and hunting to logging, mining, and military needs. Recent proposals in Congress have sought to undermine the primacy of wildlife preservation by placing other uses on a legal par.

Freshwater lagoons, beaches, and islets are parts of refuges in the Caribbean. Sea turtles and seabirds visit Culebra. Two endemic lizard species live on tiny Desecheo.

MANAGING BIODIVERSITY

Birds and big game were first systematically protected by Theodore Roosevelt, who created more than 50 refuges. Duck stamps sold to hunters after 1934 paid for refuges where Dust Bowl drought devastated waterfowl and habitat.

Biodiversity is the goal for managers who care for more than 700 species of birds, 220 of mammals, 250 of reptiles and amphibians, 200 of fish, and innumerable species of plants.

Critical species and habitat can be sustained only by managing on an ecosystem-wide basis. Natural areas must be linked by corridors, or they become biological islands.

Threatened and endangered species—a fifth of all U.S. plants and animals so listed—are supported on 55 refuges created for that purpose.

Urban refuges offer breathing space for animals and humans on the doorsteps of San Francisco, New Orleans, Philadelphia, and Washington, D.C.

SKYWAY REST STOPS

A host of Ross' geese fly over fields flooded for their benefit in California's Central Valley, a marshy cornucopia for wintering flocks before it became farmland. Waterfowl toll on crops led to creation of refuges to divert the

birds into artificially created habitat. Refuges and state and private lands manage 160,000 acres for birds amid the valley's intense agriculture. Only 5 percent of the Central Valley's original wetlands remain.

up being shared with cattle, miners, and warplanes that used the place as a target range. Air Force and Marine facilities to the north and west control most of Cabeza Prieta's airspace. Although bombing and strafing runs were largely phased out during the 1960s, low-level jet overflights and air-to-air gunnery practice are still allowed, raising concerns about possible stresses on the pronghorn and their vulnerable young.

Sonora, Mexico, which borders Cabeza on the south, has proved to be the more peaceful neighbor. The Fish and Wildlife Service is working closely with a biosphere reserve there, El Pinacate, to aid the pronghorn, lesser long-nosed bats, and other species in need of special attention in both countries. The cattle are gone now, and so is the fence that used to separate Cabeza Prieta from Organ Pipe Cactus National Monument, another key part of this international desert ecosystem. Of the refuge's 860,000 acres, 803,000 have been placed off-limits to development—if not to sonic booms—making this the largest wilderness refuge in the lower 48 states.

"Cabeza's so big we don't have the money or staff to stay on top of all our chores," Bob Schumacher, the manager, told me. "We'd be lost without our volunteers. They keep an awful lot of the refuge system going." Schumacher was nodding toward Leonard "Smokey" Parish, a retired engineer, who had just returned to headquarters after driving an injured owl to a clinic 150 miles away.

"I've taken hawks, songbirds, desert tortoises, and other animals for help," Parish said. "So far, I've only lost one patient. I check the roads for washouts, read rain gauges in remote spots, get information from vegetation study plots. If it's a chance to get out into the desert, I'm ready to go."

Only one route runs the length of this refuge:

PRAIRIE RESCUE
Remnant tallgrass nods in a pre-Civil War graveyard as Patrice Petersen-Keys collects wildflower and native grass seeds to replant in Iowa's Walnut Creek NWR. Only .01 percent of Iowa's prairie remains. "Old graveyards weren't farmed," she says, "so they've preserved our prairie." Volunteers like Petersen-Keys perform many tasks. "They're taking the long view," says assistant manager David Aplin, "doing something for their grandchildren."

El Camino del Diablo, the Devil's Highway, winding 130 miles through rock and sand where temperatures reach over 100 degrees most days from June through October. Visitors need four-wheel drive, a permit, and plenty of water. Each year only a few hundred venture the whole way. Many an early explorer and settler died trying on horseback. I made my trip last as long as I could.

Camping out for several nights, I decided that Cabeza Prieta is, hands down, the refuge that protects the most stars. I would fall asleep like a child still young enough to think he could count them all and awake where mountains rose in ranks of orange, black, pink, and white, holding life as strange and wondrous as anything I had dreamed.

I hiked from granite spires to volcanic cinder cones among Gila monsters, bobcats, prairie falcons, flowers smaller than the dewdrops they captured, ocotillos with extravagant crimson blossoms, vermilion flycatchers, and desert bighorn, which can go long stretches without drinking, withstanding the loss of as much as 20 percent of their body weight through dehydration.

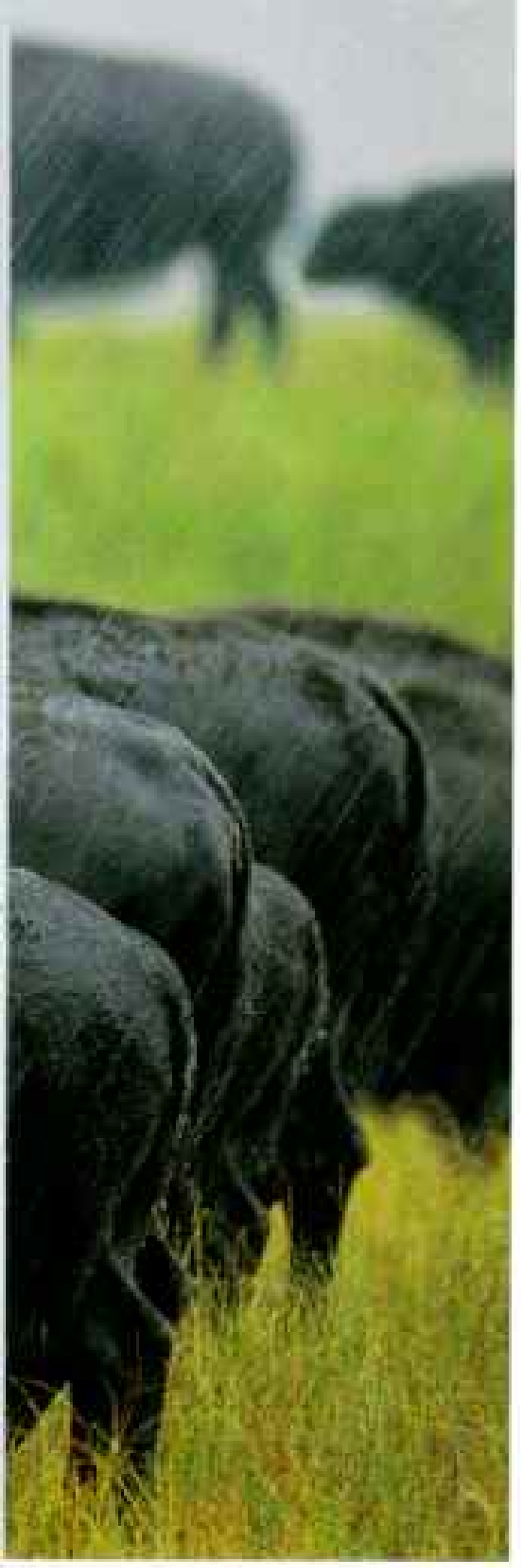
Near a wash edged with ancient ironwood trees, I ran into Joe Mueller, a biology professor from the College of Marin in California, and several of his students and friends. This wasn't an official class trip. "We're just out on our own, 'ologizing'," Mueller explained. That meant doing a little field geology, ornithology, entomology—whatever fed their curiosity. He showed me tarantula burrows: "They put a little pile of debris next to the hole, see?"

So I learned how to pick out tarantula burrows and, that night, how to call in great horned owls from their saguaro perches. Amid the uncluttered desert contours of Cabeza Prieta's backcountry, with its spiced, earthen bouquet, I could almost envision that time, not so long ago, when the whole earth was a wildlife refuge.

A FAR DIFFERENT sort of road leads toward the entrance of the 14,400-acre Chincoteague NWR on Assateague Island off Virginia's coast. It breeds fast-food outlets and curio shops. Once inside the reserve, I found myself in a summer tourist throng; 1.3 million visitors pour through little Chincoteague each year, many drawn to its sandy shores.

As July afternoon temperatures pushed into the 90s, I decided to join in refuge bodysurfing and beach-blanket lounging. The scene came complete with lifeguards, changing rooms, and "Parking Lot Full" signs. I thoroughly enjoyed the plunge. But exactly what all this had to do with wildlife was hard to tell. Neither of the two species causing tourist jams along the narrow main road was even a native—wild ponies and sika deer. The horse was imported from Europe, the sika from Asia in the early 1900s.

"We have an identity problem," Bob Wilson, the deputy refuge manager, confessed. "Most people think we're a national park. That's partly because we're next door to Assateague Island National Seashore, run by the Park Service. Chincoteague has a special agreement with the Park Service to manage the public-use section of the beach. But if



NATIVE'S RETURN
Flourishing where once they neared extinction, a herd of American bison at Fort Niobrara NWR grew from six donated by a Nebraska rancher in 1912. "This was one of the service's first successes," says refuge manager Royce Huber. Healthy numbers now allow surplus animals to be auctioned. At the annual roundup a stray calf gets a boost from Fish and Wildlife cowboys. Grown, it can weigh a ton. "You herd 'em in the direction they want to go," Huber says.

you're willing to walk as little as half a mile, you can find quiet, and you can learn what a wildlife refuge is all about."

Following Wilson's directions, I quickly reached tidal pools shared by blue crabs, willets, black skimmers, and huge, mixed flocks of glossy ibises and egrets. Close by were freshwater impoundments carefully maintained at different levels depending on the season: shallow in spring for migrant shorebirds and deep over winter for a mixture of snow geese, ducks, and tundra swans.

Farther inland rose tall phalanxes of loblolly pine, a key habitat for the Delmarva fox squirrel, an animal endangered on the mainland and transplanted here a few years back in the hope of establishing an additional population. The refuge has acquired several small barrier islands and helps manage wildlife on Wallops Island in cooperation with the National Aeronautics and Space Administration. This additional habitat is especially valuable to two imperiled beach nesters—piping plovers and least terns—and to black ducks, which dwindled in the face of overhunting and losses of eastern wetlands.

After coming upon several different families searching through binoculars for a glimpse of the first bald eagles known to nest at Chincoteague, I recalled that bird-watching now brings ten million dollars annually into this area—and between five and nine *billion* dollars into the economy nationwide, on a par with ticket sales for movies or professional sporting events.

DURING HIS TWO TERMS in the White House, President Theodore Roosevelt established more than 50 wildlife refuges. Meanwhile, he withdrew enough other public domain lands from the control of commercial interests to provide space for future refuges, along with our national park and forest systems. "The greatest good of the greatest number applies to the number within the womb of time," he believed, "compared to which those now alive form but an insignificant fraction."

New additions to the refuge system came slowly, and the Dust Bowl years of the 1930s sent populations of many migratory birds plummeting. In response, Congress passed the 1934 Duck Stamp Act, which tacked a conservation fee onto waterfowl hunters' licenses. At last Fish and Wildlife had enough revenue to start methodically acquiring wetlands up and down the four major flyways. The number of refuges jumped dramatically.

With passage in 1980 of the Alaska National Interest Lands Conservation Act, both the refuge and park systems doubled in size. Although 96 percent of all refuge units are outside Alaska, the 49th state contains 83 percent of the acreage. The 4.9 million acres of Alaska Maritime NWR consist of about 3,000 different headlands, sea stacks, reefs, and islands, including Cape Lisburne in the Chukchi Sea, Forrester Island off the southern Panhandle, and most of the Aleutian chain. Superimposed on the lower 48, this arcing reserve would stretch coast to coast. Arctic National Wildlife Refuge takes in the eastern part of Alaska's Brooks Range and North Slope—19.5 million acres, far more than all the lower 48 refuges combined.

BIGGEST OF ALL is Yukon Delta NWR in Alaska. Its boundaries enclose 22 million acres, some of them "submerged lands." You could fit Maine inside. For eight months its lakes and meandering river channels lie frozen in silence. By mid-June, when I arrived, bar-tailed godwits from Australia called out next to semipalmated sandpipers from South America. A tundra swan lay preening atop a nest mound with soft fur and scraps of hide worked into it—the likely remains of a fox that had misjudged the strength in that graceful neck. The coastal plain was spangled with dwarf salmonberry and crowberry flowers and the eggs of an estimated hundred million nesting birds from all four North American flyways and every continent bordering the Pacific Ocean. This was payoff time for a University of Alaska, Fairbanks, research team near the mouth of the Tutakoke River. They were keeping close watch over a colony of brant as long as the light lasted. Which, this far north, was 24 hours a day.

I found Jim Sedinger, the project leader, gulping coffee in the warmth of a portable hut where laptop computers hummed next to piles of muddy hip waders. He was preparing to put web tags on goslings to help study their movements and early survival. Since adult birds lead their precocious young away from the nest site almost at once, the trick is to catch and mark them as close to hatching as possible. "Bring food," he told me, heading out into a steady wind straight off the Bering Sea. "It'll be another long one."

We no sooner crossed to the Tutakoke's opposite bank than I had my hands full of still damp bundles of peeping, gray fluff. Parent birds trotted across the mudflats, cussing us loudly. The bolder parents flew up and whapped us with their wings. We were getting dive-bombed the entire time by Sabine's and mew gulls, which nest among the brant. And if one of the gulls passed too near a nest of black turnstones, the shorebirds took off in pursuit, matching the intruder zig for zag.

When we found an egg that the gosling inside was just beginning to pip open, Sedinger would peel away a bit more of the shell, pull out a wet, struggling leg and clamp on a metal tag, then push the foot in, tucking the egg back with the others in their down-lined bowl. Premature tagging: the only way to keep up with the thousands of goslings hammering their way into the world around us.

BEYOND FENCES
Hard weather drives elk down from summer pasture to wintering grounds in National Elk Refuge near Jackson, Wyoming. A fence keeps them out of town; otherwise they are free to roam beyond the refuge into parks and wilderness areas. Winter concentrates as many as 10,000 head here, making it one of the country's largest migratory elk herds. "You also see swans, bighorn sheep, eagles, coyotes," says manager Jim Griffin. "I call it the winter Serengeti."

"Virtually all the emperor geese and cackling Canada geese in North America breed in this refuge," ecologist Roger Ruess said around midnight as a coppery sun skimmed the horizon. "So do about three-quarters of the brant and greater white-fronted geese. They concentrate in a fairly narrow band along the coast that favors grasses and sedges over tundra shrubs. Our studies show that the geese actually help maintain the habitat in this nutritious, early stage of succession by grazing and by enriching the soil with droppings, almost like wildebeests do in the Serengeti."

The myriad birds, black bears, moose, wolverines, mink, musk oxen, bearded seals, and beluga whales protected by Yukon Delta NWR are also the resource base for almost an entire Native American culture. Yupik Eskimos own four million acres within the refuge boundary, including much of the coastal bird-breeding grounds. They have subsistence

hunting and fishing privileges on all of the rest.

The 20,000 or so resident Yupik usually handle their own affairs. But between the 1960s and 1980s, counts of various geese species revealed startling declines. Concerns about overhunting finally led officials in both Alaska and California, where many of the geese winter, to the conference table.

"We actually ended up taking Yupik elders down to see the wintering grounds in California for themselves when we were arguing over a goose-management plan," said Dennis Strom, the deputy refuge manager. Admitting that some of the missing geese had been shot by its own hunters, California reduced the allowed take. The Yupik agreed to halt egg gathering and midsummer hunting but insisted on the need to hunt birds in spring and fall.

"When I was young," 67-year-old Julia Cholok recalled, sitting among dwarf birch at a bend of the Kashunuk River inside the refuge, "people sometimes starved before winter was through. For us the geese were always the first fresh meat in spring. We used to catch them just by setting snares out in the tundra, there were so many."

The Yupik call what they do catching, not killing. In their cosmology, animals give themselves to hunters who show need and respect. If motorboats, snowmobiles, and rifles let people catch more than ever before, how can that cause harm where there is so much land and so few humans?

Alaskan sportsmen, seeking to maintain viable numbers of geese, sued the Fish and Wildlife Service, the Alaska Department of Fish and Game, and Alaska native groups to enforce the existing ban on spring hunting. In 1987 a federal court ruled that policing the ban is up to the Fish and Wildlife Service.

The number of emperor geese has recently begun to increase. All the other species on the

refuge have been recovering since the management plan was signed in the mid-1980s.

Fish are this culture's mainstay. Julia Cholok was cutting up salmon—fresh kings and silvers—with a rounded knife called an ulu. She told me the Yupik believe that the more you share, the more you will catch the next time. When I got back into my boat, I was carrying a salmon from her net in each hand.

I went splooshing across the tundra that sunlit night with another research crew, this one from the Alaska Science Center in Anchorage. They were putting tiny radio transmitters on spectacled eiders, listed as a threatened species in 1993. Placing the first eider we caught under a portable X-ray machine for a quick snapshot, we found a lead shotgun pellet lodged in its gizzard. Lead had appeared in one of every four eiders examined the previous year, biologist Margaret Petersen informed me. Since these sea ducks winter far out in Arctic waters, they must be getting the lead here in the delta, picking up the spent pellets from bottom muck while feeding. Birds often seek out such hard material—normally pebbles—to aid the muscular gizzard in grinding food.

Lead shot has damaged the vitality and reproduction of a wide array of waterbirds in more populated areas. Whether it contributed to the spectacled eiders' downfall is not yet clear. But that pellet hovering among the outlines of bones on the X-ray film, held up for view against what seemed an infinite expanse of pristine land, was further proof that no place is immune to the touch of humanity.

ALASKA REFUGES are by no means the only ones where people harvest wildlife. Down in the Louisiana bayou country near Lake Charles, I was swatting at mosquitoes by a grove of bald cypress when Hal Broussard, an oil-field worker who had been hunting in Lacassine NWR for 25 years, hauled ashore a pirogue with four mallards and a green-winged teal in the prow. He pumped my hand and proclaimed, "I just love this marsh. It's very expensive to lease a hunting spot on private land around here. That can run $250 to $300 a day. A normal working person can't afford it. I believe without the refuge system we wouldn't have any public waterfowl hunting."

Hunting is permitted in more than half the nation's refuges. In aggregate, the system logs about 1.6 million hunting visits a year. Obviously quite a few people would agree with Hal Broussard that opportunities for the sportsman are among the most important things refuges preserve. On the other hand, hunters and fishermen are outnumbered four to one by visitors who come just to watch and learn about wildlife.

Trapping is also sanctioned in many of the refuges—207 at last count. In most cases it is encouraged as a way to limit problem animals, such as skunks that plunder bird nests or muskrats that weaken the dikes around ponds with their tunneling. Elsewhere trapping is allowed simply as a type of outdoor recreation. In Louisiana's Sabine NWR, a short distance west of Lacassine, David Toups's skiff held a bleeding heap of nutria—large, long-furred rodents introduced from South American wetlands. Wading through the muck to check another set of steel jaws in the rushes, he said, "I run 157 traps out here right now, and I'll tell you, it's hard work. You'll get the odd mink or coon. But you also get ducks in your sets, like the teal I found in one this morning. And gators steal your nutria while they're still in the trap. I used to do gators too."

Sabine holds a lottery for the trapping of a thousand alligators each year and gets a share of the money when the animals are sold. The proceeds go to the National Wildlife Refuge Fund, which distributes revenues to local governments to make up for the fact that federal property is tax-exempt. Fish and Wildlife biologists say harvesting a thousand gators is well within acceptable limits, because Sabine supports at least 40,000, and they produce lots of eggs. That being so, what should the refuge say to the owner of a commercial gator ranch who recently asked permission to gather 20,000 eggs annually? Raising alligators for their meat and hides is becoming big business in Louisiana. One state-run refuge already allows an egg harvest. If federal refuges decide to allow it as well, what next?

I was talking such things over with Will Nidecker, Sabine's manager, as we skimmed along in an airboat to check on a miles-long, multimillion-dollar access road being built through the refuge by an oil company. The oil-and-gas industry does business on 35 different refuges, and Sabine is a hot spot. At any given time, the refuge is monitoring a dozen actively producing wells, along with petroleum tank farms, drilling *(Continued on page 28)*

ALASKA

The wild treasure

"The wrong way to photograph a musk ox!" Joel Sartore describes the rattling experience of a bull's mock charge on Nunivak Island in the Bering Sea. The animals' instinct to gather shoulder-to-shoulder and face down trouble is effective against wolves but useless against guns: Musk oxen were shot out of their Alaska range by the mid-19th century. Animals shown here come from Greenland stock transplanted in 1935. They prospered on an island devoid of animal predators; now approximately 70 are taken yearly, half by sport hunters who fly in for trophy bulls.

For eating, the local Eskimos prefer tender cows, says Alice Williams. She provokes a laugh from her daughter, Patricia, with the head of a musk ox shot by her husband. As for the pelt: "We comb out the qiviut, the underwool. You can make scarves and ladies' stuff."

Alaska holds the largest refuges in the system. Yukon Delta NWR, which includes Nunivak and surrounding "submerged lands," is the biggest—at 22 million acres about the size of Maine. Just behind it in size is Arctic NWR on the Arctic coast, where an untapped oil field lies under a major caribou calving ground, whose future is in doubt.

FOLLOWING PAGES: A living sea of tundra stretches around a band of reindeer on Nunivak. They are herded by the Eskimos, and their meat sold commercially.

ALASKA

A sprawl of walruses basks at a haul-out site in Togiak National Wildlife Refuge beside Bristol Bay's teeming waters. Bulls fatten on clams and mussels to store up strength for a northward migration to mate, primarily during February. Airplanes flying low along the coast can send thousands

of walruses stampeding into the water, injuring or killing some and burning off valuable energy among the others. Refuge staff, operating under the Marine Mammal Protection Act, have secured legal convictions of pilots who disturb the resting animals.

CONDORS ON THE RISE
Reared by captive parents, four recently released juvenile California condors feast on a stillborn calf supplied by Hopper Mountain NWR, center for efforts that have successfully returned 17 of the birds to the wild.

(Continued from page 22) projects, and seismic exploration. "We have problems with maybe one out of every five wells," Nidecker told me. "Not with the big companies so much but with small, seat-of-the-pants contractors, who tend to cut corners. They spill things like diesel fuel, drilling lubricants, and hydraulic fluid just trying to get down to the oil and gas as fast as possible."

That started me wondering: Just how did the idea of creating safe havens for wildlife turn into gator trappers motoring past oil rigs? Jet skiers jousting with fishermen in refuges in the Florida Keys? Bird-watchers and hunters glaring at each other in Umatilla NWR on the Columbia River?

Waterfowl hunting was first permitted in 1929 on Upper Mississippi River refuge. By the 1950s a number of refuges set up as inviolate sanctuaries were gradually opened to hunting. The justification was that sportsmen were the chief financial supporters of conservation, and they were—through their duck stamps. But because duck stamp money could only be used to buy waterfowl habitat, much of the system was operating like a duck factory. Fixated on maintaining water flow to ponds, managers often paid scant attention to other species, except to eradicate predators.

About 90 percent of the refuge system has been carved out of existing federal lands such as national forests and rangelands. In many cases the kind of industry allowed there under the principle of multiple use, such as mining, oil drilling, and grazing, came along when that acreage was transferred. Of the money used to purchase refuges, most came from the Land and Water Conservation Fund. Set up in the 1960s with revenues from offshore drilling leases, the fund supplemented duck stamp sales. The fund's mandate was not strictly to conserve wildlife, but to increase public space for outdoor recreation.

Refuge managers are charged with making certain that all activities are "compatible" with wildlife. Somehow, holding hunting-dog field trials, power boating, and riding beach buggies and other off-road vehicles met the compatibility standard, as did commercial fishing, timber cutting, haying, and leasing refuge land for farming. Attempts by committees of Congress to define the line where real compatibility ends and misuse begins have met with no success.

AS AUTUMN MISTS drifted up the Missouri River and through the cottonwoods lining its shores, I drifted down in a canoe listening to the echoes of elk bugling to one another. The river courses through a remote part of central Montana, and the 1.1 million acres of the Charles M. Russell

NWR stretch for 125 miles along its banks.

Don Burke and his family live a couple of hours and 21 cattle gates down the road from Glasgow, the nearest town. They run cattle across 20,000 acres, almost half of which are on the refuge. "They cut the number of animals we can graze there from 2,040 to 1,163," Don shouted over a chorus of forlorn mother cows as we leaned on the corral where he and his neighbors and some hardworking horses were sorting the calves for market. "That's straight out of our income. The local refuge guys aren't so bad, but you never know what rules are coming next out of some bureaucrat back in Washington."

His wife, Julie, shooed a calf into a pen for future breeders and came over to add, "We have no guarantee we can pass this operation on to our three boys. The family guides elk hunts now to make up for losing half of our grazing permits."

Old ways are changing fast in this part of Montana. Together with the Bureau of Land Management, which oversees adjoining land, and the state wildlife department, the refuge has made a somewhat radical compact with neighboring ranchers about prairie dogs—not to poison the rodents, as in the past, but to keep enough within the ecosystem to support a reintroduction of endangered black-footed ferrets. One frost-rimmed night in October I found myself pulling up the panel on a small crate set

atop a prairie dog mound, and a bandit-masked face attached to an improbably long, mobile neck poked out for a look around.

I couldn't say whether ferrets have a sense of wonder. I only know this one had spent all its life in captivity, and now it was sliding those stretched-out forequarters down to sniff aromas wafting from the burrow below. Glancing up, the animal's large, black eyes reflected the first stars it had ever seen without a screen in the way. Suddenly, the ferret was out and circling the burrow, nosing a sagebrush stem, then rippling over to sniff at the boots of a semicircle of biologists and volunteers gathered to watch. And then, flashing down into the labyrinth of the prairie dog's realm, it was gone. "Freedom," whispered Lou Hanebury of the recovery team. I was thinking: Whatever else the refuge system has or has not done, this could not be any more right.

The 1973 Endangered Species Act spurred refuges to pay attention to a broader array of flora and fauna. The system harbors 168 threatened or endangered species at the moment. Nevertheless, 60 percent of all refuges tolerate activities harmful to wildlife, according to surveys by the General Accounting Office and the Fish and Wildlife Service itself. Both studies, however, noted that the Fish and Wildlife Service has no control over the most harmful practices, such as military activities and oil drilling.

In 1992 a high-level citizens commission organized by the activist group Defenders of Wildlife confirmed that the National Wildlife Refuge System was "falling far short of meeting the urgent habitat needs of the nation's wildlife" and suffering from "chronic fiscal starvation and administrative neglect." A kingdom without a solid constituency, the refuge system operates with less money per employee and per acre than any other federal land-management agency.

"People think you create a refuge and just let nature be nature," said Dennis Woolington, a refuge biologist working in California's Central Valley. "But it's almost never that easy, especially on these little fragments within a highly developed landscape. Things are too out of balance. You either do constant management of resources, or you lose them." You have to fix broken floodgates and clean clogged ditches and fight for a share of limited water supplies. You have to seed wildlife foods and plow under invading weeds. You keep certain habitats open by burning and close off others from the public during sensitive periods for animals such as the birth season.

Refuges are asked to handle more public use all the time. Their backlog of maintenance and repair is huge and mounting, and Congress has added 80 new refuges to the refuge system over the past decade. What hasn't grown apace is the annual operating budget, presently at 169 million dollars—the price of about five of the jets that roar over Cabeza Prieta.

Some members of the 104th Congress have suggested selling off refuge units as a solution. Others favor opening the system to more activities as a way of building public support. In April the House passed a bill called the National Wildlife Refuge Improvement Act. Sponsored by Representative Don Young of Alaska, the measure would substantially alter the Fish and Wildlife Service's management priorities by redefining the purpose of the refuges so that recreation, hunting, fishing, and trapping would be given the same importance as protection of wildlife. The bill now awaits action by the Senate. The future of the wildlife refuge system will also be shaped by what happens to three other acts: Clean Water Act, Wetlands Protection Act, and Endangered Species Act.

When I asked the chief of the refuges, Rob Shallenberger, for some perspective, he replied, "Wherever possible, we're trying to corral or scale back activities not directly related to conservation. It's frustrating, though, to be responsible for wild communities that have developed over millions of years and see the policies for managing them get jerked around every few years by congressional cycles."

IN MY TRAVELS I had noticed one widespread and very positive change—a strong new emphasis on ecosystem management. "It means reaching out beyond those white refuge-boundary signs," Shallenberger told me. "Even before we embraced this as our official policy, a lot of our managers had already realized that this was the only way to get the job done."

Once, California's Central Valley supported wolves, golden grizzlies, pronghorn, deer, spawning salmon, and steelhead. Today the valley's floor is a grid of fields made level to within a fraction of an inch by laser-guided equipment and watered via concrete-lined

MULTIPLE HITS

Darts stab the desert in Cabeza Prieta NWR, where towed aerial targets fell during live-fire, air-to-air combat training. Jet noise may stress wildlife, but military overflights are still allowed.

Across a Louisiana marsh a shipping channel ushers tankers and chemical carriers through Sabine NWR, prime wintering ground for 300,000 snow geese and ducks. If response to an oil spill came quickly enough, gates could be closed to protect part of the refuge.

ROOM TO RECOVER

Every bird has its roost in Florida Panther NWR, thanks to habitat preserved primarily for the endangered big cats. Endangered wood storks have grown in number on nearby preserves and parks, and the birds have

now expanded their range in the refuge. Protecting lands for species at the top of the food chain saves many other species lower on the chain by increasing suitable habitat.

canals. Possibly the most productive farmland in the nation, it is being replaced in turn by towns and suburbs. Only about 5 percent of the valley's original four to five million acres of wetlands remain. Yet these still provide a winter home for most of the waterfowl on the Pacific flyway.

One April dawn, orange as mallard feet, I watched tule elk moving through bulrush and swamp timothy. They were part of a herd fenced within a 760-acre pasture on San Luis NWR near the booming town of Los Banos. By the late 1800s this small type of North American elk had declined from half a million to fewer than 20. Surplus animals from San Luis and other herds have helped rebuild the state's population to nearly 3,000.

The bulls' antlers were in velvet and glowed like dew. Behind me, long-billed dowitchers, least sandpipers, and other shorebirds from as far away as South America were stopping in by the tens of thousands to refuel. They skittered across shallow pond edges like wind gusts, perforating the mud in their search for insect larvae, and then whirred on, small packets of warmth impelled toward the cold immensity of the tundra.

San Luis is jointly managed with two other national wildlife refuges in the Central Valley: Merced and Kesterson. But the focus these days is on the fabric to which they belong—160,000 acres defined as the Grasslands Ecological Area. A fifth of it is federally owned. The state controls 16,000 acres. All the rest is in private hands.

Through a program called Partners for Wildlife, the San Luis refuge complex offers technical advice, plant surveys, loans of equipment, and funds to people interested in improving their land for native species—developing a pond, for instance, or restoring a riverside woodland. Most are folks who just

SURROUNDED
Endangered deer wander onto busy roads near Florida's National Key Deer Refuge, a checkerboard on heavily developed Big Pine Key. Last year cars killed 66 of the some 300 key deer left. "They sleep under people's houses," says assistant refuge manager Michael McMinn. "They're becoming urban deer. They're cute as hell, and people feed them. They run up to cars when they see one slow down." The future? "The secret to survival is habitat, habitat, habitat."

enjoy having more critters around. Others hope to generate extra income as private reserves for sportsmen.

Over the past 16 years the refuge complex has acquired conservation easements on 133 properties totaling 59,000 acres within the Grasslands ecosystem. "We appraise the land and pay the owner as much as 50 percent of its value in return for guarantees that the place won't ever be developed in ways that destroy existing habitat," explained Randy Riviere, the easement program manager. "Given the pace of real estate development, our main concern is preserving a buffer of open space, which means ranches and farms. The way I see it, we're helping sustain traditional human communities as well as natural ones."

Sometimes the agreement is as simple as requiring a farmer to delay cutting a field until the waterfowl nesting there have hatched their young. Quite a few easements are with duck hunting clubs delighted to see wetlands protected and to have the money for their own wetland management. I wondered, though, what some of the ranchers were thinking.

Just off Bear Creek Road in Merced I found a tall, white-haired cowboy who sure didn't look like he put up with much nonsense. His name was Bert Crane, and his family has run cattle on the Sunrise Ranch for five generations. "A rancher has to be a conservationist too," he said, hitching up a big-buckled belt, "because if you're even a little short on grass, everybody—cows, wildlife, and the stockman—goes hungry." The Arena Plains, a pocket of the Merced NWR, used to be part of the ranch. Crane and his children can still graze their cattle there as long as the refuge issues permits. Turns out the refuge folks want him to add extra cows some months, since short, grazed, resprouting grass makes the most nutritious forage for geese.

"We're keeping some sandy spots grazed down for the horned lizards too. They like open areas," Crane added, leading me through his property to an avocet nest he was keeping an eye on. "We're thinking hard about an easement on the rest of the ranch. Getting paid just to keep doing what you've done all along is a pretty good deal."

The project leader of the San Luis complex, Gary Zahm, told me, "Back in the mid-eighties, neighbor relations were lousy. The Merced refuge was an atrocity; every single wetland acre was hunted. And Kesterson was so contaminated with selenium from agricultural wastewater, the coots were producing horribly deformed embryos." Managed with the Bureau of Reclamation at the time, Kesterson was made an official refuge unit in 1991, and its health continued to improve, thanks to donations for restoration from two sportsmen's groups, Ducks Unlimited and the California Waterfowl Association.

With so many kinds of support flowing from refuges out to the private sector and from citizens back to the refuges, Gary Zahm wasn't boasting when he went on to say, "Grasslands is a great model of how we can learn to live together. This is an international resource, and our actions here are just as important as what happens to forests in the tropics. Species live and die depending on what we do. It's incredibly difficult, but we're still a success story." To me, that summed up the entire refuge system. □

ROYAL GOLD
of the Asante Empire

Watchful eyes scan the crowd as Asante sword bearers escort their king, Otumfuo Opoku Ware II. Borne above the heads of 70,000 Ghanaian and international guests in Kumasi, Ghana, in August 1995, the Asantehene celebrated the 25th anniversary of the start of his reign. Amid kaleidoscopic color and regal pageantry, chiefs, umbrella carriers, and ranks of horn blowers put on an opulent display of Asante wealth. From gilded staff heads (above left) to headbands, on this day all that glittered truly was gold.

Article and photographs by
CAROL BECKWITH
and ANGELA FISHER

Only a smile outshines the headpiece and pectoral disk of a sword bearer. The disk is a badge marking his additional role as a soul washer, charged with absorbing any evil aimed at the king.

Each move has meaning as a member of the court performs a ceremonial dance. Her jewelry and kente cloth—like those of her fellow dancer (left)—have been traditional royal attire since the 18th century.

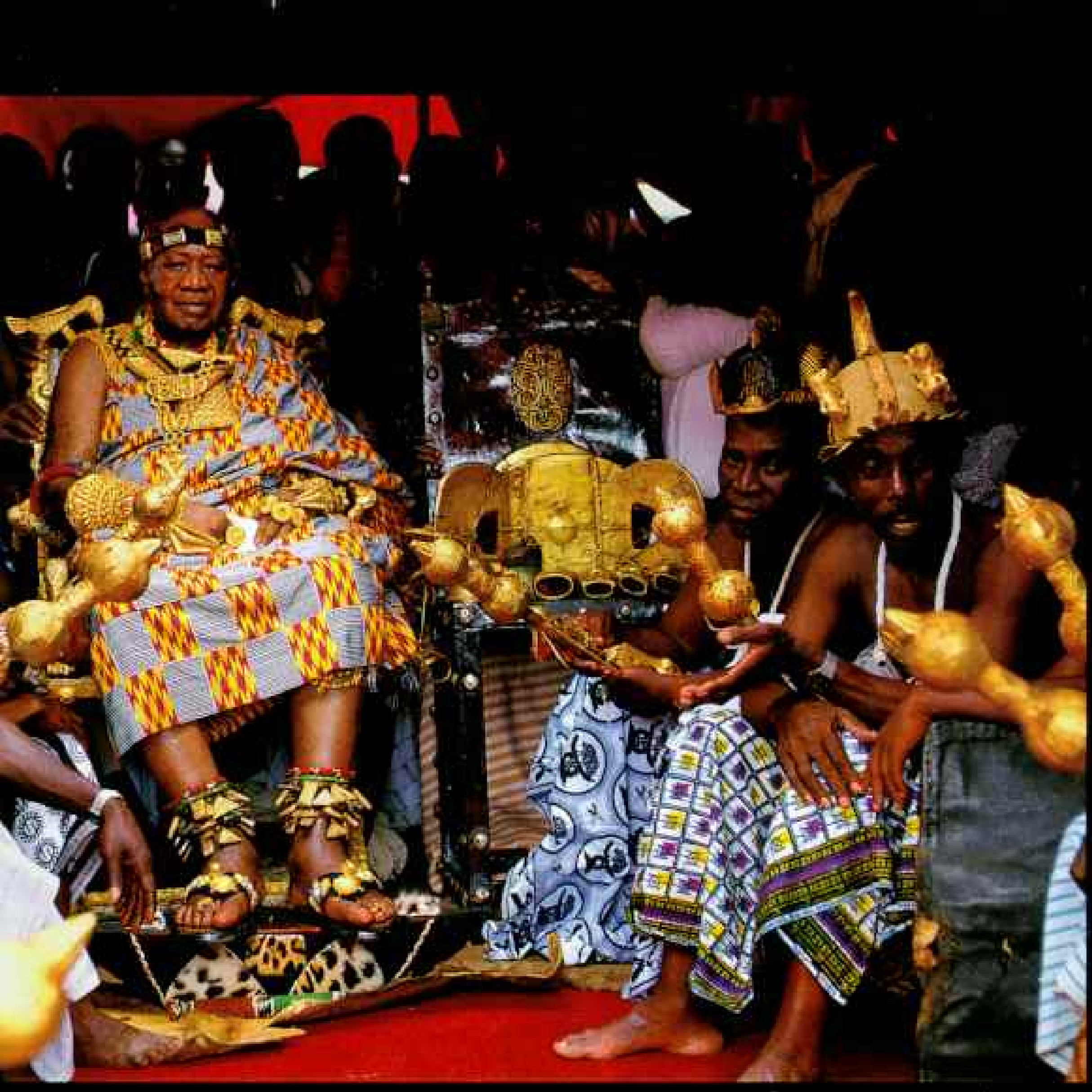
Holding court for thousands of well-wishers, the king surveys the revelry in an outdoor stadium in Kumasi, the heart of the Asante nation. This day was the final flourish of a year-long celebration honoring the Asantehene, king of one of Ghana's largest ethnic groups. For six hours the procession of embellished dignitaries and attendants filed into the arena, each a testimony to a history rich in gold.

Local inhabitants have been mining the precious metal since the 1300s. Asante goldsmiths—who also work in brass—have specialized in casting, perfecting the lost-wax process. Today few of the oldest pieces of cast gold remain, in part because of the practice of melting down old ornaments to create new ones.

One survivor of raids, wars, and the goldsmiths' crucibles is revered by the Asante as the soul of the nation. The Golden Stool, placed on its own chair next to the Asantehene, is decorated with bells and effigies of slain enemies. So sacred is it to the people that no one—including the Asantehene—must ever sit on it.

Asante oral tradition says that the stool was conjured from the sky in 1701 by the chief priest of Osei Tutu, first leader of the Asante empire. In 1896, after more than 20 years of war with the United Kingdom, the defeated Asante hid the Golden Stool. It did not resurface until 1921.

Carol Beckwith and Angela Fisher often collaborate on stories for the magazine, reporting recently on African voodoo (August 1995) and fantasy coffins of Ghana (September 1994).



His forearms gleaming, the Asantehene is all but immobilized by the weight of bracelets and rings crafted by the kingdom's most talented goldsmiths.

A WAY WITH WORDS

Couriers of the word, royal spokesmen are also the king's advisers. These high-ranking intermediaries deliver the proclamations of the king to the crowd. Their gilded staff finials, like this hand and key (left), symbolize proverbs such as "God opens all doors."

Opening the way for the Asantehene, the chief sword bearer (right) carries Mponponsuo, the golden snake sword, on which the Asantehene swears allegiance.

ICONS OF STATUS AND WEALTH

Laden with gold, a prominent woman of Côte d'Ivoire's Adioukrou people—distant relatives of the Asante—displays only a third of the ornaments in her jewelry chest. Gold dust, once prized as currency, flecks her face on a day when she and her husband are honored for reaching a noteworthy level of wealth. Unlike her braceleted Asante kinswoman (below), whose jewels belong to the royal court, she will pass her treasures on to her heirs. □

By **CHARLES E. COBB, JR.**

Photographs by
MICHAEL S. YAMASHITA

Delayed for days by fog, wind, and rain—weather as usual in the Kuril Islands—a passenger helicopter drops in on Paramushir, a piece of an island chain its Russian owners call "the end of the world." The former Soviet Union won the Kurils from Japan at the end of World War II. Fifty-one years later Russia clings to its trophy in the rich fishing grounds of the North Pacific, defying Japan, which wants the southern Kurils back. The islands' inhabitants just want their hard lives to get easier.

Russia and Japan contest a wild island chain

Storm Watch

Over the Kurils

A laboratory for hardy scientists, the crater bay on uninhabited Yankicha teems with marine life, the product of an unusual environment in which cold ocean tides mingle with superheated waters from volcanic vents. "Of all

northern regions the Kurils stand out as the least biologically known," says Ted Pietsch, leader of a survey funded by the National Science Foundation that in two years has revealed 60 new species—insects, spiders, and mollusks.

OUTWARDLY there was nothing unusual about the Japanese cruise ship *Coral White*. It was sleek and gleaming white and comfortable looking, though a lot smaller than the kinds of floating palaces that take you to the tropics for a week. On the face of it the only odd thing about the *Coral White* was its destination: Shikotan. Like all the other islands in the Kuril archipelago, Shikotan is off-limits to the Japanese. And even if it weren't, you'd have to wonder what kind of person would pay to come here.

"Horrible . . . uninhabitable . . . arid rock" was the assessment of French explorer Jean-François Galaup de la Pérouse in 1787. The islands were so foggy he abandoned his intention to go ashore.

Flung across the cold North Pacific between Japan's island of Hokkaido and Russia's Kamchatka Peninsula, the more than 30 Kuril Islands and dozens more islets are often dreary. They are also contested. In the aftermath of World War II, Japan lost the Kurils to Russia, and 17,000 Japanese were expelled, most from the southern islands of Shikotan, Iturup, the Habomais, and Kunashir, just 13 miles from Hokkaido. Ever since, Japan has pressed a claim to what it calls the Northern Territories.

Only five islands are permanently inhabited: Paramushir with an estimated 4,500 people, Kunashir with 4,000, Shikotan with 1,500, the Habomais with 300, and Iturup—from where Japan launched the attack on Pearl Harbor—with 6,000. There are also perhaps 7,000 Russian border troops in lonely bases throughout the Kurils. Most of the civilians live in seven towns, in which 40 percent of the houses don't have indoor plumbing. Life here has always been hard, but since the end of Soviet rule, government support has dwindled, and it's become even harder. One problem is that nearly all the wealth from the main industry—fishing—goes to Moscow.

Shikotan is 17 miles long, 8 miles wide, and uncomfortable. Its administrative center, Malokurilskoye, where I was watching the progress of the *Coral White*, is as mangy as the stray dogs that wander its streets. All you have is the fish-processing plant and a few kiosks that pass for shops. The tiny houses, with their outer skin of peeling tar paper, sag with age. Nondescript apartment blocks rise above the rubble of homes destroyed by a 1994 earthquake, which took a dozen lives. With some 35 active volcanoes, the Kurils (probably from the Russian *kurit*, to smoke) are part of the Pacific Ring of Fire, and earthquakes are a perpetual threat.

What Shikotan and the other islands lack in man-made attractions, they make up for in raw nature: fjords, fish-filled streams, splashing waterfalls amid magnolia, birch, spruce, and giant bamboo. Winters are harsh. In the brief summers, when the sun shines, the rugged landscape can be stunningly beautiful, but when the gales blow and rain and fog roll in, the islands have all the allure of a penal colony.

Apart from Vyacheslav Bikov, vice-mayor of the southern Kurils district, and a handful

The Japanese return, if only for a day, to tend the overgrown graves of their ancestors. On Shikotan, Setsu Nitta leaves offerings of red rice, sake, and flowers on her father-in-law's plot. She last knelt here as a young woman, one of 17,000 Japanese expelled by Soviet troops by 1949. Grave-tending missions provide a means for Japanese to visit the Kurils. Unwelcome are fishermen from Japan. Authorities have jailed dozens for poaching offshore.

Former staff writer CHARLES E. COBB, JR., is now pursuing a variety of freelance projects. MICHAEL S. YAMASHITA traces his beginnings as a photographer to a 1971 trip to Japan. His recent book, *The Mekong: Mother of Waters*, stemmed from his coverage of the river for the February 1993 issue.

of others, no one else in town seemed the slightest bit interested in the arrival of Japanese visitors from the *Coral White*, which had disappeared from view, heading for the other side of the island. But the odd couple from NATIONAL GEOGRAPHIC—Mike Yamashita, the Japanese-American photographer, and I, the African-American writer—did turn heads. "He's from New Jersey?" asked an incredulous Russian on meeting Mike. Another guy trailed me with a video camera, which made me wonder if I was the first black man to set foot on Shikotan.

Vice-mayor Bikov invited Mike and me to join a small, ad hoc welcoming committee for the special visitors from Japan. First we had to get to the opposite shore.

"No problem," said Bikov airily. "We have tractors." Presently two low-slung army half-tracks clattered up a muddy street near the town's harbor. Bikov had borrowed them from the military base on Shikotan. We set off cross-country in the treaded tin cans, lurching over ruts, stalling on the steep hillsides. An hour later we arrived at a bay. The wrong one.

The *Coral White* was visible in the distance, but to get to that bay, our driver said, we'd have to go on foot or by boat—the terrain was too rough for the machines. It was time for a break. Bikov's wife, Natasha, and several other women unloaded a huge cooking pot and began preparing fish soup. The men settled into conversation on the beach.

Then a launch from the *Coral White* showed up—a rescue party for the welcoming committee. "We understand your problem," said the pilot, smiling. "Come with us."

It was well past midday by the time we reached our goal: a little cemetery on a grassy plateau overlooking the bay where the *Coral White* was anchored. The graves in this cemetery were overgrown with grass and weeds,

Local hot spot, a thermal pool draws a crowd on Kunashir. Nature provides some of the few luxuries in the Kurils, where many homes lack hot water and supplies arrive fitfully. Gardens are the best bet for fresh produce.

but they were not forgotten. By an official 1991 agreement, Japanese who lived in the Kurils before the Russian takeover are permitted to return to honor their dead relatives. Today a group of about 40 Japanese men and women, most of them elderly, had gathered with gifts and commemorative markers. The only sounds were their muted voices and the soft chanting of a Buddhist priest brought here for the occasion.

"It's over here, I know," said Setsu Nitta, leading her sister-in-law Fujie Ishii to a corner of the graveyard. The women's quiet dignity barely masked their excitement. "Here! Here!" Mrs. Nitta dropped to her knees where a circle of stones and scattered pieces of glass had caught her eye.

One day in 1948, when Setsu Nitta was 24, Russian soldiers came to her village with the order that everyone was to be sent to Japan within 48 hours. One of her last acts on Shikotan was to build a mound of stones and place a bottle of sake at her father-in-law's grave.

Mrs. Nitta rose and bowed deeply. Then she reached into her bag and pulled out a bottle of sake. "Oh, grandfather," she said respectfully, pouring the sake over the grave, "you've had nothing to drink for so long. You must be very thirsty."

Before returning to the *Coral White*, Mrs. Nitta left a small wooden marker on the grave that said, I WILL TAKE SHELTER IN THE LAND OF AMIDA BUDDHA. Then she took out another bottle of sake and laid it next to the marker. Why not pour it? I asked.

"He used to drink a little too much," Mrs. Nitta said with a twinkle. "I told him, 'Save it and drink little by little.' " She paused, then added quietly, "I don't know if I'll get back."

JAPAN AND RUSSIA have a long and contentious history in the Kuril Islands. Cossack trappers in search of fur seal and sea otter pelts came from the north in the 1700s, even as Japan's powerful Matsumae clan was trying to subjugate the native people in the southern islands. These people, who came to be called Ainu, are of mysterious origin, but they may

Extreme Geography

Substantial pieces on a diplomatic chessboard, the Kurils are in physical fact small volcanic islands flung between Russia and Japan. Only five of the more than 30 islands and dozens of islets are permanently inhabited, with soldiers accounting for nearly a third of the population of 23,000. A deadly earthquake in 1994 persuaded many civilians to leave for good.

Basing its claim on 19th-century treaties, Japan demands the return of the southernmost islands: Kunashir, Shikotan, Iturup, and the Habomais. The bitter dispute has prevented Japan and Russia from signing a World War II peace accord.

0 100
MILES

MAP BY NGS CARTOGRAPHIC DIVISION

IMAGE GENERATED BY ROBERT STACEY, WORLDSAT INTERNATIONAL INC., AND JIM KNIGHTON

have migrated from northeast Asia thousands of years ago, settling as far south as Hokkaido. No Ainu live in the Kurils today, but about 24,000 Japanese report Ainu ancestry.

From the start Russia and Japan each had its eye on the archipelago. Beyond furs, the Kurils were a strategic prize: a Pacific frontier for Russia, stepping-stones to mainland Asia for Japan. An 1855 treaty established a Japanese-Russian border between the islands of Iturup and Urup. In 1875 Russia gave all the Kurils to Japan in exchange for southern Sakhalin. But tensions persisted, and in 1904 war broke out. When Japan won, a year later, it regained its Sakhalin territory.

Then came World War II and the territorial carve-up at the Yalta Conference. "I only want to have returned to Russia what the Japanese have taken from my country," Joseph Stalin told President Franklin Roosevelt. Japan says it isn't bound by a secret agreement that did not legally transfer the southern Kurils. The official record is unclear, however, and the dispute drags on. Meanwhile Russian border troops still guard the islands.

Apart from their geopolitical value, which has waned since the end of the Cold War, the Kurils are awash in valuable salmon, flounder, tuna, shrimp, clams, and crab, as well as kelp and sea urchins—delicacies in Japan.

"Historically the islands are Japan's," said Toshiyuki Akizuki, a former law professor I met in Sapporo, the capital of Hokkaido Prefecture. Would Japan regain the islands? "Nobody knows," he replied. "If Yeltsin says 'Yes,' he loses his political life."

Russian President Boris Yeltsin has hinted at his willingness to return the southern islands in exchange for a multibillion-dollar infusion of aid and investment. Among Russians, though, there's widespread resistance to giving up the islands, and every time the subject comes up, ultranationalists protest loudly.

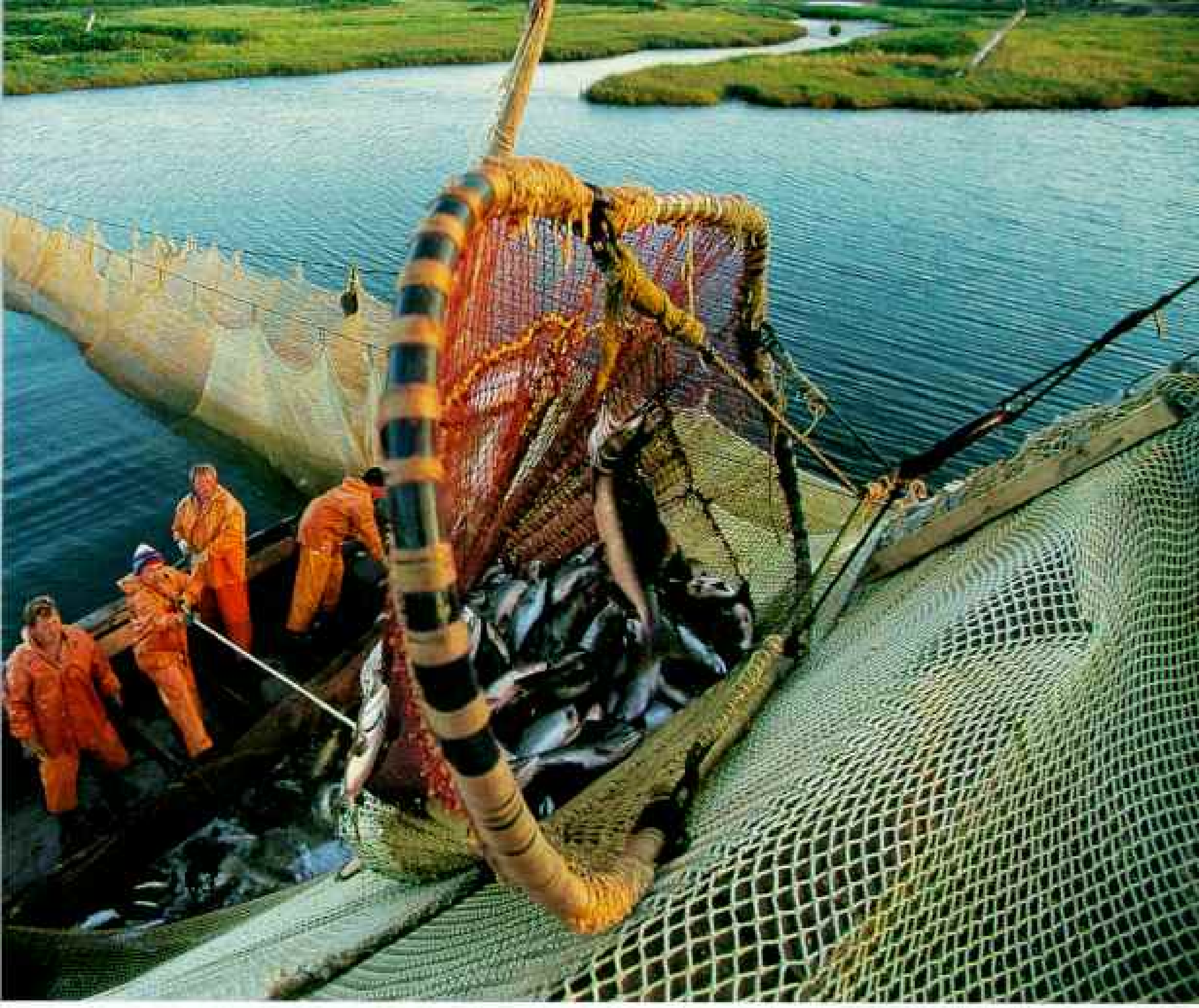
The majority of Kuril Islanders want to remain Russian citizens but wonder if improved relations with Japan wouldn't improve their lives. As Nikolai Pokidin, mayor of the southern Kurils district told me on Kunashir, "We could set up mutual businesses, do fishing together, work with no problem of territory."

The Kurils desperately need money—for roads, schools, hospitals, and services—and a common complaint among islanders is that Moscow ignores them. The staple industry, fish processing, is suffering from neglect.

Salmon may run but they can't hide from Iturup fishermen, who unload a weir strung across the Reydovaya River. For all the wealth produced by the Kurils—a third of Russia's fish catch comes from the greater island region—little returns to upgrade the area's primitive infrastructure. Women endure squalid conditions (bottom) at a scallop-packing plant on Paramushir. One of the island's two newly privatized plants has been modernized.

Since the demise of the Soviet Union four fish canneries and packing plants have shut down. Four of the remaining six are state run, yet Moscow has no money for repairing their aging machinery, let alone buying new equipment. "We're forgotten by God and by government," said a worker in the Shikotan plant, where production has dropped from a thousand tons a day to a hundred.

IF KURIL ISLANDERS feel forgotten, they also feel isolated from one another. To go to Paramushir from the southern Kurils, I first had to take a boat to Korsakov on the southern end of Sakhalin, then drive to the airport at Yuzhno-Sakhalinsk, which is the administrative headquarters of the Kuril Islands. There I boarded a plane for Khabarovsk 350 miles away on the Amur River. Then it was a long flight to Petropavlovsk on Kamchatka, where I spent hours waiting for the "regular"



Beaten up by blizzards and typhoons, the town of Yuzhno-Kurilsk, population 2,500, grimly stands its ground on Kunashir. Housed in barracks-like apartment blocks, workers once earned nearly triple what they could on the

mainland. Now, with the financial distress of Russia, wages, if paid at all, barely equal the Russian average. In a recent poll some residents said they would accept Japanese control if it meant higher living standards.

helicopter to Paramushir (foul weather delay). To travel 650 miles in the Kurils, I had had to make a journey of nearly 2,000 miles via the mainland, which took three days.

The southern Kurils are at least connected with one another by ferry; Paramushir has only the state-owned helicopter service. When you land on the island, you find that Severo-Kurilsk, the main town, has three paved streets—the only ones in the Kurils. It also has several small grocery stores.

In the store run by Olga Blofinskaya I saw another effect of isolation. Prices are high, largely because it costs so much to bring things in. To make a modest profit on a five-pound chicken, for example, Olga must charge the equivalent of ten dollars, almost three times the price in Moscow. Lightweight foods are more affordable—things like freeze-dried, beef-flavored noodles from Japan or South Korea. "It's a Russian national dish here," laughed Olga.

There wasn't a single fresh fish in her store. Salmon and other fish are almost all exported, mostly to South Korea, Japan, and the Russian mainland. Islanders either catch their own fish or buy it canned or smoked. Olga did have a few bedraggled vegetables for sale—local onions, potatoes, and cabbages—and the shelves were well stocked with vodka.

THE STORE was a good place to meet people, and soon I was deep in conversation with Anatoli Blokhin. Blokhin, who is a fit 69, had come in carrying two milk pails, one empty and one half full. Every morning except Sunday, weather permitting, Anatoli sells milk to four of the stores in town; this is his last stop. Olga paid him 15,000 rubles ($3) for just under a gallon of milk.

Kuril Islanders are enthusiastic hosts—a visitor, after all, is a curiosity who offers a rare moment of diversion—and Anatoli was no exception. I must come home with him, he said. Anatoli's place was a decrepit 1950s apartment building on a hilly (and, yes, muddy) back street. I never went inside, because we got sidetracked at the small barn where the Blokhins keep their two cows and a calf. Anatoli's wife, Tatyana, was giving the cows their morning feed of hay.

"We don't live—we are just surviving," snapped Tatyana, who mourned the passing of the old days. The Russian government gives the Blokhins a monthly pension of 840,000 rubles ($168). Selling the milk helps, but even with that, Tatyana said, they barely get by. She recited the litany of expenses. "One month of hay for the cows is 150,000 rubles. We need six tons of coal in winter—that's 300,000 rubles a ton." Tatyana gestured heavenward.

I asked the Blokhins what life was like before the reforms.

"We came to Paramushir in 1959, after I finished military service," Anatoli said. "This was the place for a young man then." A man like Anatoli, with little education, could earn nearly three times as much in the Kurils as on the mainland. This was because the Soviet government was encouraging pioneers to settle the Pacific frontier to open up its vast resources. The government took care of these people with generous subsidies for schools, health care, and other social services.

"I worked at everything," said Anatoli, who job-hopped to make more money. "I was a ship hand on fishing boats, a day laborer on

Communal toilet training gathers toddlers at a Paramushir nursery school. Most of their parents work on fishing boats or at processing plants.

Flowers bloom from the hands of students (top) on the first day of school on Kunashir. After the 1994 earthquake, which crumpled factories and houses, many families removed children from the island. Now enrollment is rising again.

construction projects, and I was a guard at the warehouses at the port." Every year the young couple took a month's vacation on the "continent," as islanders call the mainland.

"It was so easy," said Tatyana, with a mixture of anger and despair. "Now nothing helps, nobody helps."

IN RUSSIA THESE DAYS despondence isn't unique to the Kuril Islands, but conditions there are especially tough—more so for the elderly—and opportunities are limited. The population shrank by a third following the devastating earthquake in 1994, though some of those who left are now returning. Despite all the hardships, these rough volcanic islands exert a powerful hold. It's the same kind of frontier appeal that makes Alaskans such vehement boosters of their state.

"I wouldn't want to leave," said Alex Khotyaninov, a 32-year-old electrician on Kunashir. "I cannot live in the city with those noises and crowds of people. My wife wants to leave. We have a slight problem."

Women who have husbands like this call them *romantics*. Maria Shevchenkov, a former Muscovite who works at the tiny museum on Kunashir, has one. "If he can wear his camouflage and hiking boots and walk far from people," she said, "he is happy." When I asked what makes Maria happy, she spoke wistfully of Moscow. "I miss it," she sighed.

Peter Zabolotny, 42 and youthful, is a romantic of sorts. Zabolotny is the director of the Sunrise Company on Paramushir, and he's on his way to becoming one of the most successful entrepreneurs in the Kurils. Peter was beaming as he showed me around his brand-new scallop-packing plant. It was being built by an Australian company and would soon be finished. New freezers lined one wall of the building, which covers an area as large as two football fields, and workmen were busy installing fluorescent lights.

Back in 1991 when Russia was beginning to shed state-owned enterprises, Peter, his brother, and four other managers in the state-run factory decided they could do a better job. "We saw that it was the wrong way," he said, referring to the inefficiency and low productivity of the old system. (Peter's comment brought to mind my earlier visit to the state-run cannery on Shikotan. Workers were having to stuff salmon into metal cans by hand

Dressed for success, frontier style, Alexander Sanin works the phone in his well-stocked home on Kunashir. He prospers as a dealmaker for fishermen selling their catch to the Japanese. Fresh-air entrepreneur Tatyana Kolesnikova (opposite) showcases fur hats she brought in for resale on Iturup.

because the packing machine was broken.)

Zabolotny and partners got a lucky break from the state-owned northern fishing fleet, which had a monopoly on both fishing and fish processing in the northern Kurils. The company had been ordered to cut costs and become self-supporting, so it sold the packing plant and restricted itself to fishing, which is cheaper than running a factory. Peter's group secured a loan of $100,000 from an Australian bank, took over the state factory, and began building the new plant.

"Have you seen the 16th century?" Peter asked in mock horror as we crossed the road and entered a dank, windy building. Built in the 1950s, the old scallop factory was Soviet-classic. It was dimly lit and had a cracked concrete floor that was soaking wet. Women grouped around a wooden table were deftly shelling scallops and pitching them into shallow metal boxes. A conveyor belt carried the scallops to the washing room. They were then packed, by hand, into wooden boxes and loaded onto pallets in a refrigerated room.

The process will be much the same in the new factory, but working conditions will be so much better that Peter expects productivity to rise. "We'll need more workers," he said. "That means the quality of life here will pick up too."

I asked one woman at the shelling table how she liked working for Sunrise. "I'm making more money," she said, without missing a scallop.

In 1995 Sunrise packed a ton or more of scallops on good days, almost all of which went to Seattle. Peter wouldn't reveal the company's earnings, or his own salary, but he was proud of the fact that the 137 employees take home an average of $500 a month—almost five times the wages of their counterparts in state-owned plants. Pay is based on productivity, and workers often put in overtime, even double time. "Incentive," Peter said. "We're trying to change from old processes to new."

Changing old processes was Boris Yeltsin's

Long faces anticipate long hours as cannery workers on Kunashir absorb a stern lecture from a supervisor on the virtues of efficiency. These *sezoniki,* or seasonal workers, have come from throughout Russia to work during the

summer fishing season. Little exists to distract them, except perhaps to hike into the woods to pick wild mushrooms or to stroll a beach and gaze wistfully at Japan's island of Hokkaido, only 13 miles but another world away.

aim in December 1992, when he issued an order to create a Kuril Islands free economic zone. The idea was to liberate the islands from the heavy hand of Moscow by giving them control over exports, the right to keep foreign currency earned through trade, and the power to impose quotas on foreign vessels fishing in Kuril waters. Also, the tax on a company's earnings, now about 80 percent, would be drastically cut to give entrepreneurs like Peter Zabolotny incentive to start new businesses. But Yeltsin can't authorize the plan. Under the Russian constitution only the Duma, the lower house of the Federal Assembly, can do that, and so far the Duma has balked.

"About 20 laws will have to be changed or enacted if the zone is to be implemented," said Evgeniy Rybakov, head of a government office on Sakhalin whose purpose is to spur the Duma to action. "There is progress," he said, holding out a thick sheaf of papers. "This is development for every inch of these islands. I invite you to visit in the 21st century. I will even pay all expenses."

ONE REASON why nothing has been done is that the proposed changes would shrink the profits of controlling interests outside the islands. Kuril Islanders may be the kith and kin of mainland Russians, bound by blood and language, but in a sense they are also the citizens of a client state, whose wealth is extracted and sent abroad.

Roughly a third of Russia's fishing catch comes from the greater waters around the Kuril Islands. But nearly all the Russian and foreign trawlers that fish those waters are from Sakhalin and other ports outside the Kurils. Most of the 200 million dollars they bring in goes directly to Moscow as taxes, duties, and other fees. In 1994 the Russian government earmarked only 25 million dollars for

Above politics (and below the photographer's helicopter) Kudryavyy volcano sends out signals proclaiming true wilderness 3,235 feet high on Iturup. Some 35 volcanoes smolder on the archipelago the Russians call Kurilskii, probably from *kurit*, to smoke. The islands form part of the Ring of Fire, where oceanic plates slide under continental plates. The volatility of nature—and of politics—conspires to drive people off the Kurils, a home best suited to the strong and the stoic.

investment in the Kurils. Yet somehow even that small sum has been spent elsewhere, as Vladimir Korelski, chairman of Russia's Fishing Committee, reluctantly admitted. In cash-strapped Russia the Kuril Islands just don't have much pull.

"It's like they don't even realize there are people living here," a fisherman on Shikotan told me. "They say, 'Oh, Kuril Islands, isn't that where the volcanoes are?' "

Evgeniy Rybakov says that if the economic zone is put in place, trade with Japan will increase, and the Kurils will attract new factories, fishing fleets, homes—and prosperity. For the moment, though, any hopes for a better future are clouded by the political dispute over the islands, which could keep them from taking part in the anticipated boom in Russia's resource-rich Far East.

Alexander Sanin is one Kuril Islander who has made a business out of this political uncertainty. Once a week Sanin leaves his home on Kunashir for several days and travels to Japan with Russian trawlers that have been fishing in the region and are going to Hokkaido to sell their catch. Sanin is crucial to the transactions: A bilingual broker, he handles the negotiations and translates bills of sales and other official paperwork from Russian into Japanese and vice versa.

Sanin, who is 34, grew up in Crimea before moving to the Kurils in 1984. Ten years ago he began learning Japanese from language books and by tuning his TV to Japanese shows broadcast from Hokkaido. "I could see the possibilities," he said simply.

The possibilities are now creature comforts: a Nissan four-wheel drive, two televisions, and a stereo system. He's proud of what he's achieved for his wife, Svetlana, and daughter, Yana, who's now two. She'll soon be going to school, which has Sanin worrying about what Kunashir has to offer. He said they may leave. "I'll probably go to Japan and teach Russian to the Japanese."

Closer ties between the Kurils and Japan seem inevitable as trade and mass communications break down cultural barriers. It's already happening. Several times a year Kuril Islanders visit the Japanese port of Nemuro on the eastern side of Hokkaido.

On one such exchange a Russian ship, *Mariana Cvetaeva*, leaves its passengers on Japanese soil. The Russian guests are shepherded onto spotless buses by white-gloved hostesses. They're whisked off for three days of education and shopping. The first stop is the nature center north of town, where there's a brief lecture on why the southern islands belong to Japan. Signs in Russian read, "Return the Northern Territories" and "Give Us Back the Occupied Lands." The dark shape of Kunashir is visible in the distance.

Then the Russians hit the shops in Nemuro to spend any money they've managed to save. In one store there's a sign in Russian over the door saying, "Electronics—Russian spoken here." The owner apologizes to me for her rusty English. "I'm using only Russian and Japanese now," she says.

It made me think that if high-level negotiations inside the portals of Tokyo and Moscow don't settle the long dispute over the Kurils, the solution may instead grow out of day-to-day dealings between the islanders and their Japanese neighbors. □

BRONZE ARROWHEADS (ABOVE RIGHT) WERE FIRED FROM CROSSBOWS. THE WOODEN SHAFTS HAVE DISINTEGRATED.

China's Warriors

Rise From the Earth

After 2,200 years an armored archer still scans the horizon for enemies of Qin Shi Huang, China's first emperor. The life-size statue belongs to a garrison of some 1,400 pieces: archers, cavalry troops, charioteers, infantrymen, and horses. They are part of a great terra-cotta army slowly being unearthed near the emperor's tomb outside the city of Xian.

Article and Photographs by
O. LOUIS MAZZATENTA

Excavation chief Zhu Sihong knows his soldiers well. "Kneel beside that archer," he says, "and imitate his expression. You will feel as if you are ready to fight." I drop to the archer's position and am energized to enter the battle—any battle.

Surrounded by a collapsed roof of ancient timbers protected by a new exhibit hall (above), Zhu and I stand in a square recently excavated below the roof in Pit 2, one of three pits in Qin Shi Huang's Museum of the Terra-cotta Warriors and Horses.

Workers brushing away tamped earth (opposite) discovered remains of the 7,000-square-yard roof of pine logs that sheltered the terra-cotta army. The roof's collapse may have been caused by a fire set by rebels shortly after the emperor's death. I see remnants of the fire in charred timbers.

The three pits are filled with about 8,000 clay soldiers and horses. Nearby, an eroded 250-foot-high earthen mound rises over the emperor's tomb. Remains of a palace and secondary pits containing bronze chariots and the skeletons of horses and rare animals have been discovered as well.

"All of this," says historian Li Yu-ning of St. John's University in Jamaica, New York, "was a manifestation of the first emperor's quest for immortality and eternal glory and power."

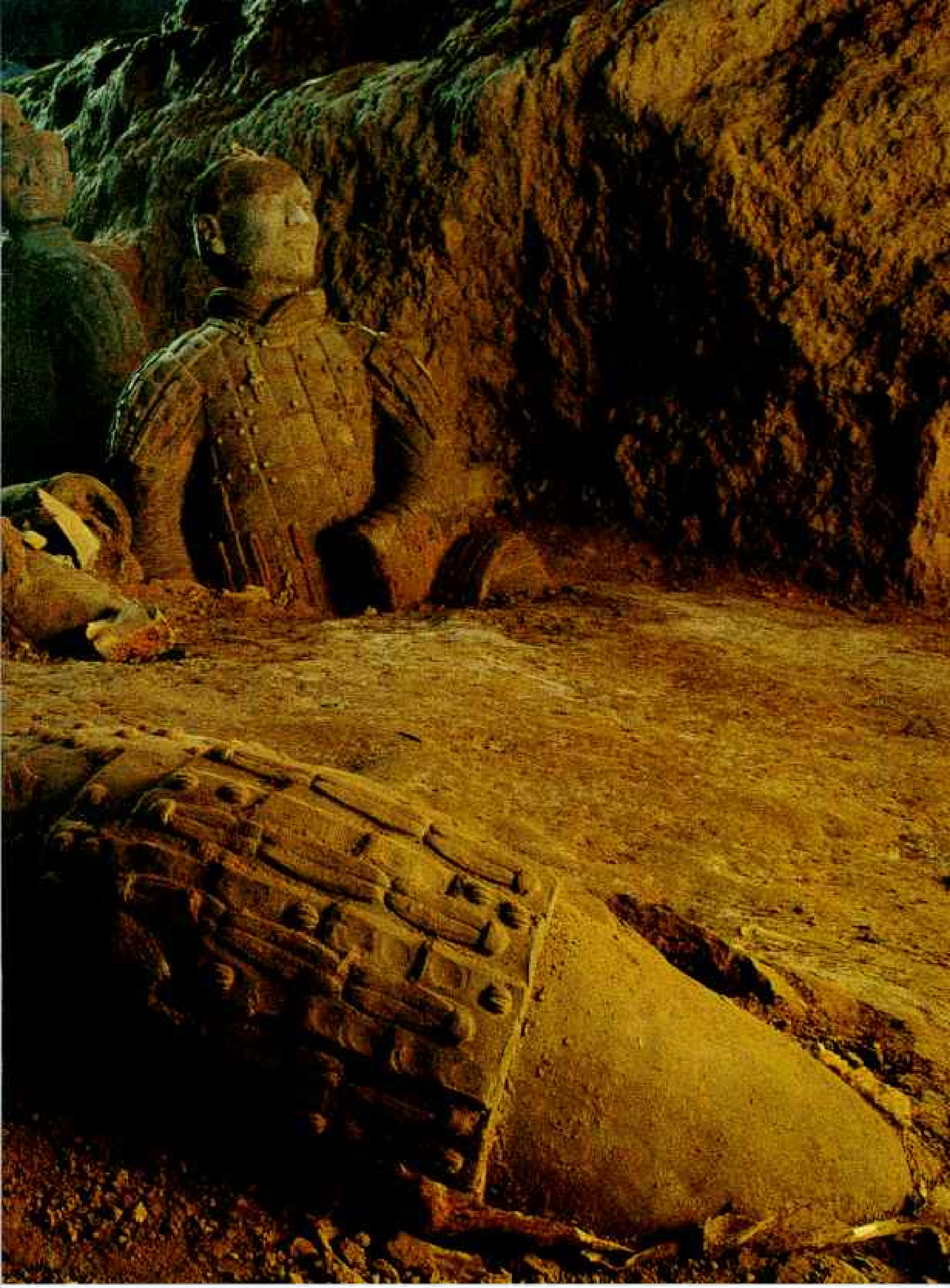
Qin Shi Huang declared himself emperor in 221 B.C., after defeating six warring states and unifying China. He quashed the power of the feudal nobility and recruited competent administrators to manage a dynastic system that lasted into this century.

Archaeologists uncovered Pit 1, filled with over 6,000 life-size warriors and horses, in 1974 and then began searching for other pits nearby. A tip from an elderly farmer led them to a wide field, and extensive test drilling uncovered Pit 2 in April 1976. Pit 3 and an empty fourth pit were found later.

Fifteen sections were opened during the 1976 trial excavation of Pit 2, then refilled until the official excavation began in March 1994. The work is proceeding in phases. After the entire roof is exposed—a chore nearly completed—authorities will decide on a sequence for unearthing the soldiers and horses still buried below.

Former Senior Assistant Editor Lou Mazzatenta contributed 16 articles to the magazine in his 32-year career, his favorites being those on archaeological subjects such as Ramses the Great (April 1991) and Herculaneum (May 1984).

As if waiting to arise to a new dawn, an archer lies in a partly excavated section of Pit 2. These archers fared



better than standing soldiers because their kneeling position buffered them from the roof's collapse.

"General"
Cavalry
Standing archers
Kneeling archers
Charioteers and infantry
"General"
PIT 2
Unexcavated areas are shown white.
Reserve chariots
Ramp
Reinforced dirt walls
Pit 3 1976
Pit 2 1977
Pit 3 1977
Pit 1 1974
N
0
½
MILES
Outer city
Inner city
Palace remains
Rare-animal zoo
Convicts
Horse skeletons
Bronze chariots
Qin Shi Huang tomb
7 human skeletons
Horse skeletons
Terra-cotta figures

The emperor's army emerges

Key units of a disciplined force line Pit 2. Kneeling archers (blue) and standing archers (yellow) rained arrows on the foe. Cavalry with saddled horses (pink) and charioteers with infantry (green) could slash at the enemy's weakest point. A reserve force of chariots (orange) is poised for action.

In Pit 1 thousands of infantrymen are assembled in ranks. Pit 3 holds 68 soldiers, perhaps in a command post; a fourth pit is empty, its completion perhaps thwarted by a rebel uprising.

ART BY DOUG STERN

When Yuan Zhongyi first arrived in 1974 to investigate artifacts found by farmers digging a well, he thought his work would take a week or so.

"A grandmother had placed terra-cotta heads on her mantel to worship as gods," he recalls. "I collected all the pieces, and then we began to dig. We could not believe what we found." Now director of the terra-cotta army museum, Yuan (right) still enjoys examining chariot horses coming to light in Pit 2.

The new exhibit hall (above), made of four different colors of marble from Fujian Province, opened in October 1994. Covering Pit 2, the building allows visitors to observe an immense excavation in progress. At the same time, it protects the site from the elements and air pollution. Two million visitors view the terra-cotta army yearly.

Excavation of Pit 2 is expected to last seven or eight more years. Additional buildings may house other sites on the mausoleum grounds. Some archaeologists envision an extensive complex with structures over pits containing the horse stables, seven human skeletons (possibly Qin Shi Huang's children, murdered in a palace intrigue after his death), a cemetery of prisoner-laborers who built the mausoleum, and more.

It is a prospect that would have seemed unthinkable to Yuan Zhongyi when he first set up his tent and collapsible bed in the middle of an open field two decades ago.

Restoration by hand and computer

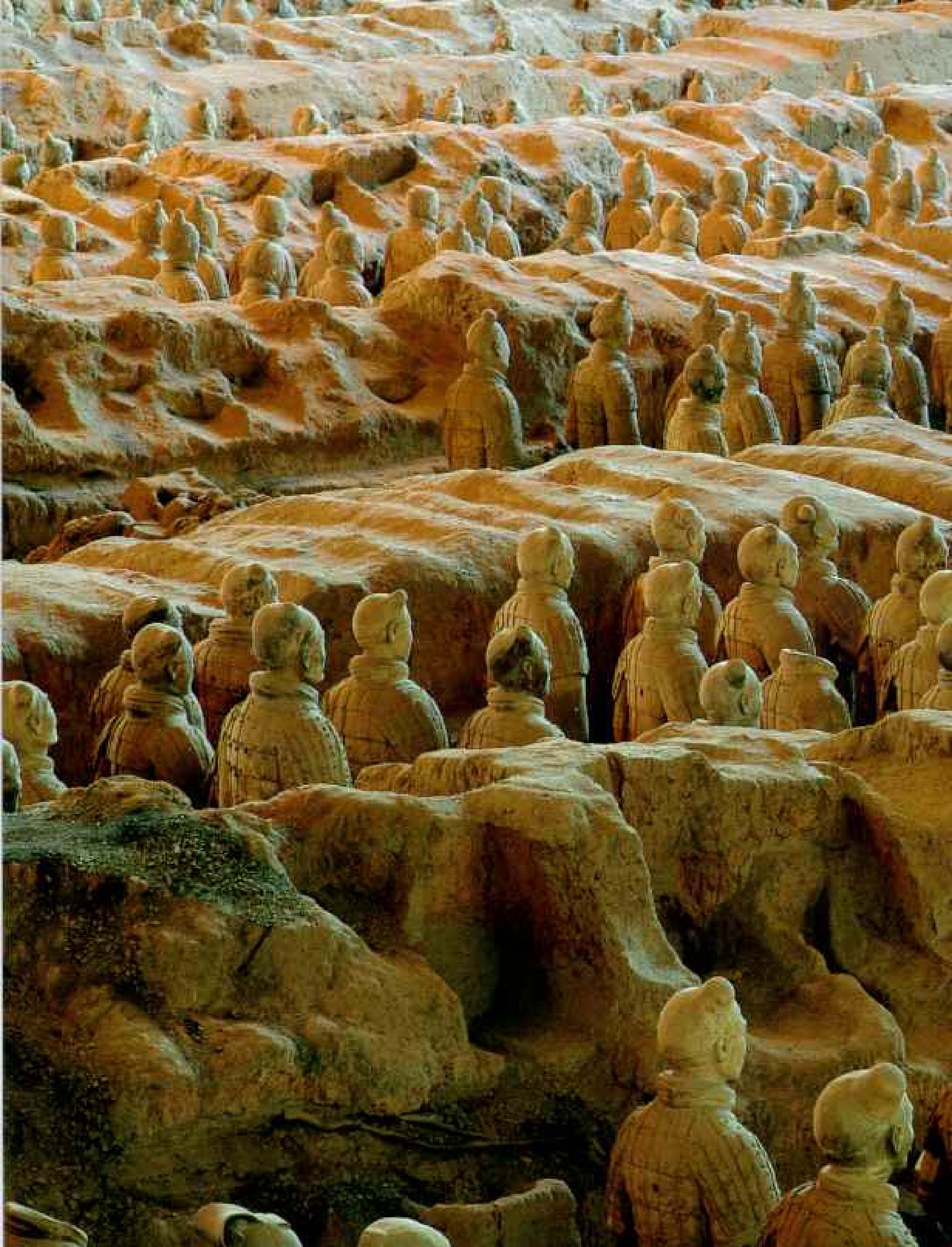
A technician injects glue made of shark's lung under paint detaching from a face (top), one of only a few still showing original pigment.

An archer reveals details of hair (above) and hemp soles (below), but the figure lacks color until artist Doug Stern paints an image (left) with a computer.

Ravages of floods, fire, and time have erased original paint from statues such as this one of a high-ranking officer, possibly a general (below), discovered in Pit 1. Two similar "generals" have been found in Pit 2. Ancient pigments made from minerals were mixed with a binder such as animal blood or egg white to color

the statues. Charcoal may have once tinted the hair.

Guided by flakes of paint and historical sources, Stern used a computer with an electronic pen and tablet to hang colors on photographs of the archer and the general (left) from Pit 1. Without actually tinting the original statues, an approximation of the figures' original appearance is achieved and can easily be modified to reflect future research.



Ready again to march into battle, 38 columns of soldiers
In Pit 1 face east to counter enemy attacks. One thousand

of the more than 6,000 soldiers and horses in Pit 1 have been restored to standing position, four abreast.

Firing up an army of clones

To gain insight into ancient techniques—and to produce statues for sale—the museum has installed a workshop to re-create terra-cotta troops.

A worker loops coils of wet clay to form the body and arms of a reproduction (right). Placing a hand inside the body for support, he beats the coils together with a paddle. Fingerprints and paddle marks found in broken ancient statues confirm the technique's authenticity.

Freshly molded hands (below) await attachment. Ancient craftsmen also used molds to mass-produce heads and ears. Armor details were sculpted manually (right). A half inch of fine clay was laid over each molded head and hand-worked to give each its own character. Heads were fired separately (bottom right) and later attached to bodies.

Still moist from creation, soldiers stand at the ready in a museum factory kiln (above). First a low fire is set to dry the statues. Then coal is added to raise the temperature to the 1000°C (1800°F) required for successful firing. Temperature control is difficult, and about 10 percent of the firings fail. "We cannot always put theory into practice," says factory manager Li Jianxiang. "We must rely on experience."

Statues are baked for several days until they glow red. When they are done, workers remove the hot terra-cotta from the oven (right). They rap knuckles against the statues: A hollow thud indicates a defective product, a metallic clink a successful one.

"If we find one piece that fits in a day—that's a lucky day," says Song Yun (above, at left), who has worked for 19 years mending broken soldiers.

A company of partly assembled statues stands behind him as he tests a missing part with co-workers in Pit 1. If a perfect fit cannot be achieved, the piece goes back into inventory. Eight skilled workers toil daily trying to make the right connections.

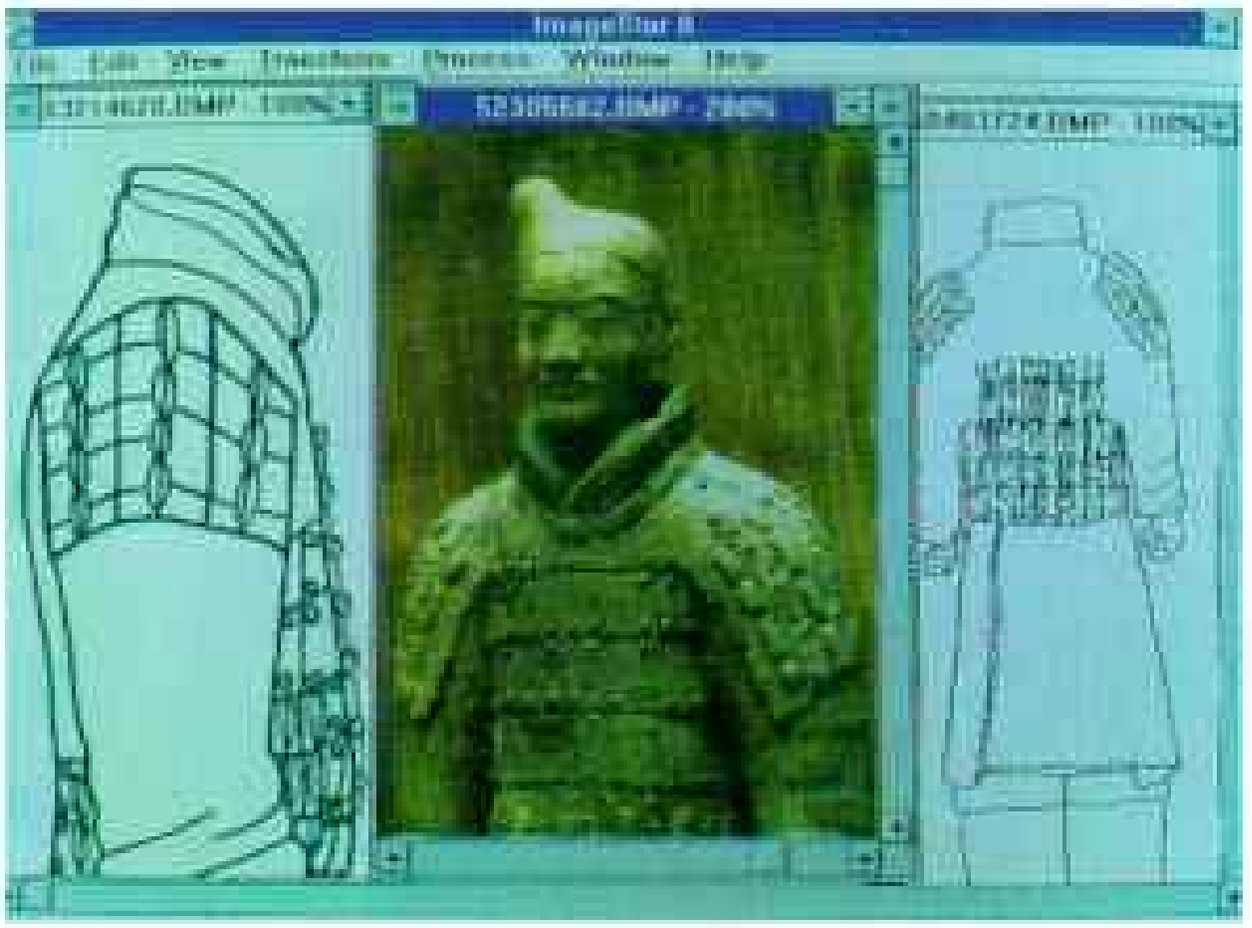
A soldier's face gazes wistfully skyward in a heap of crumpled comrades (opposite). To aid assembly, pieces are coded. Marks indicate where the item was found and to which statue it might belong. Thousands of fragments awaiting connective surgery have lain for years in long piles at the western end of the pit. Buried beneath them, more statues await resurrection.

Each soldier's face is distinctive, and some experts think that real soldiers served as models. "Because each statue has its own personality," says an archaeologist, "we have special feelings for all of them."

In the museum's computer center a monitor displays a photograph and detailed sketch of the back and side of an armored soldier (bottom). An exhaustive database is being compiled on all statues, bronzes, and other artifacts found in the pits. Their images, descriptions, and conservation history will be stored for future reference.

The computer center is also working toward production of a CD-ROM for tourists and another for scholars. Inspired by the film *Jurassic Park*, one engineer would like to develop a program that would manage artifacts, buildings, and grounds. The system would be particularly important in any future excavation of Qin Shi Huang's tomb.

"Instead of keeping track of dinosaurs," says He Fan, a technician at the computer center, "we will keep track of our warriors."



Emblems of imperial might

"A creation of awesome scale and accomplishment—an unforgettable symbol of the power of China's first emperor," says Jeffrey Riegel of the University of California at Berkeley. A strong morning sun spotlights the grandeur of armored soldiers leading a horse-drawn chariot past the serrated roofline in Pit 1.

Intent on unifying his conquests, Qin Shi Huang standardized weights and measures, written language, and currency—including the bronze ban liang coin (left). His massive public works projects—among them the Great Wall—demanded hundreds of thousands of forced laborers and huge tax levies.

A split bronze tiger (below) testifying to the authority of the bearer would prevent possible mutiny: Only a general with the emperor's matching half could procure troops from a provincial prefect.

"Qin Shi Huang wanted an army with him after he died," says museum director Yuan. "His underground empire was a miniature of his real one." More than 700,000 laborers toiled 36 years building his monument. At the age of 49, after an 11-year reign as emperor, Qin Shi Huang died while on a journey in search of the elixir of life. Four years later a rebel army set the mausoleum ablaze.

"Qin Shi Huang gave impetus to all of Chinese history," says Yuan. "He did some bad things, yes; but he did more good than bad." □

Like a spaceship on a strange planet, the *Johnson-Sea-Link* submersible reaches for a sample of the mussels ringing a pool of brine on the sea-floor. The profusion of life 2,000 feet below the sea astonished scientists who discovered this inhospitable world in 1984. Research has since revealed that these mussels and other animals survive on bacteria that consume naturally seeping gases.

LIFE WITHOUT LIGHT

THE COLD DARK
DEPTHS OF THE GULF
OF MEXICO HARBOR
MILLIONS OF
CREATURES
SUPPORTED BY
UNDERLYING FIELDS
OF OIL AND GAS.

By Ian R. MacDonald and Charles Fisher
Photographs by Jonathan Blair

NO MATTER HOW many dives we make, the transition from the surface to the depths is always intense. The sky disappears in a rush of foam around the clear observation sphere of our submersible. The light softens, then fades slowly. Bioluminescent organisms soon glow like sparks rising from a campfire. Two thousand feet down we land on an underwater lake of brine so dense that it remains in a depression on the seafloor beneath the Gulf of Mexico. Ripples spread to the lake's shore, cold and dark but far from barren. A colony of mussels surrounds us. Amazingly, they are living off naturally seeping gases, without the benefit of light-driven photosynthesis.

The lake lies about 80 miles off Louisiana, where the continental slope starts its descent to the Gulf's basin, some 12,000 feet deep. Across most of its northern edge the slope buckles into mounds, ridges, and valleys. These formed during the upheavals of a vast salt deposit laid down more than 150 million years ago.

Rising relentlessly, the buoyant salt cracked the increasingly dense layers of sediment that had settled on it through the ages. Fissures reached the seafloor, allowing oil, natural gas, and related substances to seep into the Gulf. This chemical enrichment has fueled the development of luxuriant communities of animals such as clams, mussels, and tube worms.

Scientists have long known of similar clusters at hydrothermal vents, yet until a dozen years ago no one imagined that the seafloor here could support such abundant life, and no one had reason to look.

In the 1940s the first offshore oil wells in the Gulf began to open some of the world's richest fields, but technology limited production to depths of only a few hundred feet. Not until the late 1970s did new engineering techniques allow drilling platforms to take exploration into the deeper waters where seeps appear.

Oil companies have a tremendous economic interest in discovering seeps—proof that pay dirt lies below—and employ an array of scientists in the quest. In 1984 researchers from Texas A&M University made a surprising discovery. Hoping to study how chronic exposure to oil affects marine life—important information for assessing accidental spills—they trawled above seeps, expecting to find a few sick fish and crabs. Since no sun reaches the deep sea, there are no plants to eat, and the sparse material drifting down from surface waters cannot feed many animals.

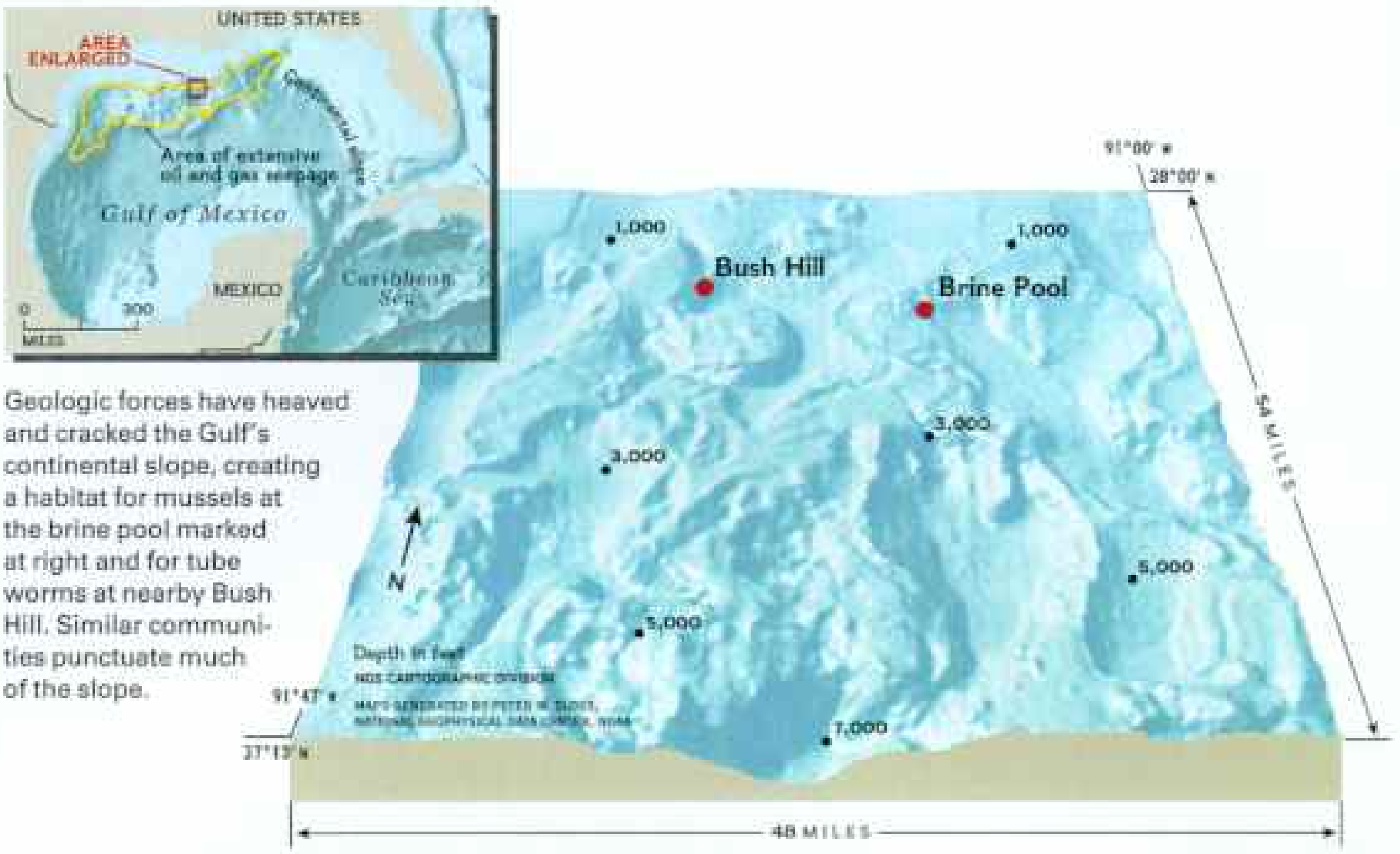
An iridescent sheen the size of a dinner plate spreads from a drop of crude oil atop the Gulf. Escaping through fissures in the earth, such drops indicate that oil and natural gas deposits lie below. As technology has improved, prospectors have moved to seeps in deeper water, leading scientists to the animals that congregate there.

Instead their nets came up so full of mollusks and tube worms that they could hardly hoist them onto the ship. Assuming the leathery tube worms had washed down from coastal waters, the researchers almost pitched them overboard.

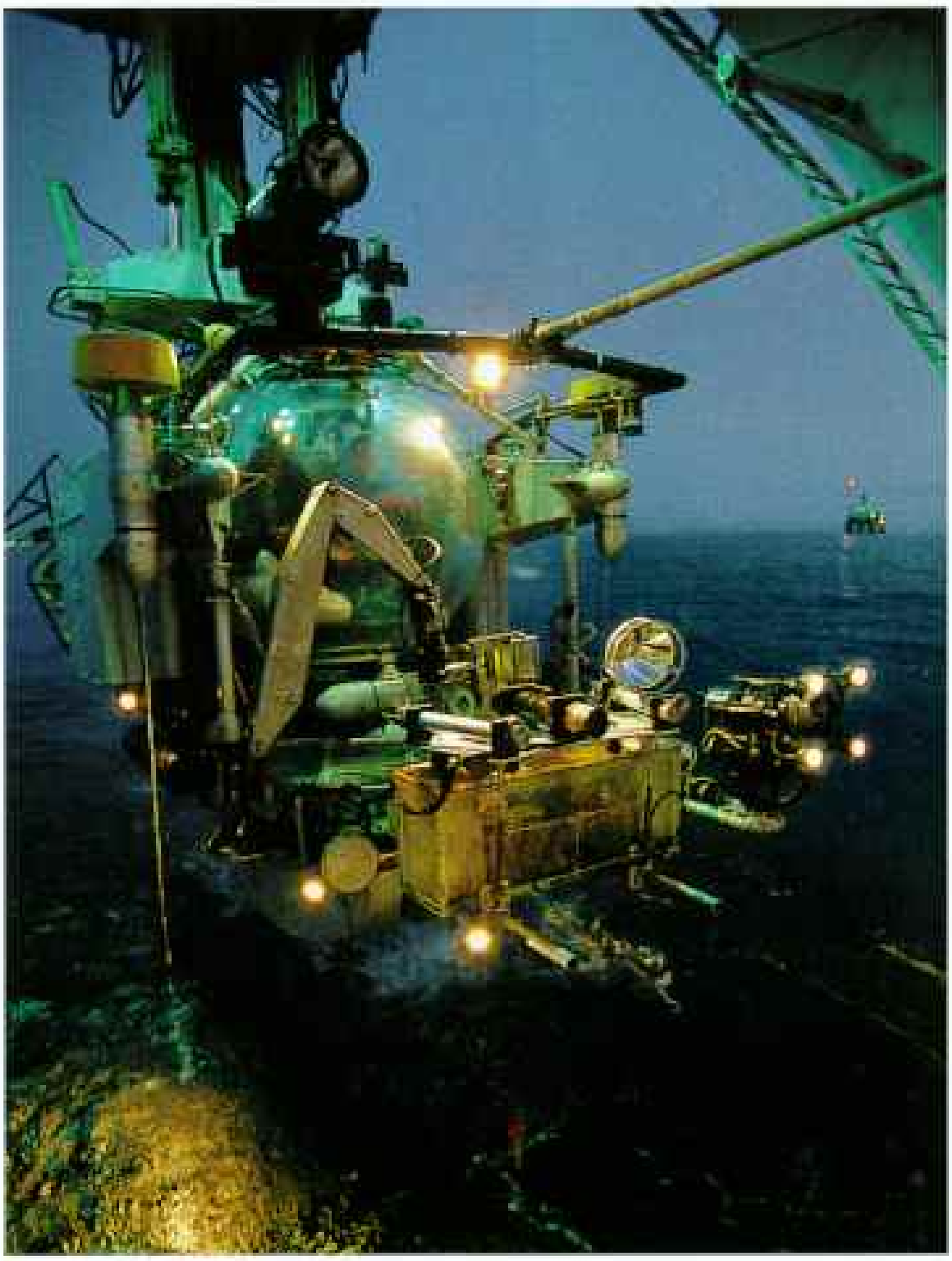
We now know that methane and hydrogen sulfide feed bacteria that support the tube worms and mussels. They have likely established their long-lived colonies over hundreds of square miles, at depths below 1,200 feet. Though the two creatures tend to congregate around different geologic features, both rely on a symbiotic relationship with bacteria.

These animals may contribute to the health of the planet. The mussels, for instance, help remove methane—a gas thought to be involved in global warming—from the Gulf. How much gas their communities consume is one of the many mysteries that remain about the creatures that inhabit this realm of perpetual darkness.

IAN R. MACDONALD is an oceanographer at Texas A&M University. CHARLES FISHER is a marine biologist at Pennsylvania State University. JONATHAN BLAIR last photographed the Silver Bank for the July 1996 GEOGRAPHIC.



Geologic forces have heaved and cracked the Gulf's continental slope, creating a habitat for mussels at the brine pool marked at right and for tube worms at nearby Bush Hill. Similar communities punctuate much of the slope.



Getting Down to Business

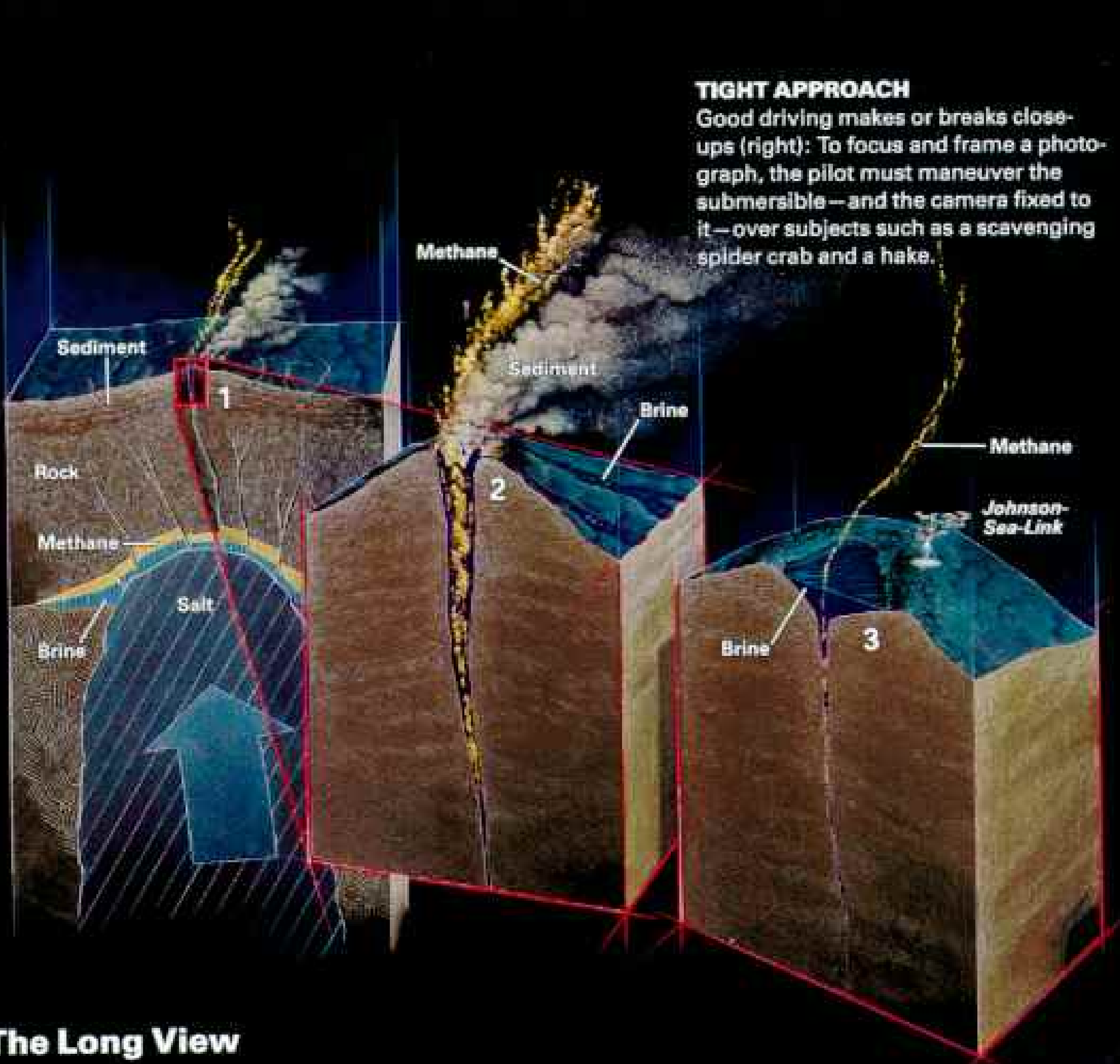
Reeled onto the mother ship at day's end, a submersible holds the catch in its collection box, foreground. Scientists waiting on deck will rush specimens in buckets of cold water to the ship's lab. Their experiments depend on two dives a day during a yearly cruise of just a few weeks. "You learn to ask questions real efficiently," notes author Chuck Fisher.

When researchers first trawled this area a dozen years ago, they expected a small haul of sea life sickened by oil. They got just the opposite. "Nets were so full of shells and tube worms they were threatening to rip," says Fisher.

Kin to the short-lived colonies at volatile hydrothermal vents (GEOGRAPHIC, November 1994), mussel and tube worm communities here thrive for centuries, supported by the steady seep of gases.

DIVE TIME ON JOHNSON-SEA-LINK COURTESY HARBOR BRANCH OCEANOGRAPHIC INSTITUTION AND NOAA

TIGHT APPROACH
Good driving makes or breaks close-ups (right): To focus and frame a photograph, the pilot must maneuver the submersible—and the camera fixed to it—over subjects such as a scavenging spider crab and a hake.



ART BY C. BRUCE MORSER

The Long View

Salt deposits from the days of the dinosaurs gave rise to the contorted geology that allows colonies of seep mussels to thrive. During the Jurassic period the precursor of the present-day Gulf of Mexico dried up, laying down a massive salt bed. Once waters returned, sediments accumulated and were compressed as overlying layers—and weight—grew through the millennia. Increasingly compacted, they turned to rock.

Salt, however, cannot easily be compressed. Eventually, several million years ago, the rock became denser than the salt below it. The salt then began to rise to the surface, propelled by the same principle of buoyancy that makes oil seeping from the seafloor float to the top of the denser seawater.

Forced upward, huge pillars of salt *(1)* crack the rock. When one of these pillars, called diapirs, pushes into a pocket of natural gas trapped between layers of rock, the methane-rich gas rushes through the cracks to escape, the authors believe. "It releases tremendous amounts of energy," explains Ian MacDonald. "Imagine an aquarium full of mud and a high-pressure hose underneath." The result: a seafloor crater *(2)*.

After the initial blowout, salt from the diapir continues to mix with water trapped in the rock and forms brine. Much denser than seawater, the brine settles in the crater to form a lake *(3)*. In time the crater walls collapse, creating a broad beach that the mussels can colonize. Methane, now bubbling up gently in the brine, provides nutrients. The mussel community on the beach mapped at right has likely flourished there for centuries.

IAN MACDONALD (ABOVE AND BELOW)

A NEW ANGLE
The latest in underwater imaging shows the halo that hundreds of thousands of mussels have formed around a brine pool some 60 feet long by 40 feet wide. Attached to NR-1, the U.S. Navy's smallest nuclear submarine, a laser line scanner mapped the pool section by section. Assembled, the sections yield a picture unaffected by reflections from floating particles that tend to distort conventional underwater photographs.

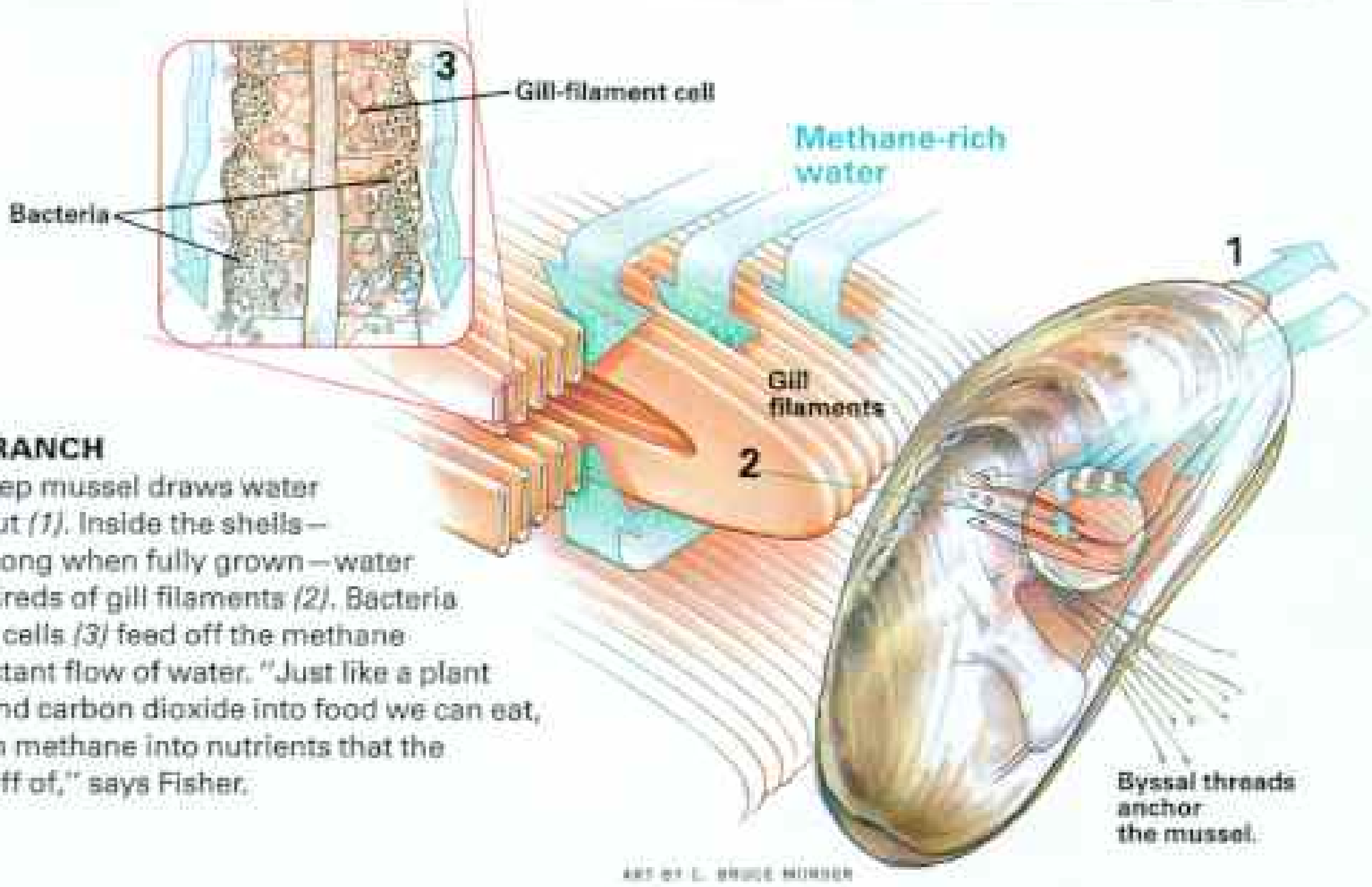
Living on the Edge

Location is everything, even when a home is underwater. Mussels (above) that fall into the brine lake or get flooded die quickly. Almost four times as salty as seawater and containing no oxygen, the brine is lethal to most animals.

On the other hand, mussels close to the lake benefit from being near the source of methane, which supersaturates the brine under extreme deep-sea pressure. Young mussels crowd the rich inner edge of the colony; empty shells litter the outer fringes.

"In the lab you can take this mussel, give it methane, and watch the shell grow," says Fisher. Yet what seems like simple cause and effect actually involves a unique symbiosis. The mussel doesn't mainline the methane; bacteria in its gills feed on the gas, and the mussel consumes the bacteria, the bulk of its diet. With a mouth and gut, a seep mussel can also feed like its relatives that live in shallow water – filtering particles of food from the water – and may take in vital supplements that way. "When you're living off one symbiont, you're in danger of a junk-food diet," says Fisher.

The community is a smorgasbord in the desert of the deep. Squat lobsters nip at mussels, snails eat bacteria from shells, and eels feed on whatever they can (above right). A lone fish waits for a meal to swim past (top right).



THE BACTERIA RANCH

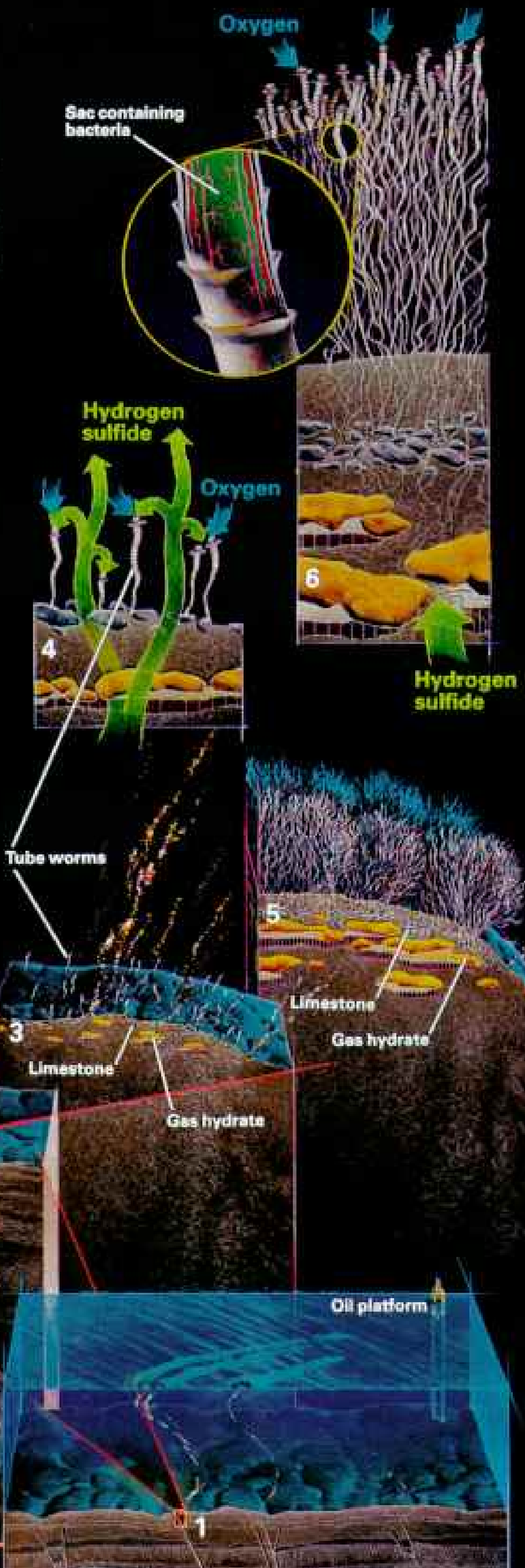
Cocked open, a seep mussel draws water in and pushes it out *(1)*. Inside the shells—about five inches long when fully grown—water washes over hundreds of gill filaments *(2)*. Bacteria that pack filament cells *(3)* feed off the methane carried in the constant flow of water. "Just like a plant turning sunlight and carbon dioxide into food we can eat, these bacteria turn methane into nutrients that the mussels can live off of," says Fisher.

ART BY L. BRUCE MONGER

Geology Baits the Hook

Sometimes miles long, cracks in rocks under the Gulf can let oil and associated gases escape from the same kind of reservoirs that an offshore rig taps *(1)*. Bacteria collect there to feed on the chemical feast. Some create a mat on the seafloor that traps the oil and gas *(2)*. These bacteria give off high concentrations of carbon dioxide, which eventually forms carbonate rock such as limestone, offering a firm base for tube worms to colonize *(3)*. Cold combined with pressure creates a gas hydrate—gas held in a lattice of water crystals (opposite, bottom)—which further traps the oil and gas below. In the sediment other bacteria transform hydrocarbons and sulfate into hydrogen sulfide.

Gas-laden water percolates into a young colony. There a worm's gill-like plumes extract hydrogen sulfide and oxygen *(4)*. Both pass into a central sac to feed bacteria there, which the worm "milks" for food. As the colony ages, its foundation solidifies and slowly blocks the gases *(5)*. Eventually, a worm must seek out the hydrogen sulfide with its rootlike end *(6)*.



ART BY C. BRUCE MORSER

An Oasis of Worms

As thick as shrubbery, a tube worm colony 15 miles from the brine pool lives up to its nickname, Bush Hill. Worms stained blue a year ago show less than an inch of new, white growth. The longest, at eight feet, are more than a century old.

Such communities dot the continental slope wherever free-floating larvae settled at a seep. The biggest may contain tens of millions of residents.

"They're really lovely," says MacDonald. "They look like topiaries."

Flushed with blood, plumes blossom from the top of each worm. Blood also colors the thin walls of the buried trunks. Hydrogen sulfide, lethal to most creatures, can enter either blood-enriched end. There the gas binds with a specially adapted hemoglobin, which carries it to symbiotic bacteria. As the base rock becomes impenetrable in very old communities, the worms in the center likely die when their access to hydrogen sulfide is cut off.

Like seep mussels, tube worms attract visitors. Squat lobsters, such as the one grazing above, nibble bits from the plumes and leave them ragged.

ROGER SASSEN

Fishing for Results

A six-foot dogfish prowls near a research marker on Bush Hill, the high-grass savanna of this deep-sea world. Like lions and leopards, top predators such as sharks and rays may stalk the smaller animals that depend on the tube worms and nearby seep mussels for food.

Scientists wonder how far

CHARLES FISHER

this food web extends and how much it affects the health of the Gulf.

"Ten years ago we wouldn't have asked those questions, because we would have assumed that they weren't important," says Fisher. "Now we know they are well worth pursuing." □

MOR

North Africa's Timeless Mosaic

By ERLA ZWINGLE

Photographs by BRUNO BARBEY
MAGNUM

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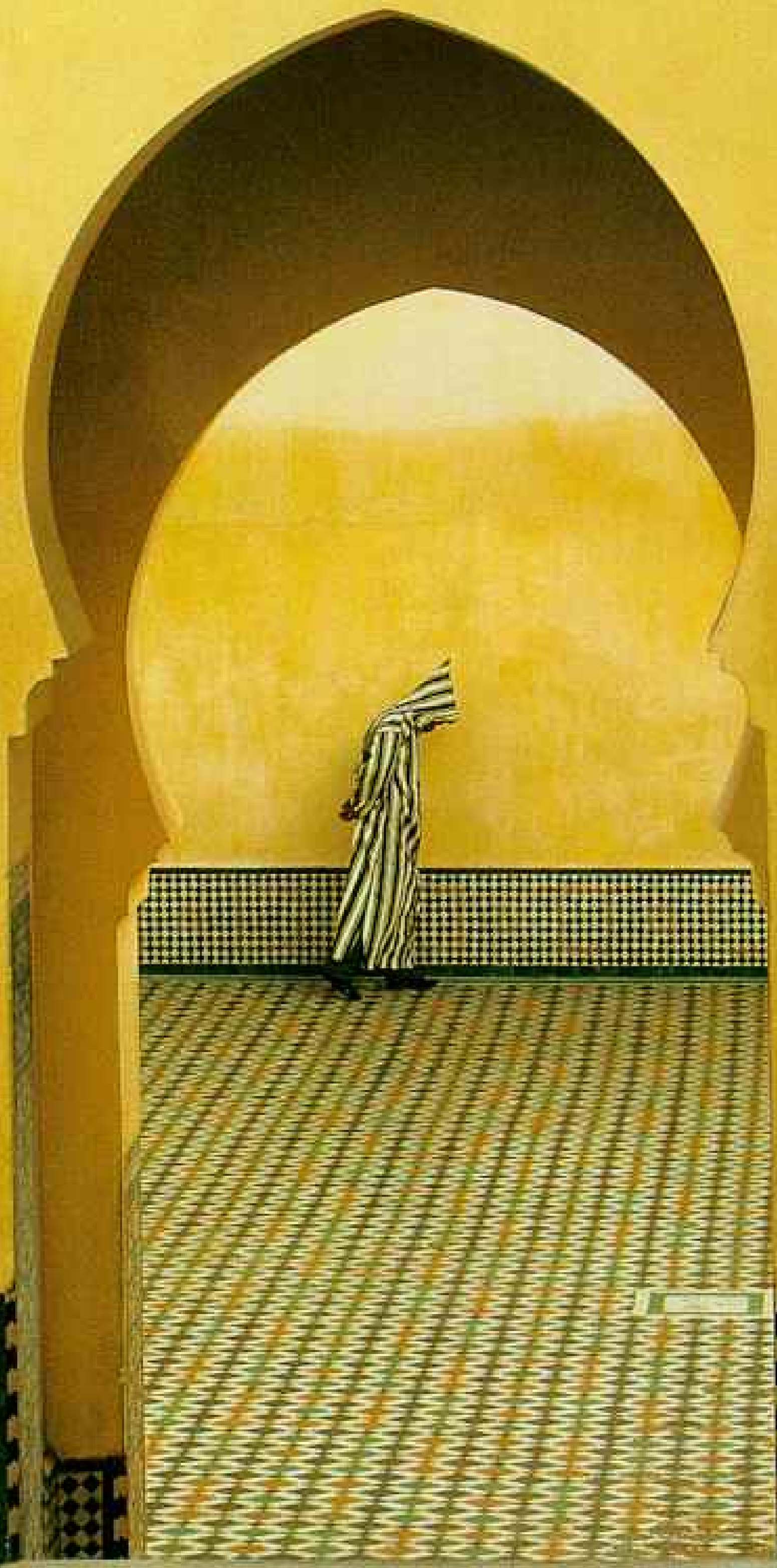


Like a tile to be placed in the design, a pilgrim moves through the shrine of Moulay Ismail—the sultan who united Morocco in the 17th century and earned the country international renown. He also tortured his slaves and pampered his camels. Such incongruities are typical of Morocco, a land where beauty and adversity walk side by side.

Pirate stronghold for centuries, the coastal city of Essaouira (formerly called Mogador) was fortified in the 1760s by a French architect held captive by the sultan. Today it thrives on fishing—one of Morocco's growth industries—which accounts for 15 percent of all exports.

THAT SPRING AFTERNOON in the heart of Marrakech was uncommonly hot and dusty. Through the window of the house where we sat came the usual Moroccan cacophony of traffic—the drill-like whine of motorbikes, the roar of countless unmuffled cars and buses and taxis. But then we heard something else: drums, reedy pipes, men singing.

A wedding procession was moving down the street toward a house where the bride was waiting. Buses and taxis slowed to pass the seven small wooden carts, each drawn by a dusty donkey. The carts were laden with elaborately wrapped wedding presents. Two bands of hired musicians, one at the front and one at the end, took turns extolling the bride and the bliss that awaited the couple. From time to time the procession paused, and passersby would stuff money into the musicians' pockets, sleeves, even under their caps, where the cash formed a fluttering fringe.

As the spirit moved them, the bride's attendants, each wearing a vivid satin dress, would begin to dance sinuously to the urgent, complicated handclaps of the musicians. With each stop the dancing and singing became more fervent. Atop the last cart was a tremendous ram; he lay on his side, firmly lashed, panting rapidly, his eyes closed. I had the feeling he knew the day was not going to end well for him.

There was something powerful, even biblical, about the scene, made stranger by the diesel exhaust surrounding it. But a month in this country made it clear to me that the scene was also powerfully Moroccan, a vital mixture of ancient customs and modern ideas, of sudden beauty and persistent poverty, of tenacious past and imperfect present. The new urgency in Morocco is how to prepare to meet the future.

Morocco is a nation of nearly 28 million poised on the northwestern cusp of Africa, a mere eight miles from Europe. This geographic circumstance has, over the past 3,000 years, given Morocco an importance far beyond its small size. It has taken the best from Phoenicians and Romans, Arabs and black Africans, Muslims and Jews, indigenous Berbers and periodic European colonizers: Portuguese, Spanish, and finally the French.

Moroccans are justly proud of their past brilliance; of their medieval empire, which stretched from Spain to Libya; of the refuge they provided to thousands of Jews expelled from Spain in the 1490s; of their kings, such as Juba II, who married the daughter of Marc Antony and Cleopatra and wrote learned treatises in Greek on philosophy and botany; of the fact that Morocco was among the first nations formally to recognize the fledgling United States.

Today, 40 years after gaining their independence from France, Moroccans are facing an array of challenges perhaps greater than all that have come before. A high birthrate means that half the population is under 20 years of age. That overwhelming reality already exerts pressure on virtually every aspect of society, especially on education (too many students, not enough schools) and on the economy (190,000 young people a year enter a job market that can handle only about 130,000). So many Moroccans emigrate to find work that the money they send home is one of the nation's main sources of hard currency. More and more people abandon the countryside to try their luck in the cities; 30,000 arrive in Casablanca every year. And there remain deep rifts between rich and poor, city and countryside. Even within families there are often sharp differences of opinion between generations. Sensing the potential instability beneath all this, Moroccans cast an uneasy eye on the violent Islamic fundamentalism in neighboring Algeria.

Former assistant editor ERLA ZWINGLE last wrote for NATIONAL GEOGRAPHIC on Venice, Italy, where she now resides as a freelance writer. BRUNO BARBEY lives in Paris but spends much of his time photographing North Africa and Asia.

Just eight miles from Spain, Morocco might have lost its soul to Europe—but refused. Though conquered by Rome and colonized by Spain and France, Moroccans held fast to their Berber culture, while adopting the Islam brought by Arabs from the east.

The political structure to address these problems presents difficulties. There is a constitution and a parliament, but a multiplicity of parties in the grip of a crepuscular old guard jockey for position under the stern control of an absolute monarch, King Hassan II.

Then there are the Berbers, descendants of an ancient race that has inhabited Morocco and much of North Africa since Neolithic times. Outside the cities Berbers are often easy to distinguish from other Moroccans by their dress. In the deep south, toward the Sahara, women in black glittering with sequins saunter along the road. In the west they are swathed in white. Some Berbers of part Caucasian ancestry have fair complexions and blue eyes.

Inasmuch as an Arab ruling class has dominated Moroccan political life for many years, it's tempting to think of Berbers as exotic outsiders, but in fact they preceded the Arabs in this stony land and are still the country's bedrock. More than a third of the Moroccan population speaks at least one of the three Berber languages (and some still speak only Berber). "Morocco *is* Berber," says Mahjoubi Aherdan, longtime leader of the Berber party, "the roots and the leaves."

Morocco's greatest glory as an empire—the mid-11th to the mid-14th centuries—came under a succession of Berber dynasties. The Berbers have always been famous as warriors, yet despite their numbers, for generations they lived apart, a visible but mostly silent presence, notoriously resistant to being controlled by any system beyond the tribe. But today Berbers are part of mainstream society, and Morocco is newly inclined to acknowledge its Berber heritage.

Finally, there remains a problem even more basic than all the others: the Moroccan approach to problem-solving itself, a languid version of fatalism that can be charming if you're not trying to accomplish something.

"Here time isn't money yet," said Hakim Benjelloun, a Casablanca architect trained at the University of California, Berkeley. "If a project is a month late, that's fantastic. Here's the definition of Moroccan time: If you have an appointment at 1 p.m., you arrive at 2 and wait until 3. If he's not there by 4, you wait until 5; then you leave."

For many Westerners, this attitude has long been part of Morocco's appeal. For at least a century, artists and writers reveled in what they felt was a new kind of freedom. For hippies in the 1960s, Morocco was one of the great places to go; American rock star Jimi Hendrix, for one, spent five years in Diabat, a village near the Atlantic coast whose ruined palace inspired his song "Castles in the Sand." French artist Henri Matisse said that his time in Morocco marked a turning point in his career; some say it gave his work a new spirituality. Scores of writers have tried to capture the essence of Morocco. Describing the Tangier market, Mark Twain wrote, "The scene is lively, is picturesque, and smells like a police court."

On the whole the fabled romance of Morocco eluded me. Though pleasant, the prospect of lounging in a shadowy café sipping yet another small glass of mint tea saturated with sugar never struck me as a newer, deeper level of spirituality, and endless hours driving my battered rental car on twisting roads, facing headlong Moroccan drivers who had clearly made their peace with God, produced a sickening mixture of fatigue and fear. The real Morocco, I was to find, is less about romance and more, much more, about adversity, struggle, and hope.

SOUTHEAST FROM MARRAKECH, toward Ouarzazate and Zagora, the Sahara begins to sweep silently across the horizon. Instead of dunes there is a flat, stony plain, broken by reddish sand buttes and strips of green date palms bordering thin rivers. Monotonous little red-brown villages literally built from the earth are strung along the highway: mosque, café, gas station, and arcaded shops, including at least one butcher with miscellaneous chunks of meat hanging out in the open air. Small groups of men, most of whom are wearing the traditional *djellaba*, or loose cotton caftan, sip mint tea and watch the road.

The paved road ends at Zagora. It has a bustling, frontier atmosphere cheerfully geared toward tourism, primarily camel treks. Abderrazzak Mejda, my interpreter, and I had called ahead to reserve two days, three camels, one wrangler, and a cook. I was hoping that the desert would reveal something of the real Morocco.

No need to dwell on the camels; they made the usual alarming noises but

Desert way station, Marrakech prospered from the gold, ivory, and other exotica that passed through on camel caravans bound for Timbuktu or the Barbary Coast. Winston Churchill, who took painting holidays here, called Marrakech the "Paris of the Sahara." Today this city of 600,000 is Morocco's third largest.

were tranquil enough. More interesting was the young man who tended them; his name was Brahim, and he had been born in the desert. He was friendly but reserved; he wore a djellaba over blue jeans, the customary cotton-gauze turban, and rubber flip-flops. All he carried was a small stick, but the camels obeyed him. Whenever we stopped to rest, he would light a Marlboro but wouldn't take a drink of water. For me, the desert air was parching.

We strode slowly across the hard, pebbly ground, past small clumps of hardy wildflowers. After four hours a few genuine dunes began tentatively to appear, and among them was a collection of tents.

Our tent was a classic three-walled structure made of heavy wool blankets slung on poles. The cook, another young man, had already prepared tea and *tajine*, the traditional meat and vegetables slowly cooked in a covered clay pot. Brahim made the bread.

A last delicate pink cloud drifted away as the light faded and stars gathered

Snake charmers, acrobats, beggars—all throng at night to a dusty clearing in Marrakech called Djemma el Fna ("assembly place of the nobodies"). There they compete with water sellers and food stalls for the attention—and dirhams—of passersby.

Working to the music of hammer on silver, sons polish their father's handiwork in Place Seffarine—the metalworkers' market—in the old city of Fez. A nearby shop sells verses from the Koran (right). Family businesses are common; they provide a cushion against poverty for those who learn a trade as children, then live in the family home as adults.

overhead. Brahim heated a batch of largish black stones in the campfire, mixed the bread dough, sprinkled it with water, pressed it onto the hot stones, and proceeded to bury stones and dough in the sand. He then covered the mound of sand with burning twigs. After an hour or so he removed the round loaf and scraped off the sand. The bread was soft and fragrant, and we ate it all.

But despite the traditional trappings—the carpets on the sand, the camels belching in the darkness—somehow it didn't seem real. There were faint Land Rover tracks, and the lights of Zagora dimly glowed in the distance. The desert had clearly become just another tourist commodity, with overnight nomads and Coleman lanterns.

Still, this was undeniably part of the real Morocco. Tourism is Morocco's third largest industry, after agriculture and mining, generating a billion dollars a year. Europeans come for hiking and skiing in the Atlas Mountains, or to the beaches around Agadir, or for fishing or golf or hunting birds. Americans come for the culture, the faintly sinister convolutions of the medieval *medina* of Fez, where they comb the market for amber and silver and leather and carved wood.

Brahim has long seen his future in tourism. His father is dead, and as the oldest son of a family of five he is trying to develop a plan to help support them. "What I want is to save enough money to buy my own camels," he told me. "That way I can organize my own treks, instead of working for someone else." It was after dinner, and we were sitting on the ground around a low table, nibbling sliced melon.

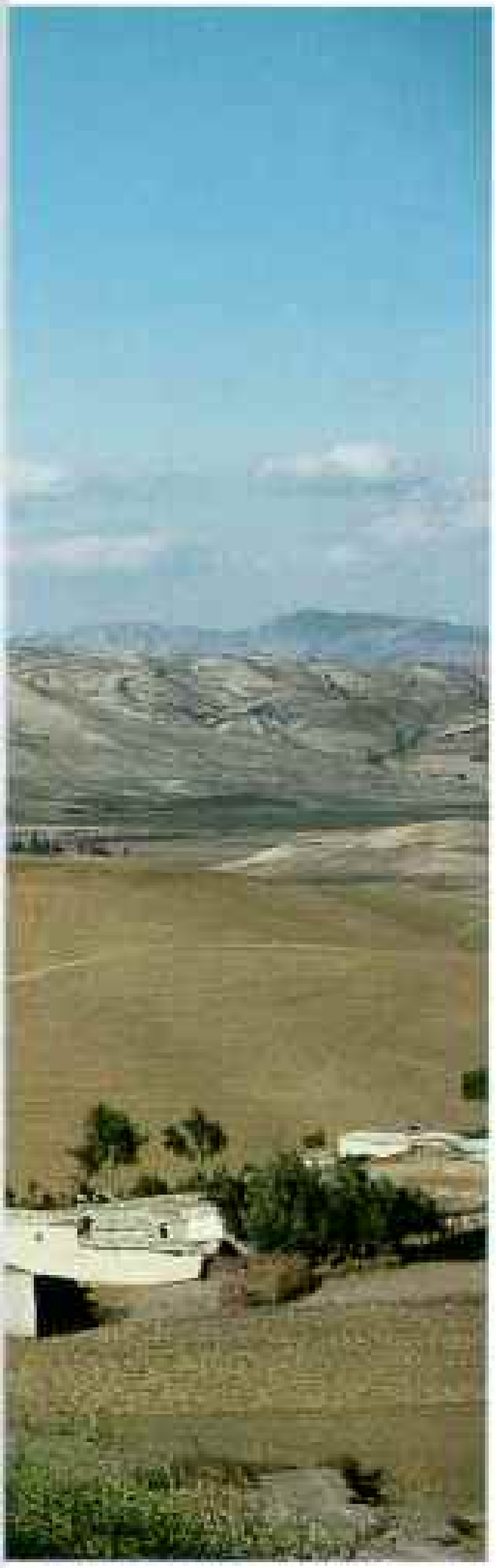

فسيكفيكهم الله
وهو السميع العليم

Straight and hard as his rifle barrel, a Berber tribesman in Tissa prepares to take part in a fantasia, *a traditional entertainment that simulates mounted warfare. Behind him lies the Rif Mountain stronghold of the nation's ten million Berbers—fierce fighters who rebelled against the Spanish in 1926 and inspired Morocco's quest for independence.*

How much does a camel cost? "A good one will cost 7,000 dirhams [$800 U.S.]," Brahim said. "All I need is to buy the camels; I can borrow the saddles and other things from my friends."

Though the per capita income in Morocco is only $1,300, Brahim seemed less concerned about finding the money than about learning to read and write. Nearly three-quarters of the rural population is illiterate, and even though Brahim had an impressive memory, quickly trying out bits of Italian, English, and German that he'd picked up from tourists, he knew he could never operate a business without acquiring some formal education. He had no idea where to start.

It was midnight. Brahim removed a dung beetle from the carpet and spread out several wool blankets for me that were as thick and heavy as felt. The breeze slowly dropped. I awoke briefly once. The air was freezing. The distant stars magnified the silence.



BRAHIM'S DETERMINATION to improve his prospects was not unusual; in Morocco the struggle to make a living is ubiquitous. I saw young men in the foggy forest outside Rabat, the capital, tending makeshift stands piled with white truffles, the common local variety. Arranged in neat pyramids, the fungus sold for about three dollars a pound. There were stands strung out along the road for miles, one stand within sight of the next. I never saw a car stop.

There was the ancient man walking slowly down the street in Casablanca carrying a censer. He would enter a shop, a café, or an office and spend a moment gently swinging the censer on its chain to send perfumed clouds into the air. There was no fee; he accepted whatever people wanted to give for this unbidden service.

More common and less beautiful were the shoeshine boys constantly circulating through the cafés, tapping their brushes against small wooden boxes that served as footrests. Then there were the little boys roaming the streets of Fez with mere handfuls of things to sell: small packets of tissues, flashlight batteries, cigarettes. They would pass the cafés and offer these things in a whisper, urgently, watching for police.

Other Moroccans work just as hard but at a much higher level. Abdelaziz Alaoui comes instantly to mind.

One morning we climbed into his Mercedes and sped along the highway from Marrakech toward the city of Benguerir. Plains speckled with sheep stretched out in every direction. The sun was already high; the line of eucalyptus trees along the road gave only the impression of shade. Alaoui was talking on his car phone in Arabic while keeping up a running commentary to me in fluent English.

Alaoui is a business consultant with a master's degree in political science. For a number of years he worked in the United States. When he returned to Morocco, he ran for parliament. "I lost," he said. "But I learned things. Less than two miles from my house there were villages with 5,000 people, and they had no water and no electricity."

We're heading now to visit a few of the eight villages that are part of a pilot project Alaoui has created to provide new wells, solar energy, and a *hammam*, or traditional public bathhouse. It's a combination that he's convinced is ideal, both for the villagers and for his business.

"When I asked people what they needed, they said 'Water. Water. Water.' The main activity in every village is to get water. Right now their whole life revolves around getting 50 gallons a day. If you want people to stay in rural areas, you must give them access to water. So what kind of income-producing situation could we create?"

Alaoui and his partners decided that building a hammam was the answer. Instead of traveling four or more miles to Benguerir every week to pay 50 cents to bathe, now villagers will pay the same to use the hammam in their own village. The new well is pumped by energy from a solar kit, and the cost of the kit will be paid off with the bathhouse money.

We pull off the road and drive about half a mile along a stony track to the village of Nouaji. There is a group of people at the old well, each waiting a turn to dip from a dripping black leather bag. Not far away, young men are finishing the concrete work on a trough with four faucets that will send the leather bag into retirement. A new 12,000-gallon water tower stands ready nearby.

An otherworldly town, Chechaouene, in the Rif Mountains, is luminous with shades of blue from indigo-tinged whitewash, thought to repel insects. Refugees from Andalusia came here in the 1490s, when Christians drove the Moors from Spain. They later built mosques and tiled courtyards reminiscent of their homeland.

Robed dignitaries from all parts of Morocco gather in Rabat to mark the anniversary of King Hassan II's 1961 coronation. Respected abroad for trying to broker a Middle East peace, the monarch is also popular at home—despite Morocco's problems, which include a faltering economy and an unemployment rate of 16 percent.

"Do you know how many villages there are in Morocco like this?" Alaoui says. "Thirty-six thousand. If we would do a hundred a year, it would take us three and a half centuries to finish. This gives you an idea of the problem."

A few miles past Nouaji we drive into town, pass a proud billboard—BENGUERIR, CITY OF THE FUTURE—and turn off the main street toward the slums. They're not far. A yearlong drought has driven many to try their luck in this city of 47,000. They settle uneasily into illegal, hastily built concrete-block houses. There are desolate stretches of waste ground with sheep feeding on piles of garbage. Sewage trickles across the street; thin little girls struggle home with heavy plastic jerry cans of water from the few, often contaminated wells.

"Probably 80 percent of the small cities of Morocco have the same problems," Alaoui declares. "Water, sewage, houses, jobs."

We take the road back to Marrakech, passing the billboard as we pick up speed. "Yes," Alaoui says. "It *is* the city of the future."

FOLLOWING PAGES: *To purify themselves before entering the tomb of Moulay Idriss II in Fez, visitors perform ritual ablutions at a courtyard fountain. Idriss made Fez his capital in 808.*

Slums—the worst I saw spread northward from the edges of Casablanca, with crude little huts made of corrugated iron, bits of plastic, scraps of wood—are the most vivid example of the poverty many Moroccans continue to endure. During the 1980s King Hassan imposed stringent economic measures to curtail inflation and shrink debt, and his success has been widely applauded by international banks. But for many Moroccans life remains marginal at best.

Moroccans confront their problems with particular dignity. Newcomers to the cities endure the hardships of their new surroundings with the stoicism essential to farmers and shepherds. I finally gave up waiting for a voice raised in lament, a fist shaken at the heavens. Protest and criticism exist but come from the middle and upper classes; the Moroccan of the countryside simply doesn't complain. In fact, those who had the most to lament always seemed to say the least. Mohammed Ben Ahmed, for example.

The village of Tassoukt lies southeast of Marrakech. As I rounded a curve in the road, I was startled to see a row of six mud houses that had collapsed, literally dissolved by a torrential rainstorm three days before. Under the scalding sun a few men were slowly digging in the heavy mud while several other men and boys stood nearby. Mohammed Ben Ahmed, an elderly man with a dark, heavily lined face, was also watching. One of the houses had been his.

"It was like the sky broke," he explained. "My family and I had only two minutes to get out." But all his sheep and donkeys, along with everything else he owned, lay buried in the mud. His friends were digging out the dead animals before they began to smell; he didn't say that they were also removing the remains of his children's future.

"Some government officials came to take down the information," he continued. "I'm supposed to receive some kind of payment." But he knew that there had been even worse flash floods to the south, and Tassoukt wasn't considered particularly important. The expression on his face told me he wasn't counting on receiving much money, and not soon. "We're all staying with my relatives," he said, "till I can rebuild the house." I couldn't bring myself to ask how long it would take to rebuild his flock.

An air-conditioned tour bus roared past. Through the windows several tourists snapped pictures.

AS THE ONLY NORTH AFRICAN COUNTRY without oil, Morocco has had to make the most of its other advantages. The ocean off Morocco's Atlantic coastline is one of the richest fishing grounds in the world, with some 240 species. In 1995 fish-processing plants produced 227,000 metric tons of sardines, mackerel, tuna, and fish meal. Moroccan fishermen took 571,000 tons of sardines, which was 67 percent of their total catch. Morocco also contains the world's largest phosphate deposits, and although the market was recently depressed, mining remains a major enterprise.

But agriculture has always been Morocco's strength. Morocco's farmers produce everything from wheat and olives to flowers and kiwifruit, and there is a growing export trade—primarily citrus fruit and tomatoes, to Europe, Canada, and now the United States. A range of climate and soil is kind to a variety of crops: in the north, grapes, fruit, olives, and wheat; to the west, more wheat, oranges, vegetables; in the south, dates. And more dates.

As recently as 30 years ago 70 percent of the people lived in the countryside. Today rural folk account for slightly less than half the population. Yet except for the Imperial Valley-like farms near Agadir and Fez, most agriculture continues on small holdings with a minimum of technology.

After several weeks in Morocco I began to feel overcome by the choices, problems, and possibilities facing the country. Hoping for a broader perspective, I went to a dinner party at the house of architect Hakim Benjelloun and Zineb, his wife.

Their house in Casablanca was an oasis of cool marble and calm. Masses of fresh-cut roses stood in crystal vases, and candlelight glinted off silver picture frames. From small bowls there arose the delicate scent of dried roses, a specialty of the mountains northeast of Marrakech. As servants came and went, Zineb presided tranquilly over huge platters of roast lamb and chicken with pears. A small group of young professionals ate, drank French wine, smoked Cuban cigars, and argued about Morocco.

I commented—innocuously, I thought—that I'd never seen so many banks as there were in Casablanca. With nearly three million people and 60 percent of the country's industry, Casablanca is Morocco's largest city and main commercial center.

"Actually Morocco is underbanked," promptly replied Ghassan Musallam, a director of the Arab Maroc Bank. "Many people outside the urban areas use only cash."

I'd heard a lot of excited comments about King Hassan's recent state visit to Washington, D.C.; many people seemed to think that money and investors were going to start pouring in. Musallam doubted it. He seemed to delight in nettling the others.

"Moroccans themselves don't invest, so why expect foreigners to?" he asked. "Where is the private sector? It's almost absent. And what's lacking, as in many developing countries, is teamwork. It's not there. You can see it in the attitude of managers—committees are something new in the mental attitude."

I asked him what he thought were the most important areas to develop. Agriculture? Fishing? Tourism?

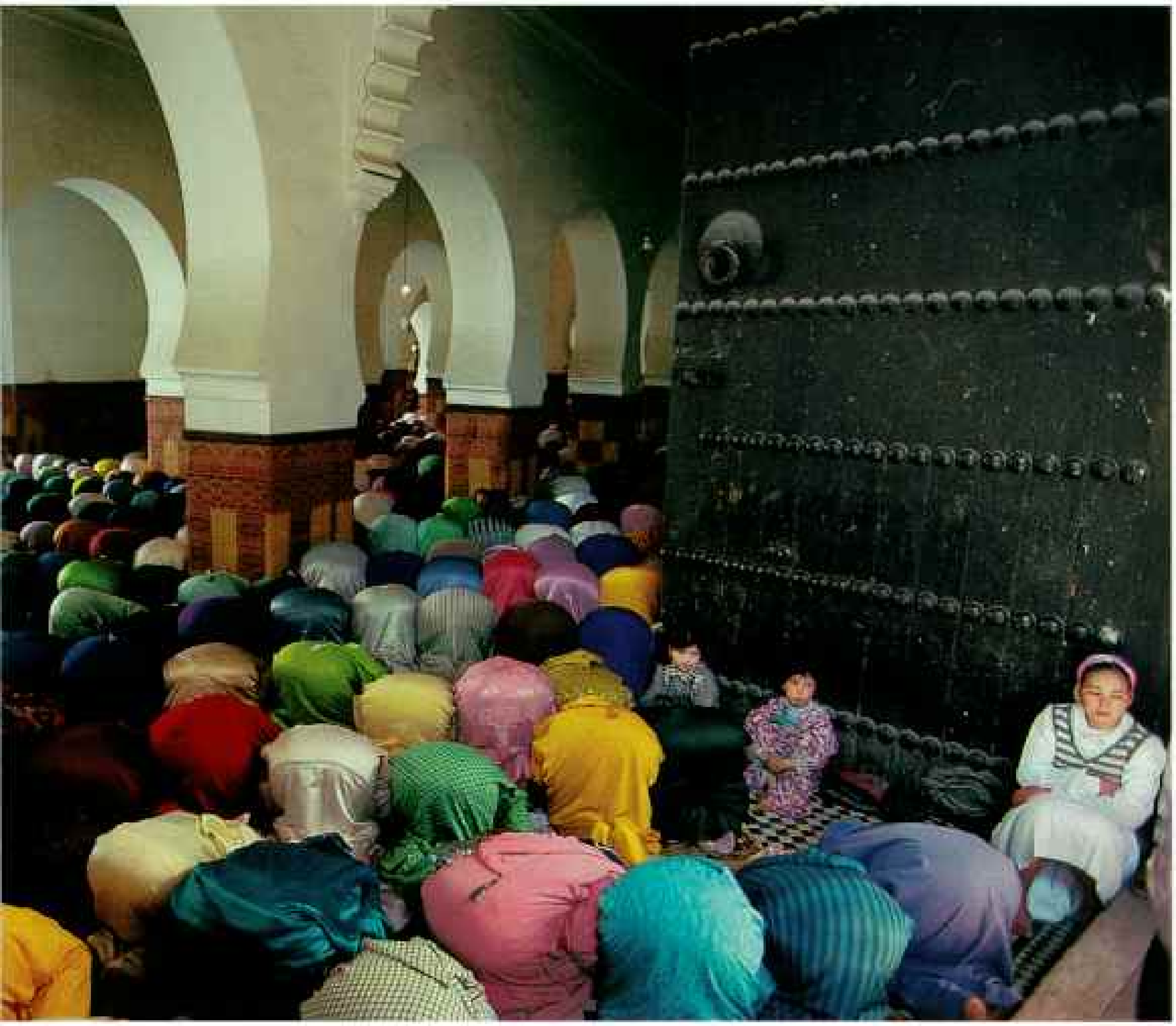
"All of them are priorities," he replied. "But you have to give them enough resources to *be* priorities. If you ask a banker or an industrialist how the country is developing, he can't answer. If there is a genuine will at the top to do something, this isn't being translated into decisions."

There were cries of protest from around the table. "We must be positive," said another banker, "otherwise we'll be overwhelmed."

"We're not a perfect country, but we are perfectible," added a bureaucrat. "When I look east and south, I thank God for the way things are here."

Economic stresses in Morocco have created a culture riddled with corruption. The subject comes up easily and often in ordinary conversations.

For example, it is well-known that along the north coast there is a flourishing black market in goods smuggled from Europe, everything from televisions to



Peace settles over the Qarawiyin Mosque in Fez as Muslim women face Mecca to offer prayers during the holy month of Ramadan. Founded in the ninth century, this venerated mosque gave rise to Qarawiyin University, the oldest Arab university in existence. Shuttling between Fez and Moorish Spain, its graduates helped end the Dark Ages in Europe.

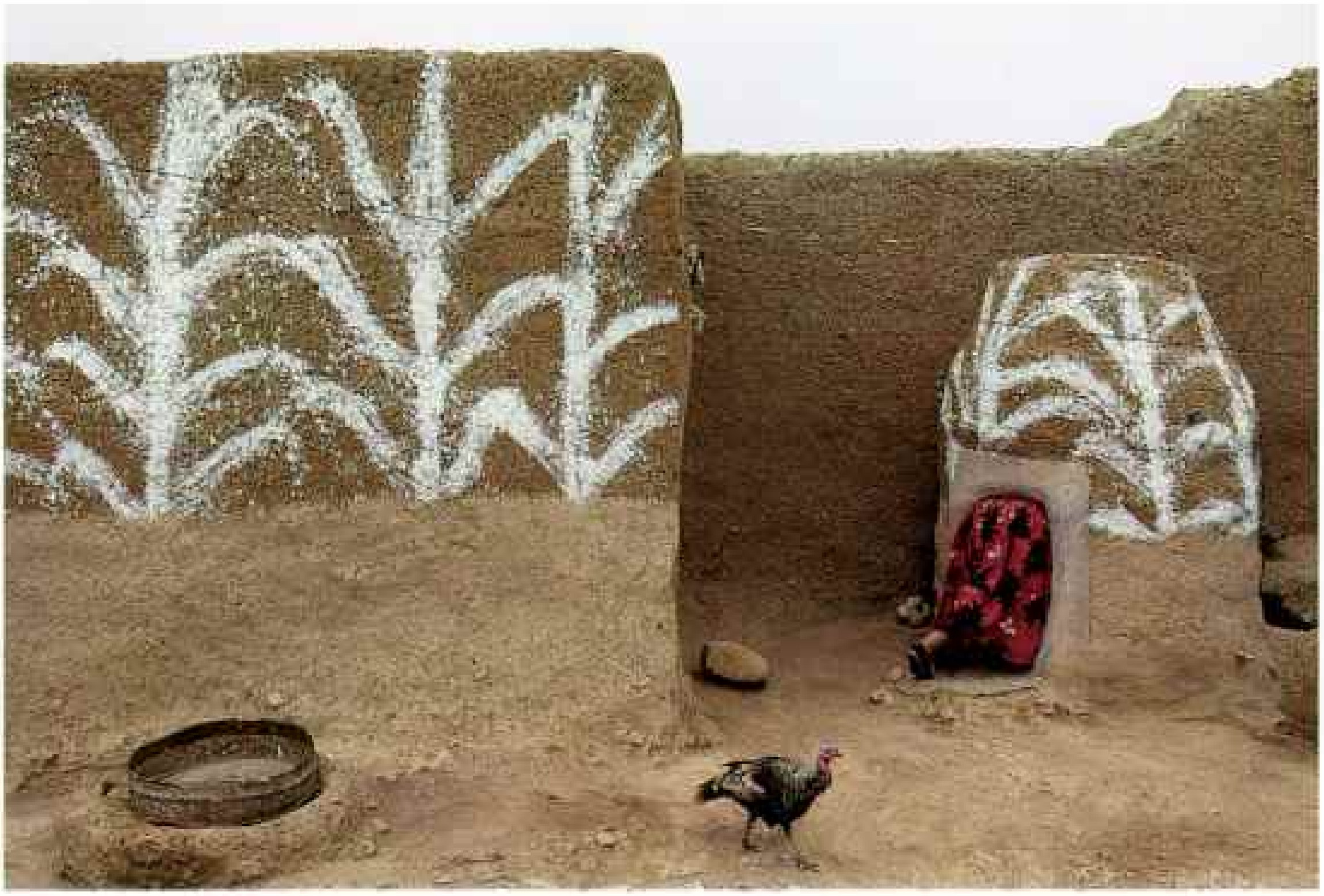
stolen cars. The north is also notorious for kef, or marijuana, which is made into hashish; a reported two billion dollars' worth a year goes out to Western Europe. Sections of the road through the Rif Mountains are lined with young men holding out handfuls of tinfoil packets. And then there is the matter of outright bribery.

"Let's say a policeman gives you a ticket," explained a young professional woman in Rabat. "He has a wife and four children—how could you imagine that this person could live decently on his salary of maybe 2,000 dirhams [$230 U.S.] a month? So everybody understands that instead of paying the parking ticket of 100 dirhams to the state, you give him 50 instead not to write the ticket. It's quite logical—it's a kind of charity. And everybody knows it, even the government. But what can they do? They can't increase the salaries. And even if he did make more, it wouldn't be enough to survive."

It is true, as Moroccans tend to boast, that their country is an oasis of order in

Shielded by his woolen djellaba, *a Berber picks his way along muddy trails of the Ait Bou Guemmez Valley in the High Atlas mountains. These rocky slopes have isolated this Berber village for two millennia—even as Berbers at lower elevations intermarried with Arabs and other latecomers.*

The family hammam, *or bath, is a fixture of daily life in Moroccan villages like Mzouda. Built of dried mud and decorated with chalk motifs, the hammam intensifies the effect of well water heated over a fire; the air inside reaches a temperature of 120°F. "Most people don't linger," says a visitor to Mzouda. "It's like bathing in an oven."*



a region of conflict. But this has come at the cost of some liberties. Political dissidents have been imprisoned, prompting steady criticism from Amnesty International. While not exactly a despot, the king retains real power under the Moroccan constitution. To enforce austerity measures in 1983, King Hassan assumed all legislative and executive power, ruling by decree for six months. The fact that he belongs to the longest-lived Islamic dynasty in the world, and claims to be a descendant of the Prophet Muhammad, also gives his reign a particular moral as well as political force.

Therefore the increasing popular desire for a more democratic government is directed primarily toward ministers and elected representatives; criticism of the king remains unthinkable. Yet even as many Moroccans referred darkly to their fear of speaking openly (I was surprised at how many requested anonymity), they also seemed to think that the sacrifice of a degree of freedom was an acceptable price to pay for some stability. "Even if we're in a closed system," one man told me, "there's a little hole where we can breathe air."

ISLAMIC FUNDAMENTALISTS in Morocco are not inclined to be quite so tolerant. It is unclear how many fundamentalist groups there are, but four are large enough to be noticeable. But on the whole, this movement so far appears to be more important in terms of culture than politics. The soil for religious radicalism is not as fertile in Morocco as it has been in Algeria, Egypt, and Tunisia.

Morocco has a long history of religious tolerance. At the end of World War II

the country had 300,000 Jews, whom King Mohammed V had steadfastly protected from Nazi persecution. Most have since emigrated to Israel, France, and Canada. In 1973—five years before the Camp David peace accords—a group of Moroccan Muslims and Jews organized a meeting between Egyptians and Israelis. In addition, King Hassan officially received the late Israeli Prime Minister Yitzhak Rabin.

Morocco's even longer tradition as an independent kingdom also gives it an inherent resistance to imported rhetoric. Many Moroccans, in fact, boasted to me of their differences from the other Arabic-speaking countries. "Morocco is the only Arab culture that wasn't conquered by the Turks," said Hicham Senoussi, a young bureaucrat in Rabat. "And though we've been very influenced by Africa, we are close to Europe. So it all creates a different chemistry."

Televisions beam the sermons of Egyptian imams but immediately afterward show florid Egyptian soap operas. After-school cartoons are briefly interrupted by the call to prayer, then continue as usual. In the Arab League Park in Casablanca, where university students daily escape the confusion of their homes to study in the shade of the trees, you are as likely to see girls wearing jeans and American baseball caps as the modest djellaba and head scarf of the more traditional Moroccan woman.

I brought up the subject with Khadija Fassi-Fehri, the wife of the governor of Old Medina and three other districts of Fez. She has lived in France and traveled in the U.S. and speaks several languages, including fluent English.

"Morocco has nothing to prove in regard to religion," she told me with

The shadow of history plays across Essaouira, whose crenellated battlements repelled both pirates and European navies. Today a quieter invasion—a revival of fundamentalist Islam—is at hand. So far Moroccans have shunned radicalism, though they share the hardships that fuel such movements.

conviction. "In Algeria they had no identity, no roots. They were always conquered. But Moroccans have always kept their dignity and their respect, so we are not obsessed by religion. That's why nobody can come from Afghanistan and tell us, 'This is the way to be Muslims.' We say, 'Thank you. We already know this.' "

Still, King Hassan is keenly aware of the potentially perilous conjunction of economics, politics, and religion. When he came to the throne 35 years ago, he made several decisions that were dramatically at odds with other North African countries. "First, he organized the country through a market economy," Andre Azoulay, the king's economic and financial adviser (and a Jew), explained to me one day. "It wasn't easy as a Third World country to resist the temptation of that moment. He risked being treated like a traitor by other countries, because you were supposed to follow socialism and Marxism. The people who thought that socialism was the only way out were deeply angry; now their countries are in total failure."

Azoulay, a slight, courtly man, paused and gazed at me with pensive eyes. Then, in his careful but correct English, he continued: "The second choice was that King Hassan resisted the single-party system that other Third World countries adopted. In fact, it is forbidden by the constitution to have only one party. And, finally, he decided that the Western countries were the true allies of Morocco, and not the U.S.S.R., Cuba, and Vietnam. If the king had made other choices, where would Morocco be today?"

Could fundamentalists become a true political power? "No," forcefully replied a businessman in Marrakech. "They could never supplant the king, who is the leader of the Muslims. The imams pray in the name of the king. No religious group dares to say, 'We will supplant the power of the king.' "

"Given its resources, human and natural, Morocco should be able to do fine," Ghassan Musallam, the banker, told me. "It's a matter of how to put things together."

Morocco wants closer ties with Europe. Although a third of its foreign trade is still with France and Spain, reshuffled trade agreements among European Union countries have weakened or even canceled many of the traditional arrangements. In response Morocco audaciously applied in 1984—but was rejected—for membership in the European Community. Yet its cheap labor force and proximity to Europe make it almost inevitable that Morocco will someday position itself in regard to Europe along the lines of Mexico's relationship with the United States. The numbers of automobile assembly plants and garment factories in Morocco are increasing. Once fanciful talk of a bridge across the Strait of Gibraltar has now shifted to more serious discussion of a tunnel. It is toward the West, more than Arabia or Africa, that Morocco continues to look.

I WAS SITTING one morning at the Palmiers du Sud café in Casablanca, drinking café au lait and munching a chocolate brioche as businessmen read the morning papers in French and Arabic. From somewhere overhead wafted the undeniable strains of "As Time Goes By," a truly romantic touch, even though it was probably playing at the same moment in an empty elevator in Omaha.

By now I had become accustomed to this sort of contradiction. Televisions

Walking the familiar path from home to mosque, a worshiper in Tiznit passes shops closed on Friday, the Muslim holy day. Saturated with color, seared with light, even the commonplace in Morocco can become sublime. "Morocco is far from perfect," says novelist Tahar Ben Jelloun. "But the beauty of the countryside is never flawed."

beaming David Letterman into homes without plumbing. Air-conditioned tour buses spinning past collapsed mud houses where men labor to dig out their dead donkeys and sheep. To define the real Morocco, you have to define which one you mean: the rich or the poor, the Berber women of the mountains or the college girls on motorbikes, the gravitational pull of tradition or the urge to soar beyond it. All of these Moroccos are real. And I had come to discern a subtle tenacity—and grace—with which Moroccans face these contradictions that made me somehow less inclined to smile at the definition of "Moroccan time."

I still remember an encounter one hot weary afternoon in Zagora. I was walking to my car. A little boy stood nearby. When I unlocked the door, he came up and silently offered me a little gazelle he had woven from palm fronds. He didn't want money; he just gave it to me. We smiled. I touched my heart in the Moroccan gesture of thanks. He touched his. I watched him in the mirror as I drove away. He was waving. □

Traversing

Baffin Island

Away from it all: Six adventurers tackle Canada's largest island by skis, by kayaks, and on foot.

Article and photographs by JOHN DUNN

Confident that melting sea ice will still hold our weight in late June, my companions and I cross Baffin Island's Home Bay in ankle-deep meltwater. Halfway through our 1,880-mile journey, we have already skied for three months, seeking renewal of our restless spirits in the Canadian Arctic.

To travel the length of earth's fifth largest island, we ski the first 1,045 miles, kayak the next 605 miles, and hike the final 230 miles. The route takes us through three of Baffin's nine Inuit communities, where we pick up food. Twice we are resupplied by small plane. Except for a few hunters and their families, we seldom meet other people.

Maps only hint at the terrain ahead, as Mike Sharp and Bob Saunders find out, hauling a 200-pound sled through a rocky gorge on the Borden Peninsula.

MY DESIRE to traverse Baffin Island had nothing to do with turning 40 the day before I set out. No, it came from half a lifetime of dreaming about this untrammeled wilderness in northern Canada, one so enormous that it would take six months to trek its length.

As a young man in England, where the manicured countryside was the opposite of everything I imagined as wild, I'd studied maps of North America, searching for places where there were no roads, towns, or railways. Later, between jobs as a geologist in the Australian outback, I traveled by boat up the west coast of Greenland and made ski trips across Ellesmere Island, Devon Island, and northern Labrador, learning to live out on the land. Yet Baffin still beckoned.

As our plane touched down on Baffin's northern Brodeur Peninsula on March 27, 1994, I saw polar bear tracks crisscrossing the snow. Thirty hours out of my house in Calgary, Alberta, and I'd already dropped a notch on the food chain. "Better keep an eye out," Mike Sharp said. Mike, Bob Saunders, and I would ski the first five-week leg to Pond Inlet. Later Sandy Briggs, Graeme Magor, and Glen Cowper would join the expedition for varying periods.

Back home, as I was planning the route, I'd marveled at the fjords that carve into Baffin's northeastern coast and wondered at the jigsaw puzzle of land and water that straddles the island's midsection. Now it was time to see what was out there. Loading gear onto my sled, I stepped into my skis and followed Mike and Bob across the sea ice.

Midnight sun lights a glacier flowing from the Penny Ice Cap, where surrounding peaks can tower more than 6,500 feet. A remnant of the ice sheet that once smothered Canada, the Penny covers 2,300 square miles, allowing us to ski late into the season.

Skiing the northlands

Pond Inlet. Other team members prefer simply to walk down the trail. Returning from one such trip on a day when a blizzard confined us to our tents, Bob checks the sleds and reports that an arctic fox has been chewing on the runaway straps of his skis.

Mike peers out of the tent. "That's not a fox," he says. "That's a polar bear cub!"

Eager to avoid a confrontation with its mother, who may be nearby, we shoo the cub away with noisemakers.

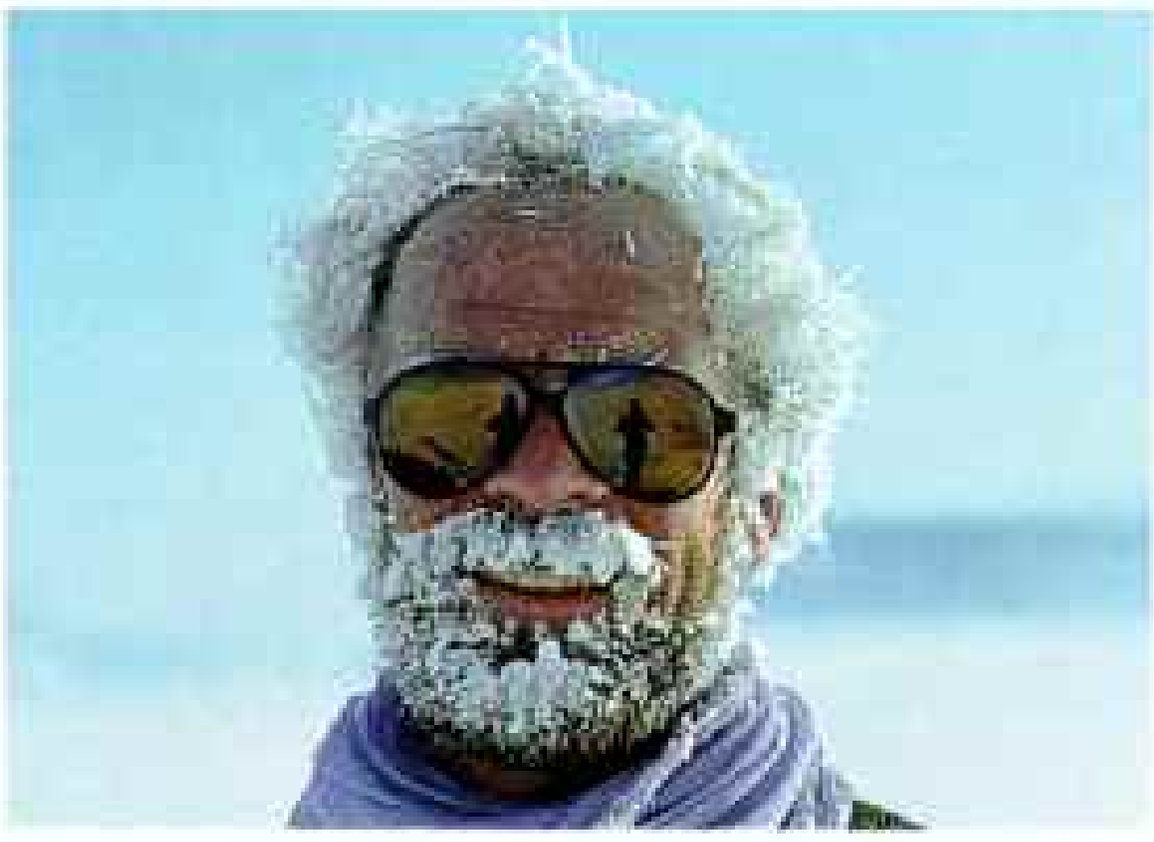
Facing temperatures as low as minus 42°F, which turn Mike's beard a frosty white (below), we spend most of the first few weeks on Baffin just trying to keep warm. The arduous work requires 5,500 calories a day, including lots of cheese and margarine.

Heading toward warmer land, Mike crosses Okoa Bay in late June (following pages). Shallow ribbons of meltwater braid the surface of the thick ice before draining down cracks or seal holes into the ocean below.

"It feels completely unnatural to ski across open water," Sandy Briggs says of his slosh across Home Bay. Despite being soaked for hours, his feet stay tolerably warm, thanks to the insulating effect of water trapped in his boots.

Taking advantage of a gusty morning, Bob hops on his sled for a spin across the slick ice—a run made more exciting by the sail blocking his view. We normally ski in front of our sleds, using the sails to provide a helpful push.

With a knack for building shelters out of snow, Sandy constructs an outhouse on an ice field south of



Kayaking the southlands

by infuriating mobs of blackflies. For Sandy it's "all part of the fun of being here."

Heading inland from the east coast, we follow a traditional route of caribou hunters that has been used since the first people migrated to Baffin from Alaska some 3,500 years ago. On a hillside above our tents near Amittok Lake (bottom left), old *inuksuit*, or stone markers, recall the presence of earlier travelers.

As days turn into weeks on the lowlands, I worry about the approaching chill of autumn. Lag too far behind schedule and matters can take a serious turn.

To make up lost time, we hoist spinnakers and sail across Mingo Lake, helping us cover a record 22 miles in a day. Though the weather in late August is mild, the water is frigid. We wear dry suits, since capsizing in the lake would put our lives in instant jeopardy.

On September 15, Bob and I start the final backpacking part of the journey. Within hours it begins to snow.

Trading sleds for folding kayaks, delivered to us by a floatplane, we step off the Penny Ice Cap directly into summer. For the next two months we paddle and portage through a maze of lakes and rivers, disassembling the kayaks when necessary to carry them over rough ground.

"They're not so bad if you keep moving," Sandy says of the mosquitoes (right) that swarm around us as soon as we leave the ice cap in Auyuittuq National Park Reserve. Within weeks they are replaced

Resting in peace on a lonely beach on Isabella Bay, a grave marker recalls the fate of a harpooner from a 19th-century British whaling ship. His memorial reminds us that life in the north can be as fragile as an arctic poppy, a lesson Bob and I learn in late September.

Trudging up a hill above Jackman Sound, we surprise a polar bear sow as she lumbers out from behind a boulder with her cub. Glaring at us, she huffs—signal of a possible attack. Fortunately she turns and drops down the other side of the hill, cub at her heels. For the rest of the journey we announce our presence, banging on our cooking pot and singing out warnings like devotees of some mad sect.

A few days later Bob and I reach the southern tip of the island, our final goal. What a privilege it was to have traveled for 192 days on what Sandy called our quest for wonder, gazing down on cottony clouds above Gibbs Fiord (right), watching glaucous gulls swoop past cliffs painted rust red with lichens, or listening to the surreal tinkling of rafts of candle ice shoved by storm waves against the rocky shore of Nettiling Lake.

Months of intense but exhilarating physical exertion and cold: A small price to pay for a lifetime of memories. □

ADAM WARWICK

■ FROM THE GEOGRAPHIC ARCHIVES

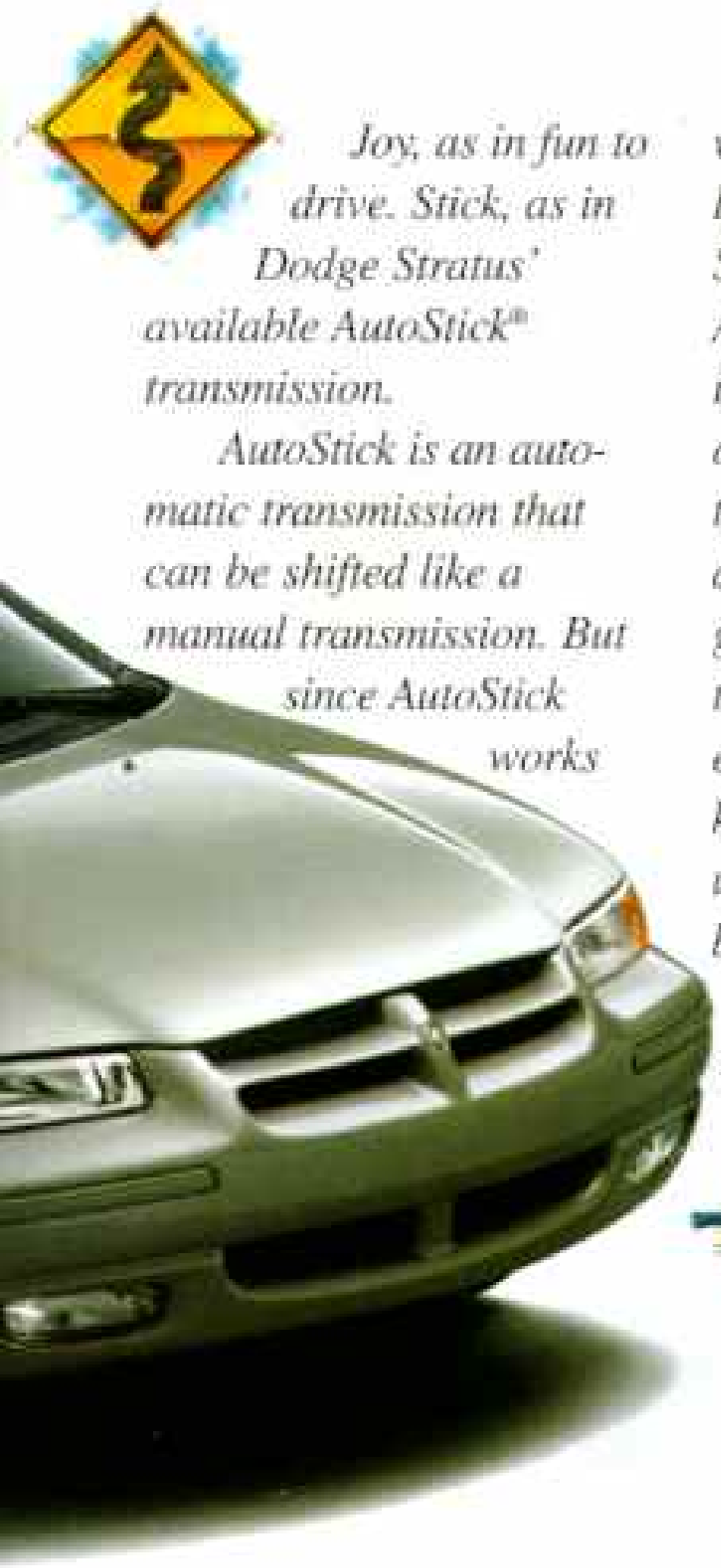
Beauty Mark

The Ainu people of Japan traditionally tattooed mustaches on their daughters by rubbing soot into small knife cuts. "It is begun with a small semicircle on the upper lip when the girl is only two or three years of age and a few incisions are added every year till she is married," read an 1893 account of the practice, banned by the government around the turn of the century. More effective than law, though, was assimilation. The aboriginal Ainu lived as far north as the Kuril Islands before most were forced to relocate to densely populated Hokkaido. That plus intermarriage with ethnic Japanese helped tattooed mustaches fall out of favor.

This photograph, taken in 1922, was never published.

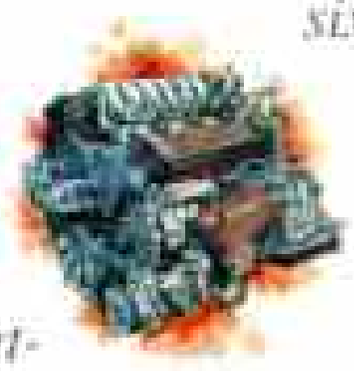
Joyst

Always wear your seat belt.



Joy, as in fun to drive. Stick, as in Dodge Stratus' available AutoStick® transmission.

AutoStick is an automatic transmission that can be shifted like a manual transmission. But since AutoStick works without a clutch, you work less and play more. Drop Stratus' gear selector into AutoStick mode and you're in control. Push it one way to upshift, the other way to downshift. Hold gears longer for better acceleration, use the engine for braking, or knock it down a gear to set up for that next corner. In brief: enjoy.



Of course Stratus offers a lot of other good stuff to help keep the adrenaline level up. Like race-bred, modified double-wishbone suspension, the road-holding stability of cab-forward design and a 2.5 liter six-cylinder engine that is included on all AutoStick-equipped models.

Stratus comes complete and ready to play. Joystick not required, but highly recommended.

To learn more about Dodge Stratus, call 1-800-4-A-DODGE or visit our Web site at http://www.4adodge.com

DODGE
Skip Barber
DRIVING SCHOOL
Dodge is the official vehicle of the Skip Barber Driving School

AutoStick.

Stratus The New Dodge

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And so have we. Because like all who labor to provide winning performance, Nikon puts a lot of effort into producing the best. Like the new Nikon F5. Loaded with unprecedented power, speed and record-breaking potential, the F5 is ready to make the world's greatest moments timeless.

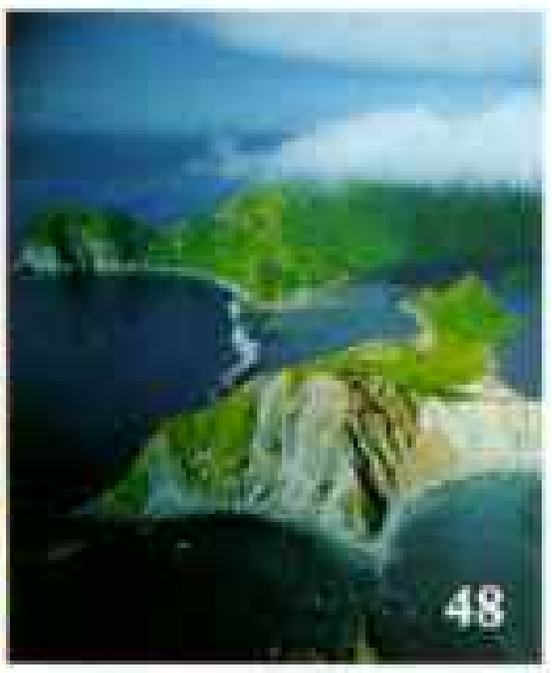
F5

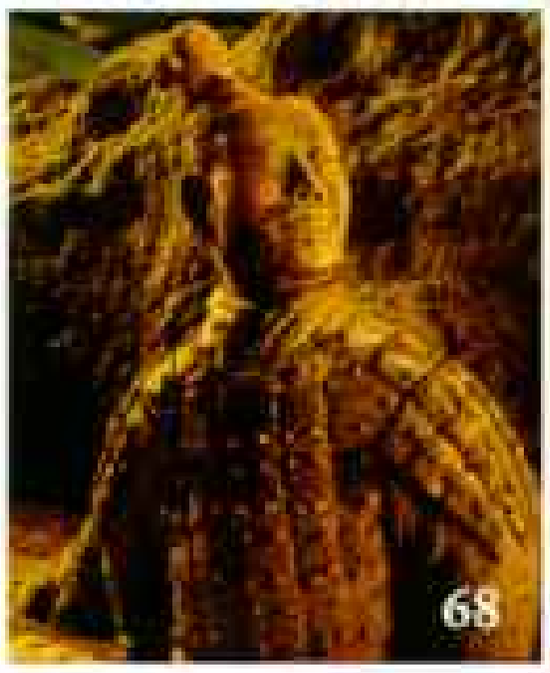
Nikon on the Net http://www.kft.co.jp/Nikon

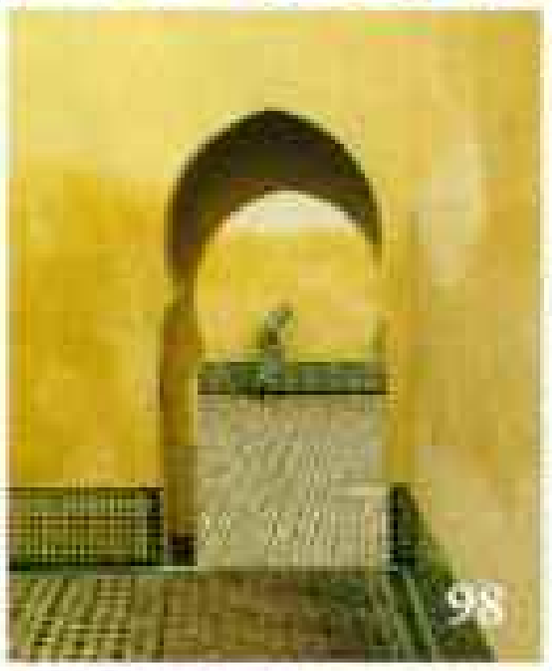
Photo: Al Satterwhite

NATIONAL GEOGRAPHIC

OCTOBER 1996







The Cover

Gold dust and elaborate jewelry proclaim the prestige of a West African matron. Photograph by Carol Beckwith and Angela Fisher

Cover printed on recycled-content paper.

KIDS WHO DECIDED TO

They come in all shapes, colors and sizes. But they have one thing in common. Heart.

They care enough to make a difference in people's lives.

That's why they're heroes. That's why they're winners of the Prudential Spirit of Community Award.

It's all part of our program for honoring kids who didn't ask what's in it for them, but simply asked what they could do.

What they did will astound you.

A girl of 12 made $20,000 selling lemonade. And gave every dollar to a center for the homeless.

A boy of 18 wondered what it would be like to walk in a needy child's shoes. When he found out, he persuaded manufacturers to donate 10,000 new ones.

Another teenager, a cancer patient himself, got high school students to connect as "big brothers" and "big sisters" with young children suffering from cancer.

There are young heroes like these throughout America. And you can help us honor them. By

PRESENTING
THE PRUDENTIAL
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AWARD WINNERS
FOR 1996

BE THEIR OWN HEROES.

encouraging a hero you know to apply for a 1997 Prudential Spirit of Community Award.

The National Association of Secondary School Principals is our partner in these awards. So you can ask for information and applications at your middle school or high school principal's office.

Or, visit our web site at http://www.prudential.com.

The application deadline is October 30, 1996.

LEFT TO RIGHT

Katherine Eller
Carver Middle School, OK

Charles Kaiser
Clatskanie High School, OR

Katy Ballenger
Olympus High School, UT

Lauren Garsten
Choate Rosemary Hall, CT

Megan Leaf
Fallston Middle School, MD

Lien Bui
Bell Multicultural High School, DC

James Edwards
Bishop Kelley High School, OK

Suerjee Lee
Battle Creek Middle School, MN

Traci Taylor
Cape Girardeau Central Junior High School, MO

Eric Perlyn
Pine Crest School, FL

Sean Miller
O'Leary Junior High School, ID

Sean Miller raised $5,000 through his work on behalf of the Rally for Life cancer walk. A victim of cancer, he was honored posthumously for his efforts.

Emily Douglas
McCord Middle School, OH

Laquisha Payne
Kingsbury High School, TN

David Levitt
Osceola Middle School, FL

Anisa Kintz
Whittemore Park Middle School, SC

Prudential

http://www.prudential.com

NATIONAL GEOGRAPHIC

Behind the Scenes

MARK THIESSEN

Winning Big—the Second Time Around

WHAT'S BETTER than making it to the finals of the National Geography Bee as a ten-year-old? Winning it two years later! Seyi Fayanju, at left, of Verona, New Jersey, did just that with a flawless performance in the 1996 Bee—sponsored by WORLD magazine and Chrysler Corporation—at our headquarters in Washington, D.C. Seyi attributes his success partly to the persistence of his sister, Lola. "She would bark out questions, and I would run to the encyclopedia for answers. I knew I'd better get it right!" Congratulating Seyi and his mother, Yinka, is Ben Graber, Georgia state Bee champion.

■ TEST YOURSELF

The 1996 Bee's final championship round asked these questions. Contestants were allowed 12 seconds to write their responses.

1. Name the 16th-century Flemish geographer who designed a map projection for use in navigation and who is credited with producing the first collection of maps called an atlas.

2. Name the Portuguese territory on the east coast of Asia that is scheduled to revert to Chinese control in 1999.

3. Name the European co-principality whose heads of state are the bishop of Urgel and the president of France.

Answers:
1. Gerardus Mercator
2. Macau 3. Andorra

Blinded by the Light

IT WAS THE PHOTO Joel Sartore almost went blind for. Shooting for *The Company We Keep*, our new book on endangered species, Joel was eager to capture a fiery sunset at Squaw Creek National Wildlife Refuge in Missouri. In just seconds, intense heat from the magnified light warped the camera's dark plastic lens filter. When Joel pulled off his sunglasses, he says, "I couldn't see color. I couldn't read the dials on the camera. I'd fried my eyes, which isn't smart for a photographer!" After they recovered, he used blackened welder's goggles.

"Don't try this at home, kids," Joel warns—but do check out the picture, in this issue's Geoguide.

KATHY SARTORE

LONG DAYS.

UNCONVENTIONAL THINKING.

COLD PIZZA.

PANIC AT MIDNIGHT.

LOTS OF COFFEE.

INSPIRATION AT 3 A.M.

GREAT CARS.

WELCOME TO
LIFE AT
CHRYSLER.

January 10, 1992:
Chrysler President Bob Lutz introduces new Jeep Grand Cherokee by driving up steps and through plate glass window of Detroit Auto Show.
"Wouldn't fit through the door," explains Lutz.

February 20, 1992:
Under the leadership of Chief Engineer Francois Castaing, Chrysler celebrates one year of working in platform teams–multidisciplinary groups brought together for more innovative, responsive automaking.

March 15, 1993:
*Two engineers "messing around in the garage" develop Chrysler's clutchless manual–dubbed AutoStick.**

April 1, 1992:
First Dodge Viper roars out of the Mack Avenue Engine Plant in Detroit expressly redesigned for specialty vehicle production. (Reports of V10 engine rumble shattering neighborhood windows unconfirmed.)

September 28, 1992:
Playing a video game with his son, Chrysler engineer conceives idea for driving-simulator technology that allows new vehicles to be "test-driven" even before they are built.

January 7, 1993:
Plymouth Prowler–concept car developed as tribute to the American hot rod–draws huge crowds at auto shows across United States, then pleas to put it into production.

August 4, 1993:
Another Chrysler first: A group of engineers, working late on new design for dual sliding mini-van doors, places order for 125 large pizzas–believed to be largest in (admittedly thetchy) history of Lorenzo's Pizza.

November 6, 1993:
Chrysler employees–7,000, give or take a few–move into 3.5 million square foot Chrysler Technology Center. A few engineers rumored missing in the days following the move.

December 6, 1993:
Viper series appears on network TV.

May 5, 1994:
Group of Chrysler engineers spends day at local shopping mall parking lot observing drivers loading packages into their cars–leading to new design for seatback release in trunk on new compact sedan.

June 6, 1994:
Viper series disappears from network TV.

September 18, 1994:
After exhaustive testing, AutoStick is approved for production in 1996 Eagle Vision TSi.

March 10, 1995:
Redesigned Chrysler, Plymouth, and Dodge minivans reach dealerships with features including dual front air bags,† optional dual sliding doors, Easy Out Roller Seats,™ and up to 14 (count 'em) cup holders.

June 5, 1995:
Chrysler Chairman Bob Eaton competes in Neon Challenge celebrity auto race; is narrowly defeated by young TV star.

July 15, 1992:
Platform team reads letters from minivan owners asking, "Why not put a sliding door on the driver's side too?"

Chrysler Sebring Convertible

Plymouth Neon Sedan

Chrysler LHS

Plymouth Neon Coupe

Dodge Viper

Dodge Grand Caravan

Dodge Ram Van

Chrysler Concorde

Eagle Talon

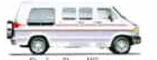
Dodge Avenger

Dodge Ram Pickup

Jeep Grand Cherokee

Chrysler Town & Country

Dodge Stratus



Dodge Ram Wagon

Jeep Wrangler

Dodge Caravan

Dodge Viper GTS

Dodge Dakota Club Cab

Dodge Neon Sedan

Plymouth Breeze

Plymouth Prowler

Jeep Cherokee 4-Dr

Jeep Wrangler

Dodge Intrepid

Plymouth Grand Voyager

Eagle Vision

Dodge Ram Chassis Cab

Chrysler Cirrus

Dodge Ram Club Cab

Jeep Cherokee 2-Dr

Plymouth Voyager

Dodge Neon Coupe

No one can say we at Chrysler Corporation haven't been busy over the past few years. We introduced "cab-forward" to the automotive lexicon. Proved with Neon that an American-made small car could not only survive but thrive. Made an American icon, our minivan, even better. And showed what's in our hearts by dreaming up audacious concept cars like Dodge Viper and Plymouth Prowler—then turning them into production models.

Our unprecedented run of new products may be why people are calling Chrysler "one very confident car company." But apparently that confidence runs both ways. Our customer loyalty (as measured by the number of people who purchase a second consecutive Chrysler Corporation vehicle) is higher than it's ever been. And the accolades our products have earned over the past few years speak for themselves.

So with a Chrysler Corporation product, you get the best of both worlds: a vehicle that doesn't look or drive like everybody else's, built by a company that understands it's what's under the sheet metal that counts in the long run. And something else: the inspiration that just seems to pour out of people who really, really like what they're doing.

Visit our World Wide Web site at http://www.chryslercorp.com, or call toll-free 1-888-GREATCARS. †Always wear your seat belt. Jeep is a registered trademark of Chrysler Corporation.
*Strategic Vision's 1996 Vehicle Experience Study" surveyed 35,652 October-November new vehicle buyers of 200-plus models after the first 90 days of ownership.

GREAT CARS. CHRYSLER CORPORATION

November 20, 1994: Chrysler Cirrus, first in all-new series of compact sedans, appears in showrooms.

December 1, 1994: Popular Science bestows "Best of What's New" Grand Award on Chrysler Cirrus/Dodge Stratus.

March 15, 1995: Chrysler Design Chief Tom Gale goes back to the drawing board once more on his own street rod.

November 30, 1994: Chrysler Cirrus voted Motor Trend's Car of the Year.

January 1, 1996: Petersen's 4-Wheel & Off-Road names Jeep Grand Cherokee Laredo V8 "4x4 of the Year"–third straight year the title has gone to Chrysler Corporation vehicles.

Later that week: CTC bowling team captures second place in Thunderbird Lanes Winter Carnival of Pins.

*April 23, 1996: Strategic Vision releases its Total Quality Award" winners for "Best Ownership Experience." Winning their categories: Dodge Intrepid, Chrysler Town & Country, Jeep Grand Cherokee, and Dodge Ram Pickup.**

January 1, 1994: Dodge/Plymouth Neon named Automobile Magazine's "1994 Automobile of the Year"–second consecutive year for a Chrysler product. (Anyone see a trend developing here?)

September 7, 1993: Dodge and Plymouth Neon named "Best of Show" at Frankfurt Auto Show by AutoWeek.

January 10, 1994: The result of an unprecedented approach to the product development process, Dodge and Plymouth Neon officially go on sale at a sticker price starting at $8,975.

July 1, 1994: In its 40th Annual Design Review, I.D. Magazine calls Dodge/Plymouth Neon, "a new archetype for personal transportation."

September 10, 1994: Neon wins international "World Car 1994" award from Italy's Motor Magazine. "Che bella macchina!"

September 30, 1994: Chrysler Design Chief Tom Gale revises design of his street rod. Again.

November 1, 1994: Dodge Intrepid wins coveted title of "Most Washable Car" from Michigan Car Wash Association.

May 4, 1992: Chrysler Design Chief Tom Gale revises design of custom street rod he is building in his garage.

September 15, 1992: America learns the term "cab-forward," as launch of new LH sedans–Chrysler Concorde, Dodge Intrepid, and Eagle Vision–is "an event that could redefine the shape of family cars," according to USA Today.

November 12, 1992: Jeep Grand Cherokee wins Motor Trend's Truck of the Year Award.

January 7, 1993: New Dodge Ram Pickup changes the rules with aggressive styling and Magnum V10 engine–most powerful engine ever in a pickup.

April 22, 1992: Chrysler wins award from Environmental Protection Agency for pollution prevention.

November 5, 1992: Chrysler honors engineering staff for 60 new patents awarded to company in 1992.

December 3, 1992: LH cars named Automobile Magazine's "1993 Automobile of the Year."

June 10, 1993: LH models receive Gold Industrial Design Excellence Awards from Industrial Designers Society of America.

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The Ice Maiden, Unveiled

SHE WAS THE MOST POPULAR GIRL in Washington, D.C., this summer—even though she died 500 years ago as an Inca sacrifice on a Peruvian mountain. More than 80,000 people visited Explorers Hall to see what may be the best preserved pre-Columbian mummy in existence. The frozen remains, brought here by Peruvian archaeologist José Antonio Chávez, at left, and our chief of translations, Kay Bazo, underwent studies at Johns Hopkins University. Results will appear in an upcoming issue.

MARIA STENZEL

PABLO CORRAL

DRAWING BY HELENA SHUMAKOVA AND WILLIAM H. BOND

Creature Feature

THE RELATIONSHIP between a photographer and an illustrations editor at the GEOGRAPHIC is necessarily a close one, involving trust, guidance, and—sometimes—pet sitting. Mark Moffett asked editor Kathy Moran to watch Baby G., his gecko, for ten days while he was on assignment in Oregon. The homesick lizard was off its mealworm feed for a while, and a surprise molting episode left Kathy a bit shaken, but the reptile was returned to the photographer in good health.

JOHN COBB, NAS

The Illustrated Woman

"THE MOMENT I saw that page in the October 1994 magazine, I knew I had to have this tattoo!" says Angela Moberly, whose fanciful deer was inspired by a tattoo found on a 2,400-year-old Siberian mummy. "I've had a lot of compliments on it. I only wish it was someplace where more people could see it."

Now it is.

—MAGGIE ZACKOWITZ

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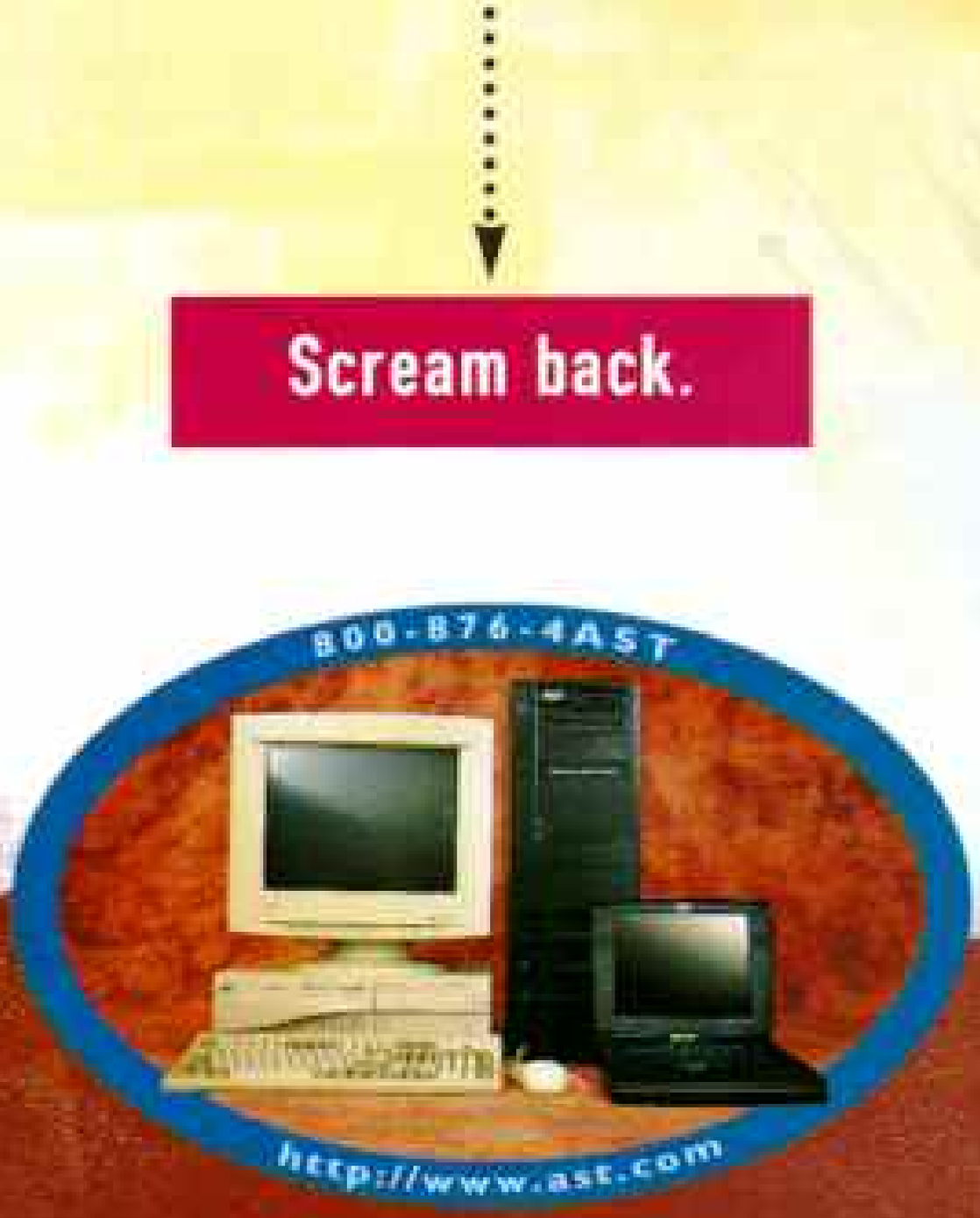

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Forum

Australia's Cape York Peninsula

Your article in the June 1996 issue was balanced and informative, although a little more optimistic about native land claims than seems to be warranted in the face of our change of government. What struck me most, however, was the poignancy of the reburial of the Aboriginal skull. Civilization will have taken a step forward when such remains, languishing in British museums and universities, are returned so they can be buried with the same care in the land to which they belong.

TRUDY BRAY
Camden, New South Wales

Cathy Newman writes about "deadly vipers like the brown taipan and death adder" in her otherwise excellent article. Vipers do not occur in Australia. All of its dangerously venomous snakes are elapids, the family to which cobras, coral snakes, and mambas belong. Death adders superficially resemble vipers and may represent an example of parallel evolution with the true vipers.

J. KEVIN BOWLER
Curator of Amphibians and Reptiles
Audubon Park and Zoological Garden
New Orleans, Louisiana

The problems of Cape York are symptomatic of the problems of indigenous peoples across Australia. The Aboriginal and Torres Strait Islander Commission was set up for our indigenous peoples to manage their own problems; however, it seems that the commission and its mountains of money cannot improve their quality of life.

JOHN CRIBBES
Sale, Victoria

In Focus: Bosnia

I'm a 16-year-old Bosnian refugee from downtown Sarajevo, now living in the Netherlands. Your article about Bosnia and its fragile peace, with the incredibly correct maps, was magnificent. From the satellite image my father was finally able to show me the mountain positions from which Serb artillery pounded and terrorized him and the 600-year-old city under the longest siege in modern times.

AMIR ČENGIĆ
Gouda, Netherlands

Serb victims of crimes in the tragic Bosnian conflict and the Muslim and Croat perpetrators were virtually ignored in your article. One comes away with the impression that no crimes were committed by Muslims and Croats.

GEORGE B. MARKOVINA
New Paris, Pennsylvania

The article says eastern Slavonia is to be returned to Croatia. Eastern Slavonia is populated overwhelmingly by Serbs because that area was always Serbian. The area's fertile soil and richness of oil make it a "must have" for Croatia in building its economy. This stolen land should be returned to the Serbs.

ALEXANDRA RADOJEVIC
Mercer Island, Washington

It was the unilateral ban on arms shipments, supported by European powers, that allowed the war to reach such a deadly crescendo.

SETH SCOTT
Carson City, Nevada

As a U.S. citizen of 40 years, but one with roots in that tragic country, I know more about the Bosnian civil war than the average American. Nowhere, including reputable newspapers and weekly magazines, was the war treated with more fairness and objectivity.

DRASKO JOVANOVIC
Batavia, Illinois

Peruvian Mummies

The custom of human sacrifice is commonly referred to as a pagan belief, but children were sometimes sacrificed and placed under buildings even after Christianity made its way through Europe. We should never attempt to change our past history by implying that such practices were not at one point part of our European heritage as well.

DAVID F. EATON
Omaha, Nebraska

The article says "The girl shows no sign of violent death." But articles from the *New York Times* and the AP news wire reported that she was killed by a powerful blow to the head. Which is right?

R. KURSHAN
New York, New York

Our article went to press before the mummy had been thoroughly examined. Watch for an update on medical findings in the January 1997 issue.

We and our two granddaughters, ages four and eight, made a special trip to Society headquarters to see the Ice Maiden. Four-year-old Hanna had seen the article and was absolutely intrigued. We consider it a privilege to have looked into the sweet face and to remember what she may have endured. It was educational for our granddaughters to learn of the Inca culture. We thank the Society and the Peruvian government for this memorable experience.

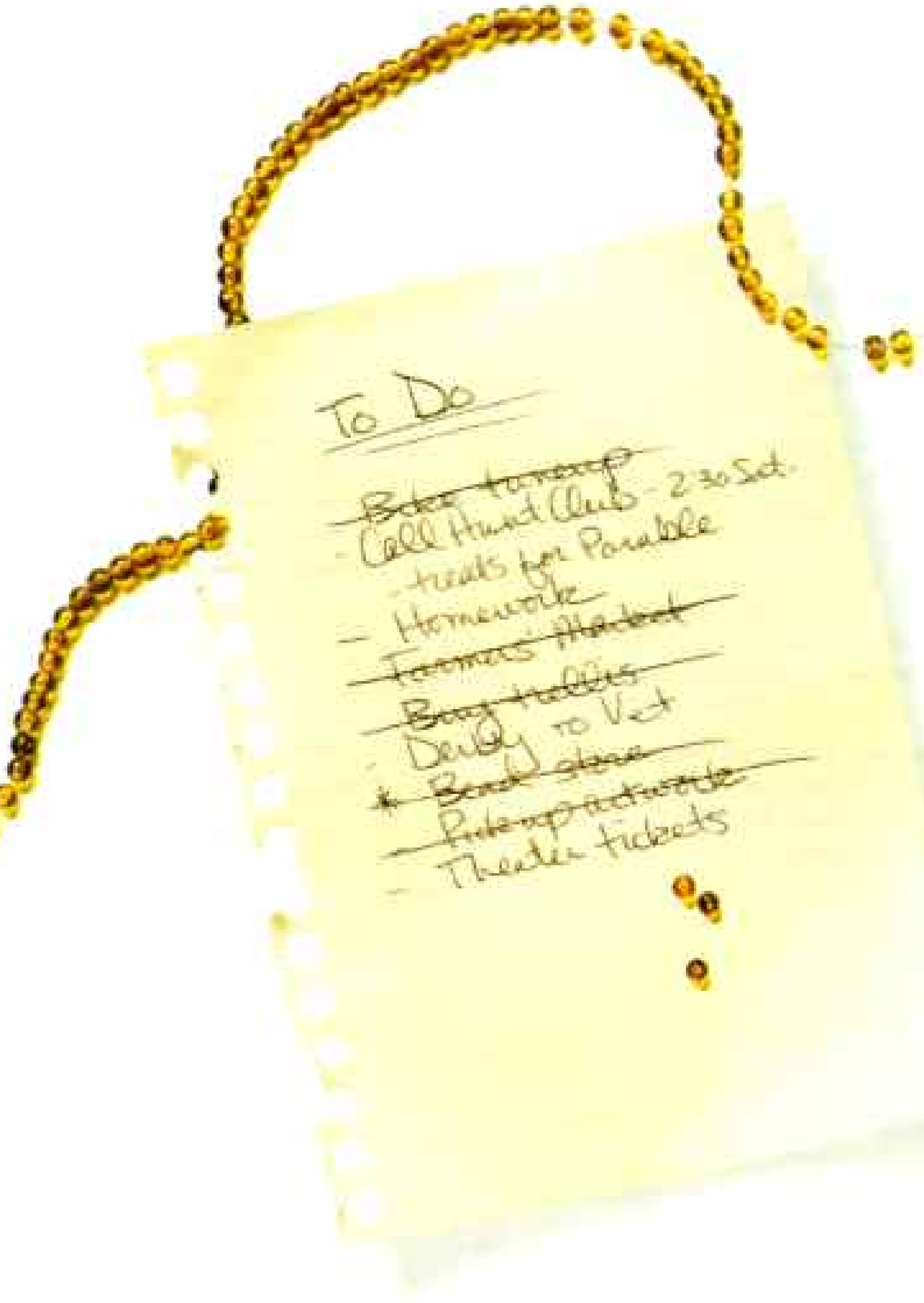
JAMES AND HELEN VANDUZER
Flemington, New Jersey

The Peruvian government should bury these reminders of mankind's monstrosities executed in the name of religion. If it could be arranged, the Ampato maiden should be returned to Peru and buried on the mountain where she met her death.

JANE B. WADE
St. Louis, Missouri

The mummy was returned in June to Arequipa, Peru, where she is protected in a refrigerated case.

THE DREADED "TO-DO" LIST.



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I was fascinated by the goods found in the burial, particularly the ceramic pottery. In *Ceramics of Ancient Peru*, by Christopher B. Donnan of UCLA, I found a piece of pottery almost identical to the pot shown on page 76. In Donnan it is described as Cuzco Inca. Perhaps the girl came from Cuzco too.

WENDELL P. KEITH
Fullerton, California

Eritrea

I was awed by the Eritrean people's Herculean efforts to pull together to create what could be an Eden of stability and democracy in a volatile region.

DAVID C. STRASSER
Albuquerque, New Mexico

What happened to Kagnew Station, the U.S. Army base that dominated the hill overlooking Asmara? I spent almost two and a half years there. Over 2,500 men were stationed there at any one time during the 1960s. I remember that Emperor Haile Selassie came for his yearly dental checkup at the base hospital, and we would have to stand guard duty.

ARTHUR LLOYD
Abbeville, South Carolina

The former base now shelters the Denden rehabilitation camp for wounded veterans, shown on pages 94-5 in the June issue. It is slated to become the main campus of the University of Asmara.

African Dinosaurs

Did dinosaurs scratch? Did they scratch their heads with their feet like a chicken? Did they roll in the dust like a buffalo or wallow in mud like a pig? While paintings of dinosaurs have gotten better, portraying them engaged in such activities would be even more realistic. I suggest that they had hair like a pig's, or even pin hairs like a chicken's, and probably also a third, reticulated eye membrane to protect their eyes, as birds do today.

LAWRENCE T. BECKERLE
Craigsville, West Virginia

Another excellent dinosaur article, but I feel that the strangely ribbed teeth of *Carcharodontosaurus* were for holding, which would suggest a diet of slippery prey such as fish or amphibians. If *Carcharodontosaurus* was a sauropod hunter, as indicated, the teeth would be larger in proportion to the skull, as with *Tyrannosaurus rex*.

STANLEY M. GIBBONS
Lewiston, Idaho

Fisheaters, such as crocodiles, possess conical teeth; the sharp-edged, blade-shaped teeth of Carcharodontosaurus *are best at cutting flesh.*

Toronto

Toronto shares with London the all-important quality of urbanity, which involves the acceptance of a responsibility to modify one's public behavior to avoid annoyance of others. The key to Toronto's character is the presence of a solid core of civilized and responsible persons of wide racial origins. The composure and persistence of the general citizenry have influenced the behavior of newcomers.

GEOFFREY WASTENEYS
Ottawa, Ontario

As a Torontonian—immigrant, proudly Indo-Caribbean, proudly Canadian—who is among the targets of Ernst Zundel's sweeping hatred, I am disappointed that the GEOGRAPHIC has given this man another forum for spreading his message. Twice found guilty of promoting hatred, though acquitted on technicalities, he continues to try to destroy bridges of communication that most of us attempt to build in our daily interactions with one another.

SHIRLEY LOBIN
Etobicoke, Ontario

Toronto is not unique in harboring a racial kaleidoscope with varying lifestyles and views. Our local media saw red because the writer of the excellent, objective portrayal of this city did not sweep the views of a notorious political extremist under the carpet. After reading the article, I feel more proud of Toronto than ever before.

MARIA BAJNOCZY
Toronto, Ontario

When I left New York City 23 years ago to attend school in Toronto, I felt I had died and gone to heaven. I still do. However, there is trouble in paradise. The Ontario Welcome Houses you praise have been shut down by our newly elected Ontario Tories. Our public transportation system is decaying due to budget cuts, even as automobiles increasingly clog our roads.

DENNIS RAPHAEL
Toronto, Ontario

In your portrayal of a "hopeful and healthy city" there was no mention of the remarkable initiative to restore the historic Don River. Community-based projects are currently under way.

MUNJU RAVINDRA
Halifax, Nova Scotia

Geographica

I was thunderstruck by the June article "Livestock's New Wave." I can't believe that Americans may soon be eating kiwi and the U.S. Department of Agriculture has approved it. The kiwi is New Zealand's national symbol and a nickname attributed to its citizens, and all species of kiwi are endangered and protected. I suggest you restrict your kiwi eating to the furry, green-fleshed fruit that we used to call Chinese gooseberry.

KEITH TONKIN
Westland, New Zealand

Rest assured that the kiwis living in the U.S. are safe in zoos. The USDA approved an all-inclusive list of ratites for meat inspection. However, only the emu, ostrich, and rhea are being farmed.

Letters for FORUM *should be sent to National Geographic Magazine, Box 37448, Washington, D.C. 20013-7448, or by fax to 202-828-5460, or via the Internet to ngsforum@nationalgeographic.com. Include name, address, and daytime telephone. Letters may be edited for clarity and space.*

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Table 1. Adverse Experiences Reported in Placebo-Controlled United States ZYRTEC Trials (Maximum Dose of 10 mg) at Rates of 2% or Greater (Percent Incidence)

Adverse Experience	ZYRTEC (N=2034)	Placebo (N=1612)
Somnolence	13.7	6.3
Fatigue	5.9	2.6
Dry Mouth	5.0	2.3
Pharyngitis	2.0	1.9
Dizziness	2.0	1.2

Due caution should be exercised when driving a car or operating potentially dangerous machinery.

In addition, headache and nausea occurred in more than 2% of the patients, but were more common in placebo patients. The following events were observed infrequently (less than 2%) in 3982 patients who received ZYRTEC in U.S. trials, including an open study of six months duration; a causal relationship with ZYRTEC administration has not been established. **Autonomic Nervous System:** anorexia, urinary retention, flushing, increased salivation. **Cardiovascular:** palpitation, tachycardia, hypertension, cardiac failure. **Central and Peripheral Nervous Systems:** paresthesia, confusion, hyperkinesia, hypertonia, migraine, tremor, vertigo, leg cramps, ataxia, dysphonia, abnormal coordination, hyperesthesia, hypoesthesia, myelitis, paralysis, ptosis, twitching, visual field defect. **Gastrointestinal:** increased appetite, dyspepsia, abdominal pain, diarrhea, flatulence, constipation, vomiting, ulcerative stomatitis, aggravated tooth caries, stomatitis, tongue discoloration, tongue edema, gastritis, rectal hemorrhage, hemorrhoids, melena, abnormal hepatic function. **Genitourinary:** polyuria, urinary tract infection, cystitis, dysuria, hematuria. **Hearing and Vestibular:** earache, tinnitus, deafness, ototoxicity. **Metabolic/Nutritional:** thirst, dehydration, diabetes mellitus. **Musculoskeletal:** myalgia, arthralgia, arthrosis, arthritis, muscle weakness. **Psychiatric:** insomnia, nervousness, depression, emotional lability, impaired concentration, anxiety, depersonalization, paranoia, abnormal thinking, agitation, amnesia, decreased libido, euphoria. **Respiratory System:** epistaxis, rhinitis, coughing, bronchospasm, dyspnea, upper respiratory tract infection, hyperventilation, sinusitis, increased sputum, bronchitis, pneumonia. **Reproductive:** dysmenorrhea, female breast pain, intermenstrual bleeding, leukorrhea, menorrhagia, vaginitis. **Reticuloendothelial:** lymphadenopathy. **Skin:** pruritus, rash, dry skin, urticaria, acne, dermatitis, erythematous rash, increased sweating, alopecia, angioedema, furunculosis, bullous eruption, eczema, hyperkeratosis, hypertrichosis, photosensitivity reaction, photosensitivity toxic reaction, maculopapular rash, seborrhea, purpura. **Special Senses:** taste perversion, taste loss, parosmia. **Vision:** blindness, loss of accommodation, eye pain, conjunctivitis, xerophthalmia, glaucoma, ocular hemorrhage. **Body as a Whole:** increased weight, back pain, malaise, fever, asthenia, generalized edema, periorbital edema, peripheral edema, rigors, leg edema, face edema, hot flashes, enlarged abdomen, nasal polyp. Occasional instances of transient, reversible hepatic transaminase elevations have occurred during cetirizine therapy. A single case of possible drug-induced hepatitis with significant transaminase elevation (500 to 1000 IU/L) and elevated bilirubin has been reported. In foreign marketing experience the following additional rare, but potential severe adverse events have been reported: hemolytic anemia, thrombocytopenia, orofacial dyskinesia, severe hypotension, anaphylaxis, hepatitis, glomerulonephritis, stillbirth, and cholestasis. **DRUG ABUSE AND DEPENDENCE** There is no information to indicate that abuse or dependency occurs with ZYRTEC. **OVERDOSAGE** Overdosage has been reported with ZYRTEC. In one patient who took 150 mg of ZYRTEC, the patient was somnolent but did not display any other clinical signs or abnormal blood chemistry or hematology results. Should overdose occur, treatment should be symptomatic or supportive, taking into account any concomitantly ingested medications. There is no known specific antidote to ZYRTEC. ZYRTEC is not effectively removed by dialysis, and dialysis will be ineffective unless a dialyzable agent has been concomitantly ingested. The minimal lethal oral dose in rodents is approximately 100 times the maximum recommended clinical dose on a mg/m² basis and the liver is the target organ of toxicity. **DOSAGE AND ADMINISTRATION** The recommended initial dose of ZYRTEC is 5 or 10 mg per day in adults and children 12 years and older, depending on symptom severity. Most patients in clinical trials started at 10 mg. ZYRTEC is given as a single daily dose, with or without food. The time of administration may be varied to suit individual patient needs. In patients with decreased renal function (creatinine clearance 11-31 mL/min), patients on hemodialysis (creatinine clearance less than 7 mL/min), and in hepatically impaired patients, a dose of 5 mg once daily is recommended. Cetirizine is licensed from UCB Pharma, Inc.

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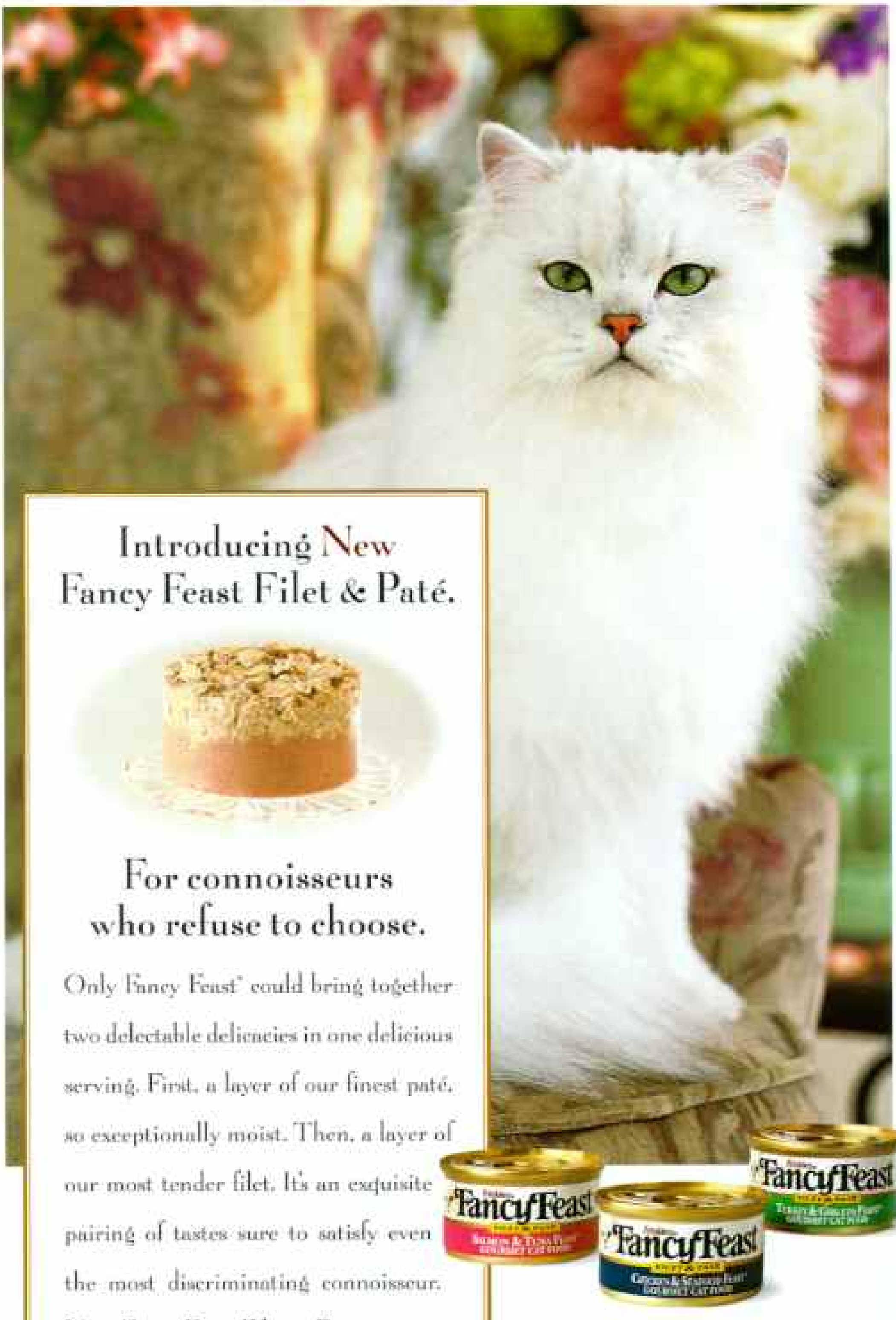

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Geographica

A Glorious Monument Survives

"I STOPPED, AWED, first by its size, then by its beauty," Thomas J. Abercrombie wrote in the September 1968 GEOGRAPHIC of his first sighting of Afghanistan's Minaret of Jam. The 213-foot-high minaret lies so far off the beaten path that it has escaped regional conflicts for more than 800 years, including the recent war between the Soviet Union and Afghan *mujahidin*, or Islamic guerrillas. Among the world's tallest minarets, it has achieved a tilt reminiscent of the Leaning Tower of Pisa.

Last year Afghan architect A. Wasay Najimi went to Jam for a UN agency. "So far, the minaret is safe," he reported after his grueling trip, the last ten miles of it on foot. Najimi urged building a 300-foot-long retaining wall, 10 to 13 feet high, to prevent erosion when the Jam River floods.

The minaret was erected during the Ghorid dynasty, which ruled Afghanistan from 1149 to 1215. Inside, twin spiral staircases led to a wooden balcony. That balcony has rotted away, says Sandy Gall, a British journalist who accompanied Najimi, but two higher balconies remain.

Gall was struck by the "pale terra-cotta in the morning sunshine, framed by jagged mountains," and geometric designs carved into the fired brick. A carved inscription from the Koran winds around the tower; another, in bright blue tiles, hails the sultan who reigned when it was built.

SANDY GALL

RON SPOMER, NATURAL SELECTION

A Cutthroat Battle Against Enemy Aliens

CUTTHROAT TROUT (left) have long ruled Yellowstone Lake, providing sport for anglers (GEOGRAPHIC, April 1996) and food for Yellowstone National Park's grizzly bears, bald eagles, river otters, and other animals. But a trout species alien to the lake poses a threat that could cause the cutthroat population to drop by 90 percent in as little as 20 years.

Lake trout probably were dumped in Yellowstone Lake by anglers who caught them elsewhere. In 1994 a guide showed rangers a 17-inch lake trout; a second was brought in six days later. Scientists soon netted two younger lake trout, a sign that the aliens were reproducing.

The lake now holds between one million and four million cutthroats; recent studies show lake trout in the tens of thousands. The lake trout swim in deeper waters than cutthroats, making them inaccessible to shore-dwelling animals, and they eat other fish, a lethal threat to cutthroats. "There's no quick fix, no silver bullet," says Lynn Kaeding, a U.S. Fish and Wildlife Service biologist. He has recommended netting the lake trout annually to limit the growth of their population.

If we don't harm the environment, we won't have to repair it. This simple idea is at the heart of NEC's environmental philosophy technologies, production techniques, and products that are increasingly compatible with nature. And NEC is continually

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Which is why, in 1970, NEC began organizing in-house groups to deal specifically with environmental issues. This has given rise to researching new and better methods to protect the environment. In many ways, this is the most important piece of our success.

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Last Week In Mr. Hoffman's Class, Michelangelo Sat On Rembrandt's Lunch.

Of course, accidents like this are bound to happen in Russell Hoffman's seventh grade art class where students actually *become* the artists they are studying.

After choosing an artist's identity to assume, each student conducts in-depth research and writes an autobiography. To further identify with their artists, for the rest of the class students may only use their "artist" name. At the end of the course artists give oral reports and answer questions from the class about their life and work.

In the eighth grade, Mr. Hoffman's students put their knowledge to work. Using enlargement techniques they learned the previous year, they paint beautiful outdoor murals of masterpieces they studied the year before.

For his innovative method of combining art, history, writing and speech, State Farm is proud to present Russell Hoffman of the Black Middle School with our Good Neighbor Award, and to donate a total of $5,000 to their Fine Arts Department and student galleries and to the Covington Musee in Los Altos, California.

No one is more deserving. After all, he taught Van Gogh everything he knows.

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LIBRARY OF CONGRESS

Ages of Conflict Spur Fight Over Sea's Name

WHAT'S IN A NAME? In the case of the sea separating Korea from Japan, a lot of politics, history, and contentiousness.

To most of the world that body of water is the Sea of Japan. But some old maps, such as this one from the early 19th century, called it the Sea of Korea. Koreans, north and south alike, prefer East Sea.

For years the Republic of Korea has asked geographic bodies, including the National Geographic Society, to follow its lead, citing Japan's 19th-century expansionism and its 1910 annexation of Korea as evidence of undue influence.

So far, no luck. The UN's 1992 Conference on Geographical Names and its 1994 Group of Experts on Geographical Names both declined to consider a name change. So did the U.S. Board on Geographic Names. The BGN opts for the commonly used name, says Randall Flynn, its executive secretary for foreign names. The Society usually follows the BGN; Sea of Japan it remains on NGS maps.

Surprising Snapshot of a Long-lost World

GHOSTLY ECHO of an ancient world, this fossilized caddis fly—among the oldest ever found—is one tiny piece of the remarkably diverse panorama of life that existed 225 million years ago in and around a lake in what is now southern Virginia. Society-supported scientists, led by Nicholas C. Fraser of the Virginia Museum of Natural History, found the New World's oldest known flies, as well as beetles and more than a thousand water bugs, almost all of them complete specimens. The site, a quarry, also produced remains of a shark, a coelacanth, several bony fishes, amphibious reptiles, and plants from conifers to ferns. "This is a rare window into a complete ecosystem at a pivotal period when many of the animals, plants, and insects we see today were beginning to appear," Fraser notes.

VIRGINIA MUSEUM OF NATURAL HISTORY

Two Greek Warriors Go "Under the Knife"

BATTLING AN ATTACK FROM WITHIN, Italian restorers armed with 20th-century technology have rescued two fifth-century B.C. bronzes, rare masterworks of classical Greek sculpture. The extraordinarily realistic male figures were thoroughly cleaned after they were found by a snorkeler off Riace, Italy, in 1972 (GEOGRAPHIC, June 1983). But, unseen, salt from the sea had infiltrated the clay casting cores of the bronzes and was corroding the inside surfaces. Specialists sponsored by the Italian firm Finmeccanica inserted a miniature TV camera and manipulated tiny cleaning tools resembling dental instruments on extension arms, entering through existing holes in the head of statue A (right), the eye of statue B, and the feet of both. Guided by video images, they scraped out 260 pounds of clay. The rescued bronzes are displayed in the city of Reggio di Calabria. —BORIS WEINTRAUB

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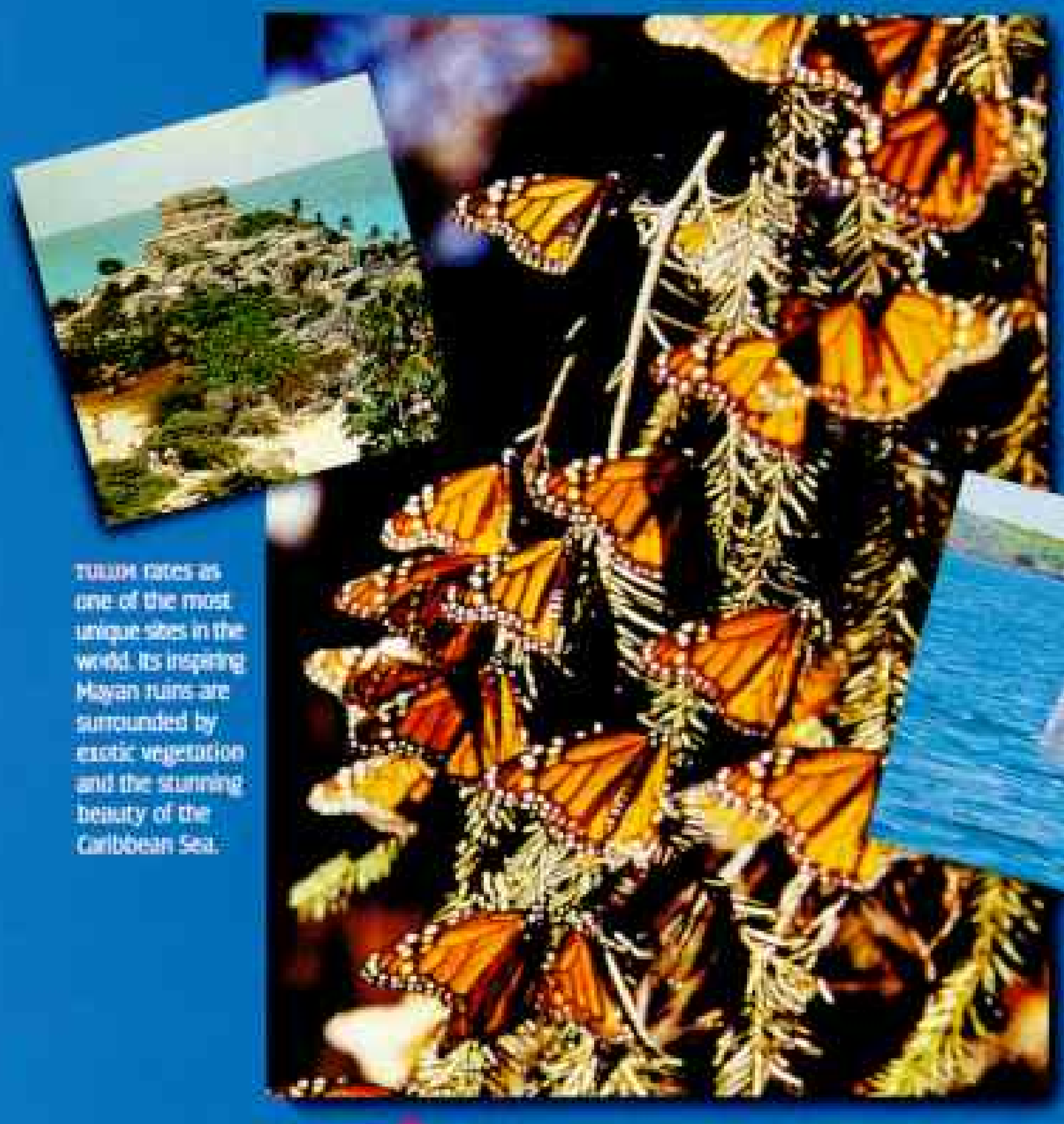

Mexico is one of the world's richest ecotourism destinations. The Monarch butterfly sanctuary in MICHOACAN is only one example of the endless wealth of our natural diversity.

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On Television

LOUIE PSIHOYOS, MATRIX (ABOVE); GLEN MARULLO

■ EXPLORER, OCT. 13, 7 P.M. ET

Fitting Pieces of a Fossil Puzzle

DINOSAUR DIGGERS delicately uncover the 80-million-year-old remains of an oviraptor at what may be the world's best fossil site, Ukhaa Tolgod in Mongolia's Gobi desert (left). Months later at the American Museum of Natural History in New York City the perfectly articulated skeleton of the six-foot-long immature oviraptor (below) awaits release from its "field jacket"—or plaster wrap.

EXPLORER's "Dinosaur Hunters" accompanies paleontologists Michael Novacek and Mark Norell on their sixth journey into the heart of the Gobi. Displaying footage from a 1920s expedition by scientist-adventurer Roy Chapman Andrews and using animation and time-lapse techniques, the film transports viewers to a world lost in time yet immortalized in bone.

■ PROGRAM GUIDE

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NATIONAL GEOGRAPHIC

EarthAlmanac

Grizzlies May Roam a Vast Wilderness Again

EVEN A BEAR could get lost in the Selway-Bitterroot Wilderness, more than a million rugged acres straddling the Idaho-Montana border. "The last grizzly there was shot or poisoned more than 50 years ago," says Chris Servheen of the U.S. Fish and Wildlife Service. Approval is pending for his team's plan to gradually release 15 to 25 grizzlies in this area. They would be moved from British Columbia, former home of this ear-tagged female, which was recently relocated to Montana's Cabinet Mountains to bolster a very small population there. The project would create the sixth major grizzly population in the U.S. outside Alaska. The largest concentration, 800 to 900 bears, lives in or around Yellowstone and Glacier National Parks. The plan has not been met with the acrimony from ranchers that accompanied the gray wolf's reintroduction to Yellowstone. If a bear strays into areas where humans live or work, a committee of residents, loggers, and federal officials would decide what action to take. "It will be a local issue, not something dictated from the outside," says Servheen.

CHRISTOPHER SERVHEEN

Protective Livestock Collars–Toxic Threat?

BANNED FOR USE in coyote bait in 1972, a poison called Compound 1080, or sodium fluoroacetate, is making a comeback. For decades livestock meat was injected with 1080 and left for coyotes to scavenge. When traces of the poison were found in eagles and a California condor, the EPA called a halt.

After more research, in 1985 EPA authorized Compound 1080 for livestock collars. Five states have received permits to use them; seven more have applied. To target a coyote raiding goats or sheep, several dozen sacrificial lambs in selected herds are fitted with collars that have rubber compartments loaded with Compound 1080; a coyote will go for the throat and ingest the poison.

Critics fear that other animals could also succumb. "Coyotes may run for miles before dying. Recovering them is vital, to prevent secondary poisoning," says Tom Skeele of the Montana-based Predator Project. U.S. Department of Agriculture officials say that the collars' use is tightly controlled and that no other animals are known to have been poisoned.

GUY CONNOLLY, USDA ANIMAL DAMAGE CONTROL

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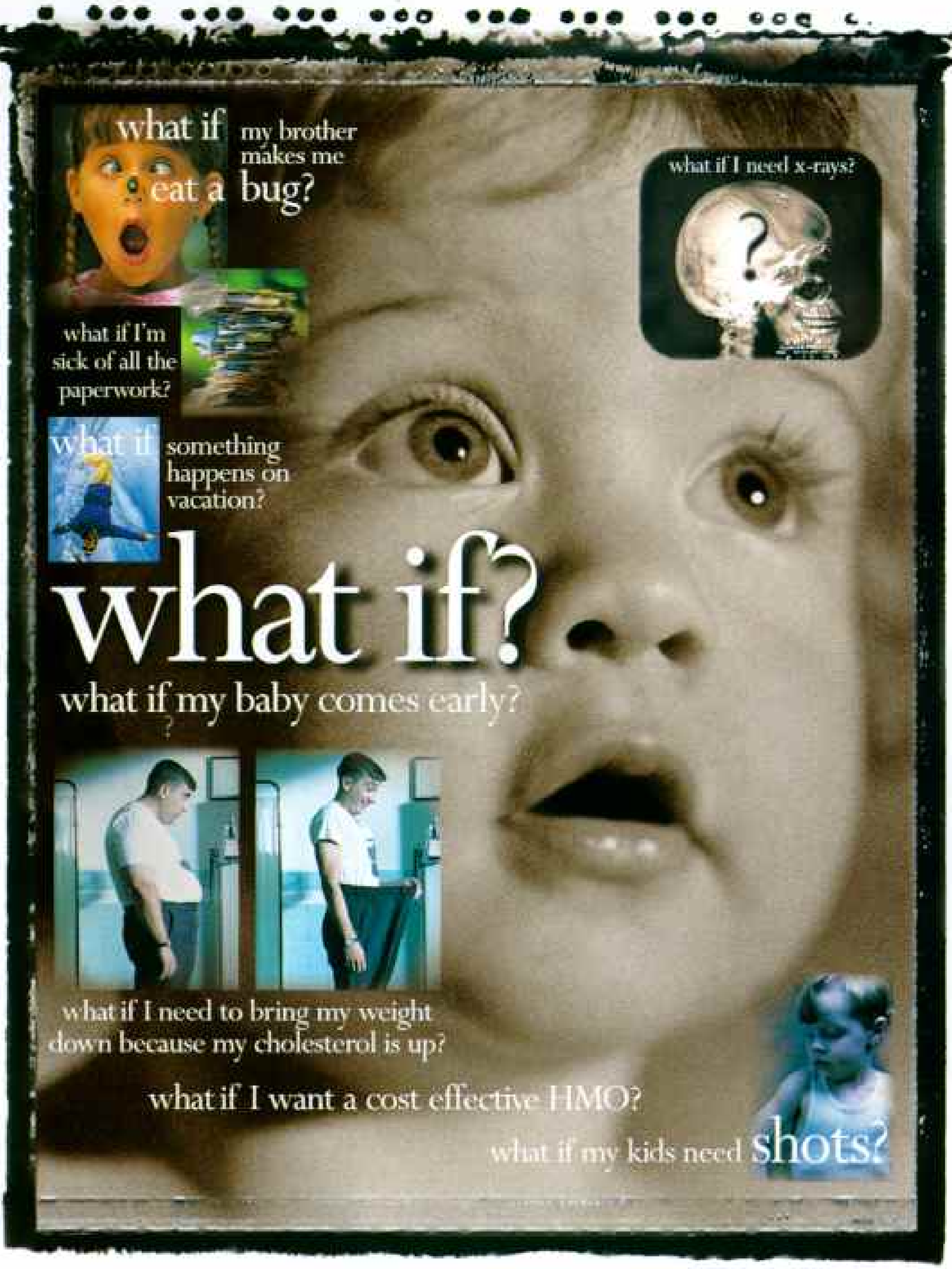

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PTEROPUS MARIANNUS; MERLIN D. TUTTLE, BAT CONSERVATION INTERNATIONAL

Flying Foxes Hang On in Guam

UNSUNG CARETAKERS of Pacific island plants, gregarious bats called flying foxes pollinate flowers and disperse seeds. An estimated 173 species range Africa, Asia, and the Pacific. But on Guam, demand for flying foxes as meat—they once sold for as much as $35 each—contributed to the decline of the island's own species and those imported from other islands.

"By the 1970s one of our two flying foxes had become extinct," says Gary Wiles of Guam's Division of Aquatic and Wildlife Resources. In 1989 an international treaty outlawed trade in flying foxes between independent Pacific nations, ending most of Guam's importation. Trade was still legal with Palau, a U.S. Trust Territory, until its independence in 1994. Wiles hopes that the 300 to 400 members of the island's surviving species (above) will soon increase.

Malady Lays Manatees Low

FATAL BOAT INJURIES regularly take a toll of Florida's estimated 2,600 manatees, but this year the endangered sea mammals have also been afflicted by a natural menace—a cryptic disease that took biologists four months to decipher. Beginning March 5, nearly 160 manatees were discovered dead off southwest Florida, including these victims on Sanibel Island. A team iced down the carcasses to preserve them so that necropsies could be performed. By May the outbreak subsided, but not until July was the cause pinpointed: poisonous phytoplankton called red tide that had been

BRUCE FINE, NEWS-PRESS

found in some waters where manatees died.

"The testing was a multistep process, but it finally revealed the toxin in the animals' livers, kidneys, lungs, and stomachs," says Alan Huff of Florida's Marine Research Institute. "This is going to be a remarkably bad year for manatee mortality."

—JOHN L. ELIOT

Cool Commodity for Criminals–Freon

A NEW CON GAME involves Freon, trade name of a coolant long used in refrigerators and car air conditioners. It contains ozone-depleting chlorofluorocarbons (CFCs), and on January 1 the U.S. banned, with few exemptions, manufacture and import of most CFC compounds. It remains legal, with a permit, to import recycled Freon, subject to a hefty $5.80 a pound excise tax unless it's reshipped abroad. To avoid paying, some importers have falsified customs forms. In March a man was convicted of tax evasion on some 500 tons of Freon; he drew a year in jail and was ordered to pay 3.4 million dollars to the IRS.

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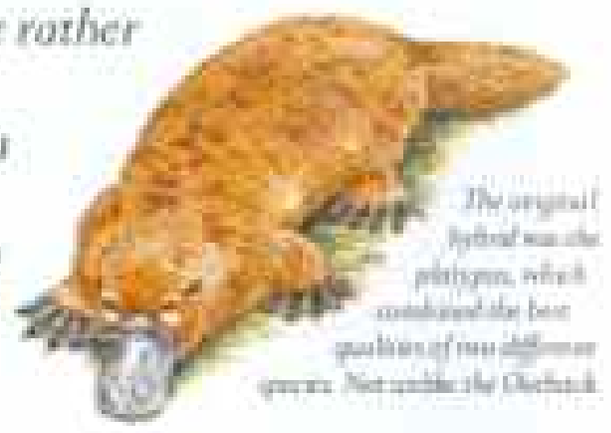

The original hybrid was the platypus, which combined the best qualities of two different species. Not unlike the Outback.

ride and suppress the appetite for fuel, without caging the rugged, freewheeling spirit of the wild. The result is an All-Wheel Drive vehicle that rides as smoothly as a

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Product comparisons based on 1998 model cars. Ground clearance comparison based on the manufacturer's published specs. Fuel economy based on 1998 EPA estimates. Pricing based on 1997 MSRP Subaru Outback

passenger sedan, but still has the ground clearance of a Ford Explorer, holds a tighter turn than a Chevy Blazer, and gets better gas mileage than a Jeep Grand Cherokee. So you get the creature comforts of a car, plus the pure animal instincts of a sport-utility vehicle, all in one wildly attractive package.

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	Subaru Outback	Ford Explorer XLT	Chevrolet Blazer LS	Jeep Grand Cherokee
EPA Fuel Economy (city/highway mpg)	20/27	15/20	16/22	15/20
Ground Clearance (in.)	7.3	6.7	8.3	7.8
Front Legroom/ Headroom	40.2/43.3	39.9/42.4	39.5/42.4	42.6/42.4
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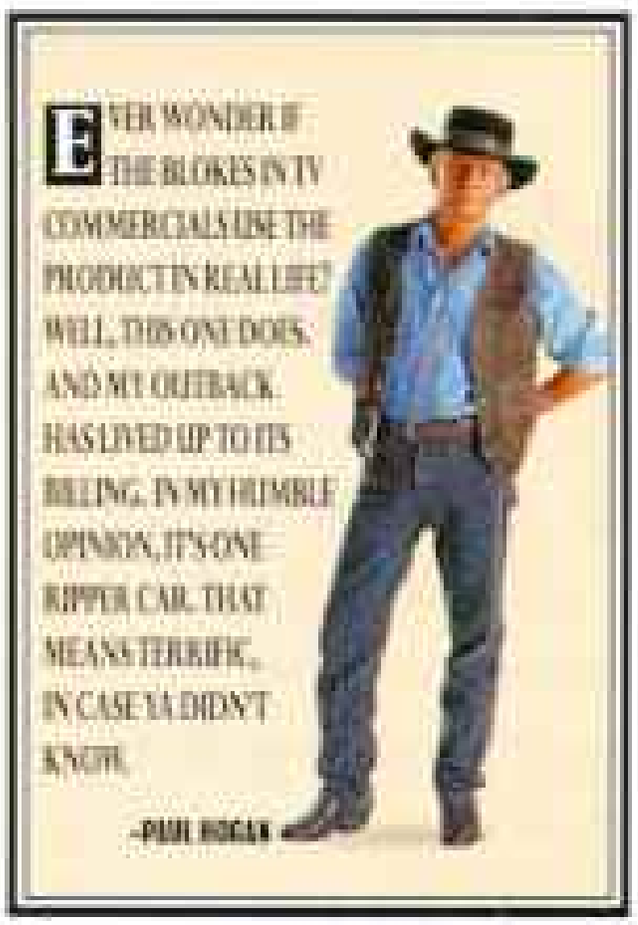

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Polar Bear *(Ursus maritimus)* **Size:** Length of male, 2.5 – 3 m; female, 2 – 2.5 m **Weight:** Male, 350 – 650 kg; female, 175 – 300 kg **Habitat:** Sea ice and coastal waters in the circumpolar regions of the Northern Hemisphere **Surviving number:** 25,000 – 35,000

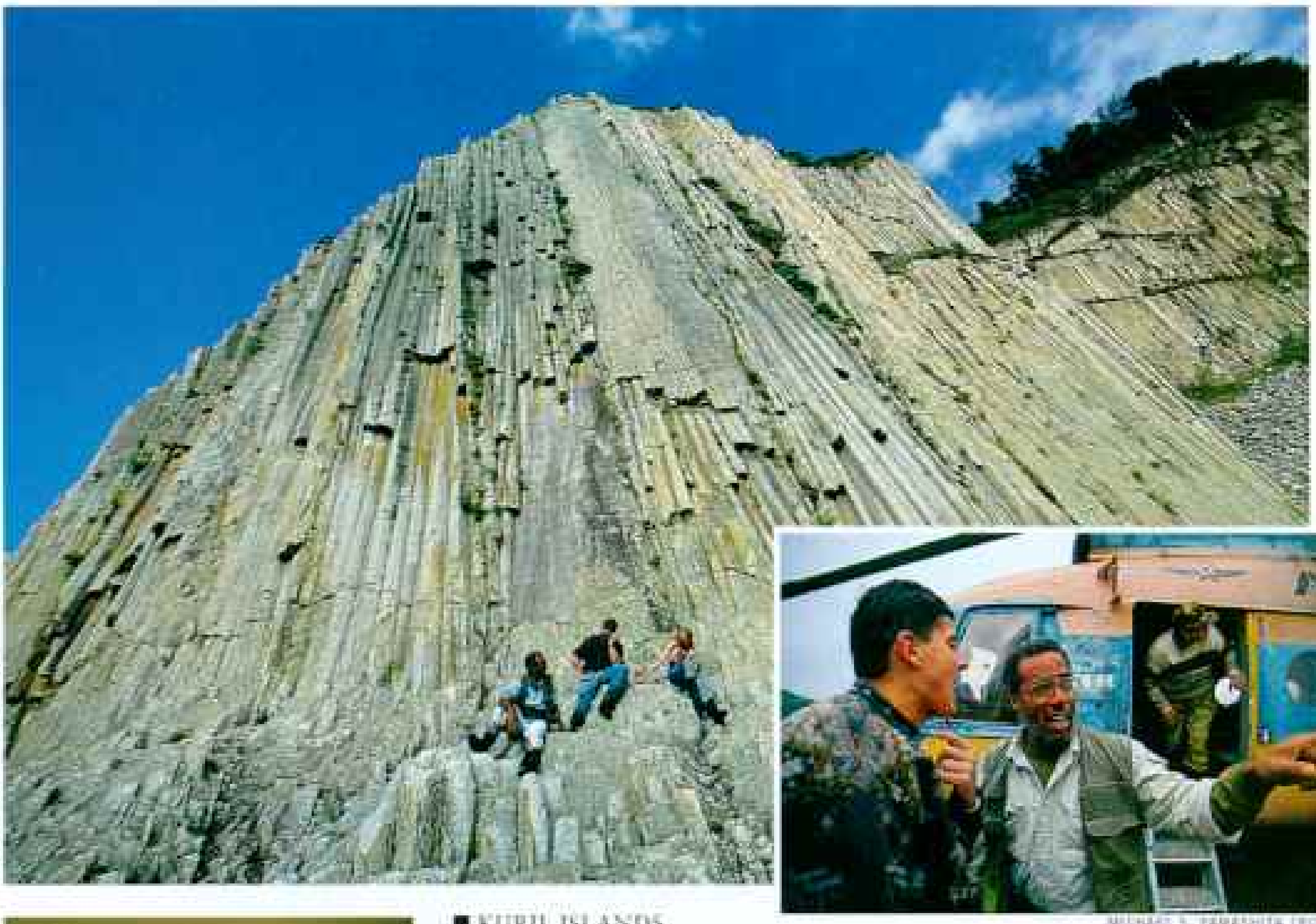
Photographed by Norbert Rosing

WILDLIFE AS CANON SEES IT

This seemingly aggressive encounter is actually just a bout of playfighting between two polar bears. In some lower arctic regions, the bears engage in such antics while waiting for coastal waters to freeze so they can return to the pack ice and a solitary life of hunting seals. Decades ago polar bear numbers were declining from overhunting, and fears of extinction united the polar bear nations to safeguard the bear's future. With protection, populations increased, but a low reproductive rate keeps these great white bears vulnerable to natural or man-made events detrimental to them or their fragile environment. As a global corporation committed to social and environmental concerns, we join in worldwide efforts to promote greater awareness of endangered species for the benefit of future generations.

NATIONAL GEOGRAPHIC

On Assignment



■ KURIL ISLANDS

Climbing New Heights

"IT'S THE MOST EXCITING THING there is to do in the Kurils," jokes writer Charlie Cobb (above, at left) of rock sitting on Kunashir's basalt cliffs, a favorite attraction in the area. Charlie climbed the towers with scientists from the University of Washington.

Accompanied by translator Vasily Mirgorodsky (inset, at left), Charlie had to fight some misgivings about flying on local helicopters—sometimes the only mode of travel available in the Kurils. "One was 20 years old," he says. "I learned later that it had no radar." A former radio correspondent, congressional aide, civil rights organizer, and bookstore owner, Charlie recently turned freelance after 11 years on our editorial staff. He lives with his wife, Ann, and their five-year-old daughter, Zora, in Washington, D.C.

■ TERRA-COTTA ARMY

Sizing Up His Subject

"I ALWAYS KNEW he'd turn into one of those," said a GEOGRAPHIC editor on seeing this photo (left) of Lou Mazzatenta. Lou has photographed his share of ancient terra-cotta soldiers, including Han emperor Jing Di's "army," which appeared in our August 1992 issue. Lou's rapport with Chinese archaeological authorities enabled him to cover new excavations near Xian. "The Chinese are as warm and wonderful as Italians," says Lou, who retired in 1994 after 32 years on staff. "I still work," he says. "I just don't wear a tie."

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NATIONAL GEOGRAPHIC

Geoguide

Where the Wild Things Go

If you examine the map on pages 12-13, you'll see that the dots marking national wildlife refuges tend to be clustered rather than scattered. Near what kinds of natural features have the refuges been concentrated? Why do you think those lands were set aside for wildlife?

When the author visited summer breeding grounds for birds in Yukon Delta National Wildlife Refuge in Alaska, he found godwits from Australia and sandpipers from Paraguay. Which birds had flown farther? Once you've guessed, use a world map or globe to check distances. What bodies of water did each of the birds cross?

On the pull-out map supplement "Federal Lands in Fifty States," every state shows some federal land, but most is grouped in one region. Considering how the nation was settled and what the landscapes are like, explain the distribution of federal lands.

As shown on the map on pages 12-13 all four migratory flyways follow north-south routes. Why? If you compare that map with the "Physical Landscape" map on the back of the supplement and lay string on the larger map to show where the flyways are, what can you say about the types of terrain over which the birds fly? Does it tend to be mountainous or flat, dry or wet?

With a deafening din snow geese (above) descend for the night at Squaw Creek National Wildlife Refuge in Missouri. These wetlands offer rest and rations to 450,000 birds on the wing between the Arctic and winter quarters along the Gulf of Mexico. A California tiger salamander, shy resident of San Luis refuge, spends life largely underground.

BOTH BY JOEL SARTORE

USE GEOGUIDE ALONG WITH THE ARTICLE "SANCTUARY: U.S. NATIONAL WILDLIFE REFUGES" IN THIS ISSUE TO CAPTURE THE INTEREST OF YOUNG READERS AND STIMULATE DISCUSSION WITH THEM.

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Matt Ryan and design staff on roof of Red Oak House, Dublin, Ireland.

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