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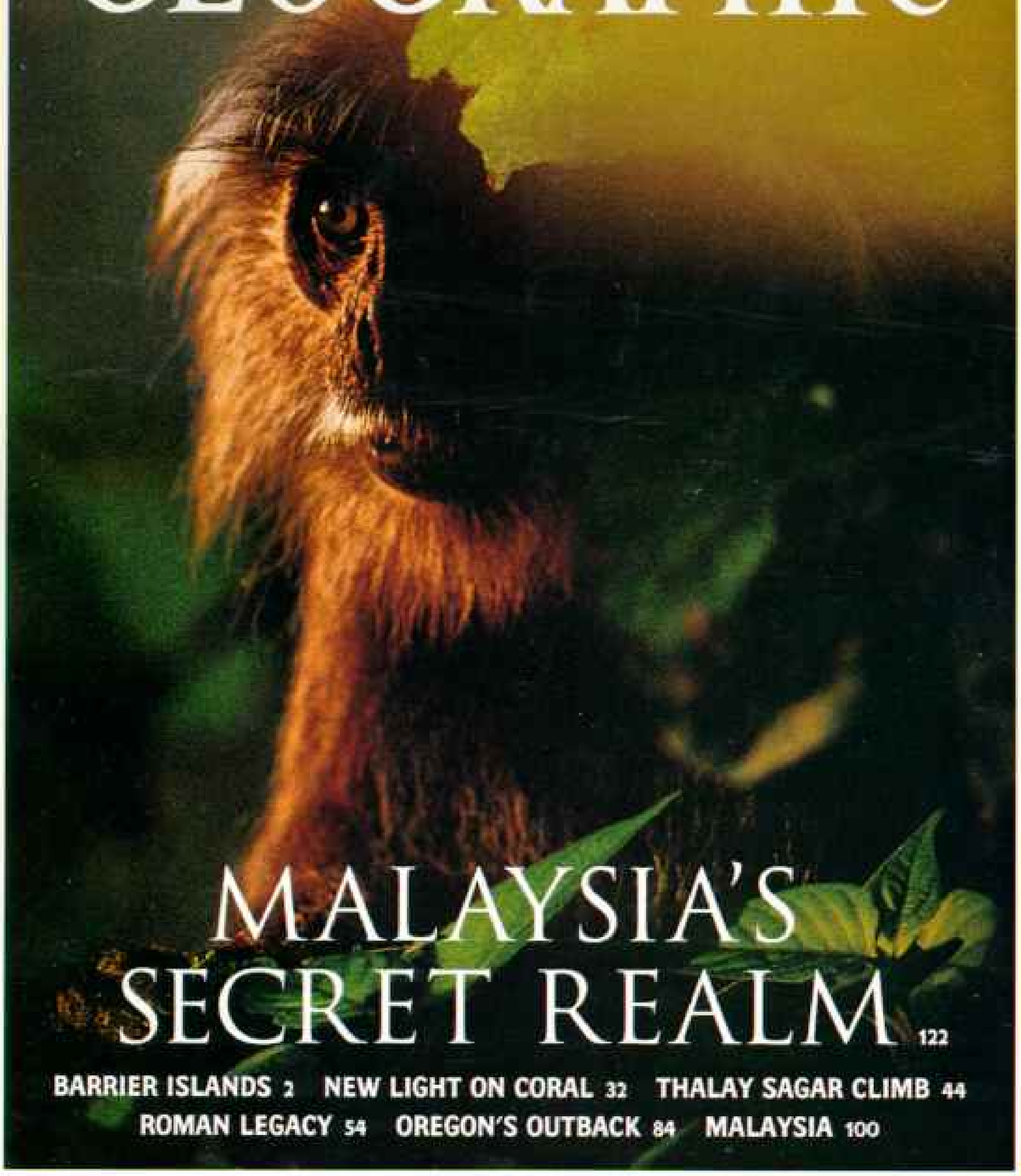

MALAYSIA'S SECRET REALM 122

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NATIONAL GEOGRAPHIC

From the Editor

FOR 108 YEARS NATIONAL GEOGRAPHIC has presented readers with people, places, and things they have never before seen—or, sometimes, even imagined.

This month, underwater photographer David Doubilet shows us Red Sea coral in a whole new light—literally—capturing the eerily beautiful fluorescence of coral when bathed in ultraviolet light.

"My diving partner David Fridman and I had yearned to photograph fluorescent coral in its native habitat," says David. "We succeeded by putting a UV filter over a very powerful 1,200-watt underwater movie light."

David's inventive approach is especially timely in 1997—the International Year of the Reef. His work is also part of a grand tradition at the Geographic, where the art of underwater color photography was invented. It started in 1926, when Charles Martin and W. H. Longley—strong on innovation but perhaps lacking in good sense—exploded magnesium powder loaded on rafts to illuminate the seafloor 15 feet below, where Longley hovered with his crude waterproof camera (above right).

In the decades to follow, Luis Marden dived with Jacques-Yves Cousteau using a camera locked in a watertight box that required that settings be made on the surface. Bates Littlehales designed the OceanEye, an eyeball-shaped camera housing that corrects water's optical effects on images. Alvin Chandler and Emory Kristof developed deep-sea imaging techniques that helped bring back photographs of the *Titanic*. It was the same type of light they used that helped Doubilet capture the neon-like glow of live coral.

For Doubilet the coral reef is "another piece of our world that we can explore using new technology and new tools." Technology and tools, that is, combined with the special genius brought to bear by NATIONAL GEOGRAPHIC photographers.

Bill Allen

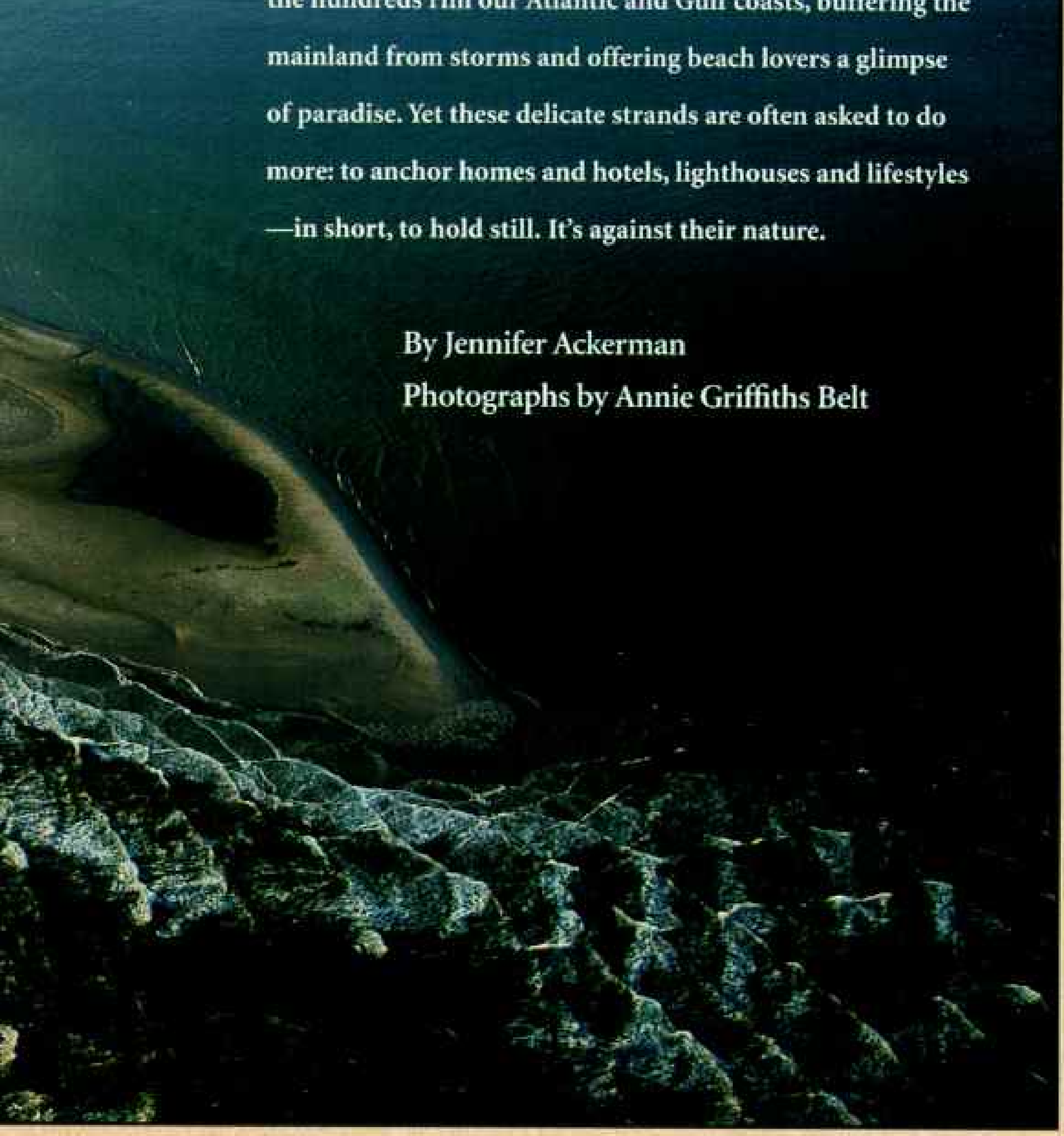
Islands at

the Edge

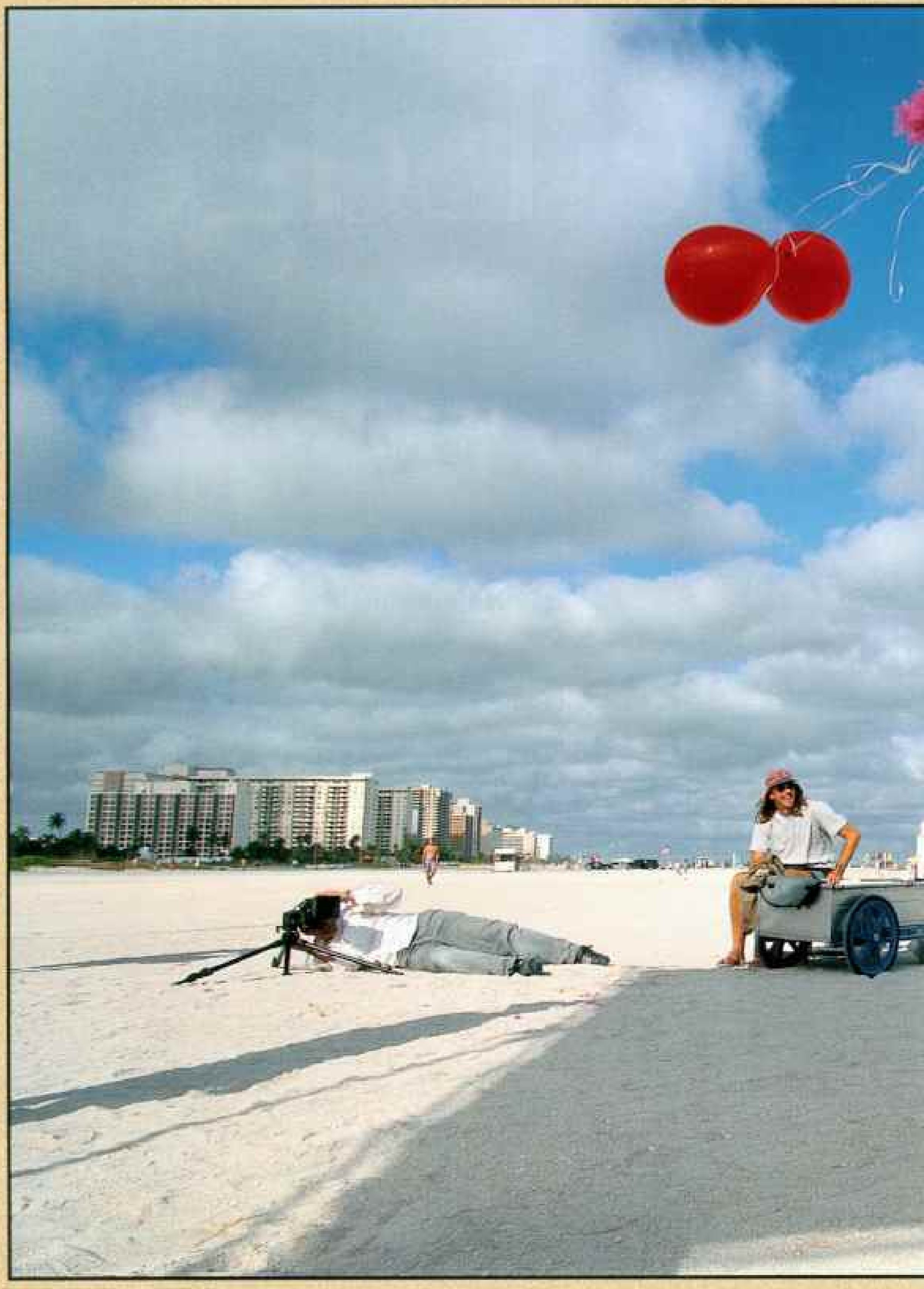
Drifting on the whims of sand and sea, barrier islands by the hundreds rim our Atlantic and Gulf coasts, buffering the mainland from storms and offering beach lovers a glimpse of paradise. Yet these delicate strands are often asked to do more: to anchor homes and hotels, lighthouses and lifestyles —in short, to hold still. It's against their nature.

By Jennifer Ackerman

Photographs by Annie Griffiths Belt



CHANDELEUR ISLANDS, LOUISIANA



Sizzle and sunshine—and picture-perfect sand—lure a photographer and his high-spirited model to Miami Beach, where 60 million dollars went to replenish an eroded shore of fine coral and shell bits with coarser grains. Harder and more compact, this "new" beach has lasted 16 years.

MIAMI BEACH, FLORIDA

THE STORM CAME to the barrier islands off North Carolina on a day with gusty winds that whitened the gray-green sea. It moved in from the south, having traveled in the parabolic groove of hurricanes around the Virgin Islands, Puerto Rico, the Bahamas, gathering strength as it spun toward the long chain of barrier islands that rim the Atlantic coast. By Thursday, September 5, 1996, it was clear that Hurricane Fran had aimed its Cyclops eye directly at Cape Fear.

The order to evacuate North Carolina's southeastern barrier islands had been issued early Thursday morning. These thin ribbons of sand lie low, five to ten feet above sea level, and bear the brunt of high storm winds, powerful waves, and flooding. In summer they are packed with hundreds of thousands of people. When the warning came, most tourists and residents retreated inland to weather the hurricane in shelters at Wilmington and Jacksonville. Donna and Don Benton decided not to leave their home at Carolina Beach. On Thursday afternoon they boarded up the windows of their two-story frame bungalow and waited. By early evening the wind was shrieking, and the rising sea was roiled to a violent froth. As the eye of the storm made landfall about 9 p.m., the fiercest winds hit, and the ocean surged over the island. "I could hear the bangs and thumps of things floating around on our first floor," Donna Benton remembers. "The garages at the condominiums across the street gave way, and the water just floated the cars across the island. Then suddenly the house next door tore loose from its foundation. We felt like we were in the middle of the Atlantic."

The morning after, the sky above the barrier islands was clear. The Bentons sifted through the waterlogged contents of their first floor. Fran had spared their house but swept away dozens of others. Block after block, Carolina Beach, Kure Beach, Surf City, and Topsail Beach were strewn with the debris of smashed cottages and condominiums. A 12-foot storm surge had overwashed the north end of Topsail Island, damaging nearly every building. Storm waters rushing back from the sound to the sea cut several new inlets, where the tide was still running out in brown roils. Up and down the barriers, three feet of sand packed the lower streets, topped by all the mundane furnishings of life—bathtubs, vacuum cleaners, chairs, a child's crib, a silver tea set, lightbulbs inexplicably intact, even a bed still perfectly made. People moved about numbly, stopping to stand before the stumps of pilings that once held their homes. The next day a search team of 60 volunteers set out with dogs to sift for bodies in the wreckage.

At final count Fran killed two dozen people and caused two billion dollars in property damage. It was the sort of storm that points

At the edge of the sea an endless dance of water and sand hypnotizes the soul, drawing us closer to the rhythms of eternity. "Each grain on a beach," wrote Rachel Carson, "is the result of processes that go back into the shadowy beginnings of life. . . ."

JENNIFER ACKERMAN is the author of *Notes from the Shore*, a book about the natural life of the Atlantic coast. Photographer ANNIE GRIFFITHS BELT most recently covered the Yellowstone River for NATIONAL GEOGRAPHIC's April 1997 issue.

EDISTO ISLAND, SOUTH CAROLINA

out the folly of getting mixed up with a barrier island on anything like a permanent basis.

Yet mix we do. Just weeks after Fran, North Carolina property owners were making plans to rebuild their beachfront structures on those same low-lying barrier beaches so vulnerable to hurricanes and other storms. They were willing to accept the risk of doing so in part because the cost of rebuilding—houses, roads, bridges, even beaches themselves—is borne largely by the United States taxpayer through the National Flood Insurance Program, the Federal Emergency Management Agency's disaster relief fund, and the Army Corps of Engineers' shoreline stabilization projects. In the minds of many people the real folly is this: Up and down the U.S. coast, public money is subsidizing private property on islands made of sand, the stuff on which, as the Bible says, only fools build.

ORRIN PILKEY, a professor of geology at Duke University and director of the Program for the Study of Developed Shorelines, once described Topsail Island to me as "a disaster waiting to happen—low, narrow, and loaded with dangerous development." We were standing on a dune at Shackleford Banks, North Carolina, a barrier island about 50 miles north of Topsail. It was a sunny day in winter. The sea was calm, but strong waves had recently scoured the beaches. Not far from the high-tide line were scarps in the dunes six feet high, miniature cliffs where charged-up surf had gnawed into the island.

I had come to Shackleford with Pilkey to try to understand what was happening—is happening—here and on most other barrier islands of the Atlantic and Gulf coasts; to understand how a barrier island responds to the

OCEAN CITY, NEW JERSEY (ABOVE); MIAMI BEACH

Replenish or perish is the name of the game in Miami Beach (bottom), where six billion dollars' worth of real estate towers over ten miles of imported beach. Such measures are temporary: A New Jersey beach rebuilt by the U.S. Army Corps of Engineers (left) was carved into sandy crags by waves from Hurricane Felix.

energies of wind and wave, to rising sea level, to storms like Fran, responds as if it were alive, with a kind of wit and wisdom of its own.

Shackleford lies at the southern end of the string of barrier islands known as the Outer Banks. Roughly nine miles long and half a mile wide, it parallels the short, sudden westward turn of the North Carolina coast. The National Park Service acquired the island in the mid-1980s. No one lives there now. There are no houses, no condominiums, no boardwalks. Just sand and plants, dune and thicket, forest and marsh.

Pilkey has been visiting Shackleford for 30 years, often trailed by a cadre of devoted students. A Moses-like figure with a silvered beard, he considers the island his laboratory and first love, and he possesses an intimate, detailed knowledge of its dynamic topography. Those six-foot scarps threaded with the dangling, exposed roots of sea oats suggest to him that the dunes are backing up, moving inland. They are not the kind of dunes you want to see in front of your island cottage.

IN THE LINGO of geologists, barrier islands are loosely defined as long, narrow bodies of sand, running parallel to the shoreline, separated from one another by inlets and from the mainland by marsh or lagoon. The term "barrier" identifies them as buffers; they protect the mainland from storm and surf. They also shelter marshes, nurseries to hundreds of species of fish and shellfish and habitat for myriad ducks, geese, herons, egrets, ibises, limpkins, bitterns, rails, coots.

Only a small fraction of the world's coastlines are fronted by barrier island chains (a recent study put the figure at 2.2 percent), most of them where the coastal plain slopes gently, where sand is abundant and waves supply enough energy to move the sand about. There are barriers off the coasts of China, India, the Netherlands, Australia, and Alaska. A snaking chain of frigid barrier islands threads the shores of Siberia. Islands of black sand rim southeast Iceland. But by far the longest stretch of barrier islands runs more than 2,000 miles along the coast of the United States in an irregular chain from New York to Texas. Its links include New York's Fire Island; the islands of the Jersey, Maryland, and Virginia shores; the long, sinuous ribbon of the Outer Banks; the Sea Islands of South Carolina and Georgia; Cape Canaveral and Miami Beach on the Florida coast; the Gulf coast's Isles Dernieres, Galveston Island, and Padre, the world's longest barrier island.

Geologically speaking, most of these islands are young. The Outer Banks are about 5,000 years old. The Chandeleur Islands of Louisiana have existed for less than three millennia.

While the catchall term "barrier island" gives the impression of uniformity, each island is unique, born of intricate combinations of sand supply, wave energy, and tidal range. Along the Georgia coast, where spring tides reach 11 feet and wave energy is low, islands such as Tybee, Sapelo, and St. Simons are relatively short. Along the North Carolina and Florida coasts, a tidal range of only two to three feet with higher wave energy creates longer, narrower *(Continued on page 16)*

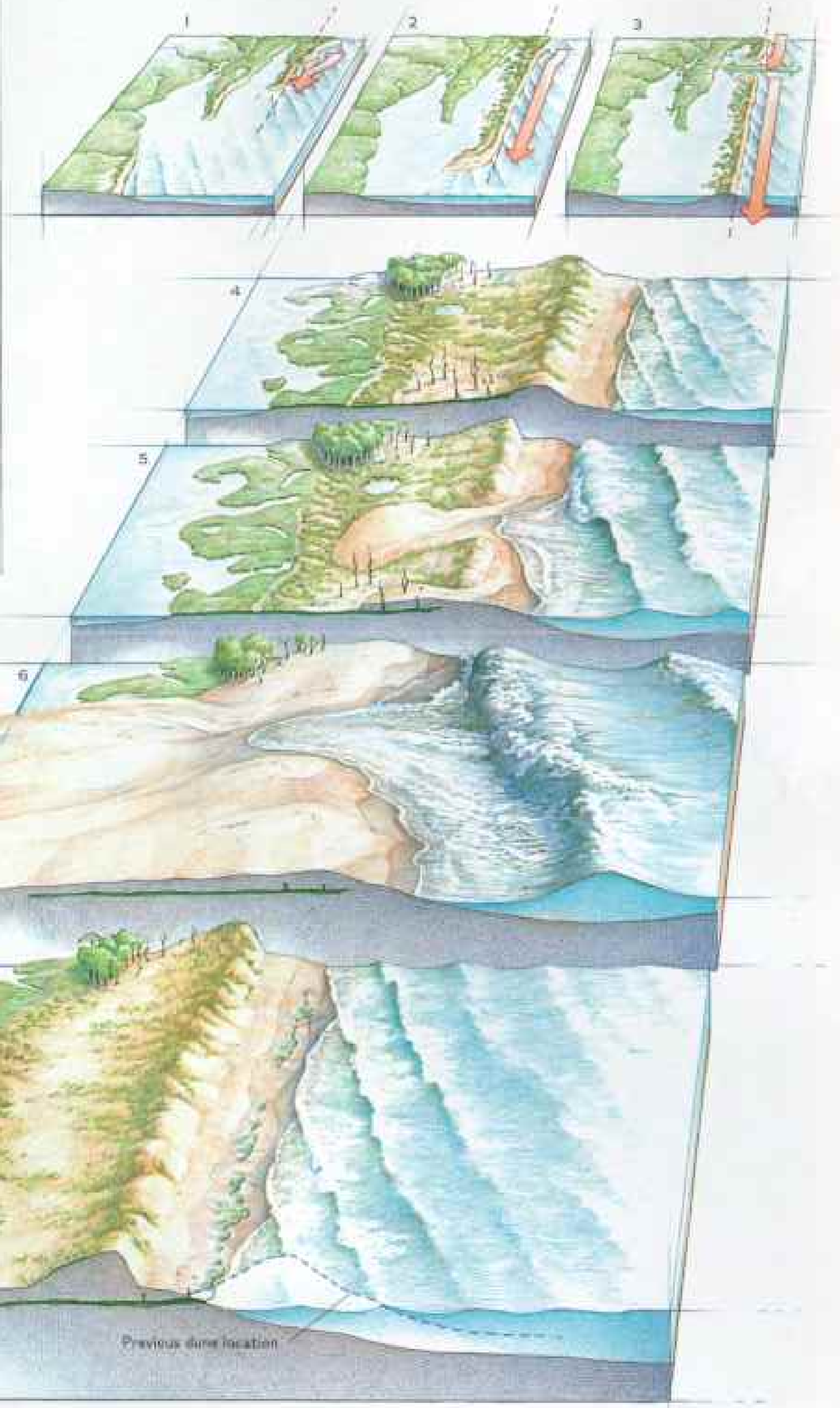
Felled by a tireless foe, Little Egg Harbor Light crashed into the sea on October 12, 1927, a moment captured on film by the lighthouse keeper's grandnephew. After standing fast on Tuckers Island, New Jersey, for 79 years, the building was undermined largely because of jetties on adjacent Long Beach to the north, which robbed Tuckers of replenishing sand and caused waves to scour its beach. Tuckers later disintegrated—although a remnant (right) reappeared a decade ago, attracting boaters by the thousands.

LIGHTHOUSE PHOTOGRAPHS BY CHARLES EDGAR NASH, JOHN BAILEY LLOYD COLLECTION (TOP); PAUL ROSA & BARBARA L. [illegible]

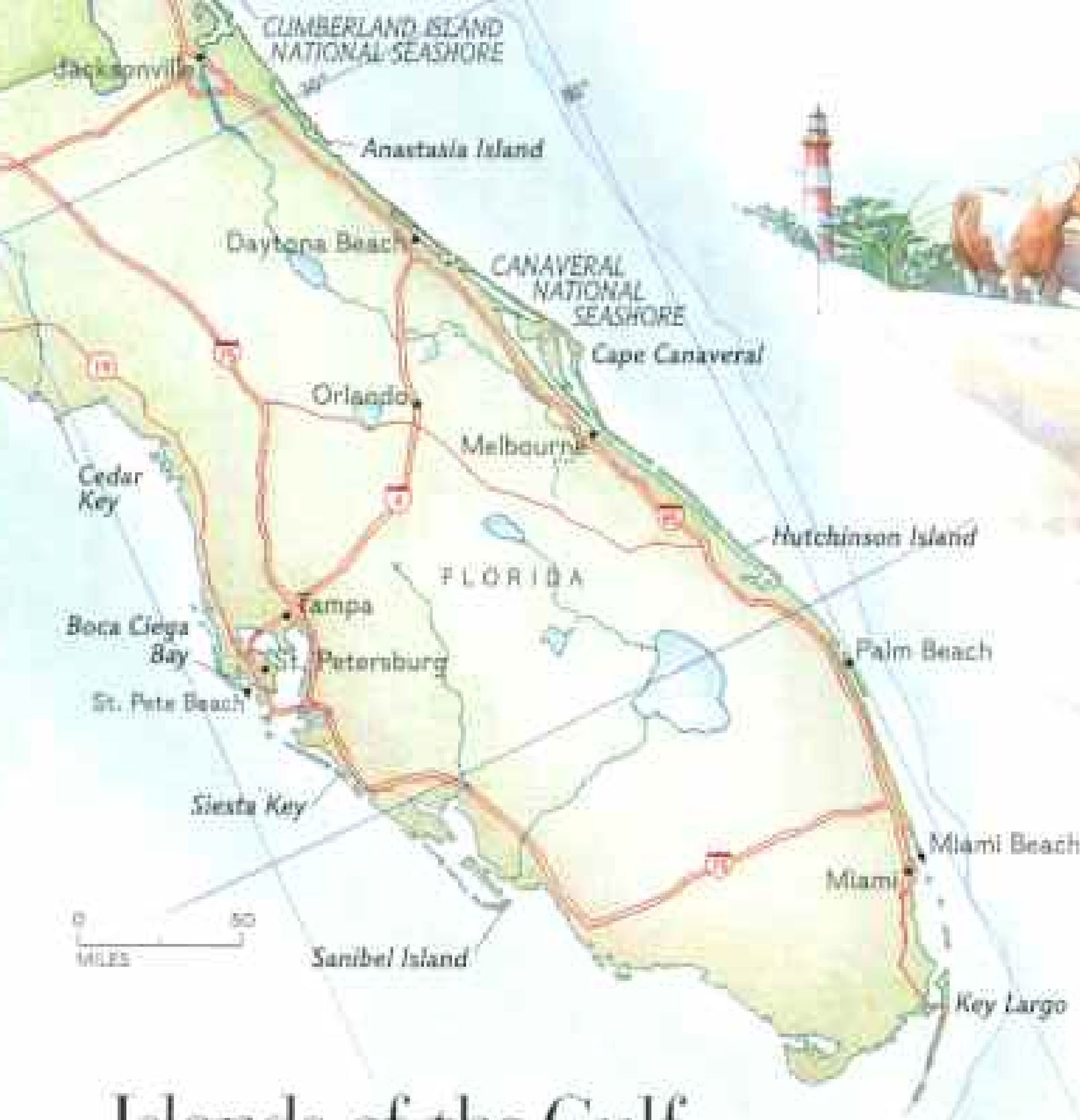
TUCKERS ISLAND, NEW JERSEY

Anatomy of an Island

Sculpted by wind and waves, barrier islands along the Atlantic and Gulf coasts of the U.S. are made of sand—mostly grains of quartz, feldspar, and other minerals eroded from inland mountains and deposited offshore by rivers. When left in their natural state, Atlantic coast islands such as Assateague (left) tend to lengthen with prevailing currents and to migrate toward land, rolling over themselves like sand in a barrel. Human development may impede this migration but can never bring it to a halt.



Assateague becomes a barrier island when a mainland spit expands (figure 1), is elongated by prevailing currents transporting sand southward (2), and is eventually breached by storm waves (3). The new island, rimmed by a sound and tidal inlets, builds itself as incoming waves dredge up bottom sediment and deposit it onshore, where winds sweep it into dunes (4). Sheltered by the dunes, a marsh develops on the sound side of the island, and plants and forests take root. When storm waves inevitably break through the dunes (5), sand invades the backcountry, covering vegetation, while surf levels the dunes (6). As sands wash over Assateague, it migrates landward (7), leaving remnants of salt marsh peat behind on the new beach (below).



Islands of the Gulf

Gulf coast islands are under even more pressure from erosion than their Atlantic counterparts. Dams and levees on the Mississippi and several Texas rivers deprive large parts of the Gulf of sediment to replace sand stripped from the islands. Heavy industrial use—including drilling and the building of jetties by oil and gas companies—also takes a toll. And the Gulf's warm waters stoke tropical storms, turning them into hurricanes. All these factors combine to create hundreds of miles of the fastest eroding shoreline on the continent.

ART BY C. BRUCE HERSEE

(Continued from page 9) islands such as the Outer Banks and Miami Beach. Padre Island, Texas, with a mean tide range of less than two feet, is so long you can feel the climate shift as you move south along its 110-mile length.

Despite their vital differences, the islands within a string are inextricably linked, explains Pilkey. "They're like the beads of a necklace, sharing the same sand supply, responding to the same body of water, subject to the same forces of change."

The crest of a 30-foot sand hill offers a 360-degree view of Shackleford Banks, where sea oats, sand, and wind have conspired to build elegant, towering dunes in the interior. Among the grasses grows an array of intriguing plants—silver-leaf croton, seabeach evening primrose, dune bluestem, seaside spurge, pennywort—which help anchor the dunes. Elsewhere there are vines of wild bean, China brier, and muscadine grape; shrubs of yaupon, beauty berry, and dwarf sumac, all superbly adapted to shifting sand. On the eastern half of the island lie sand flats and salt marsh; on the western, a wide swath of deep-green maritime forest, where red cedar and live oak clipped by the salt breeze are whittled into harmony with the contours of the rolling dunes. "Plants control the evolution of a barrier island," explains Pilkey, "and the shape of the island in turn determines the variety of plants. It's a beautifully integrated system of physical and biological life."

Much as Pilkey loves barrier islands, he would never live on one. His home lies far from the ocean in the rolling hills of Durham, North Carolina. From the chimney of his house a length of thick rope, salvaged from Shackleford and hauled home with the help of his students, stretches across the yard to an anchor sunk deep in the lawn.

As we head down the beach, we scare up hosts of scuttling sanderlings and a cormorant or two. Pilkey stoops to show me a vestigial copse of smooth, worn stumps emerging from the surf. Sand has cut away the trees' outer growth and left only heartwood, stubborn remnants of a maritime forest that shaded this spot a century ago. He bends again to retrieve the battered black shell of an oyster—more evidence of rapid geologic change. Oysters live not in waters of full oceanic salinity but in the brackish waters of the sound. "This is a fossil from a marsh that once stood here," he explains. "This beach is where the sound used to be. In a sense, ocean has come to oyster."

At the center of the island Pilkey leads me to a wide swath of sand, littered with shells and wrack. "It takes a humdinger of a storm to push sand into the middle of an island like this," he says. In narrower portions of Shackleford, overwash has swept clear across the island, pushing sand from the beach face over the dunes to the sound side of the island.

Clues such as these—scarps, stumps, oysters, overwash—quietly summarize the sequence and meaning of change on this island. Shackleford is rolling over itself, sand moving over sand, over forest and marsh and lagoon. Geology plays a quick hand on barrier islands, even without the help of hurricanes. "Overwash and the opening and closing of inlets during storms are among the chief ways an island moves," says Pilkey. "But sand is always moving here in response to quieter forces." Among them, he says, are prevailing winds that build dunes, longshore currents that carry sand along the shore in a zigzag, sawtooth stream, and the seasonal shifting of sand from offshore bar to beach to bar.

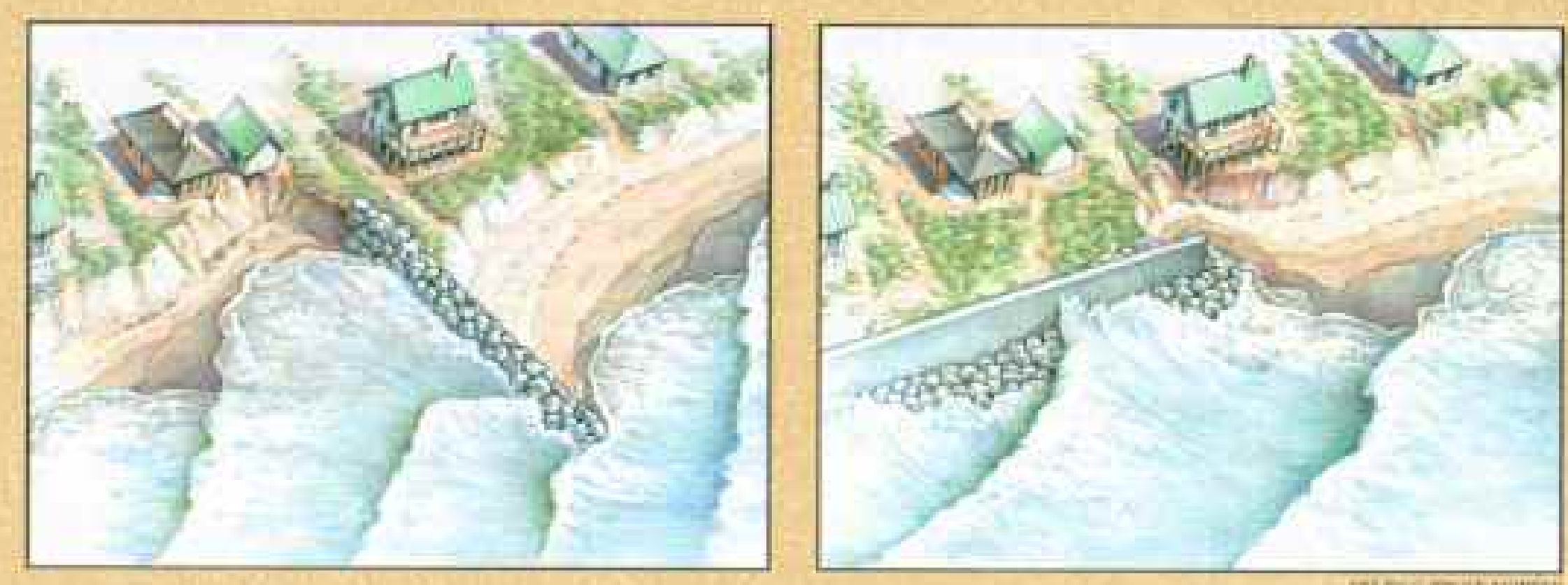
IF YOU COULD SIT STOCK-STILL and watch with a remembering eye, the forms of a barrier island would seem momentary, like the shifting flames of a fire. Every inch moves, shaped and reshaped by wind, waves, currents, and storms. The changes brought about by these forces ripple over the islands, dunes rising and falling, beach expanding and contracting, inlets opening and closing, shapes wavering and blowing, dying and being reborn, not in devastation but in constant rearrangement. Some barrier islands metamorphose so rapidly that they have been called amoeba-like, ecological banana peels, and high-speed real estate.

"The movement and change are not random, however," explains Pilkey. "They're part of a pattern of stimulus and response, part of the islands' effort to survive. Barrier islands really do act like living things; they respond in sensible, even intelligent, ways to the forces of wind and water."

That is, if they are unfettered. Pilkey believes that barrier islands must be allowed to move and change freely or they will be

PENSACOLA BEACH, FLORIDA

"We lost two homes in two months," says Susanne Silber, who sifts the debris of the family beach house, destroyed by Hurricane Opal; the Silbers' other home, in Pensacola, fell to Erin. They will rebuild, but where? "We've only got one life to live," she replies—"the beach."



ART BY C. BRUCE HUNTER

Damming the river of sand, a stone groin essentially "robs Peter to pay Paul," says coastal geologist Stephen Leatherman. It traps waterborne sand on the updrift side, thus widening that beach. But this leaves little sand to replenish beaches below the groin, which are further eroded by waves.

Seawalls, which run parallel to the shore, protect beachfront homes from battering waves and storm-surge flooding—but they can also wreak havoc with beaches. By abruptly deflecting wave energy, some geologists say, these rigid barriers increase current strength, accelerating erosion.

lost forever. His goal as their champion and protector is ambitious: He would like people to leave them alone.

THE BARRIER ISLANDS I visited as a child rise up in my mind through a meld of sensations: the good crunch of sand under bare feet, the tangy scent of salt, the cries of the gull and plover. Also the flecks of color and crushing sweet stink of suntan oil on thousands of bodies merged on the beach. I loved the raw energy of the seaside and the quiet of the lagoons and marshes. The silent, humid thatch of marsh grasses on the bayside was home to a beguiling ark of organisms: fiddler crabs and mud crabs, oysters, mussels, beetles, chinch bugs, and diamondback terrapins. Along the wrack line on the ocean side, my attention wandered from the occasional perfect whelk shell or sandpiper's cuneate footprint up to the horizon for a shot of that spellbinding blue.

We are drawn to these islands. "But look! here come more crowds, pacing straight for the water, and seemingly bound for a dive," wrote Herman Melville in *Moby Dick*. "Strange! Nothing will content them but the extremest limit of the land." In the sea-molded curves and open space of a barrier island is release from harsh lines and cramped spaces. In the blue water and white sand is a sense of things stripped clean, the big tabula rasa. When I climb up over the fat humps of sand dunes at Assateague or Ocracoke or Fire Island, I confront the sea always with the same delighted astonishment. Something in the water's wide spread both fills the mind and empties it. It is all unfathomed magnitude and mystery. Time slips by; the waves slap. The briny surf and shifting sands correspond to a memory as deep as any we possess. It is no wonder so many people consider these islands their spiritual and emotional home.

Before World War II, beach houses and resorts covered just 10 percent of barrier islands along the Atlantic and Gulf coasts. Today in many stretches the islands of New Jersey, Georgia, Florida, and Texas are one great mass of buildings sprouting from a matrix of concrete. In places such as Galveston Island and the barrier beaches near St. Petersburg, Florida, real estate developers running out of room have actually created more island waterfront by filling in marshes and building fingerlike extensions attached like tentacles to the backside of the barriers. Everywhere are condominiums and resorts offering tall promises of rainbow's end and subdivisions with names that memorialize what has been bulldozed into oblivion: Dunes West, Maritime Woods, Sea Meadows. So transformed are many barrier islands that we often pass onto them unaware that they are islands at all.

By the early 1980s, cottages, hotels, and condominiums were swallowing up barrier islands at a rate of 6,000 acres a year, often with the help of government programs. In 1982 the U.S. Congress took measures to slow the burgeoning development by creating the Coastal Barrier Resources Act. The act protects 186 areas—a total of 453,000 acres—of undeveloped barrier islands along the Atlantic

Man-made islands near St. Petersburg, Florida (right), sit a few feet above sea level on soil dredged from the floor of Boca Ciega Bay. A pair of barrier islands, at top, is all that protects them from the sea.

Getting next to the sea is a passion for the Fischer family and friends (bottom), who spend every summer at Grammy's house in Ocean Beach, New Jersey. "It doesn't get any better than this," says Debra, the mom in the middle.

BOCA CIEGA BAY, FLORIDA (ABOVE); OCEAN BEACH, NEW JERSEY

Going where the oil is, drilling companies in the Gulf of Mexico find some shelter for their operations behind barrier islands. Despite their efforts to stabilize East Timbalier with a stone breakwater and earthen embankments, upper right, the island has nearly washed away.

EAST TIMBALIER ISLAND, LOUISIANA

LOUISIANA BAYOU, NEAR FOURCHON

and Gulf coasts. Under the law those who build within these areas cannot receive federally subsidized flood insurance or federal funds for bridges, roads, or water and sewer systems. The Coastal Barrier Improvement Act of 1990 added another 700,000 acres. In many of these protected areas coastal development has nearly ceased.

Elsewhere, however, you can almost hear the sound of concrete moving like an incoming tide over dunes, marshes, and maritime forests. Thousands of people continue to build houses and businesses. Whole cities have sprung up, and those cities cannot tolerate a barrier island's natural habits.

The morning after Hurricane Fran, I traveled to North Carolina's southeastern barrier islands to survey the damage with two young geologists conducting a study funded by the Federal Emergency Management Agency. We moved up the islands slowly, counting the number of houses damaged and destroyed and comparing the damage patterns with hazard maps that scientists had compiled from studies of the islands' geologic features. The places that suffered actual damage from Fran closely matched the areas on the maps marked as danger zones: low, narrow stretches of island with few natural dunes and scarce vegetation, areas especially vulnerable to storms.

The worst hurricane in memory to hit this stretch of coast was Hazel in 1954, a storm that annihilated nearly every building on the islands of Long Beach, Holden Beach, and Ocean Isle. In the decades that followed, beach houses sprouted everywhere, most of them built by people who had never experienced a major storm. By the time Fran struck, so dense was the development on the barrier islands north of Cape Fear that a storm

Old-timer Elson "Coon" Martin, who's been fishing Louisiana bayous for most of his 67 years, says competition for market-size crabs is whittling away at the resource he depends on for a living. And as barrier islands shrink, so do the marshes they protect—nurseries for young fish and crabs. "Mother Nature bitin' back," he declares. "She bite back haaard too."

weaker than Hazel inflicted much greater damage. A man who lost his newly renovated beachfront home at Surf City told me, "I expected erosion to be a problem, but I had no idea a storm could just sweep my house away."

Geologists have been warning people for years about the dangers of building houses smack up against the sea on thin strips of sand. But so congenial is the setting on barrier islands that people seem willing to accept the risk. "It's the price you pay for living at the beach," said one resident of Carolina Beach. "You just have to be philosophical about it."

ON THE WALL of my study hangs a photograph taken by an astronaut aboard the Apollo 9 spacecraft on March 12, 1969. One of earth's features clearly visible that day from 130 miles was the fine white band of the Outer Banks snaking along the North Carolina coast. Viewed from this distance, the astonishing thing about these islands is that they exist at all, slim as a bird's leg and far out to sea.

Just what barrier islands are doing so queerly appended to the North American continent is still under investigation. One theory suggests that the barrier islands of the Atlantic and Gulf coasts were born with the rise in sea level that began at the end of the last ice age. About 18,000 years ago, when the great polar caps locked up huge amounts of water, sea level was 400 feet lower than it is today. With the waning of the ice age, the polar caps melted and the sea began to rise at a rate of several feet a century. As it rose, it flooded river valleys, leaving long, fingerlike ridges extending from the mainland. Under attack by waves the ridges eroded, forming sand spits across the mouths of the valleys that were soon breached by the rising tides. Likewise the sea inundated low areas behind dunes along the seaward edge of the continent, leaving behind a chain of above-water sandbars.

As the sea continued to rise, waves overwashed the islands, scouring sand from the front and depositing it in overwash fans on the islands' backsides. Receding in front, accreting in back, the islands maintained their elevation above rising sea level by rolling over themselves, migrating landward up the coastal plain.

Then about 4,500 years ago there came a pause in sea-level rise, which allowed the islands to grow and widen. It is pure chance that they lie in their present position.

A look at the names on a map of the Atlantic coastline suggests that people have been living on these islands for a long time. Native Americans such as the Massapequa and Shinnecock, the Accomac, and the Hatteras established villages and summer camps on the islands of New York, Virginia, and North Carolina to harvest food from the sea. They fished and clammed, caught turtles and hunted waterfowl. In general they were knowledgeable about the behavior of the sea. In fall many abandoned their seaside summer camps for permanent villages on the mainland.

Early European settlers recognized the dangers of barrier islands and largely bypassed their shores for the relative safety of mainland sites. Those who ventured to live on the

MARSH ISLAND (ABOVE) AND CAPE ISLAND, SOUTH CAROLINA

Herons and egrets call at Marsh Island, a vital nesting site for such seabirds as pelicans, skimmers, and terns. "It's critical to protect these islands, because there's nowhere else for the birds to go," says South Carolina state biologist Phil Wilkinson. On Cape Island, naturalist Sarah Dawsey lends a hand to threatened loggerheads by protecting nests from predators and erosion—and by helping hatchlings reach the sea.

islands built their houses on the sound side, protected from storm winds and waves by high dunes and vegetation. They took for granted the vicissitudes of the sea and the supremacy of its force. Some islanders learned to remove floorboards from their houses or open the front and back doors during storms so floodwaters would wash through rather than tear the houses from their foundations.

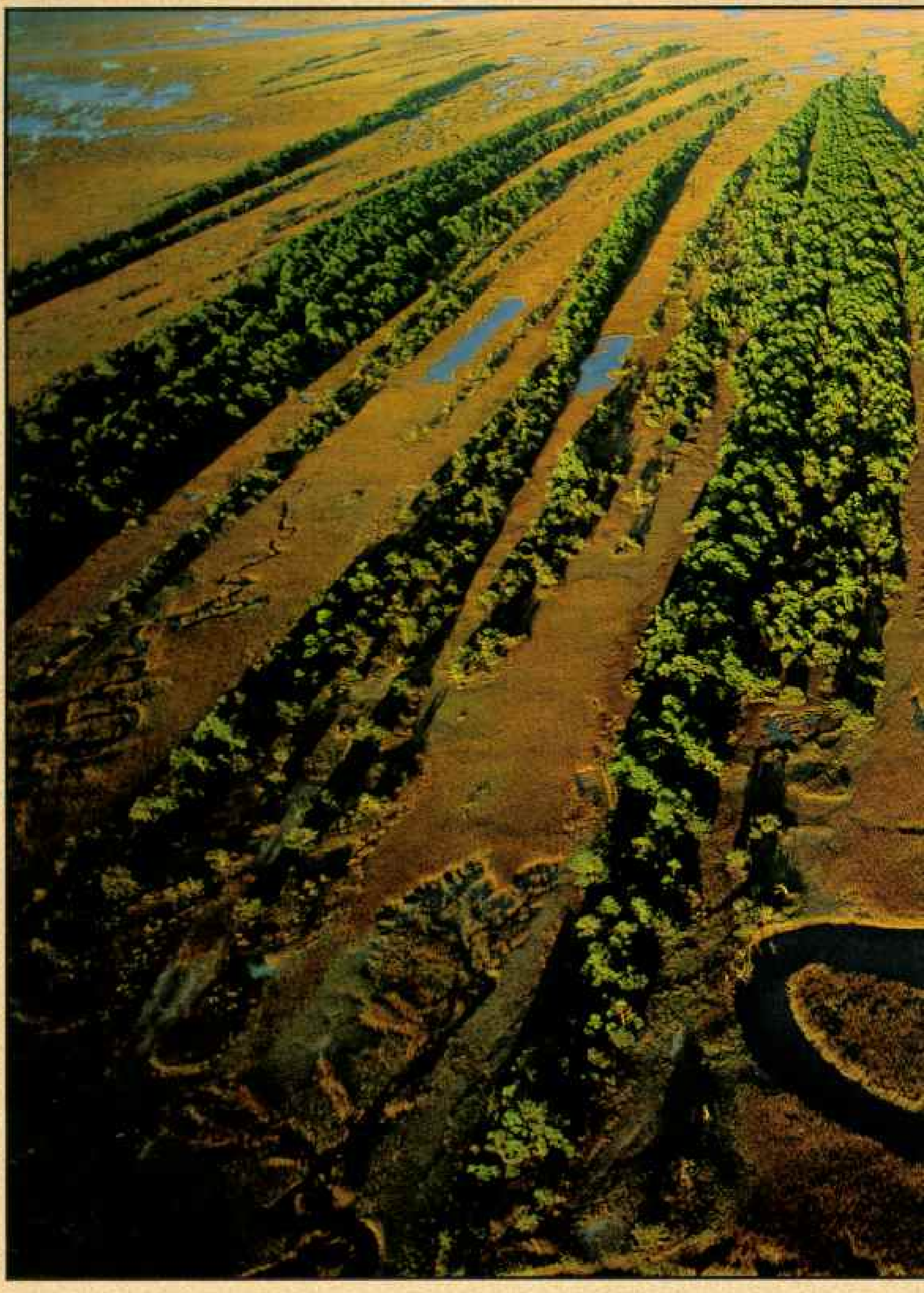
Well into this century life on barrier islands tended to be frugal, bare boned, and above all isolated, cut off emotionally as much as physically from the mainland. Often there was no electricity, no law enforcement, no doctor. In many communities generations of watery separation fostered and preserved distinct dialects and vernacular language. Some inhabitants of the Sea Islands of Georgia and South Carolina still speak a language so rich and metaphorical that visitors need a glossary to follow conversation. Vital to the Sea Islanders' daily lives are words and expressions largely unfamiliar to the modern mainland ear: *day clean* (meaning daybreak), *this side* (this island), *the sun de red for down* (sunset), *long eye* (envy), *hoodoo* (bad luck).

The dialect of Ocracoke's older inhabitants too is studded with words like *begombed* (soiled) or *quamish* (queasy). Arnold Daniels, a retired commercial fisherman now 87 who can remember the days before bridges connected the mainland with his home of Roanoke Island, North Carolina, has a brogue so strong it seems a sweet transport back in time or overseas: "There's people in my toime never was off the oiland, only by bowt to go fishin'."

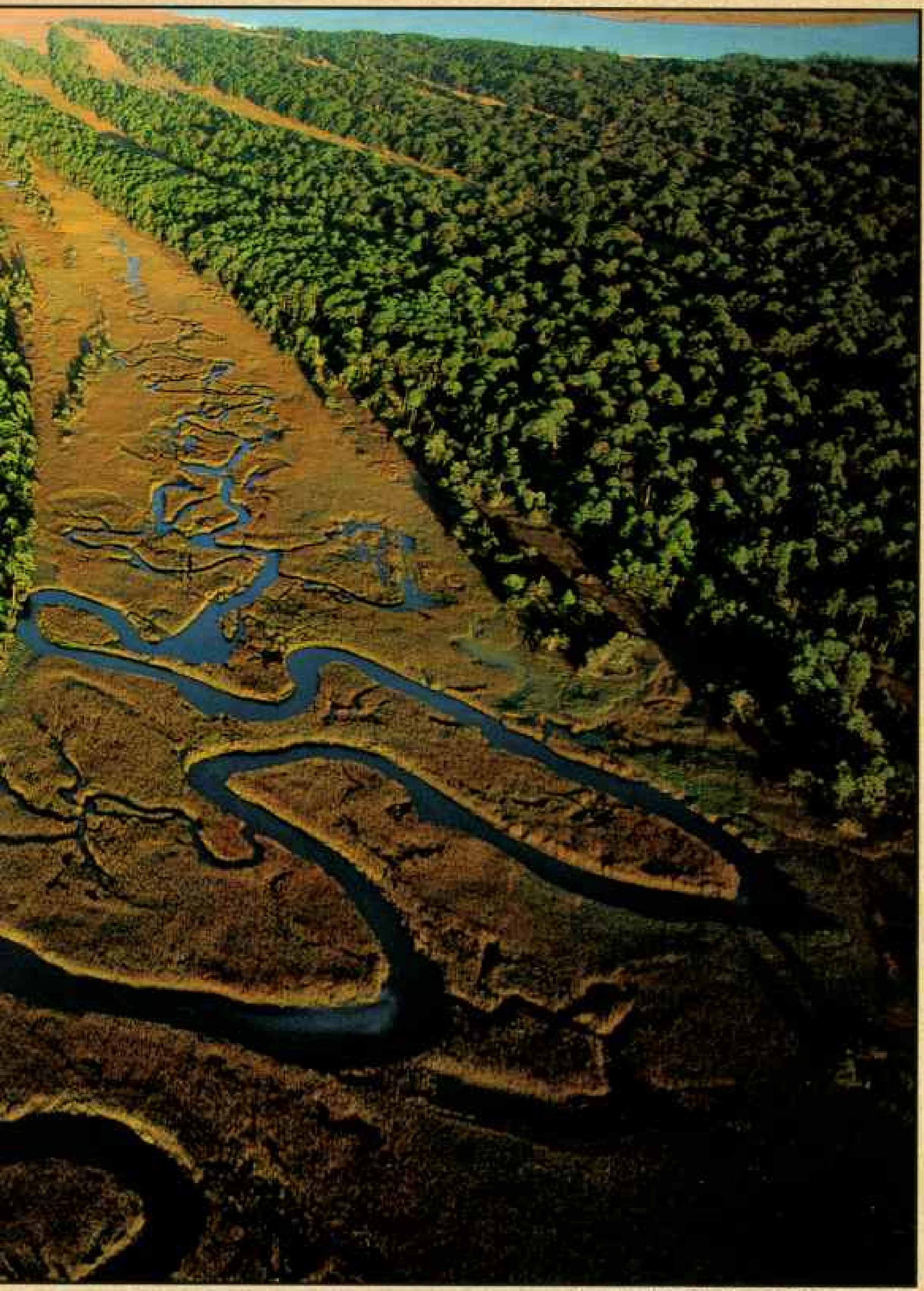
NORTH CAROLINA'S Highway 12 follows the long ribbon of the Outer Banks from Bodie Island to Hatteras to Ocracoke. As I wend my way down the banks, I'm keenly aware of feeling out to sea, connected to the mainland only by the umbilical cord of an occasional bridge or causeway. From Hatteras you can't even see the mainland 26 miles away. The wind is constant off the Atlantic.

Everywhere are man-made doppelgängers to those vestigial tree stumps and fossil oyster shells on Shackleford Banks. At south Nags Head, houses that 20 years ago stood in the third row back from the sea now stand in the first row on flamingo legs over the surf, protected only by huge battered sandbags. Just south of Oregon Inlet the road is new. The old road winds under dunes. Only a year after the new road was built, it was overwashed in places. Some people call it the Going-to-Sea Highway. On the outskirts of Rodanthe, where the road runs close to the sea, sits a tiny cemetery. The old tombstones once faced the highway. Now they face the sea.

In the past hundred years global sea level has been rising at a rate of about six inches a century. Some scientists predict that the rate will accelerate, spurred by global warming. A report issued in 1995 by a United Nations-sponsored panel predicted a sea-level rise of one and a half feet over the next century. That may not sound like much. But in places the coastal plain of the Atlantic and Gulf coasts slopes so gently that a one-foot rise in sea level could push a shoreline back nearly two miles.



Island *au naturel*, St. Phillips was formed thousands of years ago when winds blew exposed sands into linear dune ridges. Today, as sea level rises, the tides take back what the wind delivered, carving leisurely channels in the marsh.



ST. PHILLIPS ISLAND, SOUTH CAROLINA

CUMBERLAND ISLAND, GEORGIA (ABOVE); EDISTO ISLAND

Exhumed by wind, live oaks on Cumberland Island were probably suffocated by sand as its dunes migrated. Edisto (below) has "rolled over" on its way to the mainland, leaving remains of an inland maritime forest rooted on the beach.

While most barrier islands are not migrating at the moment, many are beginning to narrow, eroding on all sides, partly in response to sea-level rise. Some islands of North Carolina are melting away at a rate of two to five feet a year. The shores of Louisiana, with its flat coastal profile, are rapidly fraying, in part because the land is sinking. Louisiana's barrier islands make Shackleford Banks look like bedrock. Timbalier Island is eroding at a rate of more than ten feet a year.

Barrier islands once went where they pleased. Now we try to bully them into proper conduct. At the coastal metropolis of Ocean City, Maryland, a field of stone groins jutting into the sea helps trap a wide berth of white sand in front of the big hotels, and two jetties keep open the inlet separating the resort from Assateague Island just to the south. In essence jetties and groins act like dams in the river of sand that moves along the shore. The jetties at Ocean City have stolen sand from Assateague, accelerating the retreat of its shoreline from 5 feet a year to as much as 30. In the past half century the north end of Assateague has somersaulted over itself.

"At least jetties train natural effects," says coastal geologist Robert Thieler. "Seawalls take wave action head on, with disastrous results." Rigid structures of wood, steel, concrete, or stone built parallel to the shoreline, seawalls prevent the landward movement of sand, thus destroying an island's ability to respond to storm energy.

Barrier islands deal with the force of storms in ingenious ways. In big storms a great mass of sand disappears from barrier beaches, dragged by waves out to sea, where it collects on offshore sandbars. These act as a break for the powerful waves that follow closely one upon the other. What remains is a flattened surface of coarse, heavy, porous sand that can absorb the beating blue tons that could destroy concrete in just a few seasons. Eventually sand washes back onto the beach and blows into dunes.

"When you build a seawall, you cripple this protective response," explains Thieler, "and eventually you lose your beach. Once this kind of 'stabilization' starts, the evolution of a barrier island can in no sense be considered natural."

Sea Bright, New Jersey, represents the end point of such hard stabilization. A small town on a long, low barrier spit, Sea Bright with its broad stretch of beach was a summertime resort for New Yorkers in the early 20th century. But in later years it drew few swimmers. The first seawall was built at the turn of the century to protect a railroad. Then more reinforcements were raised to protect houses and roads from the encroaching sea. Eventually there rose a 17-foot seawall. From the seaside you could not see the beach houses; from the houses you could not see the seaside. In places the surf zone was mined with debris from failed seawalls of the past.

OVER THE YEARS the Army Corps of Engineers has mounted an ambitious program to combat the powerful marine pilferage along New Jersey's coastline by nourishing the beaches: taking sand from "borrow" areas far offshore and piping it onto beaches. Today Sea Bright once again has a wide span of sand.

Nourishment programs have protected buildings and restored beaches from New England to the Gulf coast. But only at immense cost, typically more than a million dollars a square mile. The broad, five-and-a-half-mile-long beach delivered to Sea Bright and neighboring Monmouth Beach from 1994 to 1996 cost 36 million dollars.

And that was just the initial outlay. As sea level rises and beaches narrow, replenished sand is lost to waves, currents, and storms. In "hotspots" the erosion can occur rapidly. At Monmouth Beach the Army Corps of Engineers restored a stretch of sand in front of three condominiums in 1994 and again the following year. Both times more than half of the new beach disappeared. Critics say that in such cases beach replenishment is like applying a Band-Aid to a hemorrhage.

Stephen J. Leatherman, director of the Laboratory for Coastal Research at the University of Maryland, agrees. "You can make a strong argument for it at a handful of big beach resorts like Miami Beach, where there is a huge economic base and lots of tourism," he says. "But smaller coastal communities too have come to see beach nourishment as a panacea. We're not talking about a few communities here but hundreds. They rely on it the way an addict does a fix."

"There's no question that we're in a fight-or-flee situation," says Ken Smith, founder of Coastal Advocate, a lobbying firm for coastal homeowners and businesses. "But I think the benefits of keeping barrier beaches in their place far outweigh the costs. When people go to these beaches, they want hotels. They want restaurants and boardwalks. Most of all they want beaches. If the attraction on a barrier island is beach, and beach protects the amenities that enhance that attraction, what the heck is wrong with spending money to keep the beach?"

"What is wrong is that owners of beachfront property are not paying their fair share," says Leatherman. "Other taxpayers pay the freight for federal flood insurance and beach replenishment. In nourishment projects locals pitch in about 5 percent, state and county taxpayers pay about 30 percent, and the federal government pays the rest. This is a coastal subsidy, no way around that."

Most routes to the sea are wide and paved, unlike this footpath at Avalon, New Jersey, where a three-mile stretch of dunes is preserved in its natural state. For children of all ages, the lure of barrier islands is irresistible, yet developing them is risky: The harder we try to hold these islands, the faster they move away.

ONE OF THE FEW barrier systems not caught in the tug-of-war between beaches and buildings is a chain of islands off the Eastern Shore of Virginia. One summer day, when more than a quarter million people were packing onto the ten miles of beach at Ocean City, Maryland, Barry Truitt flew over the islands of the Nature Conservancy's Virginia Coast Reserve, about 60 miles to the south. On 14 islands stretching for more than 50 miles, Truitt counted a total of 71 day-trippers. And that's the most he's seen on any one day in a long time.

A burly man with a salt-and-pepper beard and a deep tan, Truitt is director of science and stewardship at the Coast Reserve. He has been navigating the winding channels and broad bays of this region for 25 years. That makes him just a "come here" rather than a "been here." Still, if you ask him what something is, he knows. It's the sleek, vibrant green marsh grass, *Spartina*. It's a gull-billed tern. It's a tricolored heron.

As we moor our boat on the far southern tip of Wreck Island, a ripple of agitation spreads across the colony of nesting terns, gulls, and black skimmers. Truitt counts 300, no 400, no, probably close to 600 skimmers and terns. The birds have Wreck Island pretty much to themselves, and the neighboring island and the one next to that, and so on, for dozens of miles to the north and south. To be on these islands is to see huge colonies of nesting birds, to hear the whistling cry of the rare little piping plover, to be surrounded by sand, grass, water, and little else.

This was not always so. Until well into this century, a sizable population of tough, self-reliant people made a living on these islands. One of the biggest towns on Virginia's Eastern Shore thrived on Hog Island. In 1900 the town of Broadwater, on the island's bayside, consisted of about 50 houses, two general stores, an elementary school, an ice-cream parlor, and a community center known as the Red Onion, all situated two miles from the sea. But in the early 1920s storms began to take their toll. By 1933 surf lapped at the foundations of the houses. That year a hurricane

AVALON, NEW JERSEY

took 60 feet of the beach in a single bite.

"People did the sensible thing," says Truitt. "They moved." One by one islanders floated their houses by barge to the mainland towns of Oyster and Willis Wharf. By 1940 the island was virtually abandoned. Our boat skims over the site of Broadwater, now gone to sea. Hog Island waggles about, eroding in the south, advancing in the north. "I call it island migration," says Truitt. "It's only erosion if there's a house on it."

Truitt and a team of researchers recently counted 80,000 pairs of nesting birds on the islands of the Virginia Coast Reserve, many of them beach nesters that depend on overwash to maintain their nesting habitat. Without this disturbance, dune grass grows too densely for terns, skimmers, and plovers to make their shallow scrapes in the sand, and the birds must yield their nesting habitat to gulls that favor grassy dunes. When storm waves wash over the island, wiping out the dune system, the islands once again offer habitat for beach nesters. Truitt thinks of these islands as a great natural experiment on disturbance and its effect on biological diversity. "Ecologists working in mountains can wait a lifetime to witness the kind of habitat change we see here on a daily basis," he says.

On our way back to the mainland, late afternoon light falls in low rays across the islands, illuminating the tops of shrubs and trees swallowed up by moving dunes. A flock of terns rises in alarm and settles again. The transitory becomes one with the beautiful, and I think again of the barriers hit by Fran, the grief of shattered homes, the ripped and tattered fixings of human life, and beneath it all, the thin strands of sand where motion is everything. □

A New Light in the Sea

Article and photographs by DAVID DOUBILET

At twilight in the Red Sea I photograph corals with an electronic flash. They look mundane and dull (below). Then at night my diving partner David Fridman plays a powerful ultraviolet light over the same corals, and they explode with unimaginable color.

Illuminated by ultraviolet light, a knob coral pulsates with color as if lit from within. The coral absorbs the invisible ultraviolet light, then emits wild orange visible light. This is called fluorescence, a phenomenon of physics and biology that borders on pure magic.

FAVIA LAXA

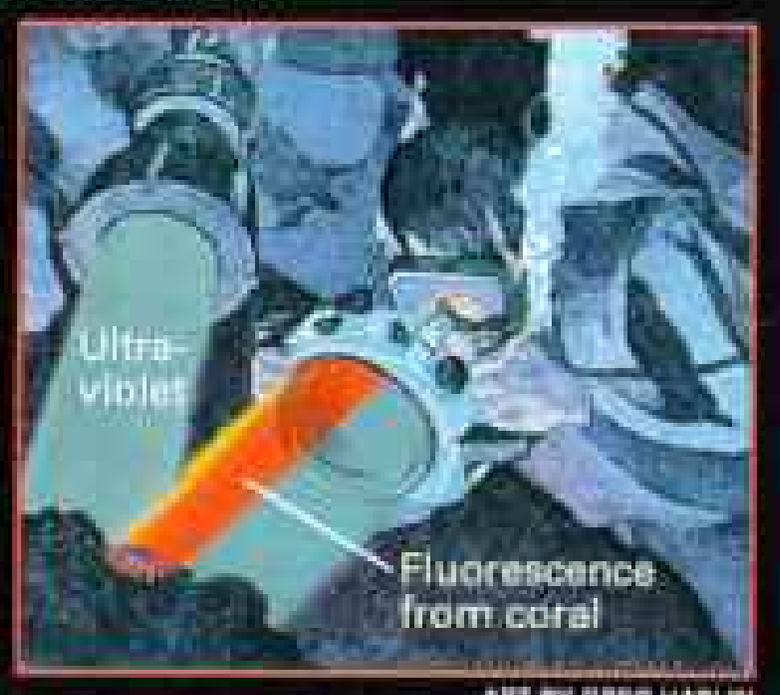
A small mushroom coral held by our friend Asher Gal seems to change like a chameleon under different light sources (below). In daylight the sea filters out most colors, so the coral appears monochrome blue. An electronic flash restores the full spectrum, showing how the coral would look out of water. At night, shot with an HMI high-intensity light with an ultraviolet filter, the coral glows with vivid fluorescence.

UNDERWATER DAYLIGHT

ELECTRONIC FLASH

ULTRAVIOLET-FILTERED LIGHT

FUNGIA COSTULATA



ART BY GREG HARLIN

FUNGIA SCRUPOSA

That some corals fluoresce has been known for decades. In 1964 marine biologist René Catala of New Caledonia wrote a book about fluorescence called Carnival Under the Sea. *"It astounded me," David Fridman remembers. As a founder of Coral World in Elat, Israel, David experimented. "I found that ultraviolet lights commonly used for black-light posters worked best on corals." This was fine for aquariums, but we needed a stronger light source when working in the sea.*

PLATYGYRA SP.

FUNGIA SCRUPOSA (ULTRAVIOLET)

In the spring of 1996 I traveled to the Interuniversity Institute marine lab at Elat, where David and I for the first time took ultraviolet-filtered HMI lights into the ocean. Corals were placed in trays under a pier, shielded from daylight. Most were later returned to the deep, where they would re-cement themselves to the reef. We photographed each coral with both standard flash and ultraviolet light. The difference was spectacular.

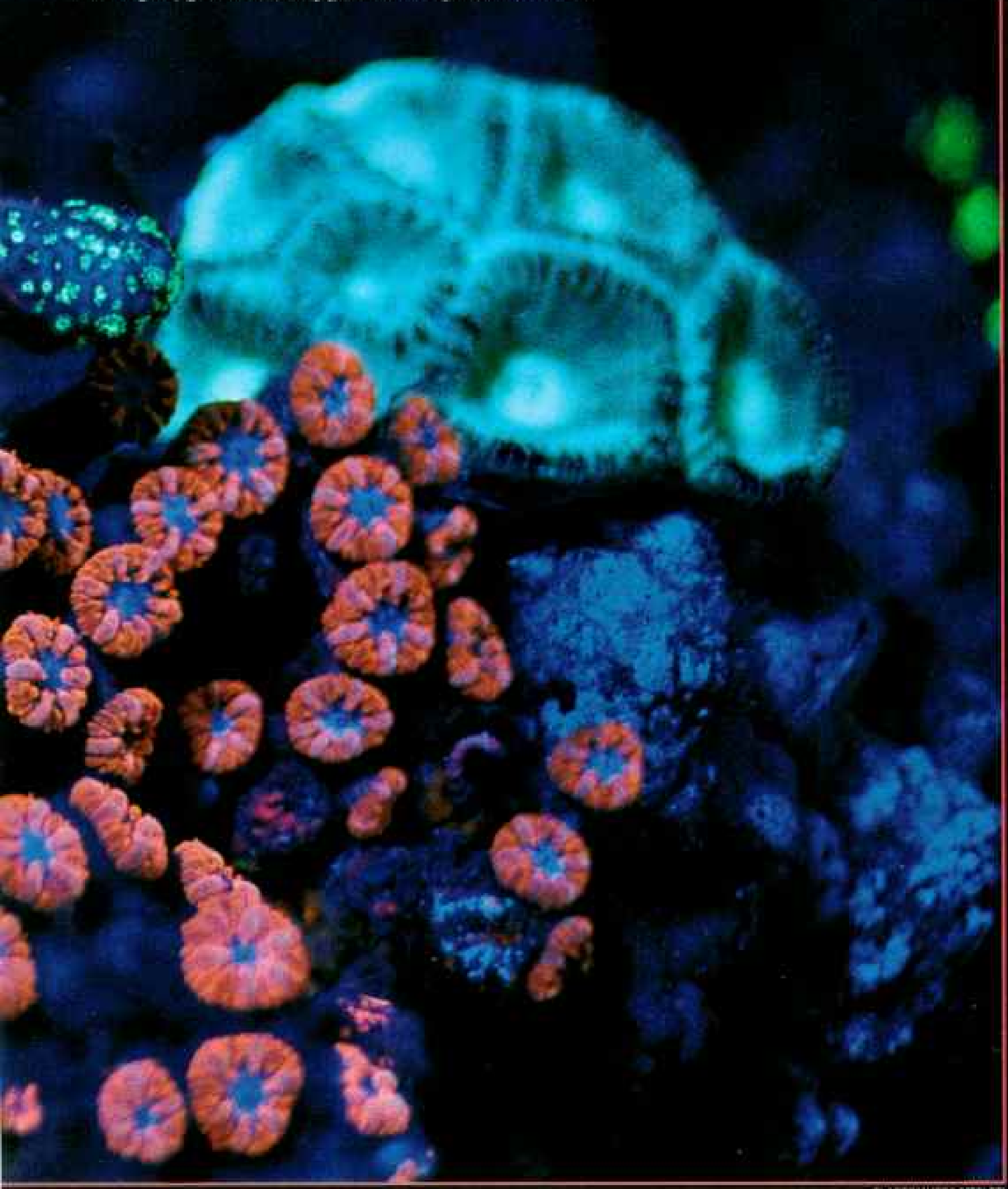
This is the 11th Red Sea story that David Doubilet and Israeli naturalist David Fridman have collaborated on since 1972.

PLATYGYRA SP. (ULTRAVIOLET)

MYCEDIUM ELEPHANTOTUS

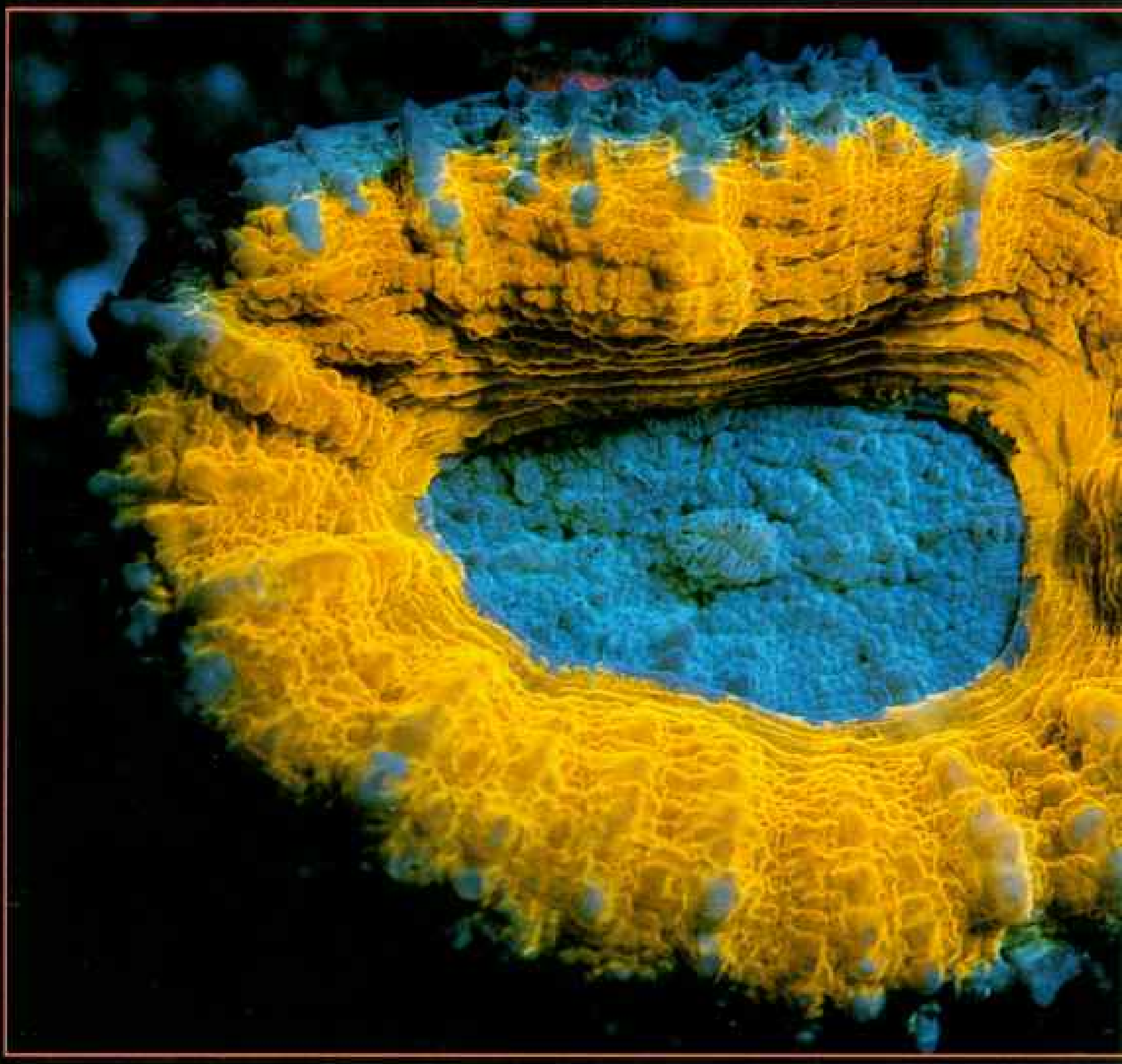
MYCEDIUM ELEPHANTOTUS (ULTRAVIOLET)

Glowing buttons, polyps of a branched cup coral are actually in hiding, their feeding tentacles having withdrawn in reaction to the ultraviolet light. If illuminated by an electronic flash, these polyps would appear dull gray-brown.

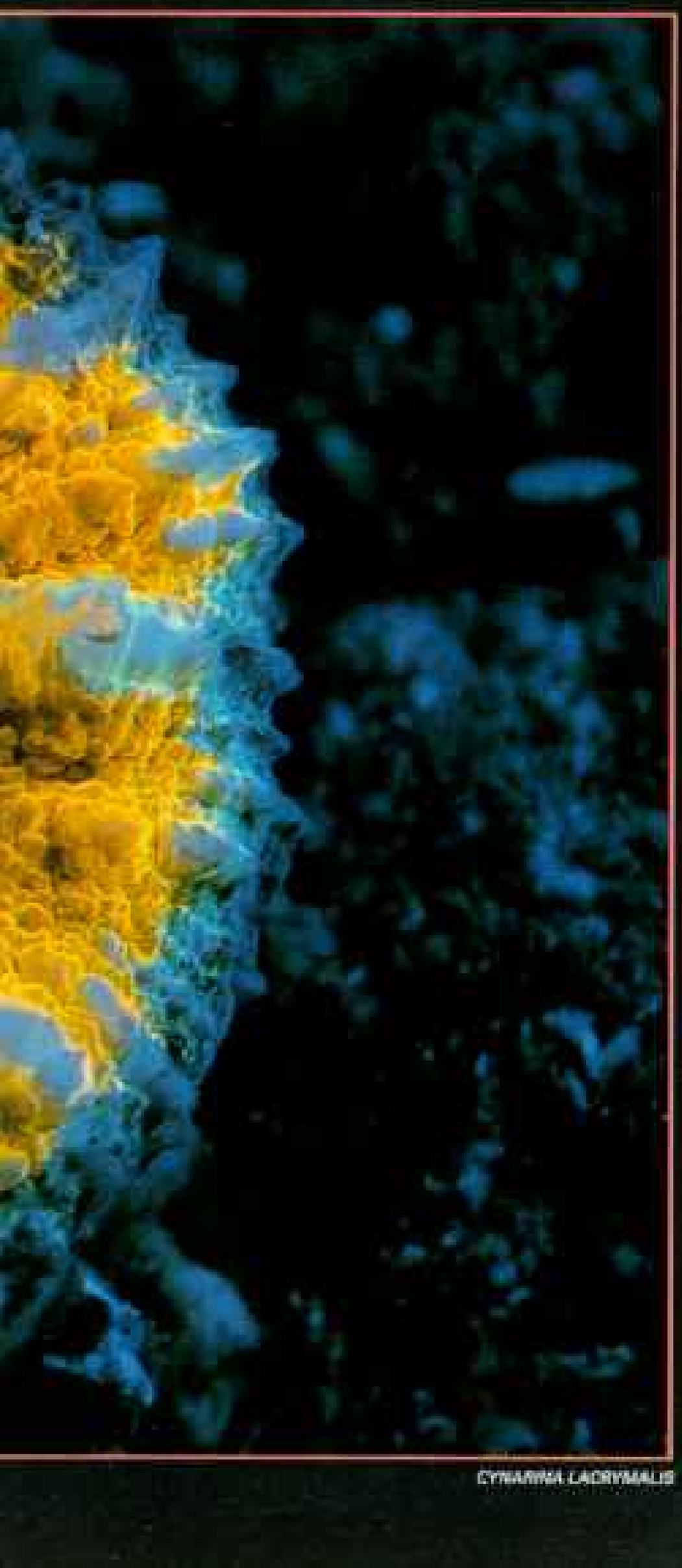


BLASTOMUSSA MERLETI

Why should just a few species of coral—like this wild-looking trio—fluoresce? I went to the Massachusetts Institute of Technology to ask Charles Mazel, the world's leading investigator of coral fluorescence. Mazel is developing new systems to measure fluorescence and believes that it might someday be used to diagnose reef health. His reply: "It's been suggested that fluorescence aids photosynthesis or that it protects against too much ultraviolet light. But there is a real possibility that corals fluoresce for no reason at all." □



LOBOPHYLLIA HEMPRICHII



CYNARINA LACRYMALIS

FAVITES SP.

Shimmering in the mist, the peak known in local legend as "the demons' churning pillar" poses a devilish challenge to climbers in India's Himalaya.

The Frozen Face

of Thalay Sagar

By GREG CHILD Photographs by CHRIS NOBLE

SHE FIGURED THEIR CHANCES of reaching the top were slim. The direct route they'd chosen up the perpetually frozen north face of Thalay Sagar, a 22,650-foot granite pyramid in northern India, was so steep and perilous that perhaps no one could climb it. At least eight teams before had failed. To succeed, she and her partner, Jay Smith, would have to claw up nearly vertical walls of rock and ice. Yet for Kitty Calhoun the extreme conditions only made it more enticing.

Kitty had nearly died here in 1986 when she and another climber, Andy Selters, were trapped by a blizzard at 21,000 feet. Cowering for eight days inside a hanging cliff tent, hungry and shivering, they were bruised and battered by falling chunks of ice before a break in the storm let them rappel down the wall to safety.

JAY SMITH (ABOVE AND OPPOSITE)

But Kitty hates to give up. The shy, five-foot-four climber with a South Carolina drawl as thick as honey turns into a pit bull on a mountain. As a young vagabond climber in Wyoming, living out of an aging station wagon, Kitty was so mountain tough she "went through winter climbing partners like they were paper towels," says Lyle Dean, an old rope mate. Honing her skills in subzero winters in the Tetons, Kitty would scowl if companions talked about retreating. "I don't want to be just a fair-weather climber," she'd grumble.

Motherhood and graduate school barely slowed her down. In 1995, while four months pregnant, she pioneered new routes up the 3,000-foot spires that crown mountains in the Aksu Valley of Kyrgyzstan. Her son, Grady, is now 20 months old. She also found time between climbs to earn an M.B.A. from the University of Washington, but she shows no sign of settling down. "To Kitty climbing is the most important thing," says a friend.

Now, as she gripped the rope at the top of a frozen gully (right), the 36-year-old looked up at the brooding north wall. September 24, 1996, she and Jay would get to 20,800 feet before a storm drove them back to base camp. September 29 the sky cleared, and the pair took another shot.

GREG CHILD, author of *Mixed Emotions: Mountaineering Writings*, made a first ascent of Shipton Spire, a 19,700-foot rock tower in Pakistan, in 1996. He lives in Seattle, Washington. Photographer CHRIS NOBLE, who climbed Thalay Sagar to 19,600 feet with Kitty Calhoun and Jay Smith, is based in Salt Lake City, Utah.

Bowing under heavy packs, Kitty Calhoun and Jay Smith lean into a bitter wind as they crunch away from advance base camp. First reached in 1979 by a team taking a less challenging route, the summit of Thalay Sagar is almost constantly shrouded in storm. When windchill plunged to

minus 40°F, Kitty and Jay considered an easier climb up one of the ridges flanking the north face. "My feet were numb, and I was getting paranoid about frostbite," Jay says. "But Kitty wouldn't hear of it. For her it was the north face or nothing."

Blasts of snow become almost suffocating.

Flowing like quicksilver around Jay at 19,000 feet (left), spindrift temporarily blinded the climbers. Funneled by folds and gullies in the 4,000-foot north face, surges of flesh-freezing powder became so thick the climbers couldn't see their own hands. "It took less than a minute for this to become unbearable," Kitty says. Caught out on a difficult pitch, Kitty clutched the shafts of her two ice axes and calmed herself by humming a lullaby she likes to sing to her son.

Even before attempting a full assault on the north face, Kitty and Jay became well acquainted with Thalay Sagar's lashing storms as they ascended to prepare the mountain with fixed ropes. Their packs of climbing gear weighed as much as 50 pounds. During one snap of frozen calm, Kitty clamps ascenders to a rope (below) to pull herself up as her crampons bite into the ice. "You have to be patient, determined, and focused," Kitty says. "Like playing a game of chess, you change strategy all the time."

By October 1 she and Jay had climbed all but the final 750 feet to the summit.

The last blizzard drives them from the wall.

In a high-altitude balancing act, Kitty eases into their hanging tent. Fighting dehydration at 21,900 feet, she melts snow to drink (below). That night a storm tossed the tent like a toy. Spindrift coated sleeping bags. Gloves froze solid. "Winter had finally caught us. Another front was blowing in," Kitty says. It could only get worse. After three nights it was clear that to survive they had to descend—defeated but uninjured. Back home in Utah, Kitty was asked if she'd return for a third try. She burst into a rowdy southern laugh: "Ask me when I've forgotten how durn cold it was." □

BOTH BY JAY SMITH

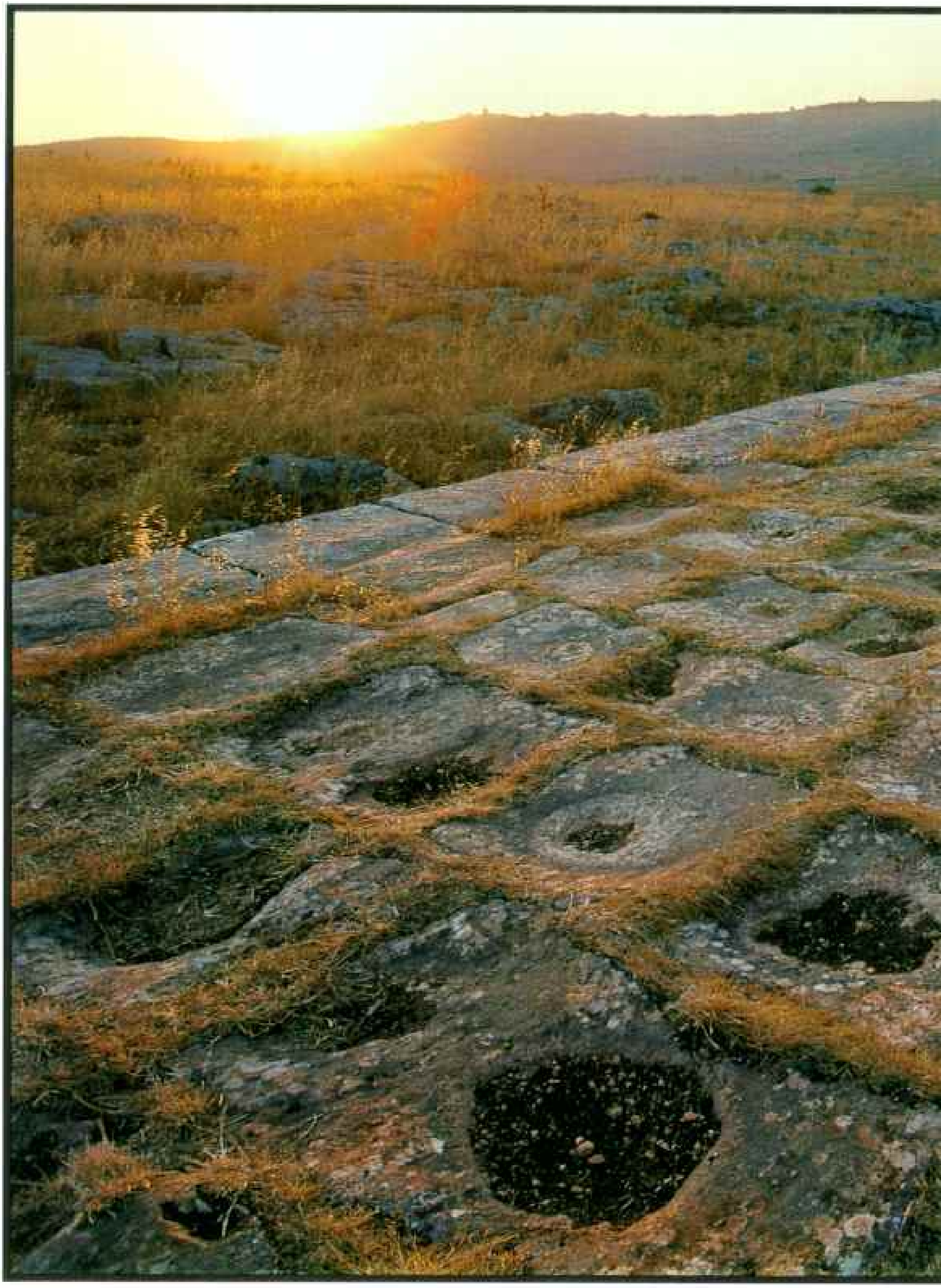
ACCORDING TO

Adorned with pillars as grand and imposing as the empire that inspired them, the Library of Celsus—even in ruins—recalls the imperial pomp of Ephesus, Turkey, one of the many far-flung cities that rose to greatness under the rule of Rome. During the first two centuries A.D., Rome cast its civilization to all corners of the Mediterranean world. And to those rulers and places that pledged unbending loyalty, Rome granted riches and stability unequaled in the ancient world.

ROME

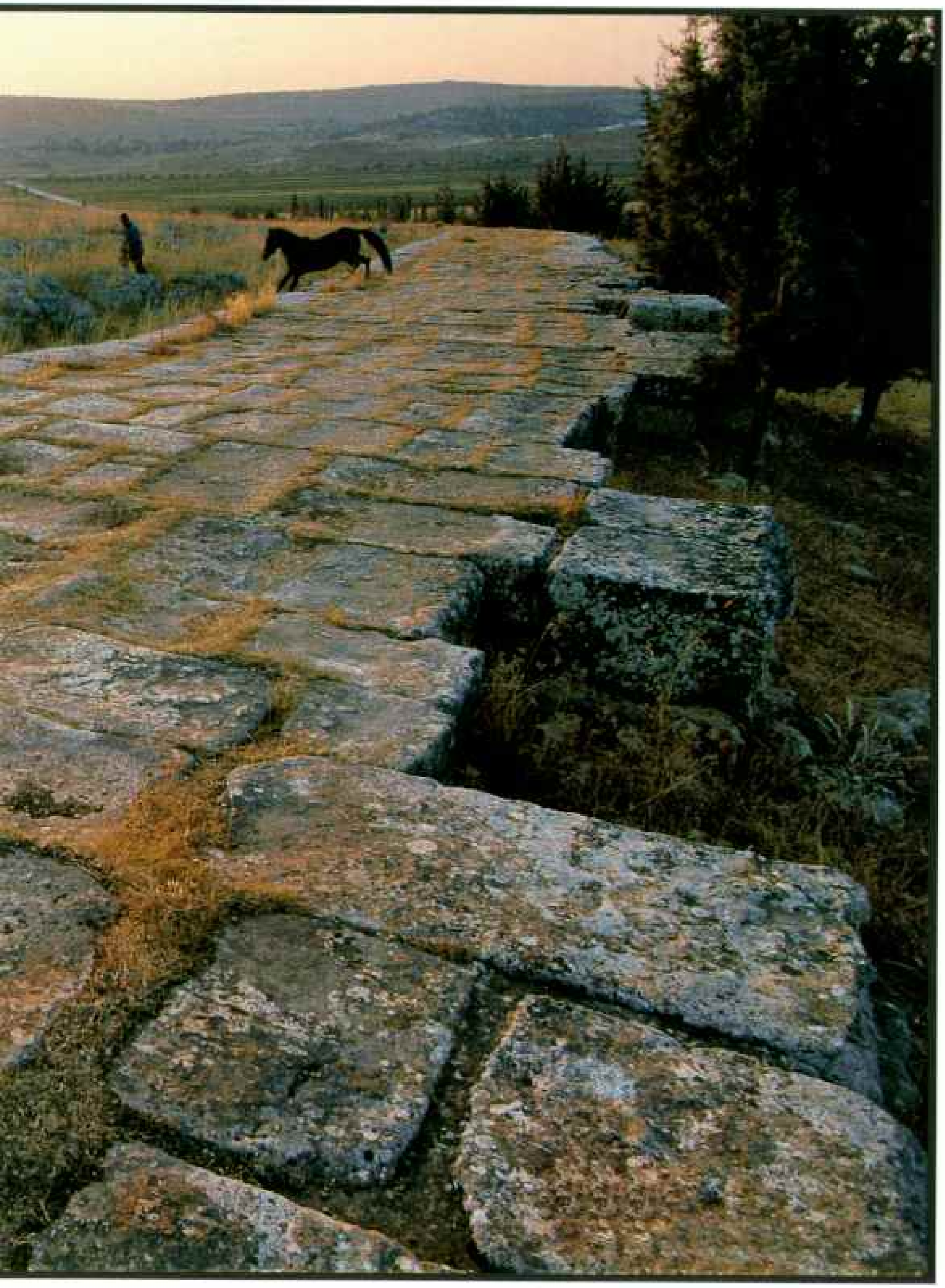
BY T. R. REID

PHOTOGRAPHS BY JAMES L. STANFIELD

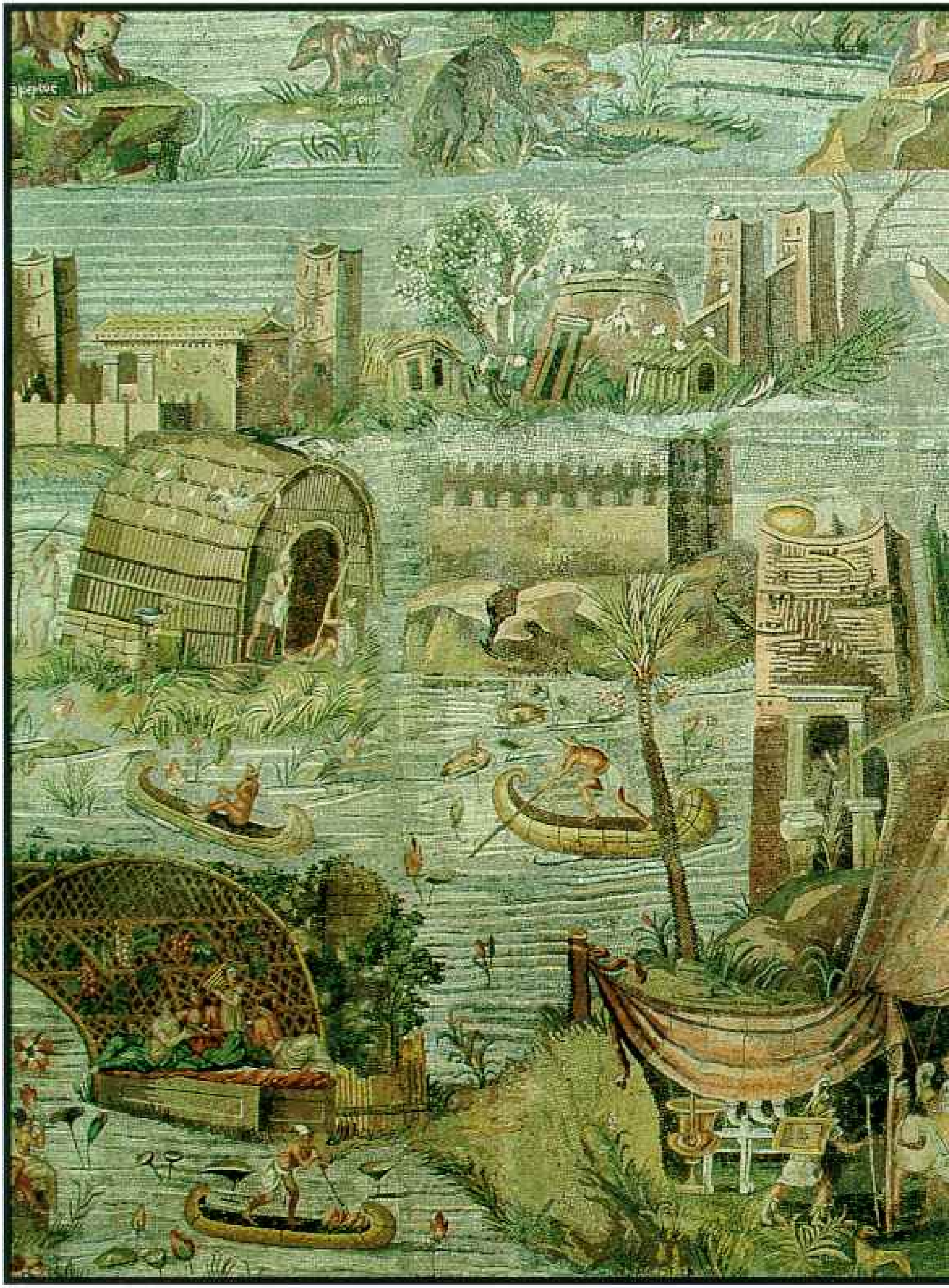


HIGHWAY OF CONQUEST

Now just stumbling blocks to a farmer and his horse, the well-trod paving blocks of a Roman road near Idlib, Syria, once resounded with the stamp of infantrymen and the clatter of chariots bringing



Roman power to the eastern provinces. Locals required a passport to travel the official routes. Traffic moved slowly, but a courier in a hurry could cover 200 miles in a day.

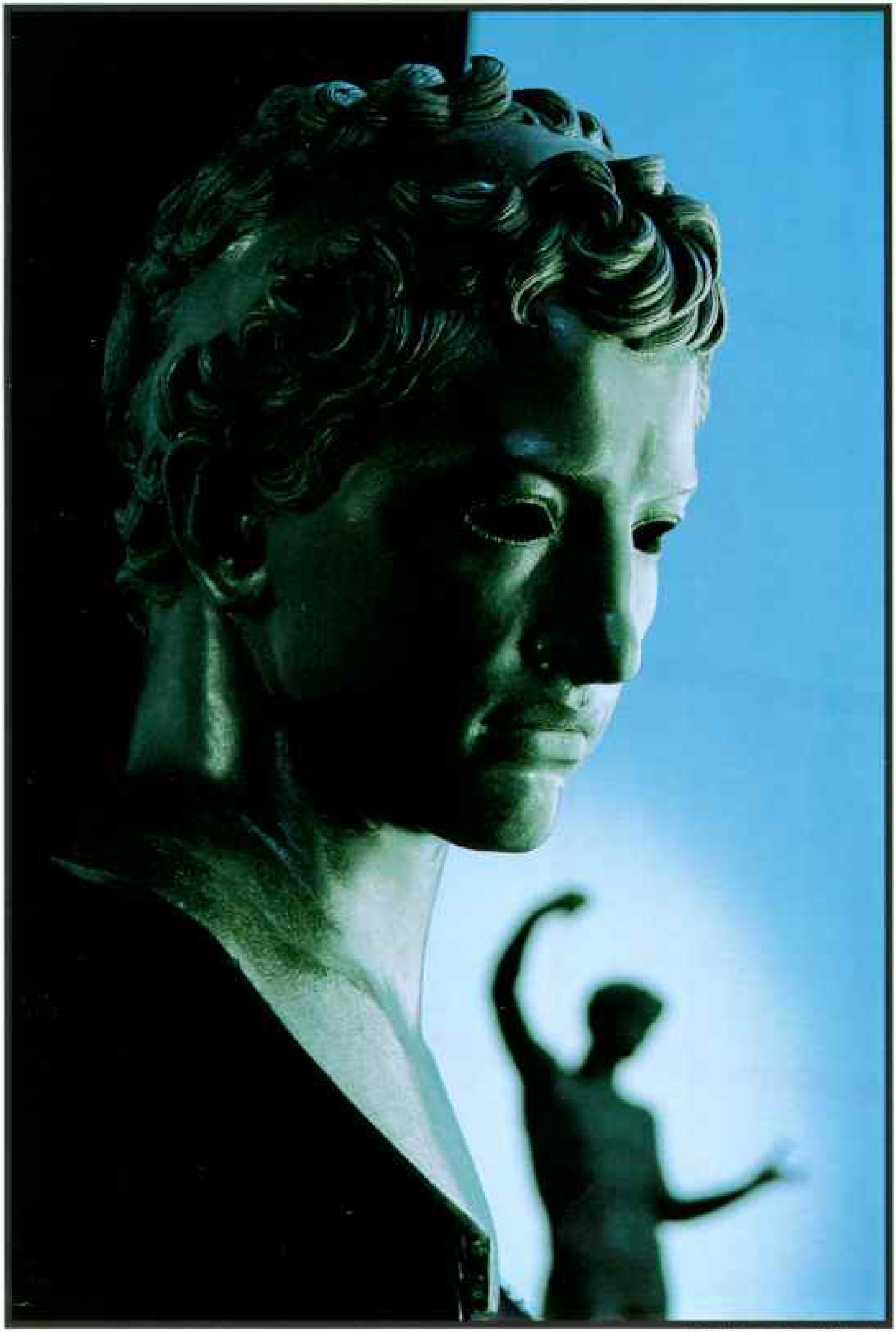


EXOTIC EGYPT

Rome's fascination with Egypt—its wild beasts, pharaonic temples, and mystical religions—expressed itself in a fanciful mosaic of the Nile River in flood. At a canopied temple, at bottom center,

MUSEO ARCHEOLOGICO NAZIONALE PRENESTINO, PALESTRINA, ITALY

Roman soldiers salute a skirted figure, possibly a priestess from the cult of Isis, an Egyptian goddess. With its secretive rites and promise of salvation, the worship of Isis captivated slaves and emperors alike.



MUSÉE ARCHÉOLOGIQUE, RABAT, MOROCCO

Juba II, the Berber ruler of Mauretania, presided over a court as luxurious and cultured as the one he had come to know in Rome as a boy. Brought to Rome as a prisoner, this native of what is now Morocco became a classical scholar and a favorite of the emperor Augustus, who sent Juba home as a king.

AN EMPIRE'S ENDURING REACH

By his own account, Quintus Horatius Flaccus was a rotten soldier. He fought for the losing side in the civil wars; when the order came to "Charge!" he dropped his shield and ran like mad in the wrong direction. Back in Rome he landed a post as a petty bureaucrat, a quaestor's clerk—not much of a job but one that left time for writing poetry on the side. He came to know great architects and builders, judges, sculptors, and political leaders. But Quintus Horatius Flaccus himself never governed a province, never built an aqueduct or temple, never created a striking bronze sculpture.

Still, when this noble Roman—known to us as Horace—sat down in 23 B.C. to review his life's accomplishments, he concluded that his contributions in poetry would outlast whatever the soldiers and builders had achieved:

> *Exegi monumentum aere perennius*
> *Regalique situ pyramidum altius. . . .*
> *Non omnis moriar.*
>
> *I have erected a monument more lasting*
> *than bronze*
> *And taller than the regal peak of the*
> *pyramids. . . .*
> *I shall never completely die.*

That famous epilogue from Horace's third book of *Odes* has been endlessly quoted as a testament to the immortality of literature. But it could also stand as a tribute to the Roman Empire and the countless Roman influences that still flow through our daily lives some 15 centuries after the walls of Rome came tumbling down.

As noted in last month's article on the rise and fall of Roman power, the small farming village on the banks of the Tiber grew to control the whole Mediterranean world—one of history's greatest achievements in the sheer art of governing. By the second century A.D. some 50 million people on three continents lived safely and prosperously under *Pax Romana*. Then, like every other great power known to history, Rome fell.

When I traveled recently to various Roman cities in Europe, Asia Minor, and North Africa, what I saw primarily were ruins—headless statues and fallen aqueducts and long rows of elegant columns broken in half, their ornate capitals scattered among the weeds. If you look only at this dented bronze and shattered marble, it seems clear that the Roman Empire is dead. In fact, though, like its greatest lyric poet, ancient Rome will never completely die. The Romans left the world a legacy more lasting than bronze or marble.

The enduring Roman influence is reflected pervasively in contemporary language, literature, legal codes, government, architecture, medicine, sports, arts, engineering, etc. Much of it is so deeply embedded that we barely notice our debt to ancient Rome. Consider language, for example. Fewer and fewer people today claim to know much Latin—and yet, go back to the first sentence of this paragraph. If we removed all the words drawn directly from Latin, that sentence would read: "The."

The Roman influence on modern language

is as basic as ABC. The most widely used alphabet on earth to this day is the one the Romans developed and took with them as they conquered the Western world. The uppercase letters you're reading are the same ones the Romans were reading in 600 B.C.; Roman publishers developed the lowercase forms around A.D. 300. The only changes since then came in medieval times, when the consonant value of *I* was promoted to a letter in its own right, *J*; and *V* was divided into *U*, *V*, and *W*. (So when you see an ancient inscription about "IVLIVS," it means "JULIUS.")

They used this alphabet to write a language as logical and as sturdy as those interlocking Roman walls that stood for centuries. Like so much else in Roman life, the Latin language was thoroughly rational and pragmatic, a product of careful engineering. For that reason educators throughout the Western world have taught Latin for 2,000 years to help students learn the basic machinery of language. This was not just so the kids could read Horace—although that was a pleasant by-product—but so they could better understand their own and other languages as well.

My own battles with *amo, amas, amat* and *hic, haec, hoc* seemed utterly useless in my teenage years. I particularly remember my hatred for a convoluted Latin construction called the ablative absolute (e.g., "Caesar, the camp having been fortified on all sides and the centurions having been dispatched, dined"). But years later when I was struggling to learn Japanese—a totally unrelated language—I came upon a common Japanese grammatical form that turned out to be exactly like the ablative absolute. I mastered it with ease. Just as my tenth-grade teacher had promised, the logical rigor of Latin had prepared me well to study any language.

There was a period—it seems to be ending, sadly, right before our eyes—when just about everybody who went to school learned some Latin. For centuries almost every educated soldier knew a little Julius Caesar, including his famous dispatch after the Battle of Zela, "*Veni, vidi, vici*—I came, I saw, I conquered." That ranked as history's greatest military message for about 1,900 years—until the fateful day in 1843 when the British general Sir Charles James Napier came up with a Latin dispatch that was even better.

Napier had set out with a small force, hoping to capture Sindh, in modern Pakistan. Back in Delhi his commanding officer, Lord Ellenborough, anxiously awaited news—"Does Napier have Sindh?" Finally Napier's message arrived from the front. Ellenborough impatiently tore open the envelope and found a single word: "Peccavi." Naturally, the officers at British headquarters could recognize this as a past tense form of the Latin verb *pecco*, meaning "I sin." In other words, "I have Sindh."

Even among people who lack such impeccable training in ancient languages, Latin pops up in conversations and documents around the world every day: alma mater, alter ego, antebellum, habeas corpus, ignoramus, in extremis, ipso facto, persona non grata, per capita, prima facie, quid pro quo, sui generis, sine die, sub rosa, vice versa, a.m., p.m., i.e., A.D., R.I.P., Q.E.D., etc., etc. Our list could go on ad infinitum, but we'd better stop here to leave space in this magazine for other things, e.g., articles, advertisements, et al. One more phrase we must mention, though, is "Carpe diem" or "Seize the day!" This still familiar expression of live-for-the-moment philosophy comes from a poem by Horace—proof indeed that he did not completely die.

The Romans loved language, wrote down everything, and placed a high priority on the mastery of Latin throughout their empire. The English historian Peter Salway notes that England under Roman rule had a higher rate of literacy than any British government was able to achieve for the next 14 centuries. The plethora of written texts, combined with the longevity of Latin, is one reason we have so much more information about Rome than about most extinct societies, ancient or not so ancient. We know more today about the central part of Italy 20 centuries ago than we know about, say, the central part of North America three or four centuries back.

ONE OF THE MOST IMPORTANT documentary legacies the Romans left behind was the law—the comprehensive body of statute and case law that some scholars consider our greatest inheritance from ancient Rome. The ideal of

Author T. R. REID and photographer JAMES L. STANFIELD covered the rise and fall of the Roman Empire for our July 1997 issue.

PAX ROMANA

"Wherever the Roman conquers, there he dwells," wrote the philosopher Seneca as he watched the empire impose itself on three continents. At its widest extent (map), the Roman world encompassed a multiracial society of 50 million people. Emperors came from Spain, Syria, and Africa. For more than two centuries prosperity and order followed Rome's advance. Pax Romana, *the Roman peace, started to crumble with Marcus Aurelius (right), who spent two decades fighting four wars and an outbreak of plague.*

EPHESUS MUSEUM, SELCUK, TURKEY

EMPERORS

SOME BRIEF REIGNS OMITTED
OVERLAPPING DATES INDICATE CO-RULE

27 B.C.–A.D. 14	AUGUSTUS
A.D. 14–37	TIBERIUS
37–41	CALIGULA
41–54	CLAUDIUS
54–68	NERO
68–69	GALBA
69	OTHO
69	VITELLIUS
69–79	VESPASIAN
79–81	TITUS
81–96	DOMITIAN
96–98	NERVA
98–117	TRAJAN
117–138	HADRIAN
138–161	ANTONIUS PIUS
161–180	MARCUS AURELIUS
177–192	COMMODUS
193	PERTINAX
193	DIDIUS JULIANUS
193–211	SEPTIMIUS SEVERUS
198–217	CARACALLA
209–212	GETA
217–218	MACRINUS
218–222	ELAGABALUS
222–235	SEVERUS ALEXANDER
235–238	MAXIMINUS
238	GORDIAN I AND II
238–244	GORDIAN III
244–249	PHILIP
249–251	DECIUS
251–253	TREBONIANUS GALLUS
253–260	VALERIAN
253–268	GALLIENUS
268–270	CLAUDIUS II
270–275	AURELIAN
276–282	PROBUS
283–284	CARINUS AND NUMERIAN
284–305	DIOCLETIAN AND THE TETRARCHY
306–313	CONSTANTINE AND THE LATER TETRARCHY
313–324	JOINT RULE OF CONSTANTINE AND LICINIUS
324–337	CONSTANTINE SOLE RULER

written law as a shield—to protect individuals against one another and against the awesome power of the state—was a concept the Romans took from the Greeks. But it was Rome that put this abstract notion into daily practice, and the practice is today honored around the world. A Latin inscription at Harvard Law School conveys the idea precisely: "*Non sub homine sed sub deo et lege*—It is not by men but by God and the law [that we are governed]."

The rule of law is so central to Western civilization that most of us take it for granted. Of course we are governed by laws, we say—it's natural. In fact, though, the rule of law is not a necessary aspect of the human condition. Another great ancient empire, China, arranged things precisely the opposite of the Roman way. Confucius and his disciples down through the centuries distrusted written laws. A dusty statute book was too inflexible to handle the infinite variety of human experience, the Chinese sages felt. They chose to trust people, not laws—to rely on innate human goodness as the best guarantee of a civil society. Even today the concept of written law and written contract is fairly weak in China and other East Asian nations within its cultural ambit. The 20th-century Chinese historian Hsiao Kung-chuan observed that if the early emperors had been exposed to Roman statecraft, and particularly Roman law, "the Chinese of necessity would have undergone an absolutely different course of development in the thousand or more years thereafter." (The world is just now witnessing a great clash of these different courses, as Hong Kong ends a century and a half of rule by British law and switches to Chinese control.*)

THE ROMANS too felt some ambiguity about the preeminence of law. "*Corruptissima republicae, plurimae leges*," the historian Tacitus observed—"The worse the state, the more laws it has." But in the ongoing struggle between the ordinary people of Rome and the governing elites, the plebeians decided they would much rather rely on laws than the all-too-human whims of their rulers. Under pressure from the plebs, the governing class was repeatedly forced to issue written codes. The first of these, the Twelve Tables, came out in 450 B.C., and the Romans

*See "Hong Kong: Countdown to China," by Mike Edwards, in the March 1997 issue.

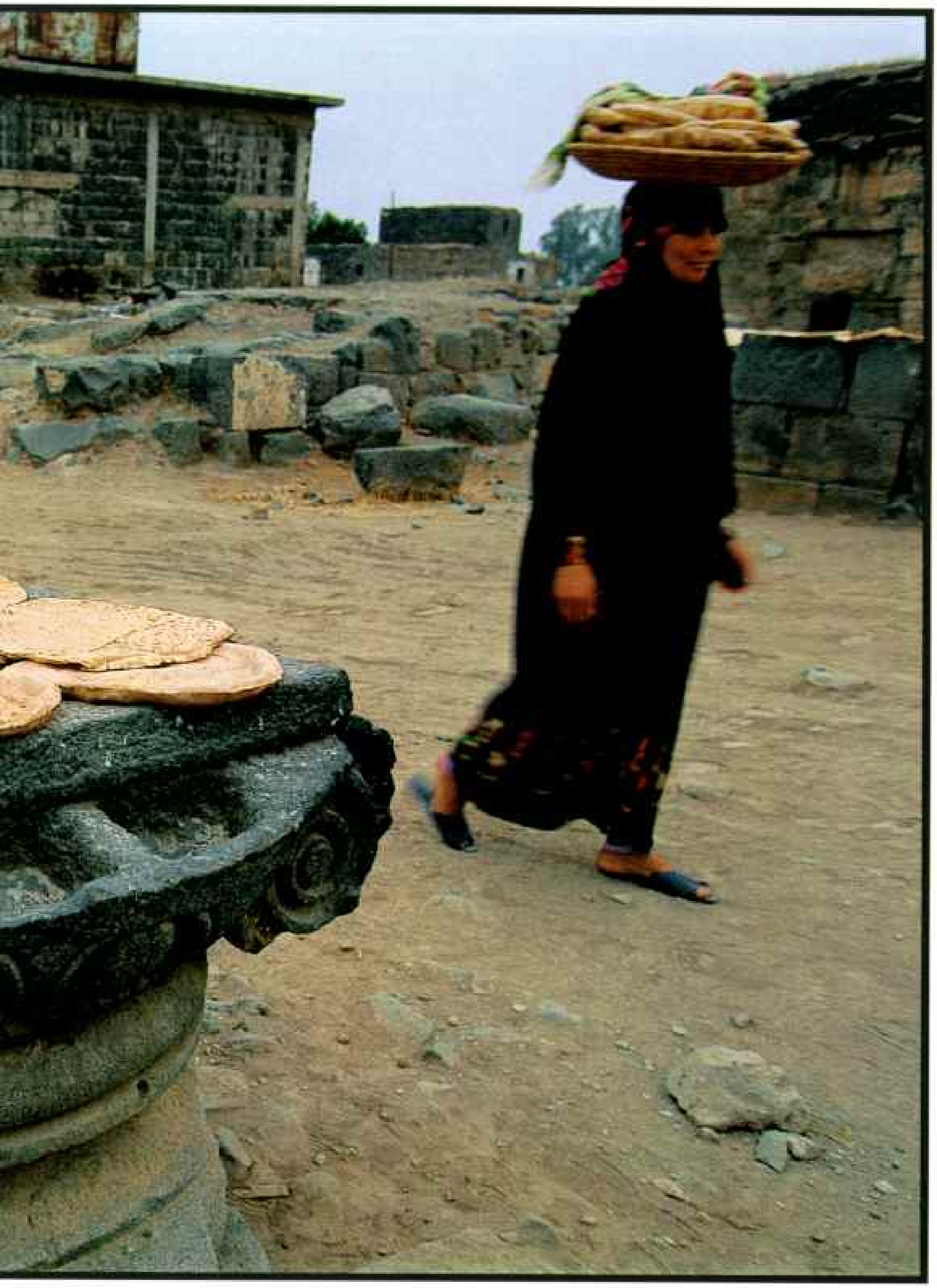
GOLDEN OASIS

Caravans bearing perfumes from Arabia, spices and rare woods from India, and silk from China passed through the colonnaded streets of Palmyra in the Syrian desert, its ruins bearing witness to one of the great crossroads of the empire. To the muscular Roman look of the city, artisans added opulent, Persian-style touches. Intricate floral carvings appear on fallen cornices and on the richly dressed tomb figures of the merchant Malko and family (right). Roman forces sacked Palmyra in A.D. 273 after its powerful queen Zenobia challenged imperial rule. Her captors supposedly led her into Rome on a golden chain.

NATIONAL MUSEUM, DAMASCUS, SYRIA

LIFE AMONG
THE RUINS

A fallen capital, carved from volcanic rock, finds a modest second life as a bread-drying rack in the column-strewn town of Busra, Syria. As capital of the province of Arabia, the ancient trading center



was dressed up with Roman theaters, baths, and a chariot-racing stadium. With the coming of Islam in the seventh century, Roman influences in the Middle East largely evaporated.

CITY OF STONE

Like the tourists who arrive by camel today (right), Romans must have gazed in awe at a temple carved out of solid rock at Petra, in modern Jordan. An Arab tribe, the Nabataeans, sculpted the caravan city out of richly patterned sandstone, the colors a delight to a young Bedouin guide (above).

continued to issue legal codes for the next thousand years. The emperor Justinian's monumental compilation of the Digests, the Institutes, and the Revised Code, completed in A.D. 534, has served as the foundation of Western law ever since.

A society with an all-powerful emperor who could kill at will, a society with millions of slaves treated as human chattel, does not exactly meet our expectations for a lawful society. But in many ways Roman law would be familiar to any fan of *LA Law* or Court TV. There were indictments and jury trials, hanging judges and softhearted ones, hard-hitting prosecutors and wily defense attorneys. In the latter category, the Johnnie Cochran of Rome was, of course, the majestic (if long-winded) advocate Cicero, a man who perfected many defense techniques still in use today.

In a Ciceronian appeal to the jury there was a standard section known as the *praeteritio*—a word based on the Latin verb for "ignore." In this part of the oration Cicero would savage his opposition, all the while insisting that he had no such intention. It came out something like this: "I will focus only on my client's innocence today, and thus I will completely ignore the fact that the prosecutor in this case is an infamous philanderer who beats his wife and steals from innocent grandmothers." Another standard gambit was the *ad misericordiam*, or appeal to pity, when Cicero would have his client's pitiful wife lead her ragged, unwashed children into the courtroom and sit weeping directly in front of the jury box. If the client was childless, there were always a few street urchins who could be hired to play the part for a day.

Two millennia before the Miranda warnings, the Romans also established safeguards to assure the rights of accused criminals. We can see this process at work in the case against the Christian pioneer St. Paul, as set forth in the New Testament in the Acts of the Apostles. (The text is somewhat suspect because it may

have been written in part to embarrass the Jews, but scholars say it is accurate on the legal points.)

In chapter 22 of Acts, Paul is brought before a Roman magistrate on criminal charges—apparently for something like provoking a riot. The police are just about to beat and jail him when Paul pipes up that he is a Roman citizen. That changes everything, and he is permitted to remain free pending a trial.

Later the chief priests of Jerusalem complain to the Roman governor, Festus, about the failure to prosecute. Festus responds, in chapter 25, with a lecture on legal rights: "It is not the Roman custom to hand over any man before he has faced his accusers and has had an opportunity to defend himself against their charges."

Eventually Paul asserts yet another legal prerogative—his right to make an appeal directly to Rome. This process leaves him free for a few more years. Paul makes his way to Rome, but then the Book of Acts ends, with no word about the final disposition of his case. Some scholars feel the charges were dropped, since there are no other records of the case; another tradition holds that Paul was fed to the lions by the emperor Nero.

In terms of modern influence, though, these rough parallels in legal procedure are less important than the Romans' genuine respect for the transcendent majesty of the law—a concept that we consider today to be a sine qua non of democratic rule. Even after Augustus established one-man rule, there was a tendency among the emperors to abide by legal dictates. There was not much people could do if a Nero or Caligula rode roughshod over the law, but for the most part even the emperor felt obliged to obey.

If the emperor himself had to honor the law, the obligation fell even more heavily on lower-ranking officials and colonial governors, the emperor's official legates to the empire. A provincial consul or curate who violated the law risked an imperial summons back to Rome, where he would be thrown *in pedica*, into chains. One reason the consul Festus is so fastidious about Paul's legal rights in Acts may be that his immediate predecessor, the inaptly named Felix, had in fact been recalled after citizens of Judaea complained that he was abusing their rights.

THE ROMAN PROCESS of making laws also had a deep influence on the American system. During the era of the Roman Republic (509 to 49 B.C.) lawmaking was a bicameral activity. Legislation was first passed by the *comitia*, the assembly of the citizens, then approved by the representatives of the upper class, the senate, and issued in the name of the senate and the people of Rome.

Centuries later, when the American Founding Fathers launched their bold experiment in democratic government, they took republican Rome as their model. Our laws too must go through two legislative bodies. The House of Representatives is our assembly of citizens, and, like its counterpart in ancient Rome, the U.S. Senate was originally designed as a chamber for the elite (it was not until the 17th Amendment, in 1913, that ordinary people were allowed to vote for their senators). Impressed by the checks and balances of the Roman system, the authors of American government also made sure that an official who violated the law could be "impeached," a word we take from the Roman practice of putting wayward magistrates in pedica.

The reliance on Roman structures at the birth of the United States was reflected in early American popular culture, which delighted in drawing parallels between U.S. leaders and the noble Romans. There was a great vogue for marble statues depicting George Washington, Alexander Hamilton, even Andrew Jackson in Roman attire. A larger-than-life statue of Washington in a toga and sandals is still on exhibit at the National Museum of American History in Washington, D.C.

In his patriotic ode "American Liberty," the first great American poet, Philip Freneau, described Washington as "a Roman hero." In 1824 the classical scholar Francis Glass wrote a curious volume titled *A Life of George Washington in Latin Prose*, full of tributes to Washington's *"diligentia, industria, et vigilantia."* Amazingly the book sold fairly well and went through three editions. When Washington resisted pleas from supporters that he serve a third term as President, the mass media described him as "the American Cincinnatus," after the fifth-century B.C. Roman who was given dictatorial powers in a time of crisis but went quietly back to his farm when the task was done. The first

THE JEWISH WARS

A moat of wilderness surrounds the desert fortress of Masada, near Israel's Dead Sea coast, site of one of Rome's most inglorious victories. For nearly two years (A.D. 72-73) fewer than a thousand Jewish rebels held out here against a siege force of 15,000 Romans. Finally the army succeeded in building a ramp to the top of the 1,424-foot-high mesa. Rather than surrender, the defenders killed themselves. Fiercely nationalistic and unwilling to worship the emperor, the Jews probably received the harshest treatment of all Rome's subjects. Twice the Romans sacked Jerusalem. A scene from the Arch of Titus in Rome (below) depicts soldiers carting off a menorah and other sacred spoils.

SOPRINTENDENZA ARCHEOLOGICA DI ROMA

AN EMPEROR'S STAGE

Light and shadow enact their daily drama in a Roman theater in Leptis Magna, Libya, the richly rewarded birthplace of Septimius Severus, Rome's first African-born ruler. During his reign (A.D. 193-211) provincial capitals grew wealthier and more distinguished. Wrote one chronicler about the upstart towns: "A single rivalry obsesses every one of them—to appear as beautiful and attractive as possible."

U.S. veterans organization, formed of officers who had fought under Washington in the Revolutionary War, was called the Society of the Cincinnati, and a town in the new Ohio territory took its name from this group.

THE BICAMERAL LEGISLATURE is not the only prominent feature of the U.S. Capitol that was borrowed from ancient Rome. The building itself, with is broad porticoes, its stately white columns, and its graceful dome at the center, is a perfect example of how much the modern world has learned from Roman architecture.

The Romans always felt, and frequently expressed, an inferiority complex toward the Greeks in the realm of the fine arts. I sometimes wish some of those Romans could travel the world today and see how their own achievements in the fine art of architecture have been flattered by imitation.

"People are always going on about how uncreative the Romans were," the American archaeologist Elizabeth Fentress told me, as we stood in the sun-streaked atrium of the neoclassical structure that houses the American Academy in Rome. "The Romans said it themselves. But it is just simply untrue. They were brilliant engineers. In the Renaissance, when there was this great fever for anything neoclassical, it was Roman not Greek architecture that was copied."

The Romans' signal contribution was the strong, versatile material they called *caementicum*, a stone soup made from volcanic ash, lime, and water, with fragments of stone or brick thrown in for strength and color. It was the first concrete strong enough to hold up over an extended space. Roman concrete made possible the great Roman arches, domes, and vaults that could stand on their own, without the forest of supporting pillars that Greek buildings had required. Roman concrete liberated the architect from the tyranny of gravity.

I recently visited two of the empire's most impressive domed structures: the Pantheon in Rome, built by the amateur architect Hadrian (who also happened to be the emperor of Rome) between A.D. 118 and 128, and the great cathedral (and later, mosque) of Hagia Sophia in Istanbul, built in the sixth century A.D. The latter, in particular, is dark and dirty now, to

be blunt, blackened by the smoke of a zillion votive candles over the centuries. And yet, there's something very close to perfection in that huge, flawless hemisphere extending like an indoor heaven 180 feet above your head.

As I stood beneath the wonderful central dome of Hagia Sophia, listening to my fellow tourists express their awe in muted tones of Turkish, English, German, Russian, Korean, and Japanese, I remembered the three basic rules the Roman Vitruvius laid down at the start of his ten-volume treatise on architecture. A good building, he said, must be functional, it must be firm—and it must be delightful.

The rational Romans didn't plunk down these great domed buildings just anyplace. There had to be a plan, a design for the city, showing where each important element of a Roman community would stand. The art of city planning is another legacy the Romans have left to our age.

Roman cities (with the notable exception of Rome itself, which was already a big, confused jumble by the time Romans got serious about

TOWN AND COUNTRY

Moroccan farmer Driss Melouli finds that the former aristocratic quarter of Volubilis, a Roman trading town, is still rich enough to provide forage for his livestock. The farms of North Africa fed Rome.

supplying wheat and olives, yet the lives of farmers—90 percent of the empire's population—were, in the words of historian Chester Starr, "grim, short, and abysmally poverty-stricken."

planning) tended to be laid out in careful detail, with grids of crossing streets arranged along a series of long axes, great boulevards interrupted here and there by a park or temple or civic center. "In the colonies," wrote classical scholar Frank Bourne, "civil engineers laid out wide streets at right angles to one another, with every fifth street an avenue of unusual breadth." Cities measured their own importance by the number of important buildings clustered around the downtown forum.

Pierre L'Enfant's plan for our capital city, Washington, D.C., with its long, straight mall lined with grand buildings and its boulevards intersecting at open circles and squares, is, in many ways, a Roman conception.

Today most of the ancient Roman cities are ruins or just historic parks preserved within some modern city, like the bits of Roman wall and the broken pillars you find in almost every major city in southern Europe, Turkey, Syria, and North Africa. Still, it is impossible to travel along the old trade routes from one old city to the next without a sense of awe at the prodigious energy the Romans poured into their empire.

Driving down the turquoise coast of the Mediterranean in southern Turkey, I stopped one day at the town of Perge, an outpost even in Roman times and a ghost town today. I strode through the triumphant gateway of Perge's protective wall, walked the colorful mosaic sidewalks beneath the great colonnade of the ancient marketplace, and strolled past the Perge theater and stadium.

Then, 20 miles down the road, I came to yet another ruin, the town of Aspendos, with its own busy marketplace, a much bigger theater, and a racetrack larger than an NFL stadium, where the Romans went to bet. Leaving Aspendos, I drove beneath the tall arching towers of the stone aqueduct that carried water from the Taurus Mountains; another 20 miles down the road I came to yet another ancient town, Side, which boasted its own wall and monumental arch, its own marketplace, aqueduct, and theater.

No matter how close to the next city or how far from the Roman capital, every town in the empire was entitled to a full infrastructure: the protective wall, the triumphant entrance arch, the paved streets, those charming mosaic sidewalks, a marble meeting hall for the local council, majestic temples honoring both the Roman gods and whatever regional deities the locals wanted to worship. There would be a marketplace—sometimes, in those steamy Mediterranean climes, encircling a central fountain.

There were fountains aplenty in Roman cities. Many Roman fountains were beautiful, and they were constant subjects for Horace and other poets. But the aesthetic appeal was secondary; the practical Romans built their fountains mainly for functional purposes. For one thing, the Romans knew that they could get an air-conditioning effect by having water splash out onto a street and evaporate from the stone (to this day, the cooling power of evaporation is at the heart of all refrigeration systems).

Mainly, though, the fountains were there at the demand of the Roman hydraulic engineers. The flow of water that came barreling into a city after 15 or 20 miles of downhill travel along an aqueduct had such momentum that it would burst any pipe. To relieve the pressure, the Romans routinely built great fountains at the point where aqueduct met city. The most famous fountain in Europe, the Trevi Fountain in Rome—the spot that inspired *Three Coins in the Fountain*—is actually the terminus of an ancient 13-mile aqueduct called the Aqua Virgo, the Virgin Spring.

Since most Roman homes had no bathtub, every town had public baths. These had hot and cold water and separate bathing areas differentiated by the temperature of the water: the *frigidarium*, the *tepidarium*, and the *caldarium*. Underground networks of lead pipe supplied the baths with clean water.

Near the baths there was often a brothel, ornamented with graphic paintings depicting the various sexual services available. For those who preferred less salacious pastimes, there were parks and public libraries and big open plazas.

Another feature of Roman cities that I particularly enjoy are the mosaics. Roman designers used mosaics everywhere—not just on public sidewalks but also on walls, floors, ceilings, tabletops. They could be simple geometric designs or unbelievably intricate pictures. The famous wall mosaic from Pompeii (now on display at the National Museum in Naples) depicting Alexander the Great battling the

HADRIAN'S WALL

The empire must have limits, believed the emperor Hadrian, a notion that would have struck some previous rulers as heresy: Rome was meant to conquer the world. To fulfill his more practical aim, Hadrian in A.D. *122 ordered his soldiers to build a wall across northern Britain that would, an early biographer wrote, "separate the Romans from the barbarians." Winding over desolate moorland and along windswept crags (above), the 73-mile-long stone and turf barrier, originally as high as 15 feet, linked a chain of forts, guardhouses, and gates. To the north, in present-day Scotland, lived Celtic tribes, who on a few occasions overran the defenses.*

HOUSESTEADS ROMAN FORT, NORTHUMBERLAND, ENGLAND

Archaeologists have unearthed ample evidence of the frontier's lonely guardians. They have found game boards, letters written on thin sheets of sapwood, leather shoes and drinking cups, and a buried hoard of silver coins, perhaps a treaty offering to a local chief. Shrines indicate that soldiers worshiped gods from all points of the empire, even local deities like these three stone figures (above right) cloaked against Britain's weather.

CRIES AND WHISPERS

The old stone walls echo again with the roars of man and beast at a bullfight in the restored amphitheater at Arles, France, one of several Roman theaters and arenas in Europe still sturdy enough to hold crowds. In the days when Arles reigned as the capital of the province of Gaul, the fare was brutal: gladiators dueling to the death or squaring off against wild animals imported from Africa. Fountains scented with lavender masked the stench of blood. Now love is in the air. A couple (below) costumed for a festival in Arles might well heed the famous advice from the poet Horace: "Seize the day, put no trust in the morrow!"

Persians was made from 1.5 million different pieces, virtually all of them cut individually for a specific point in this specific picture.

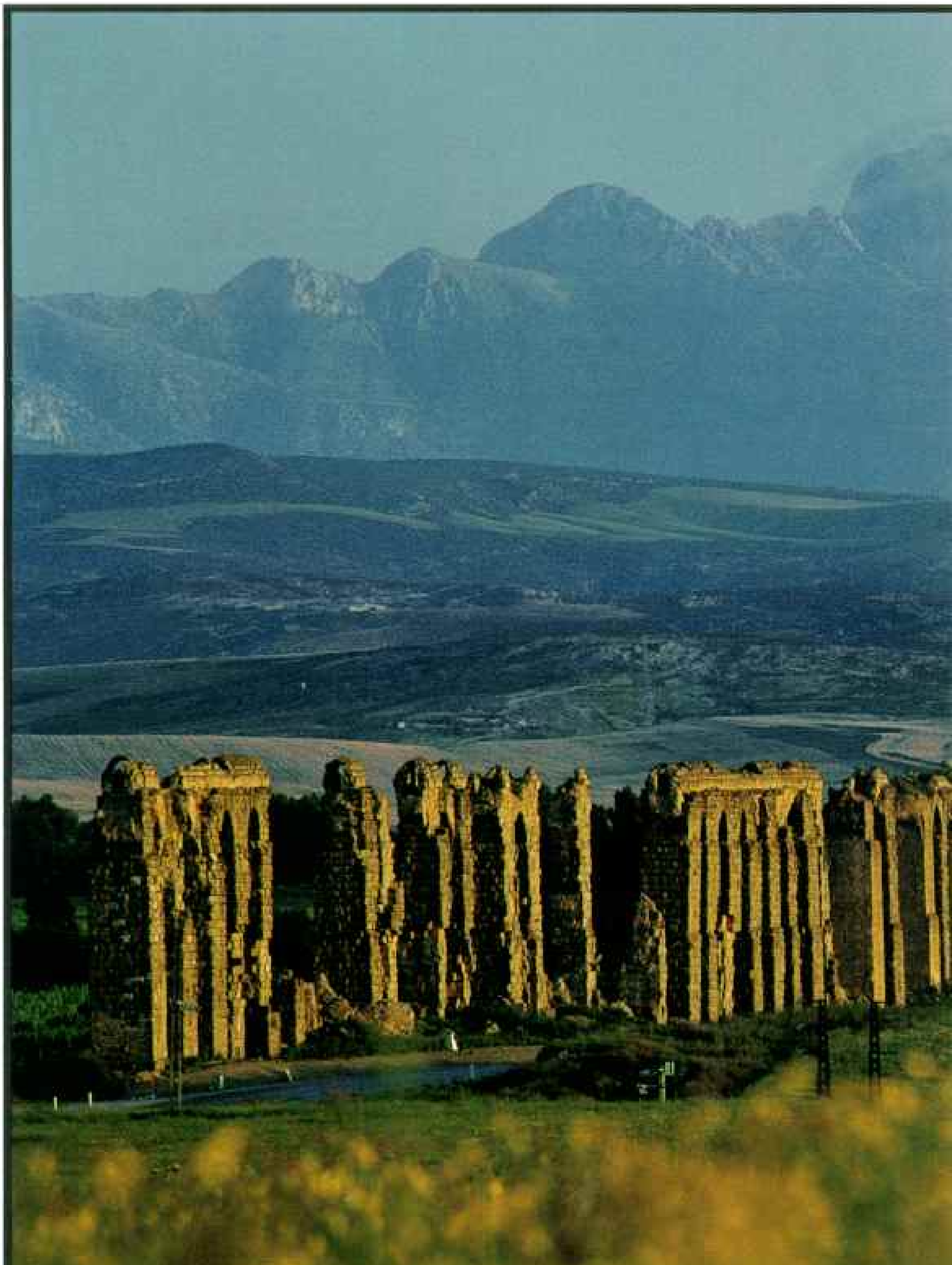
Some experts feel that the greatest Roman mosaics were those done in the provinces of North Africa—and sure enough, on the north coast of Tunisia I saw a mosaic that was so perfect it took my breath away. It is a portrait of the sea god Neptune. Somehow an anonymous artist in the second century A.D. put together a collection of colored stones that captures everything you need to know about Neptune, right down to the gleam of triumph in his eye and the streak of salt water running down his cheek.

The Roman zeal for planning extended well beyond the design of cities. These were people who lived by the motto *"Dux vitae ratio*—Logic is the guide of life." They brought this love for logical organization to the job of unifying the world.

Logic suggested, for example, that a far-flung empire needed connections. So the Romans built the greatest highway system the world had ever seen. Not just ruts along the riverbank, Roman roads were built right. There were three levels of substructure beneath the pavement. There was a prescribed angle for the uplift of the center of the road, allowing rainwater to drain off; there was special grooved pavement in steep places, so that hoof and sandal could go downhill without slipping; there was a sequentially numbered signpost every Roman mile (1,620 yards), telling things like the distance to the next town and which construction battalion had built the road. With regular changes of horses, pony-express style, couriers could cover up to 200 miles in a day—considerably faster than is possible today in some parts of the empire.

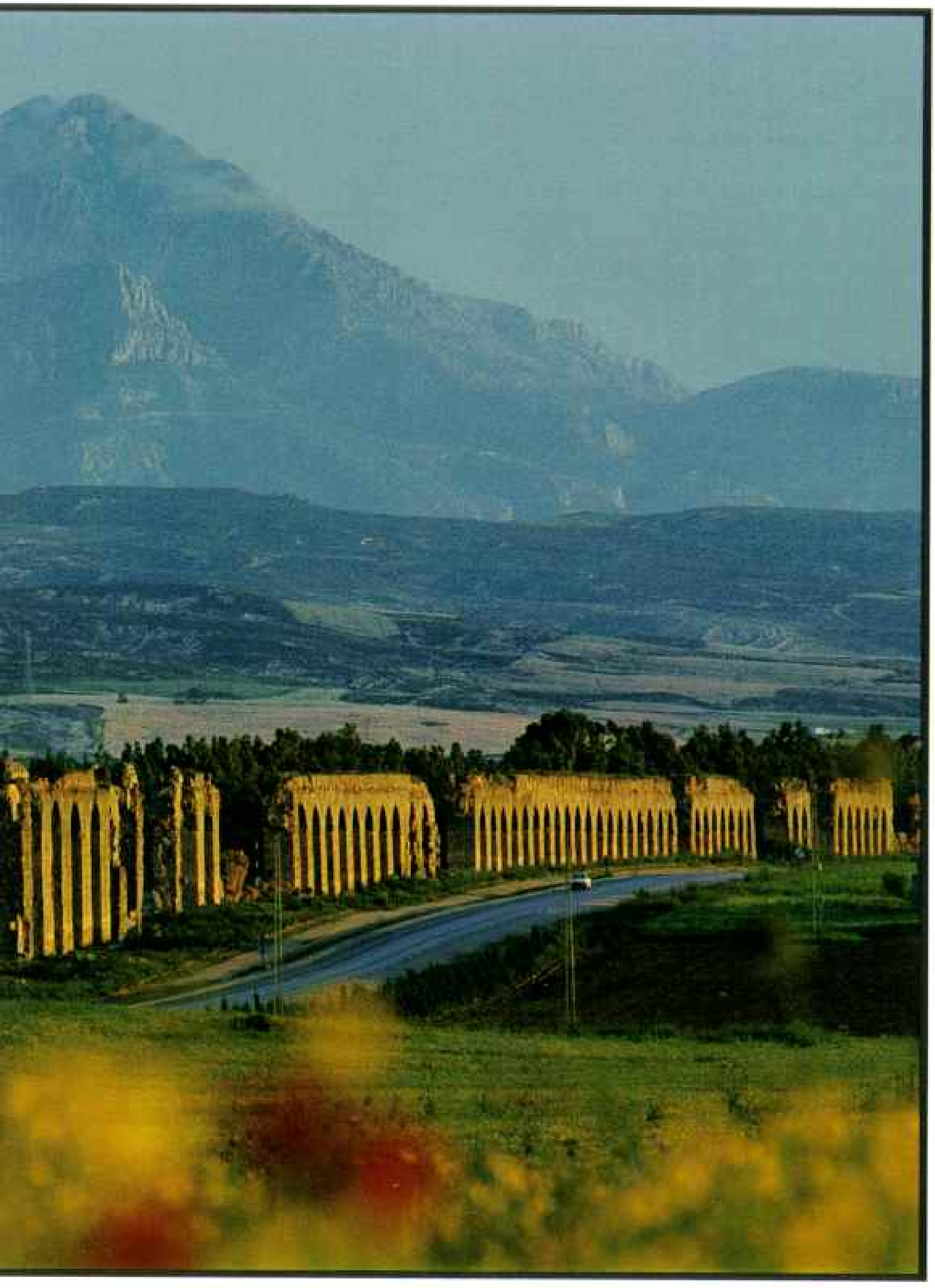
One day when I was tooling around Rome in a tiny rented Fiat, I looked up and saw a highway sign pointing to the Via Appia. The Appian Way! This highway was begun in 312 B.C. to connect Rome to its early colonies on the Adriatic—and it still heads south from downtown Rome. I couldn't resist turning onto this famous *via*, although I quickly regretted the choice; the traffic was hopeless, and the potholes felt as if they had been there for 2,300 years.

The Appian Way is perhaps the most famous of the Roman roads, but that 360-mile



AFRICAN AQUEDUCT

Water once traveled in style across Tunisia, carried by a procession of arches from Mount Zaghouan to Carthage, 50 miles away. Under Roman rule, North African cities for the first time enjoyed decent



hygiene with the delivery of fresh water for bathing and drinking. On a smaller scale, engineers built dams to irrigate vast slave-worked estates.

BEGINNING OF THE END

Flesh looks up to marble at a Rome museum, home to a colossal head of Constantine, the emperor who changed Western history. During his rule (A.D. 306-337) Constantine moved the capital east to Byzantium, which he renamed Constantinople, and became the first Christian emperor. The once invincible empire soon broke apart, leaving behind a legacy of law, language, and culture—a monument still untopplod.

thoroughfare was a byway compared with later Roman expressways. The Via Domitia, linking Italy to Spain, and the Via Egnatia, which connected Rome to Byzantium, were much longer and much more important during the years of imperial rule. An eastward extension of the Via Egnatia ran on across Turkey, southward past Beirut, and onward to the capital of the province of Syria. It was on that famous "Road to Damascus" that Saul of Tarsus encountered the blinding vision that converted him to the Apostle Paul.

It's doubtful that anybody ever traveled every mile of Roman road, but one important traveler took a fairly serious shot at it. This was the emperor Hadrian, a scholarly monarch who set out from Rome in A.D. 123 with the goal of studying all the many tribes and cultures that made up his diverse domain. When I took a long, exhausting trip around the Roman world, I often had the feeling I was traveling with Hadrian.

In northwestern England I snacked on scones and bitter marmalade as I looked out over the neatly squared corners of Hadrian's Wall, where the legions stood guard against Celtic invaders. In southern Turkey I lunched on dates and macaroons at a café opposite the ornate pillars of Hadrian's Gate. At the northern tip of Africa I sampled sweet black olives from the groves near Hadrian's Theater in Carthage—a structure so sturdy it still houses opera productions every summer, some 1,875 years after it opened.

IN A SENSE, the greatest thing of all about our legacy from ancient Rome is that the Romans didn't do all this stuff to leave a legacy for us. They designed a practical alphabet, perfected their language, wrote a comprehensive code of laws, built an intercontinental network of highways, erected great domes, and created intricate city plans because they believed in doing things well.

They seized the day, to use the Horatian expression, and when they set out to achieve something, they did not hold back. They started out as a tiny backwater in a Mediterranean world dominated by mighty city-states—and eventually took that world, and all its great cities, under their own dominion. They secured peace, prosperity, and order from the icy firths

of Scotland to the sandy shores of the Nile. There is no doubt that some Romans—like our friend Quintus Horatius Flaccus, with his "monument more lasting than bronze"—spent time now and then contemplating their place in history. But I'd argue the real Roman mindset was more focused on the here and now. They got today's job done and left the next for tomorrow. It's a spirit that Horace himself knew well, when he wasn't worrying about monuments. Of all the charming odes of Horace, my favorite is the one that expresses this characteristic sense of Roman confidence:

. . . Ille potens sui
laetusque deget cui licet in diem
dixisse Vixi. . . .

Happy the man, and happy he alone,
He, who can call today his own;
He who, secure within, can say,
Tomorrow do thy worst, for I have
lived today. □

For more on the Roman Empire join our online forum at www.nationalgeographic.com.

A SPECIAL PLACE

Oregon's Outback

By WILLIAM LEAST HEAT-MOON
Photographs by SARAH LEEN

A fiery sky ushers evening silently into southeast Oregon's high desert and renders Hart Butte in inky silhouette. Grand promi-nences command lonesome sagebrush flats in this region trappers called Malheur— "misfortune." Here lakes appear and disappear, and the only break from silence may be the honking of snow geese or a distant coyote yelping into the wind. Some find the place eerie and disturbing; others exult in its raw isolation and call it home.

ONE FINE MORNING. It was a void on my road map, a suggestion that there was only emptiness here, that drew me to this shallow lake in southeast Oregon, which is, by at least one definition, the most remote spot in the lower 48 states: I'm as far from an interstate highway as one can get. From where I stand the nearest four-lanes, I-5, I-80, and I-84, are equidistantly 160 air miles away. Interstate 84, the one I took, is by road (if you don't get lost in the maze of dirt tracks making up a fifth of the way) 250 miles away—the distance, say, from Yankee Stadium to the Pentagon, St. Louis to Kansas City, Detroit to Chicago.

I live in Missouri, and it has taken some effort to get into this heart of the Oregon high desert, from where I'll set off eastward into the blankness that cartographers marked out by showing how the paved roads run around it if not away from it. This isn't the Oregon of 60 shades of green arising from rain, rain, rain; not here the great sea stacks of the Pacific coast, nor Yaquina Bay oysters or sweet geoducks, nor espresso at the back of bookshops. This is the Other Oregon, the Big Empty, a space deformed by volcanic processes less than 30 million years ago and turned into desert by the rain shadow cast by the Cascade Mountains to the west.

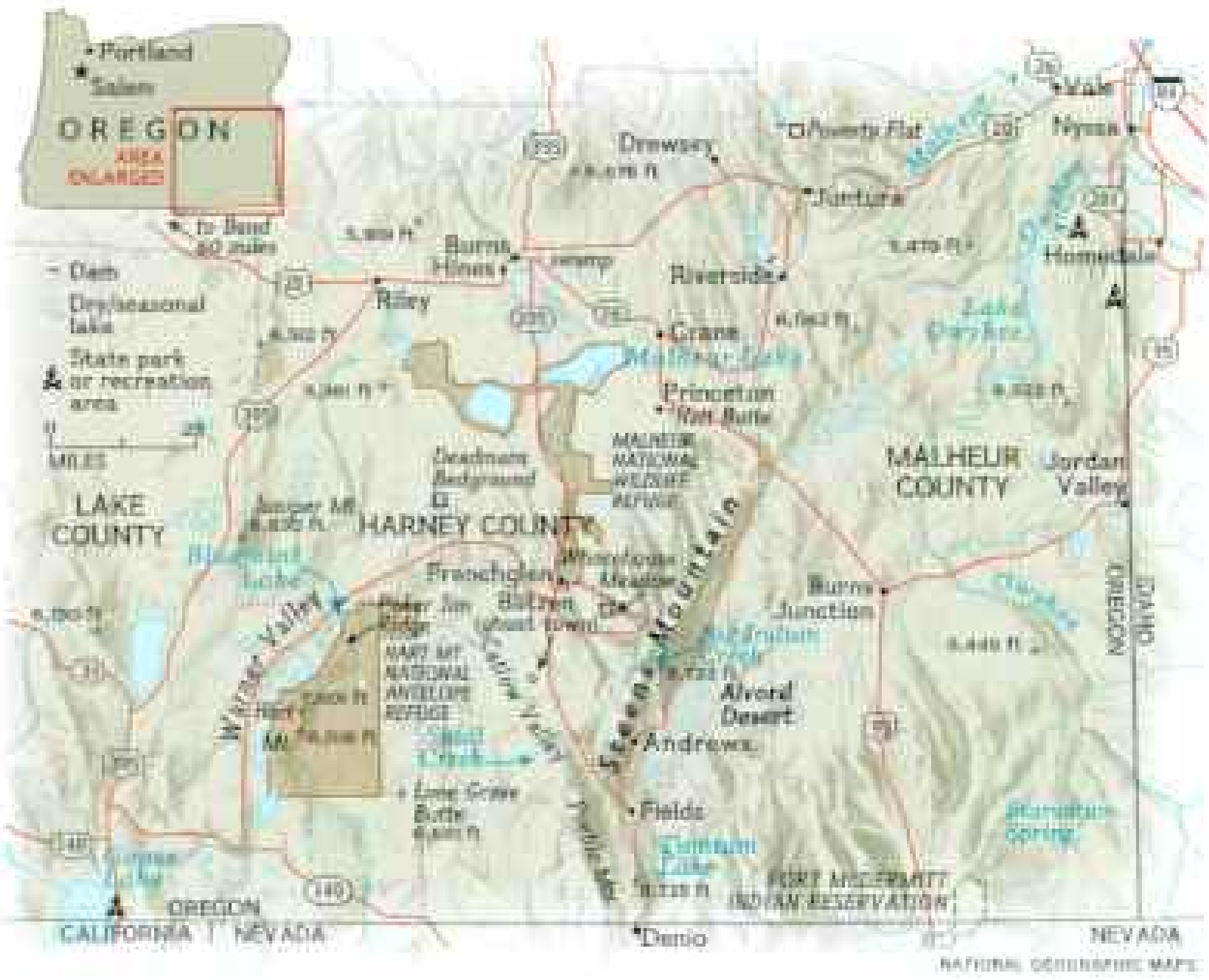
I'm standing at the northern end of Bluejoint Lake below the high, fault-block escarpment of Poker Jim Ridge, a wall of tenebrous basalt broken upward into the light of day by the great tectonic forces miles beneath. In a time when this rimrock had seen 12,000 fewer autumns, the spot I stand on was more than 200 feet below the lake surface, evidence of which shows itself as the ancient shoreline cut by waves into the ridge now 20 stories above my head. But, only a couple of generations ago, this lake and dozens of others to the south were gone; it was nothing but an unbroken expanse of cracked mud bottom at least 600 feet thick, a lake of memory marking the grave of a Pleistocene lake big enough to swallow Boston, had Boston been around.

The fascination of this place depends on trying to see what it has been, how it was so different, although everything exists in kinship, in a direct line of descent: Here fire is the father of stone, volcanoes the mothers of valleys, and wind and ice the rods of discipline that shaped their offspring. More than any other American place I know, this desert corner bespeaks change, the subtle changes sometimes a mask for the grand upheavals. Things, even mountains and hundred-mile-long lakes, vanish, come to light, vanish again. South of here huge Goose Lake dried up in the 1920s to reveal the indelible 1846 tracks of the famous Applegate immigrant trail striking right across the dried bottom, punctuated with bits of broken-down wagons, but the lake rose again to conceal history and leave residents waiting for the next uncovering.

One can wade across some of these residual waters, despite their size;

WILLIAM LEAST HEAT-MOON, who has visited all but 300 of the more than 3,000 counties in the lower 48 states, is currently working on a book about crossing the U.S. by water. Assignments for the GEOGRAPHIC have taken SARAH LEEN, a freelance photographer, as far afield as Uganda and the Kamchatka Peninsula.

Within this immensity, humankind seems almost an afterthought. Range riders pass before Steens Mountain (below and following pages), a 70-mile-long massif that crests at 9,733 feet. Steens captures eastward-drifting snow and rain, watering valley ranches on its western flanks while keeping the Alvord Desert parched.



BIG INDIAN GORGE ON STEENS MOUNTAIN

they are noteworthy because of their shallowness, yet they exist because they once were deep holes of the ancient lake. It's that kind of inversion, that irony of natural process, that marks this place: What was deepest is shallowest, what was fiery flowing magma is rigid mountain, what was buried stands high and exposed, and a hundred feet above a mud-entombed juniper forest only sagebrush can grow. Time travel is requisite to traverse this desert in any deep sense, and it is the sweep of years that creates the topsy-turviness, the undulations of a nature that appears to writhe through the eons and toss creation bum over teakettle.

This year the Warner Valley, the bottom of the primitive lake, is blue with water and golden with bunchgrasses and shrubs, a string of marshiness just waiting for the next chance to return to a small inland sea. In the 1870s a government report designated the basin as swampland, but 15 years later a writer said, "The principal portion of the valley is sterile, barren greasewood desert with only an occasional marsh or salt lake varying the monotony. It would be difficult to imagine a more desolate and God-forsaken region outside of Assyria, Arabia, or the Great Sahara."

Softly moving in pale October light, tundra swans congregate on Tumtum Lake before resuming their flight to wintering grounds in California. A buck mule deer keeps cover as it fades into the wild rye during the autumn hunting season. For Snipper the horse (following pages) the view of his ranchland home south of Andrews ends with the Pueblo Mountains.

THE SECOND DAY. The description is even more accurate beyond the rimrock. I head 16 miles southwest, then cut east between the remnant lakes to follow the steep gravel road up through the stony gap that separates Poker Jim Ridge topographically, if not geologically, from the 7,000-foot summits of Hart Mountain. I come into a place that carries Herman Melville's words about the Encantadas: "In no world but a fallen one could such lands exist."

The awesome reach eastward is a void, the stuff and soul of a cartographer's blankness, a broad whiteness on a map with no place for sensible humanity; it's rock, gravel, and scrub, where the only thing moving is a column of dust like a spectral visitant, where even ghosts must depend on the dry shaking of a rattlesnake tail to gain a voice. This igneous sprawl is enough forsaken that it made a Civilian Conservation Corps worker at the Hart Mountain camp 60 years ago brood, "The country is all right, but there's too much of it."

Life beyond the reptilian seems to have so repudiated the rocky gauntness of the flat that I find myself waiting for dusk, not to escape the sun

NEAR ANDREWS

but to close down the oppressing openness with darkness, to pull the shades of night over this immense window that looks into another time zone, and then, maybe from the mountain behind, I can hear across the Plutonian blackness the dolorous call of a coyote, its belly filled only with emaciated lizards and withered spiders, its breath coated with alkali, eyes ravenous. The sense of desolation in this long stone littering is not one of abandonment like the ghost town nearby; rather it's more severe because it rises perceptibly like the powdery dust devils and suggests that people were never here. How could they be? Why would they, except to prepare themselves for hell?

I love this cursed and sere beauty and its illusion of being the end—or the beginning—of all existence, its capacity to unnerve me as I move among the scrub and visualize my bleached skeleton with only teeth to tell who I was. Go ahead, I think, cry out for help, call until no voice is left. There'll be no answer, not now, not later. This is a common dread, and so is the one that follows it: What if someone does show up? After all, I've come for this excellent forsakenness, and now I fear somebody disrupting it. One more high-desert inversion.

I should walk here in sackcloth. Let me repent of my living too abundantly and blindly in a too easy and forgiving land and forgetting that the universe is mostly a dry, old cosmos, with wetness and life the exceptions. In this place scant rains fall sweet, but a walker must hunt out a spring where the water is still making its descent toward wicked lakes that will turn it to salt, where glaring alkali flats mock with mirages of fresh water and tops of stones turn saline white as if blessed with purity, but that blessing is also alkali.

OF COURSE this corner does have a few dwellers, cowhands wandering around after reluctant bovines, a couple of federal rangers, and a handful of people offering gasoline or a meal or place to sleep. The children, some of whom will put in more than 100,000 miles on a school bus before they complete their final year while others are stashed up north in Crane at one of the last public boarding schools in the nation, are even less visible. I have trouble thinking of these dwellers as residents, for the country will not really admit a true residency; it tolerates only passers-through, some merely going faster than others, and even those born here three generations ago have the look of itinerants, and they accept my passage politely.

Earlier this morning, under a haggard mist, fragments of basalt ridges seemed to be collapsed and broken like blocks of some grand city here heaped up and spent, there strewn about and exhausted. In the fallen rubble of the old magma fury, the toughest plants over years have been able to creep only to the edges to struggle out a barren existence in crannies.

To travel this wild of vulcanism briefly, before it numbs me, is an antidote to almost all that those distant interstates lead to, and I am happy to come away from their destinations to an isolation ever harder to find in America. And it's all made better because I know I'll leave even sooner

Like a gunfighter in his death throes, a bullet-riddled sign used for target practice barely stands near the Alvord Desert. Aspens carry more vivid impressions carved by sheepherders. Some trees portray painted ladies who did business in Whorehouse Meadow. A federal board renamed it Naughty Girl Meadow, but the locals lobbied to change it back.

than most of the homesteaders who arrived early in this century at various emplacements they perceived to be potentially hospitable. A newspaper advertised the Catlow Valley, the one I'm soon to cross:

> "100,000 acres of choice sage brush land
> in one of the greatest valleys in Eastern Oregon.
> We start excursions to settle this rich valley on April 1, 1910.
> We can settle 500 families on choice rich land.
> It will all be gone by Sept. 1, 1910. Will you join us?"

Today the valley has a single ranch and the ghost town of Blitzen ("lightning"), where many dwellers left long before their newly born could ride a horse.

I've spoken with a few people who live in the somewhat sheltered and watered nooks the desert provides here and about. They share above all else a yearning for spareness, a deep dread of congestion, and an urge to be unencumbered by just about everything except space and weather.

Had the early Spanish travelers made it this far north they might have left one of their Texas toponyms here also: El Despoblado, the Unpeopled. The dwellers would like it and find it accurate enough, for the southeast section of the great rectangle that is Oregon, one-quarter of its area, holds only one percent of its population. Still, developers look for ways to fill the land and, in fact, have succeeded near the northwest corner of this quadrangle, in Bend, in making such a usurpation happen. I've heard no one here speak of it kindly. I suspect the longing for uninhabitedness, which runs deep in the Far West, especially in Oregon, is an old thing in the

POKER JIM RIDGE

Snow squalls and fog veil Poker Jim Ridge at dusk (preceding pages). A bovine face-off outside Frenchglen frames Highway 205. "There are two Oregons," says Princeton rancher Leilani Davis, who bristles at Portlanders and other outsiders who disparage her chosen land. "We like it here. We make our living here. And it's a good life."

region, its existence proved by names left on the land: Poverty Flat, Starvation Spring, Deadmans Bedground, Lone Grave Butte, Skull Creek, and, the earliest European and most recognized name, Malheur, "misfortune."

I asked a waitress in Denio, a settlement on the Oregon-Nevada line just south, how to pronounce the name: "Duh-NYE-oh," she said, "but if you live here, it's Denial." Indeed, this is a land denied most of what most Americans believe they want today, and in this denial, in their rejection, lies the essence of the dwellers, some of whose ancestors by force took the place from the Paiute people. A highway historical marker on the eastern edge of the quadrangle, some miles north of Fort McDermitt Indian Reservation, mentions the Bannock War of 1878 and says the Paiute "ravaged the country [before] finally being defeated and dispersed." Across the last three words someone has sprayed in bloodred paint: SLAUTERED.

One more inversion of this desert: People killing each other over a landscape that, even today, will do one in for making the simplest of miscalculations: too little water, gas, clothing; too much cockiness, inexperience, anxiety. I'm mostly at peace here but never truly comfortable. As I say that,

I can imagine the cheers from the tiny café counter at Fields Station, where they keep count on the wall of the annual number of burgers and milk shakes sold: "Yes!" they hoot. "Tell about the time you got lost at dusk in that sagebrush flat, and how fear crept up your spine, and how it took forever for Polaris to rise and set you straight."

A THIRD DAY. I'm 60 miles east of Poker Jim Ridge and following the loop road up the gentle slant of the broad back of Steens Mountain, a route so softly inclined that eight-year-olds compete in the annual ten-kilometer footrace over the north leg of the course. To arrive from the west and motor up Steens is soon to scoff at calling this long, uplifted basalt block a mountain. Ridge seems to be the word. Miles up the unimpressive grade, higher, imperceptibly higher, the sage changes to alpine flowers and mountain mahogany, and then nothing at all grows; everything has turned to weather-wrecked rock; and then the earth falls completely away, and where there had been a horizon of snow and stone, there is only air, and the ground is nearly a mile down.

Longer than the Connecticut-Rhode Island border, Steens Mountain is an enormous piece of the fiery underearth tilted upward nearly two miles above sea level only later to be worn and excavated by the opposite element, water and ice. When the ice went entirely, so did the collected water, leaving mountain valleys 1,200 feet deep and nearly 3,000 above the playa, the dried mud of the old lake.

THE LAST DAY. The playa stretches twelve miles north and south and seven miles eastward from the foot of Steens Mountain. The cracks in the Alvord Desert hardpan could swallow a butcher knife, but two tons of truck sink in less than an inch. I've come to another Pleistocene lake or, rather, where one used to be, for the water that remains, having little more substance than a mirage, is a sorry lake indeed. But once, 400 feet above this bottom, fish swam.

From the east edge of the Alvord rises a white wall of alkali that makes the playa look as if it's burning. The wind drives the whirling carbonates, the produce of waters coming down from high valleys and clefts in Steens to find no lake, only a bottom that concentrates them under the dry air into a wretched bitterness that turns this level into a dazzling and lifeless flat, a scorched Tophet where the dead would not go, and that's just as well since, in season, city dwellers gang in here to land sail. Who can doubt that, were the road to Gehenna paved with asphalt instead of good intentions, tourists would come?

But today the old bottom, the packed mud crazed and glazed and scintillating as if it were again a small sea, has only a curious walker to take a mouthful of a dust devil advancing before the rolling alkali front, and he must turn toward the mountain where ice rivers once fed down meltwater from a jaggedness that stops clouds, and he wonders how any map could ever show such a risen land in a world so fallen. □

MALAYSIA

RISING STAR

Spotlighting soaring growth, the Petronas Twin Towers erupt from the skyline of Kuala Lumpur, the nation's capital. At 1,483 feet they are the world's tallest buildings. Such ambitious projects herald an economic boom sparked in part by foreign investments in technology and manufacturing that has made Malaysia one of the fastest developing nations in Southeast Asia.

Marching in corporate cadence, employees of Celcom—Malaysia's first private telecommunications company—flaunt futuristic costumes at the National Day parade in the state of Sabah. Precise timing has served the company well: It was started in 1989, after the economy had hit its stride with a

healthy 8 percent annual growth rate. That surge was spawned in the mid-1970s when U.S. and Japanese firms began manufacturing computer chips in Malaysia, transforming it from an exporter of raw commodities such as rubber and tin into the world's chief exporter of semiconductors.

By T.R. REID
Photographs by STUART FRANKLIN

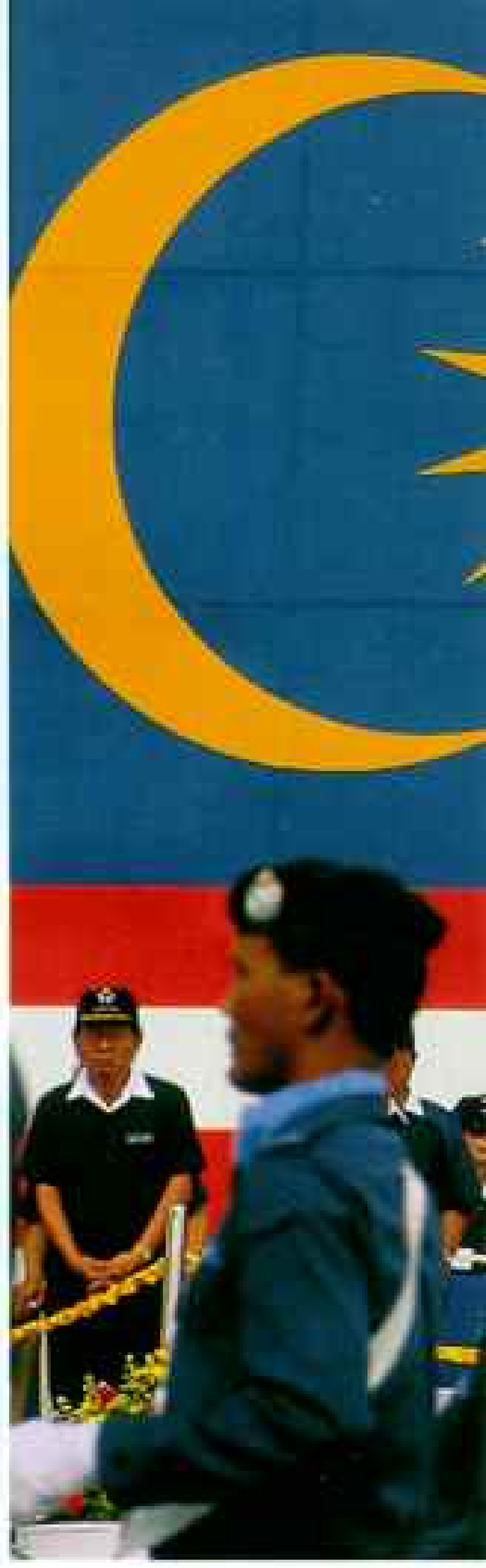
THIS IS THE FOREST PRIMEVAL—and I mean *really* primeval. The dappled splotches of sun and shade filtering through the leafy canopy 200 feet above wash over a rain forest that has been here since before humans appeared on earth. Beneath the tall and perfectly vertical trunks of the great *tualang* and *merbau* trees flourishes a dense world of palm fronds and rattan, ferns and figs and mosses, climbers, creepers, suckers—so many different types of plant life that you can find hundreds, even a thousand, different species in a single acre here in the green, green heart of Malaysia. It is a world in such careful balance that the mix of vegetation in these undisturbed jungle tracts has been essentially the same, according to fossil records, for millions and millions of years.

Oh yes, if you want to know more about this ancient place, just load in your favorite Web browser and call up the rain forest on the Internet at: www.mol.com.my/pahang/.

That says a lot about what's going on these days in Malaysia, a lush and verdant jungle country that has rocketed so rapidly into the modern era that even one of the world's oldest virgin rain forests now has its own home page.

As Malaysia celebrates the 40th anniversary of its independence this year, the nation of 21 million is riding a wave of high-tech prosperity that reflects a stunning economic transition. When NATIONAL GEOGRAPHIC took an in-depth look at this young country 20 years ago, it was primarily an exporter of raw commodities—timber, rubber, tin, and palm oil. Malaysia still produces those basic goods, but they play a much smaller role in a manufacturing economy that is now the world's greatest exporter of semiconductors.

The economic transformation has accompanied, and probably encouraged, a strong sense of community that has greatly reduced the ethnic animosities that once made Malaysia a tense battle zone of competing racial groups.



Fanfare and a massive flag inspire a royal salute from Malaysia's king at the National Day parade in Sabah. The annual event marks the country's independence, won in 1957. Yet almost 90 years of British rule left its mark: Malaysia is a parliamentary democracy with a largely ceremonial monarch. Its 13 states are led by appointed or hereditary rulers, the latter rotating the kingship among themselves.

The government even runs TV commercials—in prime time no less—showing smiling members of every Malaysian ethnic group singing a peppy anthem about togetherness: "All together, Mah-lay-see-ah, you can be a star!" To a jaded American viewer these relentlessly upbeat spots have a Mickey Mouse quality, and yet the message seems to get across.

"More than ever in my life we are feeling Malaysian now," a man told me as we drove past pristine beaches lined with casuarina trees along the coast of the South China Sea in the southern state of Johor. This man, Venugopal Dharan, wore a turban and hummed along to the sitar music playing in his dashboard cassette player. He would have seemed perfectly at home in Calcutta or Delhi, but he is in fact a native of Johor and an official in the local economic development office. "When I was in school here, we felt we were Indians," Mr. Dharan went on. "Always we were Indians, who

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T. R. REID, a correspondent for the *Washington Post*, was the paper's bureau chief in Tokyo from 1990 to 1995. Photographer STUART FRANKLIN lives in Oxford, England, a place he covered for the November 1995 issue.

happened to be living in a country with a lot of Malays and Chinese. But my children! Always they are saying, 'We are Malaysians.' "

The concept of "feeling Malaysian" is something new in the long history of this land. Blessed with a strategic location and a treasure trove of natural resources, "Melayu" was long viewed as a choice acquisition for colonial powers. For six centuries before independence, the lands that make up modern Malaysia—the southern tip of the Malay Peninsula, where the isthmus swells up like a sore thumb, plus the northern third of the island of Borneo—were controlled, in whole or in part, by outsiders: the Prince of Palembang, the kings of Siam, the Portuguese, the Dutch, the Brooke family (the famous White Rajas of Sarawak, in northern Borneo), the British, the Japanese, and the British again.

Malaysians now argue that their country has enjoyed greater economic prosperity and social harmony in the four decades of independence than in all the previous centuries of colonial rule. These achievements have created an enormous sense of national pride—pride that literally soars to the heavens.

To mark their political independence, Malaysians fly their national flag atop the world's tallest flagpole, a 300-foot monster that just happened to be placed on the cricket field of the old British colonial club in downtown Kuala Lumpur. To mark their economic emergence, they have built the world's tallest building—a matched pair of them in fact: the Petronas Twin Towers, headquarters of the national oil company. It was front-page news in Malaysia when these behemoths (they appear stark and menacing, like missiles ready to fire) were formally certified by the United States-based Council on Tall Buildings and Urban Habitat as the world's highest skyscrapers. At 1,483 feet apiece, Kuala Lumpur's towers

surpass Chicago's Sears Tower by all of 29 feet.

Malaysians are looking for other forms of recognition as well. A sports federation, for instance, is seeking Olympic acceptance of the Malay game *sepak takraw*. Played on the dusty playgrounds of many a *kampong*, or village, the sport is like volleyball, with one restriction—you can't touch the ball with your hands. Players serve, return, and even smash 60-mile-an-hour spikes using head and feet. In the most amazing move, a player flies into a half-twisting back flip and spikes the ball with a foot while suspended upside down in midair.

All these manifestations of Malaysian pride reflect a broader regional phenomenon of crucial geopolitical importance: the firm belief among East Asian leaders that the balance of global power and influence is shifting in their direction. Malaysia is just one of several East Asian countries today that boast higher growth rates, lower crime rates, lower drug use, and greater family stability than the Western democracies. The result, here and elsewhere, is a level of confidence that sometimes approaches disdain for the West.

One of the chief spokesmen for this new Asian viewpoint is Malaysia's Prime Minister Datuk Seri Mahathir bin Mohamad, a former physician known to headline writers here as "Dr. M." Chief executive in this democratic nation since 1981, he is a master planner and tactician but hardly a diplomat. "The Eurocentric world is finished," Dr. M. declares bluntly. "Asians have now found the formula."

"What we're seeing in Malaysia is the expression of a growing trend across Asia," observes John Malott, a veteran Asia-watcher who is currently the United States ambassador to Malaysia. "It's a phenomenon that I call 'Asian Pride.' The sense is, 'We're doing pretty well for ourselves, and we don't need America to play "father knows best" anymore.' "

IT'S ONE THING TO HEAR prime ministers or ambassadors talk about pride, progress, and prosperity. It's another to come up against these abstractions face-to-face in the person of an old friend. That's what happened to me when I boarded the pink "Bas Mini" in downtown Kuala Lumpur for the 10-mile, 24-cent ride through narrow streets swarming with motorcycles to the northern suburb of Kepong Bahru. I was heading to meet my dear friend Tan Gee Chin.

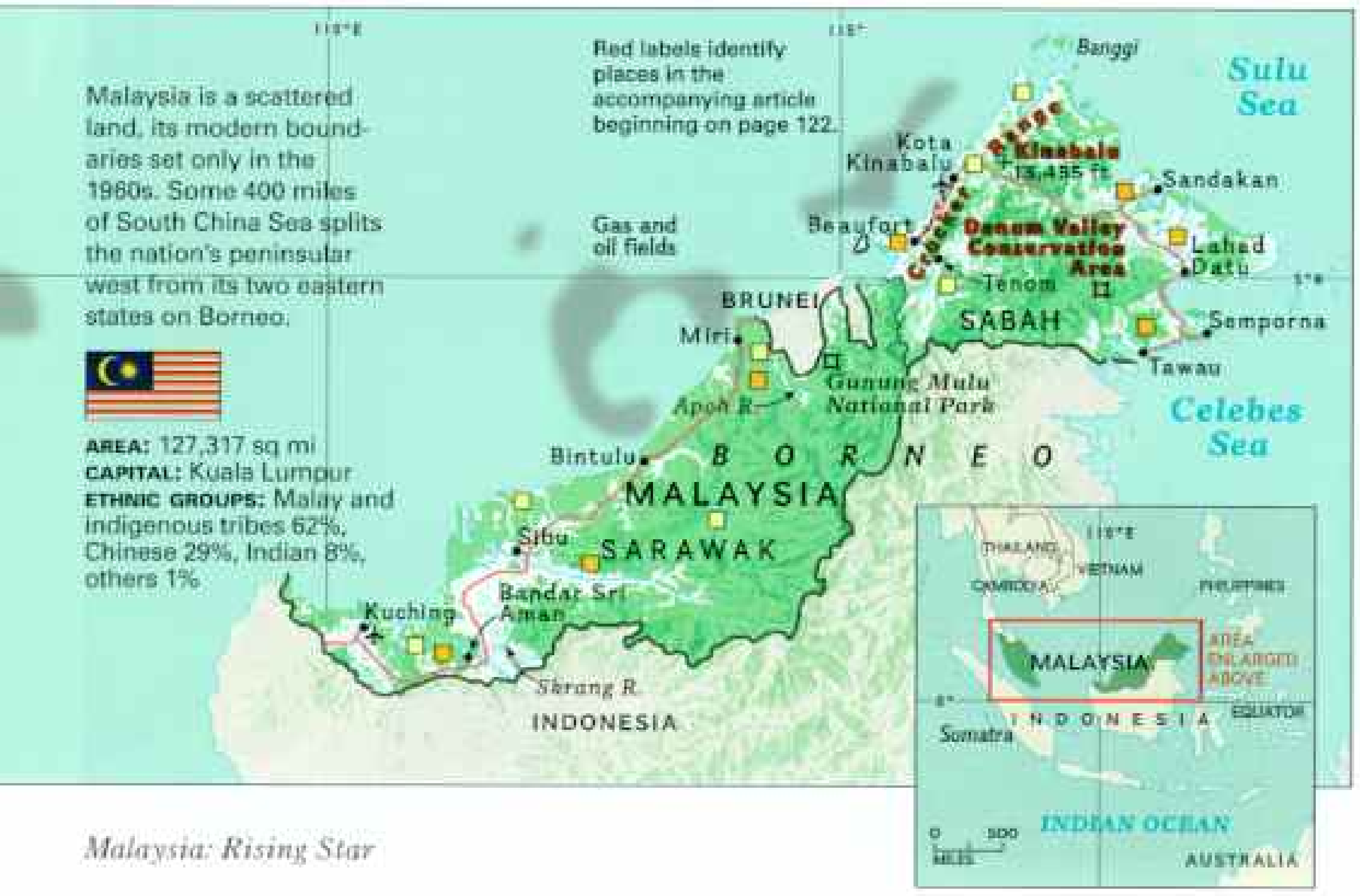
Born just before Malaysia became independent, Miss Tan has grown up and prospered with the nation. Like most Chinese-descended Malaysians, she has adopted an English name—"everybody calling me Jenny," she says. Like many Malaysians, she speaks several languages: Mandarin, Cantonese, Malaysian, Japanese, and English.

Jenny was born in Ipoh, a tin-mining town, in a plywood shack with a rusty roof. "We have very leaking, that roof," she recalled. "Every night lots wet, lots raining on my bed. But have to not complaining, because everybody else living same like that."

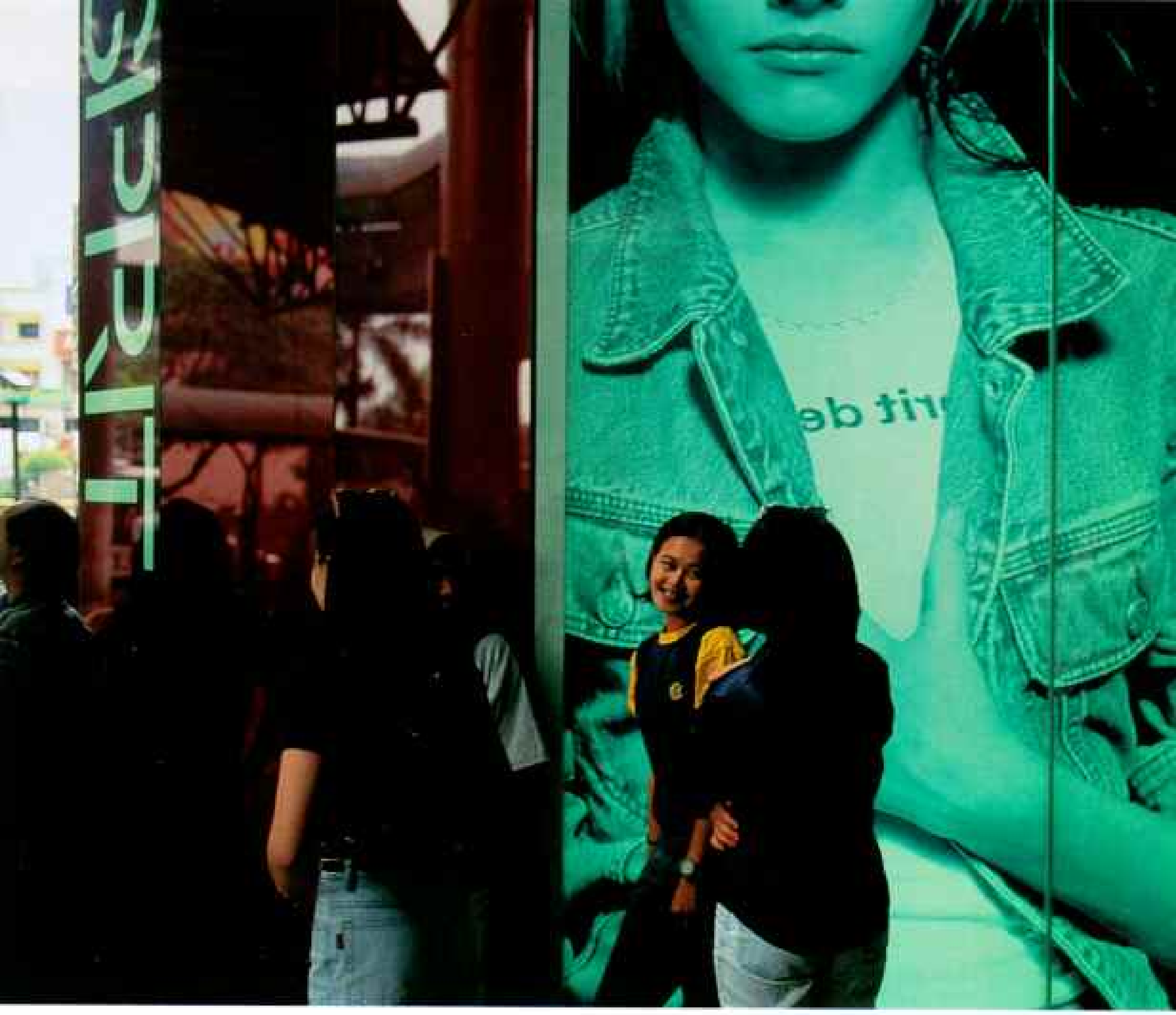
The Tans could afford only one high school tuition, and a Chinese family saved this benefit for a son. So Jenny set out at age 14 to find a job—a search that took her as far as the U.S. and then to Japan, where I met her years ago. Her brother, Tan Jee Pong, eventually became a partner in an air-conditioner shop, serving the elite few who could afford the luxury of staying cool in a tropical country.

In today's prosperous Malaysia, where air-conditioning is commonplace, the Tan family has surpassed its dreams. Jenny, who came back home when her mother wrote her that "anybody can get a job here now," has invested part of her earnings in an apartment building. With the rest, she and her brother purchased

The crowded streets of Kuala Lumpur reflect Malaysia's mixed palette—a blend of Malay Muslims, Chinese Buddhists, Indian Hindus, and indigenous tribes. In 1969 economic and political disparities among these varied ethnic groups led to violent riots. Today Malaysia's 21 million people live in harmony, bolstered by government aid to the underclass—and by growing national pride.



Malaysia: Rising Star



Western style has made inroads among the youth of Kuala Lumpur (left), but other Western ways have not: Malaysia's crime and drug-use rates are lower than the United States'. So is its jobless rate, thanks in part to foreign firms such as Matsushita Television, which opened this plant in Kuala Selangor (below left) because of the "suitable" work ethic, says director James Alfred.

the house I went to visit out in Kepong Bahru.

The new home, a white stucco town house with red tile roof, stands on a long street of identical homes in a neighborhood of identical streets. I left my shoes on the front porch, in standard Malaysian style, and stepped in to find a cool and comfortable dwelling. Jenny has one bedroom, her mother another, and her brother, his wife, and their two children use the third. In the living room Jenny's four-year-old niece was romping around shouting an English phrase she had learned from TV: "You, shut ahp!" The house has a fully equipped kitchen, several statues and altars honoring Buddha—and a roof that does not leak, even in the monsoon. It is such a far cry from the shack in Ipoh that I could barely get any of the Tans to remember what their life used to be in earlier, leaner years. "We have not much thinking about those days," Jenny told me. "Have to thinking about now, everything getting better."

Everything getting better? The economic statistics, at least, would seem to bear her out. Just 20 years ago Malaysia had a sizable unemployment problem; young workers lined up for hot, dusty jobs on rubber and oil-palm plantations. Today any Malaysian who wants to work can, and illegal aliens are flooding in from the Philippines and Indonesia to take those plantation jobs—jobs that most Malaysian workers wouldn't even consider now. Long a magnet for foreign investment, Malaysia is pouring its own money into other developing economies like Cambodia and Vietnam. This year Malaysia is expected to reach a milestone: a per capita income equivalent to $5,000 a year. This may not seem huge to Western readers, but $5,000 goes a lot further in Malaysia than in other places.

I DISCOVERED THAT when Tan Gee Chin and I visited the noisy, smelly, and colorful open-air market in Kota Baharu, way up north near the border with Thailand. The merchants were nearly all women. Wearing full-length batik sarongs of bright red, orange, pink, and purple, with coordinated scarves of emerald green or royal blue around their heads, they sat beside huge piles of fruit and vegetables, truckloads of fish and chicken, mountains of rice, and tall wicker baskets filled with eggs—turtle eggs, stork eggs, even chicken eggs.

In this sea of plenty I saw a triangular pinkish fruit I had never come across before. (It was, I learned, the *jambu*, a delicacy that has the texture of a green pepper and a flavor something like a peach.) I held up one finger and said to the merchant, "Let me try one." "One," the woman answered, holding up one finger in reply. I thought we had an agreement: She would sell me one jambu for one Malaysian ringgit, about 40 cents in American money. But I was way off. In return for my one ringgit, the woman handed me a bag containing 2 kilograms—4.4 pounds—of jambu.

Filled with pride at my bargaining skill, I ran off to show Tan Gee Chin how much fruit I had bought for just 40 cents. Jenny was not impressed. "Mis'r Reid, you crazy?" she said. "You pay a whole ringgit for just two kilo?"

Bargains like that may not be around much longer in a supercharged economy that is ripe, the economists say, for inflation. But the

Forest becomes farm in Sarawak as local people plant hill rice in ash-enriched soil. Indigenous peoples cut and burn such patches as they practice subsistence farming, allowing the land to regenerate through gradual rotation of rice, cassava, and fruit crops. Far more invasive are

plantations of oil palm (Malaysia's chief crop) and the nearly 150 logging companies licensed to fell Sarawak's rain forest for timber. Half of Sarawak—a state nearly the size of England—is zoned for selective logging, threatening ancient ways of life dependent on the forest's natural resources.

Bundling her harvest, Siti Zaenab prepares rambutan fruit to be biked to market in Alor Setar near the Thai border. Says the mother of eight, "We sell enough for the things we need." Farther south, fruit from one of Malaysia's largest oil-palm plantations rolls to mill over a light railway.

back-and-forth of the business cycle is hardly the most serious issue posed by the nation's economic transformation. Proud as they are of their new prosperity, Malaysians know that their economic leap ahead may threaten the delicate balance that keeps the diverse population functioning as a harmonious community.

MALAYSIA'S POPULATION is one of the most varied in East Asia. More than half are Malay; almost all Muslims, they speak Bahasa Malaysia, the national language. Add to their number the Bidayuh, Iban, and other indigenous tribes living mainly in northern Borneo. These tribes have their own languages and religions, although many are now Muslim or Christian. Together, Malays and indigenous groups—62 percent of the population—are known as Bumiputra, or sons of the soil.

Then there are the newcomers, originally brought in by the British to work in the tin mines and rubber plantations. The Chinese, representing 29 percent of all Malaysians, are mainly Buddhists. The Indians, who generally speak Tamil and English, make up 8 percent of the population; they practice Hindu or other religions from the subcontinent.

British colonial rulers, using the principle of divide and conquer, fostered rivalries among the races. Many immigrants from China worked themselves up from coolies to capitalists. By the time of independence the Chinese were the financial magnates of Malaysia. Many Indians were successful at small business and the professions. The Malays were poorer on the whole but held controlling political power because of their numbers.

These disparities spawned resentment on all sides, and in 1969 the animosities burst into open rioting that shocked the nation. The constitution and parliament were suspended for nearly two years. It was a time of hatred and terror that nobody in Malaysia wants to live through again.

Making the best of a bad situation, a Kayan woman bathes her baby in floodwaters from Sarawak's Apoh River. As loggers cut the surrounding forest, rainfall speeds faster off the land, causing frequent floods.

The forest still yields sustenance for a Penan woman's family in Sarawak's Gunung Mulu National Park. There they can hunt wild pig and gather edible plants—a vestige of nomadic ways altered by logging.

A quarter century later Malaysia is just as diverse, but it is a civil society—a place where tolerance has largely replaced racial tumult. How did it happen? "Partly, it's that everybody was frightened by the riots," says Patrick Mayerchak, a political scientist and author specializing in East Asia. "It's also a function of the economic boom, because life got better for everyone. The New Economic Policy was another key piece."

The New Economic Policy (NEP) is an affirmative action plan. Designed by the government in the 1970s to help the Bumiputra gain economic equality, it set rigid quotas. It limited Chinese and Indian access to universities, public jobs, and public money to make way for the "sons of the soil." Banks and investment firms were created to finance Malay and tribal businesses and give them a bigger piece of the action. By and large it worked. Bumiputra involvement in business and finance grew explosively under the plan.

The stringent quotas of the NEP have been relaxed in recent years, but special assistance for Bumiputras is still a fact of life. I met some Chinese, but not many, who are bitter about these preference programs. In fact the most articulate and heartfelt defense of affirmative action I heard came from a Chinese politician—Tan Sri Koh Tsu Koon, the slender, friendly chief minister (in effect, governor) of the state of Pinang.

"Look, the NEP was not perfect," he said in the easy, Americanized English he learned in the 1960s as an undergraduate at Princeton. "I've been quite critical of some specific cases when Chinese people got blatantly unfair treatment. But the situation we had at the end of the sixties, where the distribution of wealth was so skewed—it couldn't last. It made for an inherently unstable society. Because of the NEP, there is less racial resentment now, and more a feeling of Us—you know, Us Malaysians."

The "Us Malaysians" attitude is easy to observe when the Chinese New Year overlaps with Hari Raya, the great Muslim holiday marking the end of Ramadan. In neighboring Indonesia the Chinese New Year can only be marked with private gatherings in a home, so that celebrators don't get in the way of the Muslim majority there. But in Malaysia virtually every market, park, and restaurant bears a big sign marking both holidays, and the TV networks host joint celebrations with Chinese toasting Malays, and vice versa.

THE MALAYSIAN PEOPLE may prove less successful, though, in maintaining a balance between their traditional culture and the rush toward modernity.

I felt this acutely when I ventured to the state of Sarawak on Borneo to spend some time with the Iban, the largest of the indigenous tribes living in the ancient rain forests there. Roads are unpredictable on Borneo, and rivers remain major routes of transit. To get to Iban country, I took a long journey in a pencil-thin boat up the Skrang River. For hours the world was reduced to three ribbons of color—the caramel brown river, the deep green forest to each side, and the strip of blue sky visible between the treetops over my head. Finally we rounded a sharp curve and came upon an

Spindly legs keep makeshift houses—and the day's harvest of seaweed—high, dry, and clear of the rising tide off the coast of Semporna in eastern Sabah. Many Filipinos and Malays who traditionally fish for a living have erected hundreds of these homes in the Celebes Sea. From them they run

their cottage industry, growing seaweed on monofilament lines strung over shallow coral reefs and selling it for use in canned pet food. It's a life on tenuous footing: The Philippines still occasionally claims rights to Sabah, and the sea occasionally claims these homes during seasonal monsoons.

enormous wooden structure—it stretched for 50 yards or so—propped up on rickety eight-foot-high stilts above the riverbank.

This was a longhouse, the communal home that has been the center of life for the Iban for centuries. This one was essentially a long apartment house with a big open deck facing the river, a wide enclosed porch behind that, and then some two dozen individual *bilik*, or apartments, leading off from the porch. A crowd of Iban who were washing dishes, clothes, and babies in the river greeted me with friendly waves and warm smiles. I too broke out in a smile, partly because of this reception and partly because I had noticed that this tribe once notorious for headhunting had posted a "No Smoking, Please" sign on the entrance to their longhouse.

A rough ladder hewed from a single log led me up to the bilik of Ali anak Duman (Ali, son of Duman), a 32-year-old farmer who grows rice, pepper, and cacao. With Ali's children, parents, and siblings, ten people live in the bilik, sleeping on the straw-mat floor in one of the two rooms and eating on the floor around the open cooking fire in the other. To make extra cash, Ali sometimes takes in paying visitors like me. I happened to arrive on one of the few weekends when his four daughters had come home from the boarding school they attend upriver.

After dining on a scrumptious plantain-and-papaya stew—you eat with your hands, using a ball of moist rice as an implement—we stepped out onto that long porch, or *ruai*, the center of tribal social life. As the twilight shadows lengthened, the residents of the longhouse just hung out there, weaving rattan baskets, repairing fish nets, chatting with neighbors, rocking babies in cotton cradles suspended from roof beams. The Iban have spent their evenings this way for centuries; the feeling of shared tradition was overwhelming.

And then I noticed something missing.

Except for the infants, all those sharing tradition that night were adults. Where were the children? I searched, and I found: At the far end of the ruai, a gas-powered Honda generator was hooked up to a small TV set. About three dozen kids were watching the Malaysian music industry awards. They erupted in cheers when the coveted Best New Group award went to a Malay quartet called Shade, which turned out to be highly reminiscent of the Platters, right down to the chorus of "doobey-doobey-doo."

The kids told me that the longhouse is OK, but they prefer living in the dorm at school with its electric lights, flush toilets, and TV sets. "When I grow up, I want to be a nurse or a doctor in a city like Kuching," Ali's 14-year-old daughter, Olivia, told me. "I'm not coming back to live here."

Huddled masses of floating homes bloat the shores of Sabah. Such communities house thousands of Malaysians and illegal immigrants from the Philippines and elsewhere. The government fears that the slums may breed crime and hamper the growth of tourism.

At a mall in the state of Sarawak (below right), young men peruse the latest tapes. Many new shops here vie for buyers from Malaysia's growing middle class.

MY CONFIDENCE in the future of Iban tradition was further weakened when I traveled down a narrow tributary of the Skrang to another wooden longhouse. A festival was to be held there, I was told, with song and dance. I was given a seat of honor on the ruai and a cup of potent rice wine, or *tuak*. To a backdrop of drums and gongs, several dozen people demonstrated a dance that brought to mind not headhunters

but hula girls. Some wore colorful sarongs and silver necklaces; others danced in cutoffs and T-shirts bearing ads for Coca-Cola or Yamaha. Some seemed to enjoy the dance, but several made it appear to be an unpleasant chore.

As the only outsider present I began to get the uneasy feeling that the whole shebang had been staged for my benefit. I scrambled over to Empading, the *tuai rumah*, or chief of the longhouse, to apologize for making the tribe go to such trouble. His reply was not particularly soothing. "Don't worry," he said. "It's all part of the tour package."

THE OUTLOOK IS BRIGHTER, I think, for the preservation of the nation's marvelous natural setting. Balancing the environment and the economy is not always easy, but Malaysia has been relatively lucky in the way development occurred. The initial thrust was mainly agricultural—first rubber, and then vast plantations of oil palm, a tree with mahogany-red fruit that produces an oil valuable in food and soap (hence Palmolive). Since the 1960s thousands of square miles of virgin forest have been burned to make way for oil palm.

The Malaysian Nature Society argues that this is a loss to the environment. No plantation can be as vigorous or as varied as a tropical rain forest, with as many as a thousand different plant species per acre. Still, if there must be economic development, a plantation is less intrusive than, say, an aluminum smelter or a shopping mall encircled by parking lots.

Industrial and office parks are springing up near many Malaysian cities, and here and there stretches of green are giving way to suburban sprawl—like the new town where my friend Jenny lives, Kepong Bahru. But even today fully half of Malaysia is natural forest cover, and it is, overall, a lovely tropical land.

Sodden shoes don't dampen spirits as girls navigate monsoon waters outside their boarding school in Alor Setar. "It's frightening," says Nor Hasnize Shoeb, third from left. "There can be small fish and snakes in the water." But Nor and her friends achieved their goal, a day of downtown shopping. Likewise Malaysia—determined to achieve developed nation status—now leads the way as a model for the rest of Southeast Asia.

I found the local environmental community fairly calm about the present and optimistic about the future.

"Since I came to Borneo in 1979, there has been something of a deterioration of forested land but not on a gross scale," said Junaidi Payne, an author and naturalist who runs the Sabah office of the World Wide Fund for Nature. "One senses that the government is in control here, and the law generally works in Malaysia."

Scholarly, soft-spoken, and eminently polite, Dr. Payne showed just a flash of impatience when I asked him about fears in the West that logging companies are "raping the rain forest." "But that's not how it works," he shot back. "You don't clear-cut for logs in a tropical forest because there are no large stands of single species. The chances of wiping out any species are very low.

"The rather hopeful factor is the growth of tourism," he went on. "That creates economic incentives to preserve virgin forest so people will come to see it. One expects this to be an important activity here, and that would help maintain a natural state of balance."

A NATURAL STATE OF BALANCE—that's what Malaysia needs to cope with the various instabilities flowing from its sudden encounter with prosperity. And most Malaysians seem confident that their young nation will be able to cope. The social and economic successes of the past two decades have created a buoyant national mood.

That sunny outlook was on display one spring night when I attended a wedding reception in Kuala Lumpur—a huge affair, with some 600 guests spread over four banquet rooms on three floors of a glitzy new Chinese restaurant. The groom, Mah Swee Kien, is a customs clerk in a factory that mass produces furniture for export; his bride, Yap Cheng Hwa, is a hostess in a karaoke club. It seemed an apt metaphor for the new Malaysia because neither job even existed there when they were born.

About midway through the banquet the groom's brother, Mah ("just call me Mervyn") Swee Wee, asked all the guests to put away their cellular phones and be silent. It was time for the bride and groom to take the floor for their first—no, not the first dance, but rather for their first karaoke duet as man and wife. After the happy couple cooed a love ballad, guests by the dozen trooped to the microphone to sing their favorites. (Truth-in-journalism requires the disclosure here that my knockout rendition of "Smoke Gets in Your Eyes" drew an ovation from the appreciative crowd.)

As other crooners continued wailing behind us, I sat down with bride and groom and best man to discuss the future—of Malaysia, and of this newly formed Malaysian family. "My brother, he's going to produce the first new babies of 21st century in Malaysia," best man Mervyn pronounced enthusiastically. "The next generation will be much better off than we are! Lots of opportunity! Successful!"

And then, perhaps inspired by the musical din in the background, the best man started singing to me—singing the ditty from that nightly government TV ad: "All together, Mah-lay-see-ah, you can be a star!" □

Morning shines pearly light on mist blanketing a rain forest in Sabah. This lush wilderness—worlds apart from the logging sites and oil-palm plantations cut into once pristine woodlands—has changed little in more than a million years.

MALAYSIA'S SECRET REALM

ARTICLE AND PHOTOGRAPHS BY
MATTIAS KLUM

Each leaf a drama unfolding

BRONCHOCELA CRISTATELLA

Wearing a frayed collar of skin it is shedding, a common agamid lizard stands statue still to catch a meal on the wing—a dragonfly, perhaps, or a leafhopper. Behind it a creek runs muddy after a rain. For much of the nine months we spend in the Danum Valley (map, pages 106-107), my crew and I have only one another for company as we wait for the myriad forms of life to reveal their secrets.

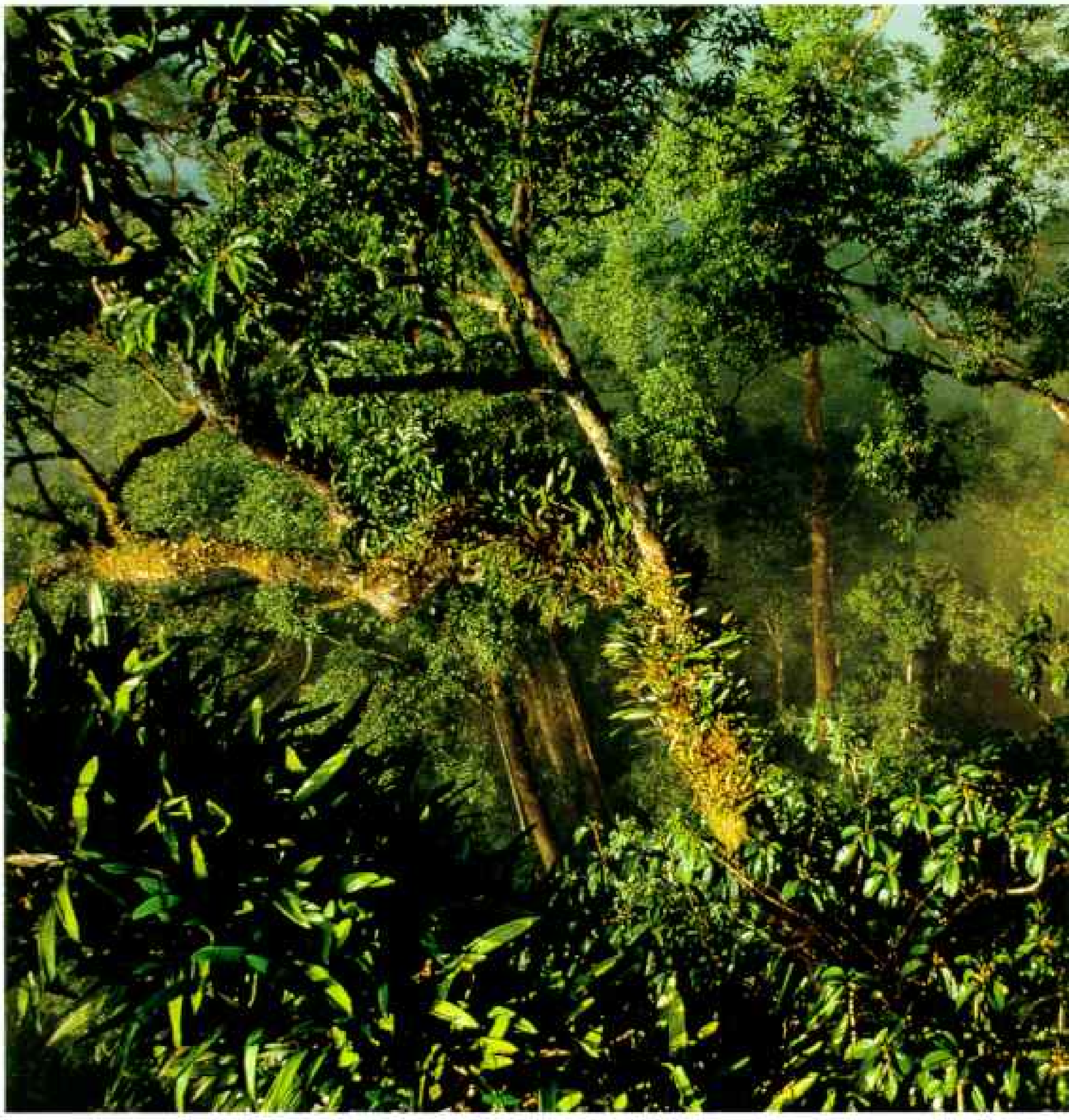
Swedish photographer MATTIAS KLUM *specializes in natural history. Images from his 1995-96 stay in Malaysia will appear in his fifth book, soon to be published internationally.*

Fragile refuge on a crowded earth

Two hundred feet off the ground, luxuriant treetops laced with epiphytes create a canopy of infinite shades of green. The air below, heavy with humidity, makes us feel as if we are camped in a confining hothouse rather than a conservation area of some 100,000 acres.

Alighting on a liana at eye level, a black-naped monarch flycatcher feeds its chick. One hard rain could sweep these creatures away, just as one crucial change in the forest's complex web of existence could wipe out their habitat in this part of southern Asia.

On a trip to Mount Kinabalu, I spot a Low's pitcher plant. Found only on the island of Borneo, its survival is even more uncertain.



HYPOTHYMIS AZUREA

NEPENTHES LOWII

A deadly monarch moves in mystery

Elusive by nature, a king cobra some 15 feet long surprises my assistant, Ola, and me as we wait in a creek-side blind to photograph wild boars. When it glides behind stones nearby, Ola turns pale. "Where is it?" he whispers. "Close," I say. Knowing this largest of venomous snakes will not attack us unless provoked, I wait calmly. The cobra reappears, I shoot two frames, and it's gone.

OPHIOPHAGUS HANNAH

The reign of nature's age-old rhythms

GONOCEPHALUS LIOGASTER

After weeks of rain, precious light penetrates the trees at sunset, burnishing a silvered leaf monkey that seems to enjoy the moment as much as we do. A lookout for its group, it scans for food such as leaf shoots and fruits, as well as for predators.

In this realm of eat and be eaten, a darting comb-crested angle-headed agamid lizard dines on a katydid.

HETEROPODA SP.

PRESBYTIS CRISTATA (FACING PAGE); RAFFLESIA PRICEI

A huntsman spider carries its egg cocoon to protect it. A rare Rafflesia, *flowering a foot wide in the Crocker Range, smells faintly rotten, attracting carrion flies for pollination.*

Every day we see a parade of plants and animals, many not yet even named. Such irreplaceable riches are surely worth saving as Malaysia's development speeds ahead. □

National Geographic, August 1997

Everything Will Be Better In This Century.

(Camry drivers take special note.)

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*Maintenance needs vary with different uses and driving conditions. See Owner's Manual for details. **Mid-size car class as defined by U.S. EPA Interior Volume Index.
†MSRP including dealer prep and destination charge. Tax, license and optional equipment additional. MSRP slightly higher in CA, WA, OR and ID. Competitive MSRPs as reported Feb. 1997.

Introducing The All-New Century By Buick.

Taurus and Accord drivers, you might want to take note too. Because this Century is vastly different from the last — redesigned from top to bottom, bumper to bumper and every place in between. Its 3100 V6 can go 100,000 miles* without a tune-up. And it's filled with so many luxurious touches like remote keyless entry, dual zone climate control and an air filtration system that removes most allergy-causing pollens. Hey, the new Century is so bright, it even turns its own lights on and off.

	Buick Century Custom	Camry LE V6	Taurus GL V6	Accord LX V6
EPA Interior Room (cu ft)	118.5	111.0	110.8	107.2
Dual Zone Climate Control	Incl.	N/A	N/A	N/A
Remote Keyless Entry	Std.	Opt.	Opt.	Opt.
Air Filtration	Std.	N/A	Incl.	N/A
Price	$19,388	$22,580	$19,825	$22,695

Everything Will Be More Comfortable In This Century.

More spacious too.** Century has more room than Camry, Accord, Taurus and just about every other mid-size car you can think of (we're told there's a Rolls-Royce that's roomier). It genuinely seats six people comfortably.

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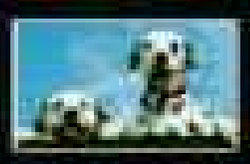

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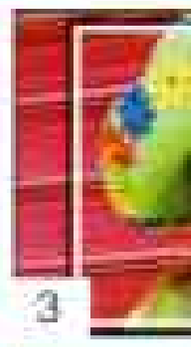
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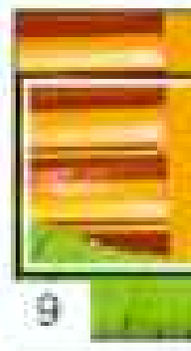
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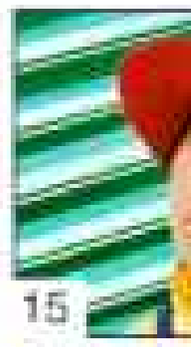
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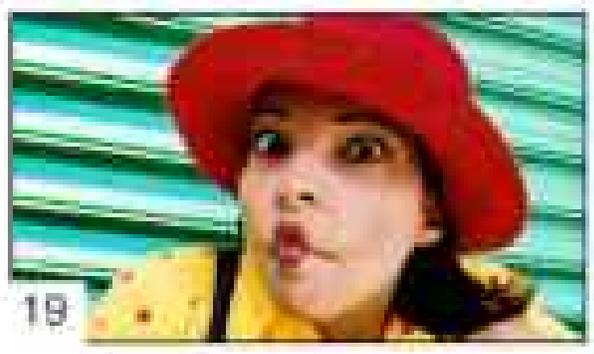
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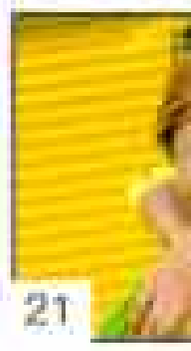
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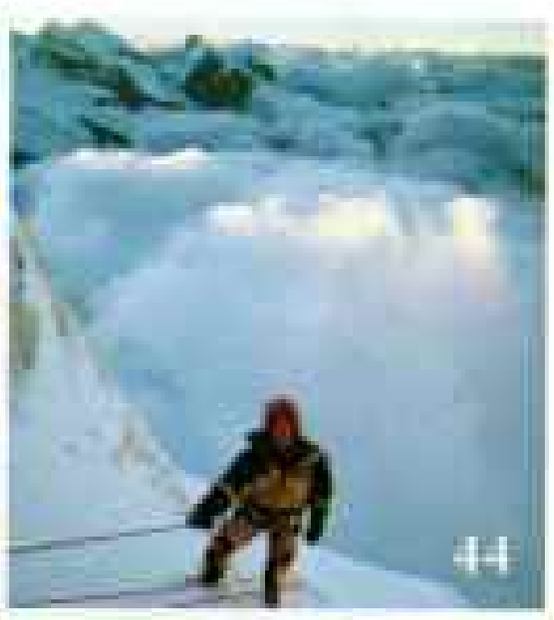

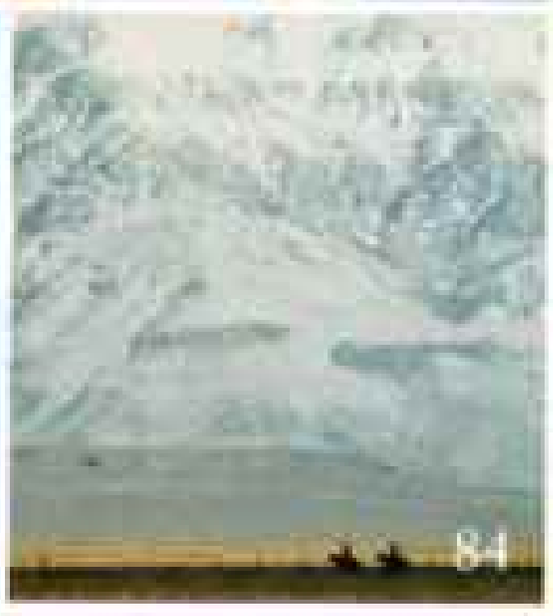

The Cover

Sunlight flashing through dense foliage in Sabah, Malaysia, burnishes a silvered leaf monkey—one of more than 200 mammals that live in this luxuriant rain forest. Photograph by Mattias Klum

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Behind the Scenes

Here's to the Green, Brown, and Blue

"We both wanted an emblem that could be instantly recognized," wrote our first full-time Editor, Gilbert H. Grosvenor, of the Society's flag. His wife, Elsie Bell Grosvenor, designed the prototype for an expedition in 1903. The colors symbolize the earth, sea, and sky. "When the flag spreads out from the flagpole by a breeze, the name of the Society appears very clear," wrote the Editor. "No one has to enquire, 'What flag is that?' "

But they may ask where it's been: deep under the sea, to the moon, flying at the North Pole, and in Antarctica when Adm. Richard E. Byrd (right) visited the Little America camp in 1956. Our staffer Barry Bishop (above) showed the colors in 1963 as part of the first American team atop Mount Everest.

ANDREW H. BROWN

ROBIN BEGEL, NGS (TOP); LUTHER G. JERSTAD

Our old flags don't just fade away. Ragged banners, like the one flown at the Pueblo Bonito site in New Mexico in the 1920s (top), are stored in our archives. And newer ones? We still send them out—to fly over the next adventure.

We're Pushing the Envelope

"It bugged me to trash magazines that libraries and schools didn't want," writes member Carol Ginthner of Las Vegas, Nevada. Her solution? Clever folding and a swipe of glue made a page from our March 1997 article on moths into the envelope for the letter she sent us. What do you do with old GEOGRAPHICS? Have any storage ideas or know of eager recipients? Write to Behind the Scenes.

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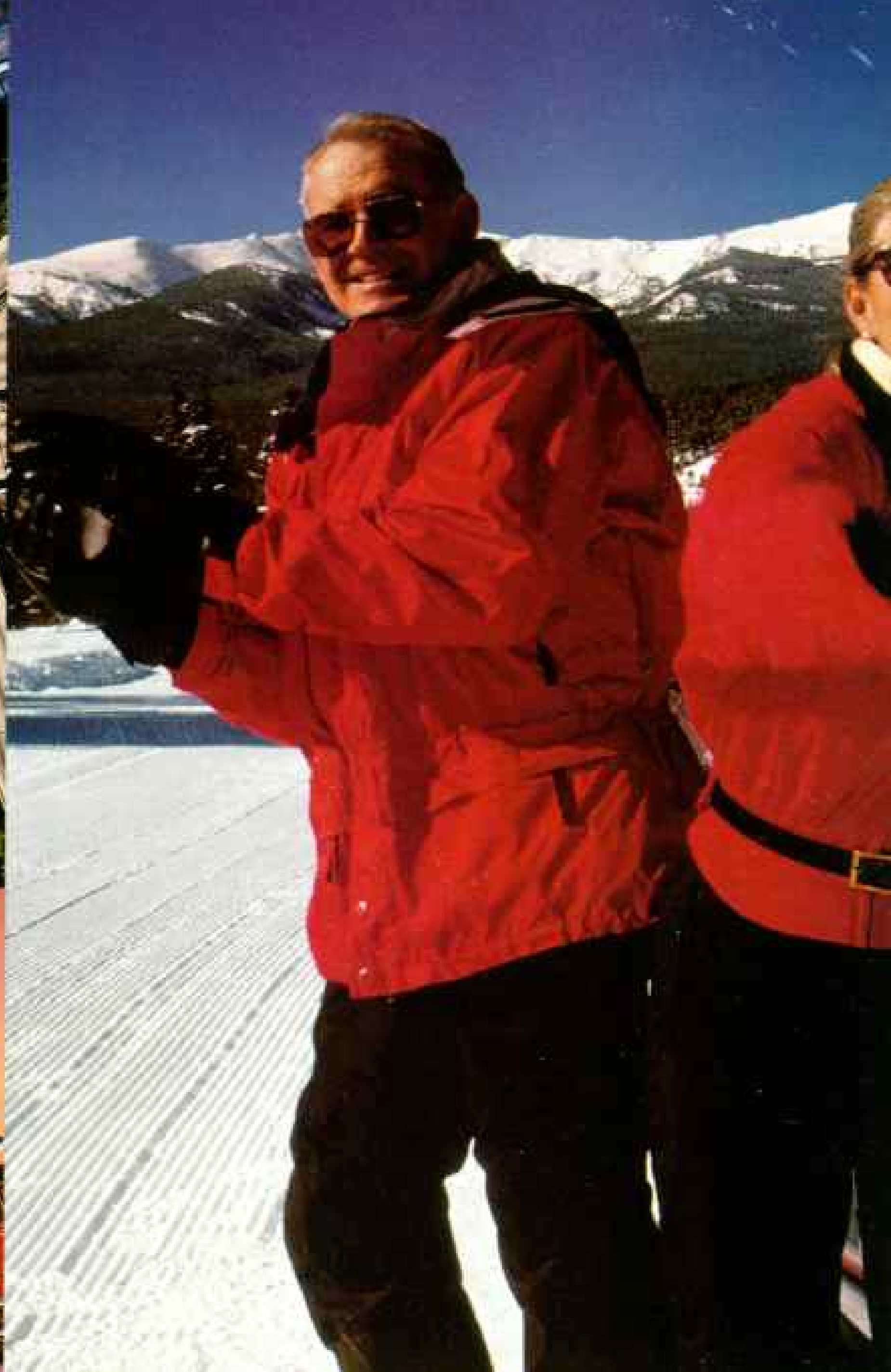
AS DEVOTED
TO YOU
AS YOU ARE
TO IT?

DOES IT KNOW WH



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Visitors To Ms. Gawel's Classroom Find Out Just How Wild It Really Is.

To help awaken them to the plight of the world's rainforests, Julie Gawel's students created one of their own.

Julie, an art teacher at Killough Middle School in Houston, Texas, designed the multi-disciplinary program for her students utilizing reading, writing, science, and art. After researching the rainforest environment, the students practiced drawing its inhabitants; learning about paint, color mixing, and texture in the process. Then they transformed their classroom with wall-size murals and papier-mâché trees filled with a menagerie of plants and wildlife.

Finally, the students invited parents and local business leaders to their rainforest, where the children made presentations and passed along the lessons they learned about conservation.

For teaching her students how to be wild about art – and the world's rainforests – Julie Gawel is our newest Good Neighbor Award winner. State Farm is pleased to contribute $5,000 in her name to Alief Independent School District.

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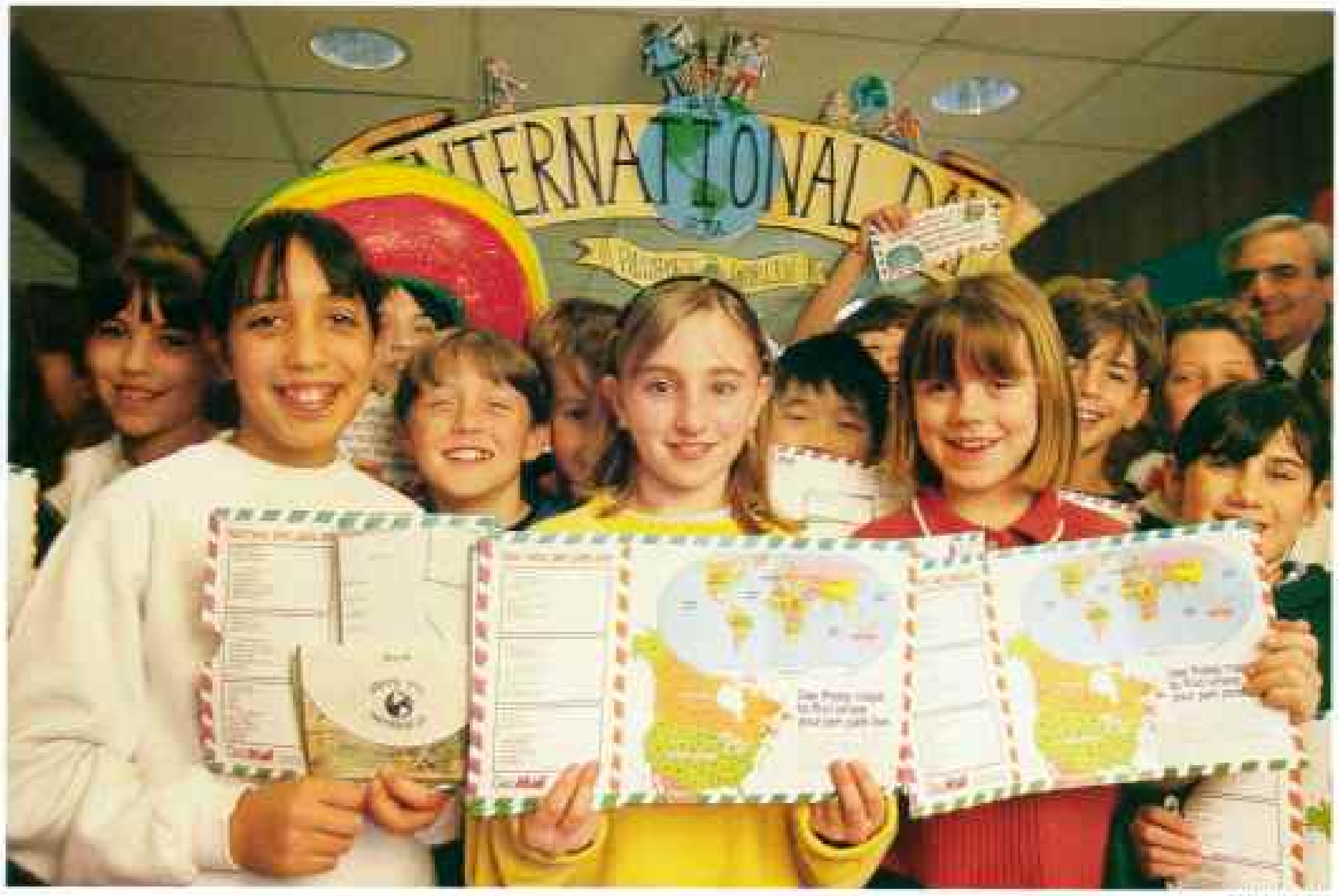

STEVE WINTER

Finding a Letter Way to World Understanding

The Syosset, New York, school district really knows how to make friends. As part of their annual International Day celebration, more than a hundred students at Berry Hill Elementary were matched with pen pals through our WORLD magazine GeoMail Pen Pal program. Each kit includes three children's names and addresses, a locator map, letter-writing tips, and suggestions for decorating mail for new pals—but no pens.

Image Collection

You think you've got a chore storing photos? Our Image Collection has more than ten million images—at right, two of our most popular—to keep track of. A staff of 37 archives our photographs for future use, storing them in climate-controlled rooms to prevent their deterioration.

Olympiad Alert

In Washington, D.C., this month watch out for smart kids! The third International Geography Olympiad will be held August 5 and 6 at Society headquarters. Teams from nine countries, including top students from our own National Geography Bee, will compete for medals.

—MAGGIE ZACKOWITZ

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Forum

In the April 1997 issue our cover story on what the Hubble Space Telescope saw drew raves. But it was "Oil on Ice," which explored the possibility of opening the Arctic National Wildlife Refuge to oil exploration, that drew the most mail.

Oil on Ice

Having just returned from my third trip to Alaska in the past year, I found your feature on the internal struggle between oil and the Arctic environment insightful. Growing up in Vermont, I saw the benefit of strict development regulations in maintaining that state's beauty. I'm amazed that more Alaskans aren't fighting tooth and nail to protect the last truly wild wilderness in this country.

DOUGLAS SOUCY
San Mateo, California

John Mitchell's article is such a capital piece of prose that it makes one want to go "into the country" and simply behold the splendor.

DAN WOLFF
San Francisco, California

As a 19-year Alaska resident who worked in Prudhoe Bay conducting oil-spill training, testing, and cleanups, I noticed something missing. There was no mention of any disastrous damage from the production of Prudhoe Bay and the auxiliary fields. I recall caribou inside the Alyeska Pump Station One fence line and birds nesting among the pipes within 50 feet of Mile Zero. The only way to decide what to do to the east is to determine what has happened to the environment in Prudhoe.

JERRY A. HUBBARD
Wilmer, Alabama

I was surprised at the omission of the well-documented fate of the central Arctic caribou herd in the 20-plus years of oil operations in the midst of their territory. Their numbers have grown significantly.

ARLIE M. SKOV
Santa Barbara, California

There are two boards established to maintain the continuance of the migratory Porcupine caribou herd, an international board and our Canadian board. Most of the herd winters in northern Canada, where we have communities who rely on caribou for their subsistence and culture. Our board is working very hard to get permanent protection for the herd's summer calving grounds along the Alaska coastal plain. Development there would have devastating results.

The map does not point out that the range of the Porcupine herd extends along the entire coastal plain of the Arctic National Wildlife Refuge [ANWR] west to the Canning River. The debate over development in the refuge has gone on for many years with no resolution in sight. Oil can be replaced; the caribou cannot.

JOE TETLICHI, CHAIRMAN
Porcupine Caribou Management Board
Whitehorse, Yukon Territory

No amount of dollars is worth ruining one of the few pristine ecosystems left on earth.

JUDITH RAY
Lyons, Colorado

Your characterization of oil money as Alaska's dominant economic factor leaves the reader with an incomplete view of our state economy, whose health is also due to the significant growth of tourism. The author must not have visited Fairbanks during the summer months, when those "superfluous super roads" are jammed with visitors in their recreational vehicles.

GARY L. ROEDER
Anchorage, Alaska

As a chemist in Alaska, I have supervised the restoration of hundreds of petroleum-contaminated sites, including the North Slope and pipeline corridor, over the past ten years. The question really is not will the oil in ANWR or the National Petroleum Reserve be developed but when. Environmentally concerned parties should concentrate on environmentally sound development to satisfy all concerns including the caribou, whales, waterfowl, indigenous people, and the possibility of global warming. This short list may become a list of errors should these areas be developed in response to an oil crisis.

CARL S. OVERPECK
Environmental Systems, Inc.
Fairbanks, Alaska

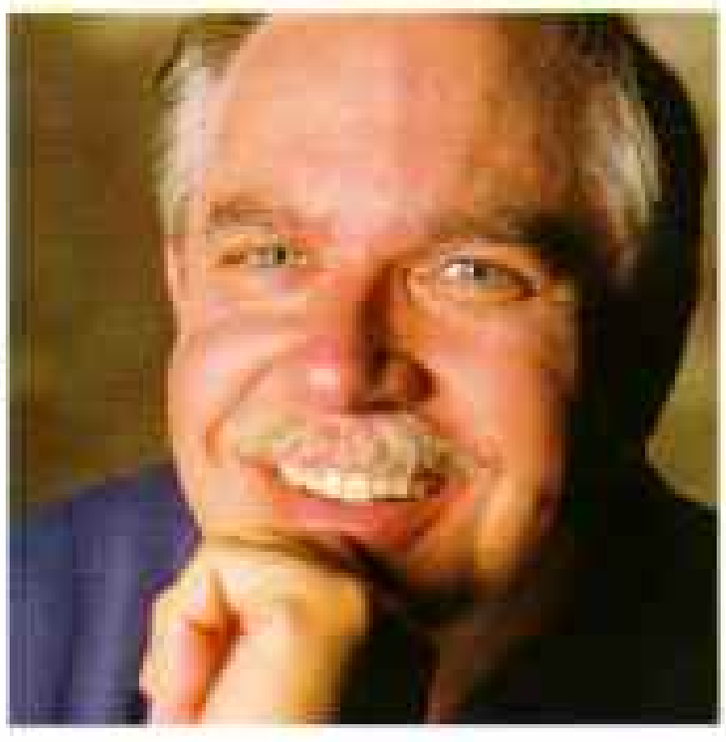
It's later than you think. The U.S. is the world's number one oil user, importing more than half its needs. Various authorities foresee a global oil-supply crisis when world demand exceeds supply forever. It would help planners to know how much, if any, oil exists in the ANWR. Don't forget the deep Mukluk well drilled off Prudhoe Bay in the mid-1980s. It was North America's hottest prospect and probably the most expensive well ever drilled for oil. But it was a dry hole. How might U.S. economic, social, and military plans change if ANWR turns out to be dry?

L. F. IVANHOE
Ojai, California

The article suggests that I, as governor, wanted to use surplus state funds to build a billion-dollar water pipeline to serve California. That is not so. Our offer to California was that if the state wanted to buy our water, it could build a pipeline to take it. An underwater pipeline is environmentally benign, and the idea, while perhaps fantastic, is not one to brush off so lightly. Alaska's fresh water, like its oil, gas, and natural beauty, is a resource the world can

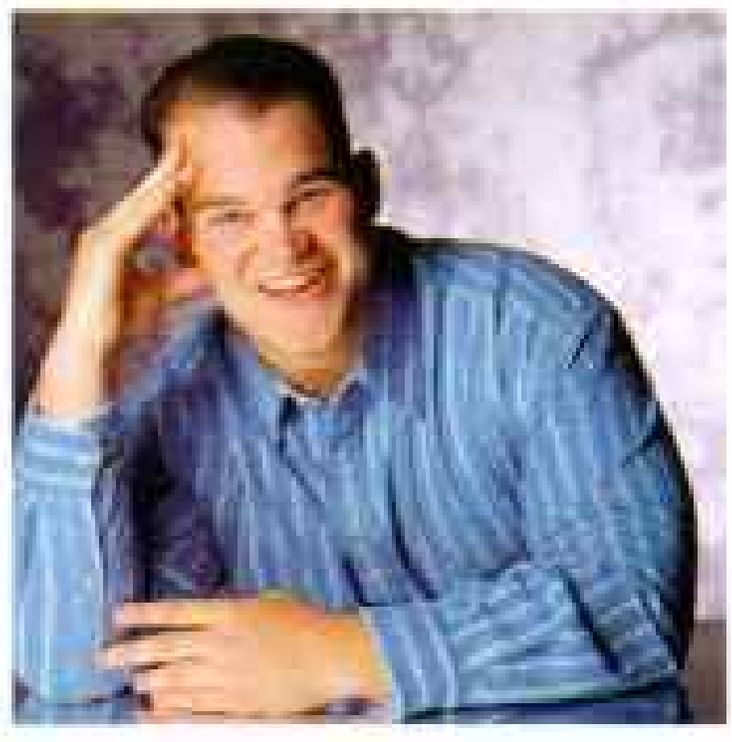
"It's important to believe my family's safe."

Wesley Howard
Loyal Ford Owner



"It feels safe. It gives me peace of mind."

Jay Seifer
Former Import Owner



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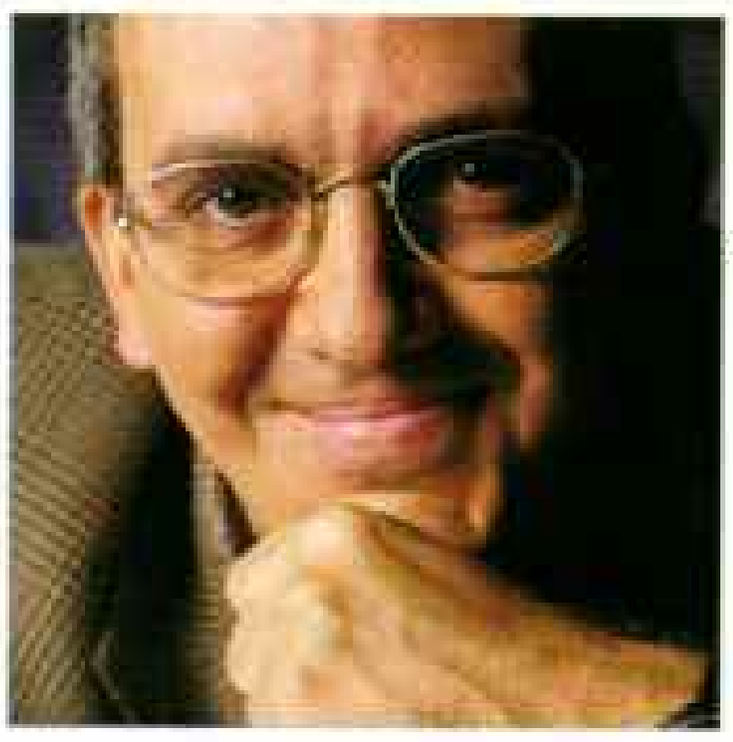

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Dennis Bryant
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WALTER J. HICKEL
Anchorage, Alaska

The Hubble Telescope

Thank you for the outstanding images from the Hubble Space Telescope. After so much trouble, it is nice to see the instrument perform as it was intended. The images from the darkest regions of space underscore how incredibly young and infinitely small we are and how truly dynamic the universe is. It embarrasses me, when I contemplate my overwhelming daily life, that we will never truly comprehend the scale of events that happen in the universe. We understand precious little about the true nature of our existence.

DIRK E. PETERSON
University of Florida Medical Center
Jacksonville, Florida

The colors intrigued me. Were they natural as in a vacation photograph or computer-processed representations?

TEEMU KORHONEN
Parma, Finland

Generally the colors are what you would see from a spaceship in the area. Looking at an object, Hubble records three digital images, each through a different color filter. When combined, these make a naturalistic color picture.

These glimpses of the cosmos evoke exciting and profoundly fundamental questions: Why is the universe the way it is? Is there a beginning or end? Why are we here? Surely such mysteries have tickled the human intellect since the dawn of our awareness. It is unfortunate that many people consider the exploration of space irrelevant and wasteful of money and effort. The pursuit of knowledge elevates all humankind. To abandon that pursuit betrays our potential to live in harmony with earth, universe, and ourselves.

ALFRED A. BERNASCONI
Gainesville, Florida

Author William R. Newcott wrote that the primary mirror was misshapen. It is interesting to know the reason. The main mirror was ground from a million-dollar blank. A device with two small mirrors and a lens was built to make sure the mirror was ground correctly. It was hung above the main mirror, and a laser was shone through the small lens onto the main mirror. The reflection by the main mirror created a pattern of light whose shape would tell that the mirror was ground exactly. But the lens was set in the wrong position by a mere 1.3 millimeters, and the technicians ground off more glass than they should have. The main mirror became two micrometers—approximately one-fiftieth the width of a human hair—too flat at the edges.

VOLKER BAUMENER
Hilchenbach, Germany

The problem with Hubble's primary mirror could have been known before launch. NASA didn't thoroughly analyze the data, and so it was surprised. Engineers at Ball Aerospace crafted the COSTAR optics that saved Hubble—and NASA's reputation.

ROGER HARTMAN
Albuquerque, New Mexico

What will happen to the telescope at the end of its useful life? It and other objects such as the Mir space station could be parked in a high orbit of no economic or scientific utility. Eventually there would grow a strange and beautiful museum in space, a memorial to the heroic first age of space exploration.

JAMES WIMBERLEY
Strasbourg, France

That is an imaginative solution. Hubble is funded and should operate through 2005. Plans for its disposition have not been finalized.

Australia's Dog Fence

The article is superb, but how do you explain that four billion dollars (Australian) equals five billion U.S. dollars on page 20 while $20 amounts to $16 U.S. on page 29?

MEIR BELTRAN
Mash'abbe Sade, Israel

The conversion on page 20 is incorrect. An Australian dollar was worth about 80 U.S. cents at press time. The Australian wool export industry yearly generates about three billion U.S. dollars.

I have always heard the dingo described as *Canis familiaris dingo*, a subspecies of the dog. Your article describes it as *Canis lupus dingo*, a subspecies of the wolf. Can you clarify?

PHILIP THEUNISSEN
Rixensart, Belgium

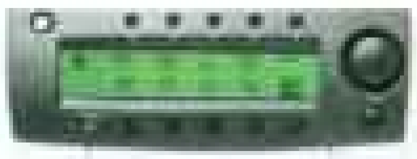
In 1982 the International Commission on Zoological Nomenclature ruled in favor of Canis lupus dingo.

The article states that, unless provoked, a wild dingo has never been known to attack a human. The line should have read "adult human." There have been reports over the years of dingoes attacking children. Australia's most celebrated murder trial hinged on whether Lindy Chamberlain killed her baby or whether a dingo took the child from a tent at a campsite. She was ultimately acquitted.

REBECCA LUPTON
East Kew, Victoria

The article was informative and well illustrated. Dingoes and domestic dogs can interbreed, and dingo populations in southeastern Australia show a proportion of hybrids. The dingo strain is an important component of the Australian cattle dog, the blue heeler, giving it the instinct to creep up silently behind cattle and bite low. Although dingoes do cause large sheep losses at times, they are an integral part of the Australian environment.

IAN WITHNAL
Brisbane, Queensland



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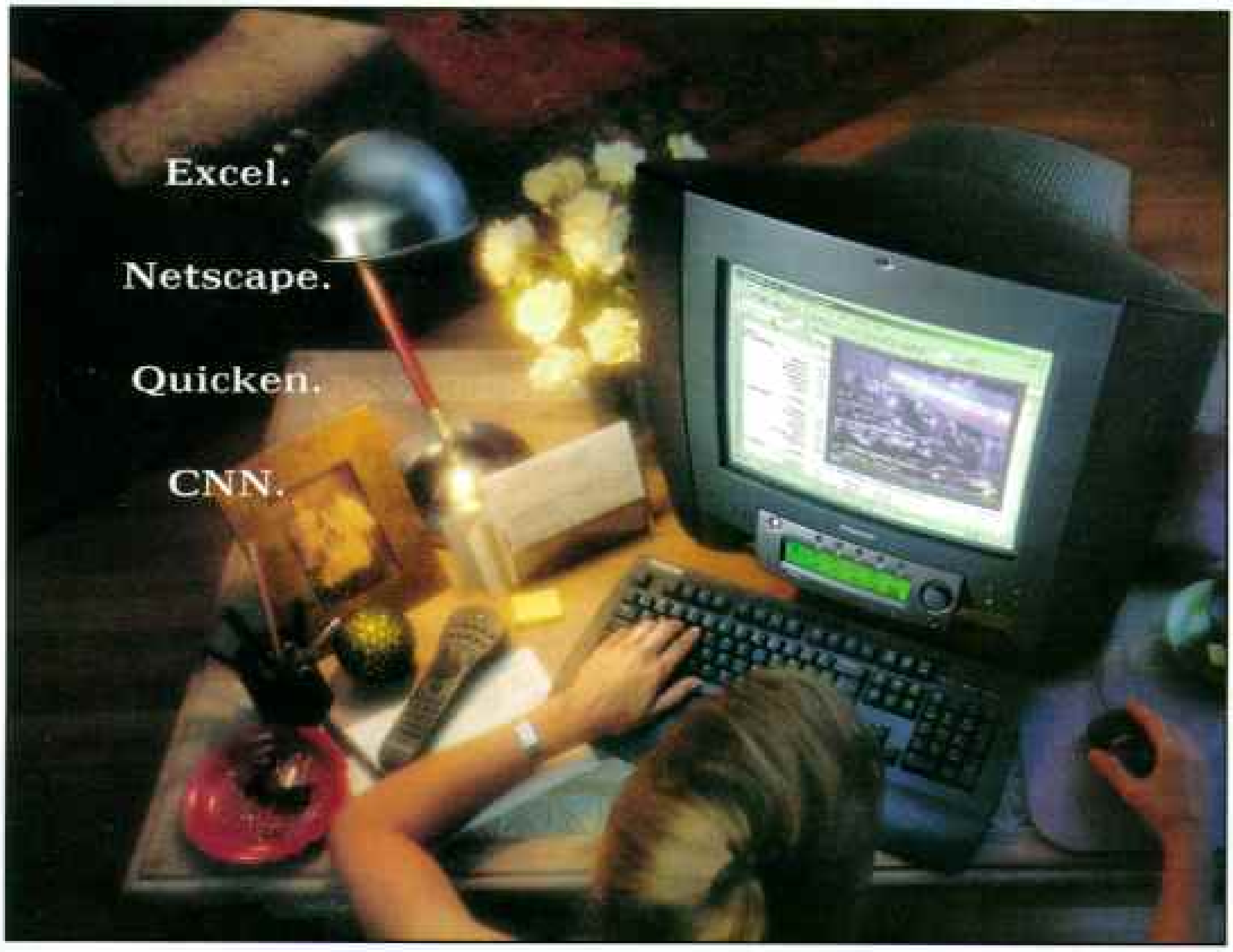

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I am employed as a stock-routes supervisor, and one of my main jobs is poisoning dingo baits with 1080 (sodium fluoroacetate). This is a necessary control measure but will never eliminate dingoes, because the cunning older dogs will not take a bait. I have seen firsthand the damage dingoes cause. Studies show where no control measures are used dingoes can kill 20 percent of the calves born on cattle stations, not to mention sheep losses.

ROBERT CARR
Mitchell, Queensland

The Yellowstone River

My husband and I floated this very special river from north of Gardiner to Big Timber several years ago. We fell in love with it and the beautiful Montana lands it threaded. Your article did not mention the extensive bank erosion from years of cattle grazing, which seems such an insult to the beauty and integrity of this magnificent river. The suggestion to plant a narrow corridor of natural vegetation is an idea worthy of consideration to restore the essence of the Yellowstone.

SANDRA TUNE
Freeport, Illinois

As a resident of Jackson Hole, Wyoming, I lived through the slaughter of a thousand bison last winter. Because of heavy snowfall they strayed out of Yellowstone National Park in search of forage. A park biologist stated that the thinning of the herd was needed since their number exceeded what the park could support. There were 3,000 bison when winter started. How sad that we feel the need to limit the bison population to only a few thousand when they once numbered 50 million in the U.S.

WINDLAND SMITH
Jackson, Wyoming

Legislation is pending in Congress involving the preservation of the region through which the river runs. The Northern Rockies Ecosystem Protection Act was created by some of the world's leading scientists and is the first wilderness legislation based on ecosystems and connecting corridors instead of state and federal boundaries. It would protect 16 million acres of roadless public lands.

NICHOLAS E. TUFF
Middlebury, Vermont

Moscow

David Remnick has given us a remarkably good report on Muscovites' lives. The West has to share some responsibility if Moscow is not doing well today. The West, while preaching democracy, failed to see that shock therapy is never good for any country. The breakup of the Soviet Union and the Eastern bloc clearly points out that when a country suddenly changes direction, the people, especially the poor, suffer.

NG AH CHAI
Johor, Malaysia

I paused at the part about a vivid presence of the mob in everyday life and the corruption of the police. I realized that it is easier to rebuild the grandiose Cathedral of Christ the Savior than provide safe streets for citizens. The sad truth applies to all ex-communist countries where the militia was established to protect the system rather than the citizen. One of the most shocking events of my immigration from Poland to the States was meeting with the friendly policeman. I was too afraid to accept his help on the road; I was convinced he wanted a bribe, and I couldn't even think what for. I was used to paying the police back in my native land. It took me years to accept the reality here.

MAREK URBANEK
Phoenix, Arizona

Geographica

In the article about a new bird discovered atop a Peruvian peak, I found it interesting that although the bird appears to have a limited range (and, therefore, an assumed limited population number), the scientific team started decimating the population under the guise of specimen collecting. Is it really important that the taxonomy of a new species be verified at the expense of even a few members of the population?

W. G. MASONER
Port St. Lucie, Florida

A specimen in hand is the only way that scientists can gain the vital information needed to describe a new species; photographs will not do. And identifying a species is a first step in preserving it. Ornithologist John P. O'Neill tells us the population seemed plentiful in its isolated location.

Behind the Scenes

After the January 1997 report about our craft group and our beautiful butterflies, calls came from all over. We sent the pattern and instructions on how to make it to many. One lady covered a bare tree branch with butterflies at the entrance of her church on Easter to bring attention to a box asking for donations for Ohio River flood victims. Others have taught their handicapped students to make them. Thank you for giving us the joy of sharing our butterflies with the world.

JEANNE VAN CAMP
Thursday Evening Crafters
Philadelphia Protestant Home
Philadelphia, Pennsylvania

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

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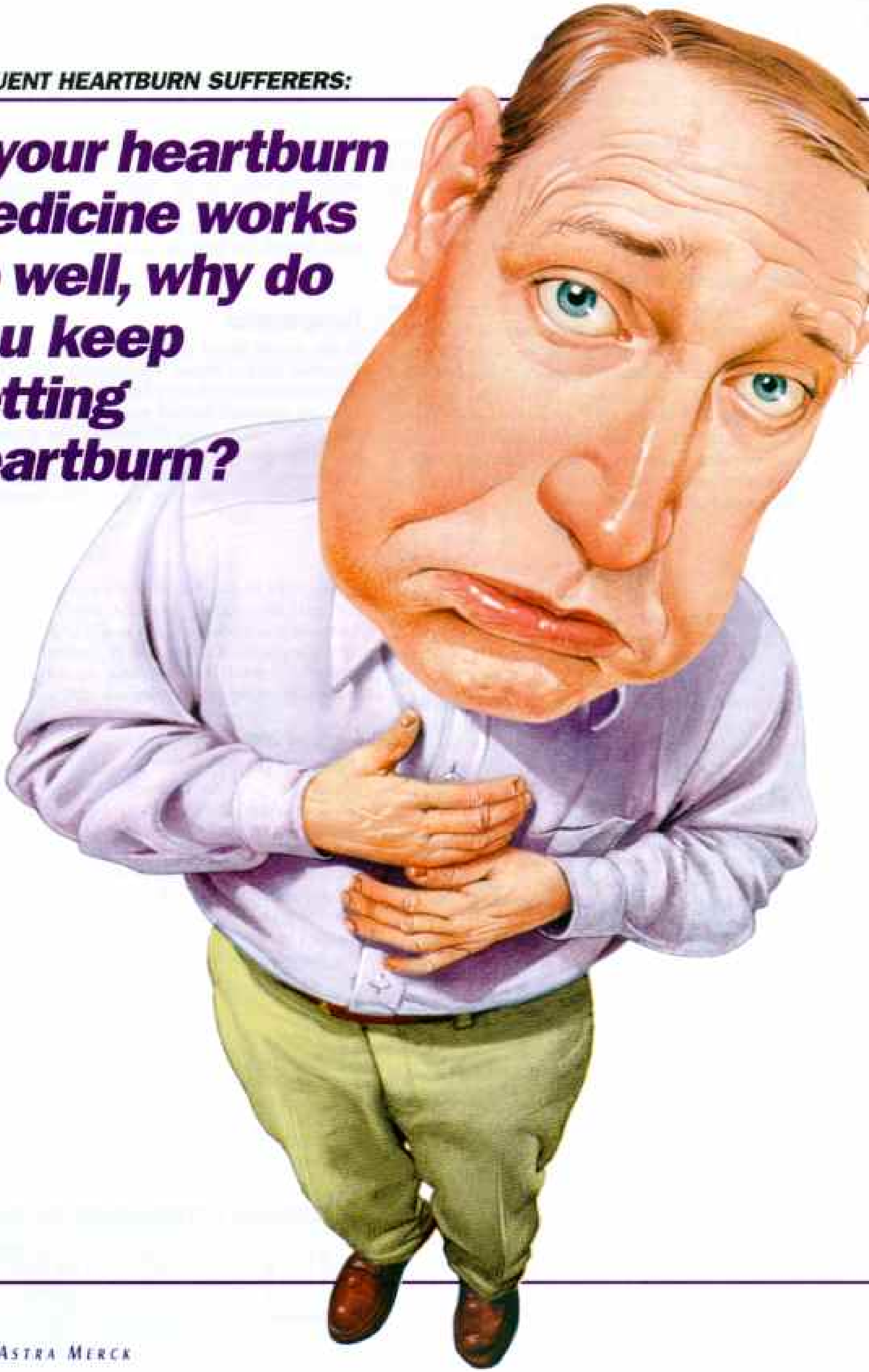
If your heartburn medicine works so well, why do you keep getting heartburn?



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PRILOSEC is generally well tolerated, but it is not for everybody. The most common side effects are headache (6.9%), diarrhea (3.0%), and abdominal pain (2.4%).

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Delayed-Release Capsules

BRIEF SUMMARY

CLINICAL PHARMACOLOGY *Pharmacokinetics and Metabolism: Omeprazole* – In pharmacokinetic studies of single 20 mg omeprazole doses, an increase in AUC of approximately four-fold was noted in Asian subjects compared to Caucasians. Dose adjustment, particularly where maintenance of healing of erosive esophagitis is indicated, for the hepatically impaired and Asian subjects should be considered.

INDICATIONS AND USAGE *Duodenal Ulcer:* PRILOSEC is indicated for short-term treatment of active duodenal ulcer. Most patients heal within 4 weeks. Some patients may require an additional 4 weeks of therapy. PRILOSEC, in combination with clarithromycin, is also indicated for treatment of patients with H. pylori infection and active duodenal ulcer to eradicate H. pylori. Eradication of H. pylori has been shown to reduce the risk of duodenal ulcer recurrence. In patients who fail therapy, susceptibility testing should be done. If resistance to clarithromycin is demonstrated or susceptibility testing is not possible, alternative antimicrobial therapy should be instituted. (See the clarithromycin package insert, MICROBIOLOGY section.) **Gastric Ulcer:** PRILOSEC is indicated for short-term treatment (4-8 weeks) of active benign gastric ulcer. ***Treatment of Gastroesophageal Reflux Disease (GERD): Symptomatic GERD –*** PRILOSEC is indicated for the treatment of heartburn and other symptoms associated with GERD. **Erosive Esophagitis –** PRILOSEC is indicated for the short-term treatment (4-8 weeks) of erosive esophagitis which has been diagnosed by endoscopy. The efficacy of PRILOSEC used for longer than 8 weeks in these patients has not been established. In the rare instance of a patient not responding to 8 weeks of treatment, it may be helpful to give up to an additional 4 weeks of treatment. If there is recurrence of erosive esophagitis or GERD symptoms (e.g. heartburn), additional 4-8 week courses of omeprazole may be considered. ***Maintenance of Healing of Erosive Esophagitis:*** PRILOSEC is indicated to maintain healing of erosive esophagitis. Controlled studies do not extend beyond 12 months. ***Pathological Hypersecretory Conditions:*** PRILOSEC is indicated for the long-term treatment of pathological hypersecretory conditions (e.g., Zollinger-Ellison syndrome, multiple endocrine adenomas and systemic mastocytosis).

CONTRAINDICATIONS Omeprazole: PRILOSEC Delayed-Release Capsules are contraindicated in patients with known hypersensitivity to any component of the formulation. **Clarithromycin:** Clarithromycin is contraindicated in patients with a known hypersensitivity to any macrolide antibiotic. Concomitant administration of clarithromycin with cisapride, pimozide, or terfenadine is contraindicated. There have been post-marketing reports of drug interactions when clarithromycin and/or erythromycin are co-administered with cisapride, pimozide, or terfenadine resulting in cardiac arrhythmias (QT prolongation, ventricular tachycardia, ventricular fibrillation, and torsades de pointes) most likely due to inhibition of hepatic metabolism of these drugs by erythromycin and clarithromycin. Fatalities have been reported. (Please refer to full prescribing information for clarithromycin before prescribing.)

WARNING: Clarithromycin: CLARITHROMYCIN SHOULD NOT BE USED IN PREGNANT WOMEN EXCEPT IN CLINICAL CIRCUMSTANCES WHERE NO ALTERNATIVE THERAPY IS APPROPRIATE. IF PREGNANCY OCCURS WHILE TAKING CLARITHROMYCIN, THE PATIENT SHOULD BE APPRISED OF THE POTENTIAL HAZARD TO THE FETUS. (See WARNINGS in prescribing information for clarithromycin.)

PRECAUTIONS General: Symptomatic response to therapy with omeprazole does not preclude the presence of gastric malignancy. Atrophic gastritis has been noted occasionally in gastric corpus biopsies from patients treated long-term with omeprazole. ***Information for Patients:*** PRILOSEC Delayed-Release Capsules should be taken before eating. Patients should be cautioned that the PRILOSEC Delayed-Release Capsule should not be opened, chewed or crushed, and should be swallowed whole. ***Drug Interactions: Other –*** Omeprazole can prolong the elimination of diazepam, warfarin and phenytoin, drugs that are metabolized by oxidation in the liver. Although in normal subjects no interaction with theophylline or propranolol was found, there have been clinical reports of interaction with other drugs metabolized via the cytochrome P-450 system (e.g., cyclosporine, disulfiram, benzodiazepines). Patients should be monitored to determine if it is necessary to adjust the dosage of these drugs when taken concomitantly with PRILOSEC. Because of its profound and long lasting inhibition of gastric acid secretion, it is theoretically possible that omeprazole may interfere with absorption of drugs where gastric pH is an important determinant of their bioavailability (e.g., ketoconazole, ampicillin esters, and iron salts). In the clinical trials, antacids were used concomitantly with the administration of PRILOSEC. **Combination Therapy with Clarithromycin –** Co-administration of omeprazole and clarithromycin may result in increases in plasma levels of omeprazole, clarithromycin, and 14-hydroxy-clarithromycin. (See CLINICAL PHARMACOLOGY, Pharmacokinetics: Combination Therapy with Clarithromycin in full Prescribing Information.) Concomitant administration of clarithromycin with cisapride, pimozide, or terfenadine is contraindicated. There have been reports of an interaction between erythromycin and astemizole resulting in QT prolongation and torsades de pointes. Concomitant administration of erythromycin and astemizole is contraindicated. Because clarithromycin is also metabolized by cytochrome P450, concomitant administration of clarithromycin with astemizole is not recommended. (See also CONTRAINDICATIONS, Clarithromycin, above. Please refer to full prescribing information for clarithromycin before prescribing.) ***Carcinogenesis, Mutagenesis, Impairment of Fertility:*** In two 24-month carcinogenicity studies in rats, omeprazole at daily doses of 1.7, 3.4, 13.8, 44.0 and 140.8 mg/kg/day (approximately 4 to 352 times the human dose, based on a patient weight of 50 kg and a human dose of 20 mg) produced gastric ECL cell carcinoids in a dose-related manner in both male and female rats; the incidence of this effect was markedly higher in female rats, which had higher blood levels of omeprazole. Gastric carcinoids seldom occur in the untreated rat. In addition, ECL cell hyperplasia was present in all treated groups of both sexes. In one of these studies, female rats were treated with 13.8 mg/kg/day omeprazole (approximately 35 times the human dose) for 1 year, then followed for an additional year without the drug. No carcinoids were seen in these rats. An increased incidence of treatment-related ECL cell hyperplasia was observed at the end of 1 year (94% treated vs 10% controls). By the second year the difference between treated and control rats was much smaller (46% vs 26%) but still showed more hyperplasia in the treated group. An unusual primary malignant tumor in the stomach was seen in one rat (2%). No similar tumor was seen in male or female rats treated for 2 years. For this strain of rat no similar tumor has been noted historically, but a finding involving only one tumor is difficult to interpret. A 78-week mouse carcinogenicity study of omeprazole did not show increased tumor occurrence, but the study was not conclusive. Omeprazole was not mutagenic in an in vitro Ames Salmonella typhimurium assay, an in vitro mouse lymphoma cell assay and an in vivo rat liver DNA damage assay. A mouse micronucleus test at 625 and 6250 times the human dose gave a borderline result, as did an in vivo bone marrow chromosome aberration test. A second mouse micronucleus study at 2000 times the human dose, but with different (suboptimal) sampling times, was negative. **Pregnancy: Omeprazole: Pregnancy Category C –** In rabbits, omeprazole in a dose range of 6.9 to 69.1 mg/kg/day (approximately 17 to 172 times the human dose) produced dose-related increases in embryo-lethality, fetal resorptions and pregnancy disruptions. In rats, dose-related embryo/fetal toxicity and postnatal developmental toxicity were observed in offspring resulting from parents treated with omeprazole 13.8 to 138.0 mg/kg/day (approximately 35 to 345 times the human dose). There are no adequate or well-controlled studies in pregnant women. Sporadic reports have been received of congenital abnormalities occurring in infants born to women who have received omeprazole during pregnancy. Omeprazole should be used during pregnancy only if the potential benefit justifies the potential risk to the fetus. **Clarithromycin: Pregnancy Category C –** See WARNING (above) and full prescribing information for clarithromycin before using in pregnant women. **Nursing Mothers:** It is not known whether omeprazole is excreted in human milk. In rats, omeprazole administration during late gestation and lactation at doses of 13.8 to 138 mg/kg/day (35 to 345 times the human dose) resulted in decreased weight gain in pups. Because many drugs are excreted in human milk, because of the potential for serious adverse reactions in nursing infants from omeprazole, and because of the potential for tumorigenicity shown for omeprazole in rat carcinogenicity studies, a decision should be made whether to discontinue nursing or discontinue the drug, taking into account the importance of the drug to the mother. ***Pediatric Use:*** Safety and effectiveness in children have not been established.

*Registered trademark of Astra AB.

ADVERSE REACTIONS: In the U.S. clinical trial population of 465 patients (including duodenal ulcer, Zollinger-Ellison syndrome and resistant ulcer patients), the following adverse experiences were reported to occur in 1% or more of patients on therapy with PRILOSEC* (omeprazole). Numbers in parentheses indicate percentages of the adverse experiences considered by investigators as possibly, probably, or definitely related to the drug.

	Omeprazole (n=465)	Placebo (n=64)	Ranitidine (n=195)
Headache	6.9 (2.4)	6.3	7.7 (2.6)
Diarrhea	3.0 (1.9)	3.1 (1.6)	2.1 (0.5)
Abdominal Pain	2.4 (0.4)	3.1	2.1
Nausea	2.2 (0.9)	3.1	4.1 (0.5)
URI	1.9	1.6	2.6
Dizziness	1.5 (0.6)	0.0	2.6 (1.0)
Vomiting	1.5 (0.4)	4.7	1.5 (0.5)
Rash	1.5 (1.1)	0.0	0.0
Constipation	1.1 (0.9)	0.0	0.0
Cough	1.1	0.0	1.5
Asthenia	1.1 (0.2)	1.6 (1.6)	1.5 (1.0)
Back Pain	1.1	0.0	0.5

The following adverse reactions which occurred in 1% or more of omeprazole-treated patients have been reported in international double-blind, and open-label, clinical trials in which 2,631 patients and subjects received omeprazole.

Incidence of Adverse Experiences ≥ 1% Causal Relationship not Assessed

		Omeprazole (n=2631)	Placebo (n=120)
Body as a Whole, site unspecified	Abdominal pain	5.2	3.3
	Asthenia	1.3	0.8
Digestive System	Constipation	1.5	0.8
	Diarrhea	3.7	2.5
	Flatulence	2.7	5.8
	Nausea	4.0	6.7
	Vomiting	3.2	10.0
	Acid regurgitation	1.9	3.3
Nervous System/Psychiatric	Headache	2.9	2.5

Additional adverse experiences occurring in <1% of patients or subjects in domestic and/or international trials, or occurring since the drug was marketed, are shown below within each body system. In many instances, the relationship to PRILOSEC was unclear. Body As a Whole: Fever, pain, fatigue, malaise, abdominal swelling. Cardiovascular: Chest pain or angina, tachycardia, bradycardia, palpitation, elevated blood pressure, peripheral edema. Gastrointestinal: Pancreatitis (some fatal), anorexia, irritable colon, flatulence, fecal discoloration, esophageal candidiasis, mucosal atrophy of the tongue, dry mouth. During treatment with omeprazole, gastric fundic gland polyps have been noted rarely. These polyps are benign and appear to be reversible when treatment is discontinued. Gastro-duodenal carcinoids have been reported in patients with ZE syndrome on long-term treatment with PRILOSEC. This finding is believed to be a manifestation of the underlying condition, which is known to be associated with such tumors. Hepatic: Mild and, rarely, marked elevations of liver function tests [ALT (SGPT), AST (SGOT), γ-glutamyl transpeptidase, alkaline phosphatase, and bilirubin (jaundice)]. In rare instances, overt liver disease has occurred, including hepatocellular, cholestatic, or mixed hepatitis, liver necrosis (some fatal), hepatic failure (some fatal), and hepatic encephalopathy. Metabolic/Nutritional: Hyponatremia, hypoglycemia, weight gain. Musculoskeletal: Muscle cramps, myalgia, muscle weakness, joint pain, leg pain. Nervous System/Psychiatric: Psychic disturbances including depression, aggression, hallucinations, confusion, insomnia, nervousness, tremors, apathy, somnolence, anxiety, dream abnormalities; vertigo; paresthesia; hemifacial dysesthesia. Respiratory: Epistaxis, pharyngeal pain. Skin: Rash and, very rarely, cases of severe generalized skin reactions including toxic epidermal necrolysis (TEN; some fatal), Stevens-Johnson syndrome, and erythema multiforme (some severe); skin inflammation, urticaria, angioedema, pruritus, alopecia, dry skin, hyperhidrosis. Special Senses: Tinnitus, taste perversion. Urogenital: Interstitial nephritis (some with positive rechallenge), urinary tract infection, microscopic pyuria, urinary frequency, elevated serum creatinine, proteinuria, hematuria, glycosuria, testicular pain, gynecomastia. Hematologic: Rare instances of pancytopenia, agranulocytosis (some fatal), thrombocytopenia, neutropenia, anemia, leucocytosis, and hemolytic anemia have been reported. **Combination Therapy with Clarithromycin:** In clinical trials using combination therapy with PRILOSEC and clarithromycin, no adverse experiences peculiar to this drug combination have been observed. Adverse experiences that have occurred have been limited to those that have been previously reported with omeprazole or clarithromycin. Adverse experiences observed in controlled clinical trials using combination therapy with PRILOSEC and clarithromycin (n=346) which differed from those previously described for omeprazole alone were: Taste perversion (15%), tongue discoloration (2%), rhinitis (2%), pharyngitis (1%), and flu syndrome (1%). For more information on clarithromycin, refer to the clarithromycin package insert, ADVERSE REACTIONS section.

OVERDOSAGE: Rare reports have been received of overdosage with omeprazole. Doses ranged from 320 mg to 900 mg (16-45 times the usual recommended clinical dose). Manifestations were variable, but included confusion, drowsiness, blurred vision, tachycardia, nausea, diaphoresis, flushing, headache, and dry mouth. Symptoms were transient, and no serious clinical outcome has been reported. No specific antidote for omeprazole overdosage is known. Omeprazole is extensively protein bound and is, therefore, not readily dialyzable. In the event of overdosage, treatment should be symptomatic and supportive.

DOSAGE AND ADMINISTRATION *Duodenal Ulcer:* Short-Term Treatment of Active Duodenal Ulcer: The recommended adult oral dose of PRILOSEC is 20 mg once daily. Most patients heal within 4 weeks. Some patients may require an additional 4 weeks of therapy. (See INDICATIONS AND USAGE.)

Reduction of the Risk of Duodenal Ulcer Recurrence: Combination Therapy with Clarithromycin:

Days 1-14	Days 15-28
PRILOSEC 40 mg q.d. (in the morning) plus clarithromycin 500 mg t.i.d.	PRILOSEC 20 mg q.d.

Please refer to clarithromycin full prescribing information for CONTRAINDICATIONS and WARNING, and for information regarding dosing in elderly and renally impaired patients (PRECAUTIONS: General; PRECAUTIONS: Geriatric Use and PRECAUTIONS: Drug Interactions). ***Gastric Ulcer:*** The recommended adult oral dose is 40 mg once a day for 4 to 8 weeks. (See INDICATIONS AND USAGE, Gastric Ulcer.) ***Gastroesophageal Reflux Disease (GERD):*** The recommended adult oral dose for the treatment of patients with symptomatic GERD and no esophageal lesions is 20 mg daily for up to 4 weeks. The recommended adult oral dose for the treatment of patients with erosive esophagitis and accompanying symptoms due to GERD is 20 mg daily for 4 to 8 weeks. (See INDICATIONS AND USAGE.) ***Maintenance of Healing of Erosive Esophagitis:*** The recommended adult oral dose is 20 mg daily. ***Pathological Hypersecretory Conditions:*** The dosage of PRILOSEC in patients with pathological hypersecretory conditions varies with the individual patient. The recommended adult oral starting dose is 60 mg once a day. Doses should be adjusted to individual patient needs and should continue for as long as clinically indicated. Doses up to 120 mg t.i.d. have been administered. Daily dosages of greater than 80 mg should be administered in divided doses. No dosage adjustment is necessary for patients with renal impairment, hepatic dysfunction or for the elderly.

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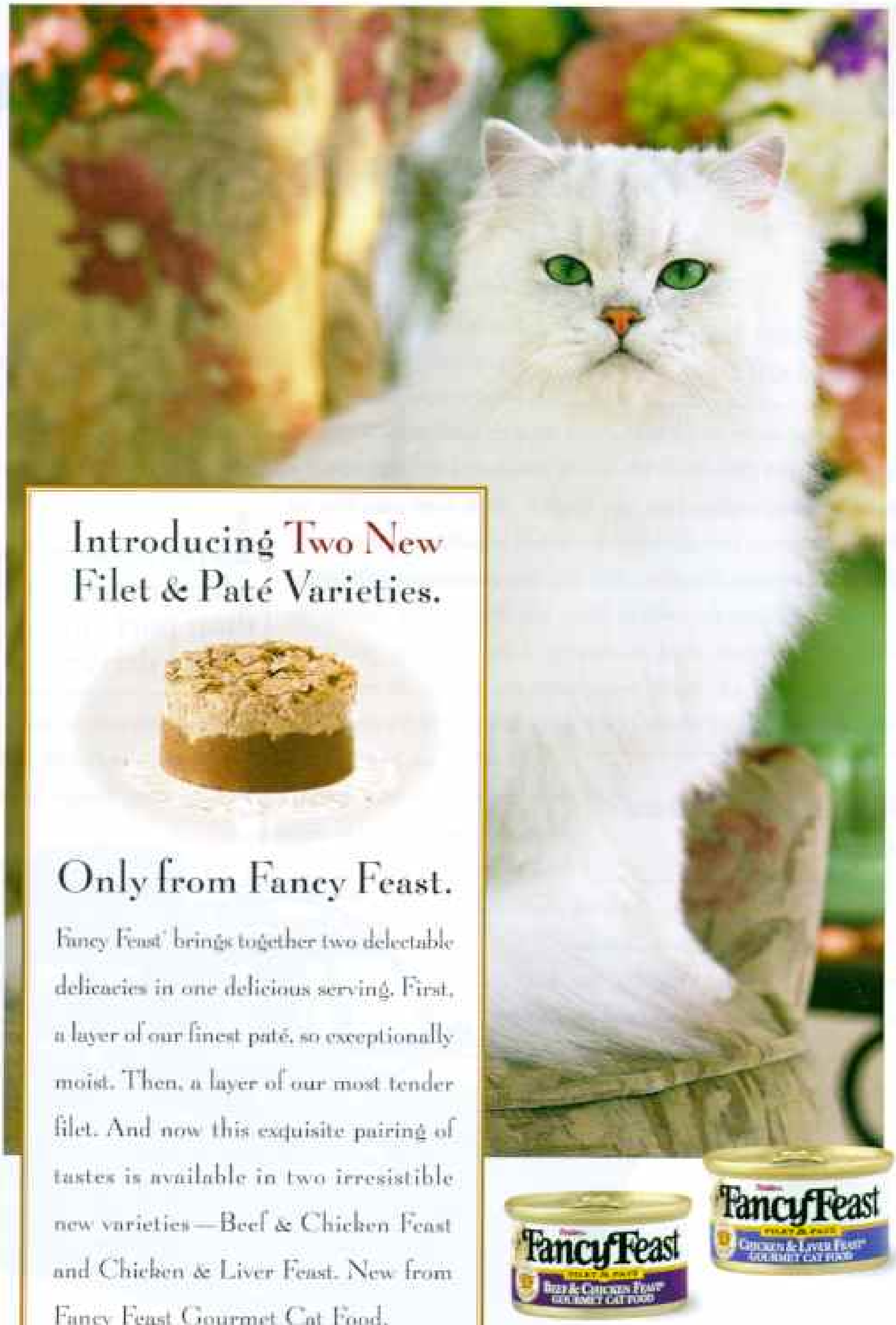
February 1997 PRC-44/2/97 PR104

NOTE: This summary provides important information about PRILOSEC. If you would like more information, ask your doctor or pharmacist to let you read the professional labeling and then discuss it with them.



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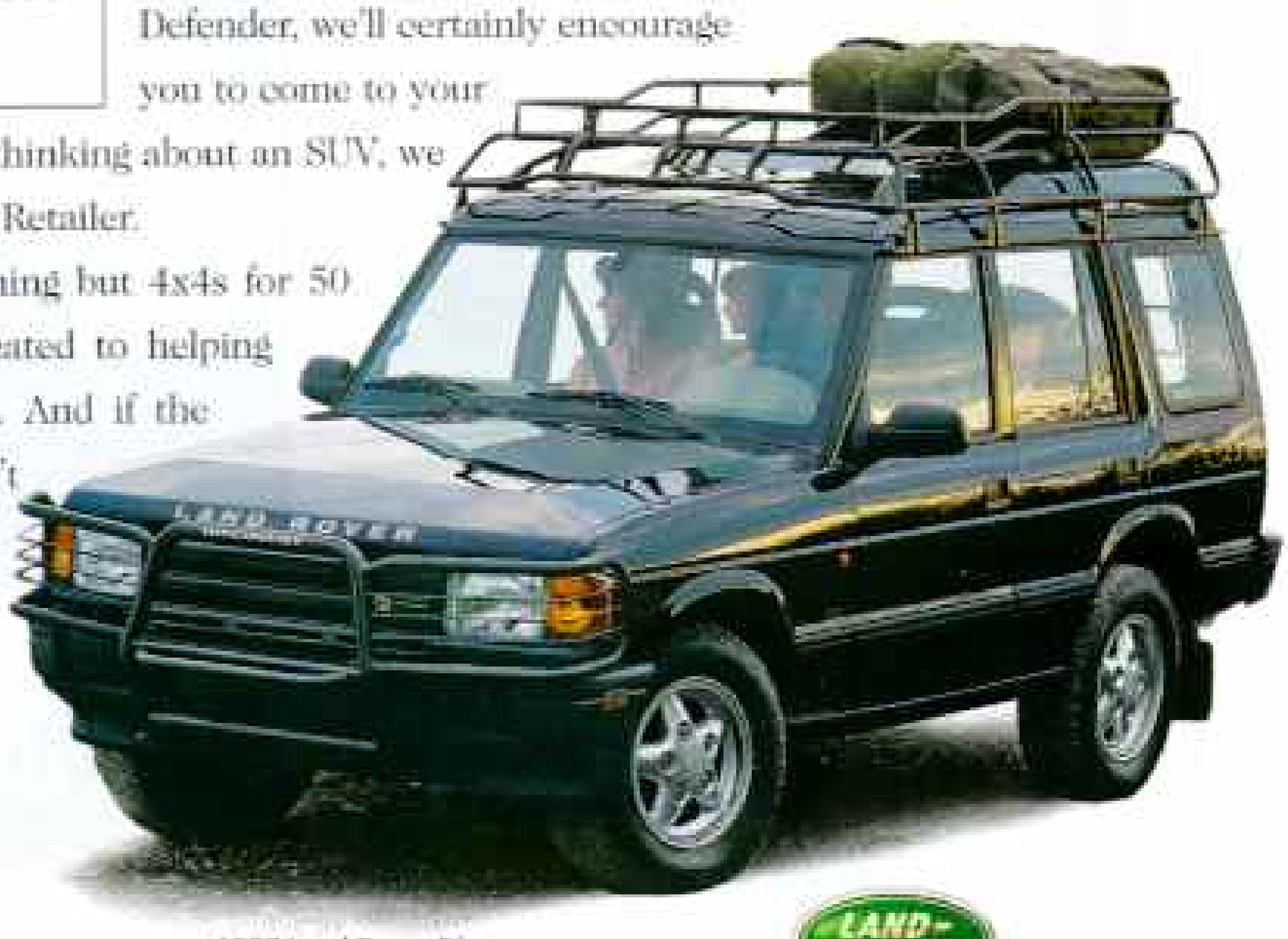

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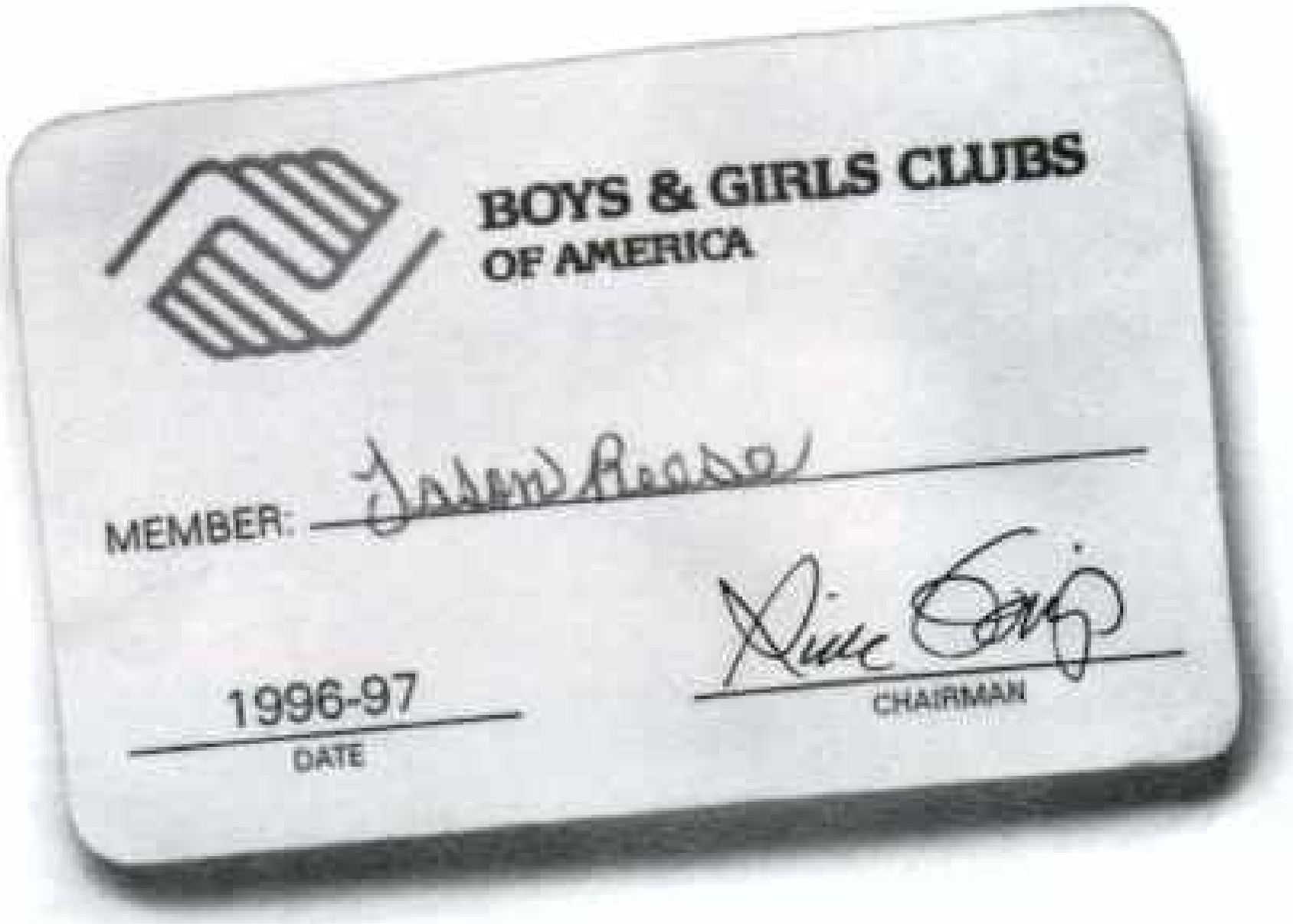

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NATIONAL GEOGRAPHIC

Geographica

WOLFGANG NEEL, STERNBALICK STAR

New Studies Age the Alpine Iceman

Otzi the Iceman was no youth on a lark when he died high in the Alps 5,000 years ago. The man, whose surprisingly intact remains were found in 1991, was practically a senior citizen.

Early estimates placed the Iceman's age at between 25 and 40 (GEOGRAPHIC, June 1993). But CT scans of the body and microscopic examination of a minute piece of bone from his left leg have led scientists to conclude that he was at least 40 years old, and perhaps closer to 50, when he died.

"Bone and the blood vessels within it constantly change throughout life," says Torstein Sjøvold of Stockholm University, who conducted the studies with Othmar Gaber of Austria's University of Innsbruck. "We were able to see those changes and use them to determine age." One clue: Otzi suffered from degenerative arthritis.

Other skeletons suggest that the mean age at death for adults in Otzi's time was about 40. "He may have been an experienced member of his community, but he was probably not the oldest," Sjøvold says.

Splendor Returns to a New York Classic

It took four years to build the magnificent greenhouse opened in 1902 and now known as the Enid A. Haupt Conservatory, centerpiece of the New York Botanical Garden in the Bronx. The cost was $177,000.

It also took four years to rebuild the conservatory's exterior shell and restore the indoor garden to its original glory. Craftsmen replaced 17,000 glass panes by hand before the building reopened last May. The cost: nearly 25 million dollars.

The firm of Lord & Burnham designed the conservatory in Italian Renaissance style, using the Royal Botanic Gardens at Kew's Palm House and Hyde Park's Crystal Palace for inspiration. But the building's grand design needed frequent repair. The heat and moisture required by indoor plants and the vagaries of New York City weather ate away at the structure, which frequently leaked.

The restored 90-foot dome rises over a central palm court that links ten pavilions. They house 3,000 rare and important plant species from a variety of environments around the world.

TOM PATT PHOTOGRAPHY, NEW YORK BOTANICAL GARDEN

Flatback Sea Turtle *(Natator depressus)* **Size:** Carapace length, approx. 90 cm **Weight:** Approx. 80 kg **Habitat:** Shallow continental seas of northern Australia **Surviving number:** Unknown

Photographed by Peter C.H. Pritchard

WILDLIFE AS CANON SEES IT

Unlike most sea turtles, the flatback turtle stays within a small range throughout its life cycle. Rarely venturing beyond the Australian continental shelf, this carnivorous forager feeds on sea cucumbers, soft corals, jellyfish and other inshore inhabitants. Nesting by day or night, the flatback lays its relatively large eggs, usually fewer than 50 in a clutch, on mainland and near-shore island beaches. When going ashore, adults sometimes fall prey to giant crocodiles. These distinctive sea turtles are vulnerable due to their restricted range, and also to incidental capture in prawn trawls. 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.

BILLY E. BARNE

A Natural Cemetery for the Desert

To Americans accustomed to the grass and rolling hills of Arlington National Cemetery these graves may be disconcerting. But the National Memorial Cemetery of Arizona, 15 miles north of downtown Phoenix, is well adapted to its Sonoran Desert setting. "We use Arizona's natural flora," says director Mary Dill of its mesquite, cactus, paloverde, and century plants. "Instead of mowers and weed trimmers, we run rakes over the sand."

The 225-acre facility opened in 1978 as a state veterans cemetery; in 1989 it joined the Department of Veterans Affairs cemetery system, comprising 114 of the 130 national cemeteries for veterans and their family members. By the end of last year 21,669 persons had been interred in the desert cemetery.

Pennsylvania's Amish Keep Rolling Along

In-line skating is not out of line for these Amish girls in Lancaster County, Pennsylvania, who enjoy participating in a modern pastime.

Though it may seem incongruous to outsiders, those who know the Amish well are not surprised by the growing popularity of in-line skates among the Plain People of Pennsylvania (GEOGRAPHIC, April 1984). "The Amish are not opposed to change per se; they are not trying to maintain a religious Williamsburg," says Stephen Scott, a historian and the author of several books on the Amish. "They're just very cautious about what changes they make."

Devices they believe would interfere with the traditional values of faith, humility, and simplicity that they hold dear—such as computers, motorized vehicles, or radios—are forbidden. But in-line skates, like scooters and traditional roller skates, although they are by no means universal, are acceptable to some Amish who believe they pose no threat to those values.

RUTH BAUM

JORGE NUNEZ

A Mammoth Graveyard Emerges in Mexico

Catastrophe struck about 11,300 years ago as mammoths grazed in a valley 20 miles northeast of today's Mexico City. Was it ash from a massive volcanic eruption? Or a giant mudslide that rumbled down a hillside? Whatever its form, the cataclysm wiped out at least seven of the giant beasts, some more than 11 feet tall.

Construction workers in San Miguel Tocuila began to unearth the mammoth bones last year. Now, sifting through the ancient ash and mud, archaeologist Luis Morett Alatorre and paleontologists Joaquin Arroyo Cabrales and Oscar J. Polaco have come upon a surprise: Some bones bear marks made by humans, perhaps as they fashioned tools or dug out the marrow. "We have three complete skulls and five bones that humans scraped or otherwise modified," says Morett. The site has also yielded bones of horses, camelids, deer, birds, fish, and turtles, all victims of the catastrophe.

—BORIS WEINTRAUB

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NATIONAL GEOGRAPHIC MAGAZINE

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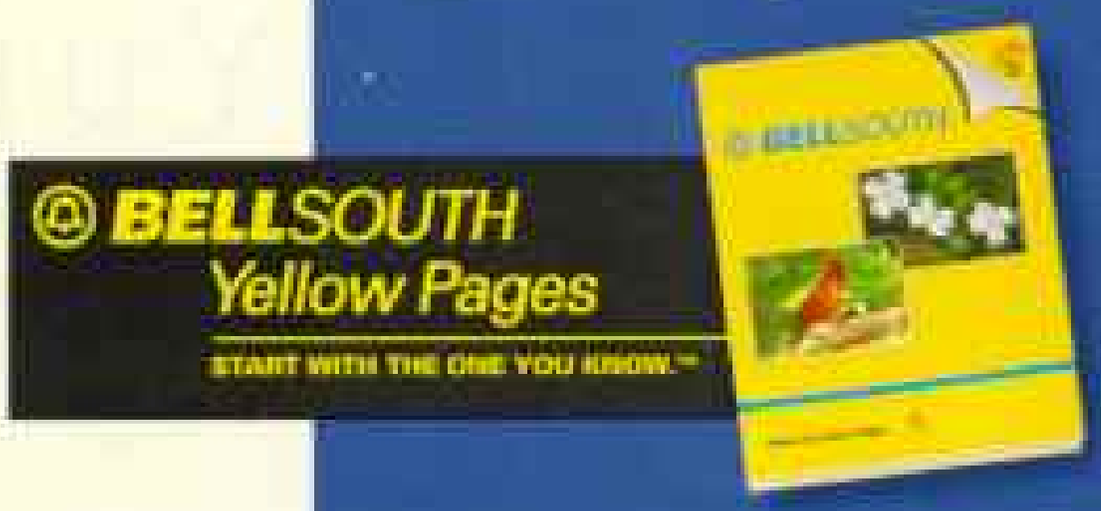

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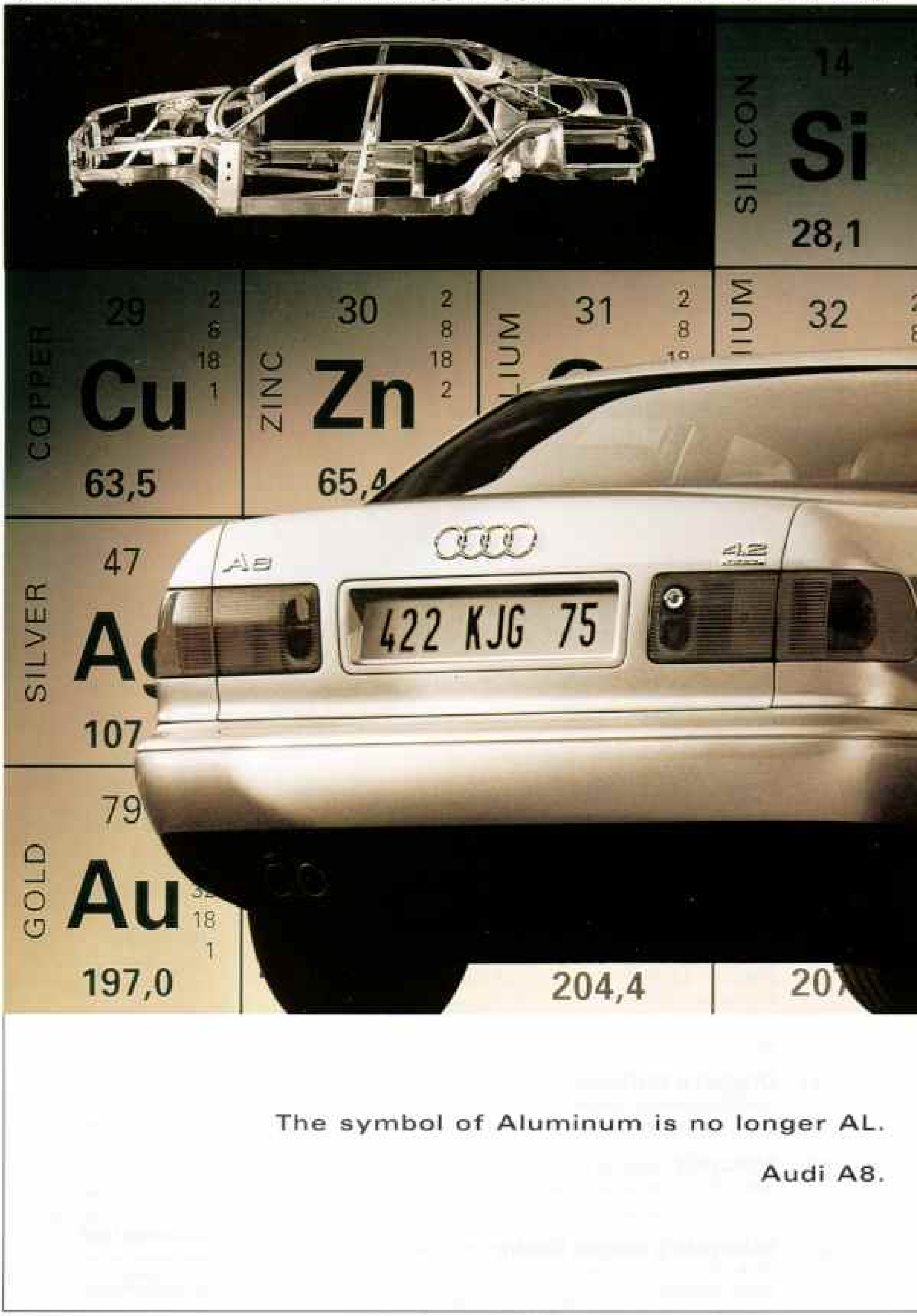

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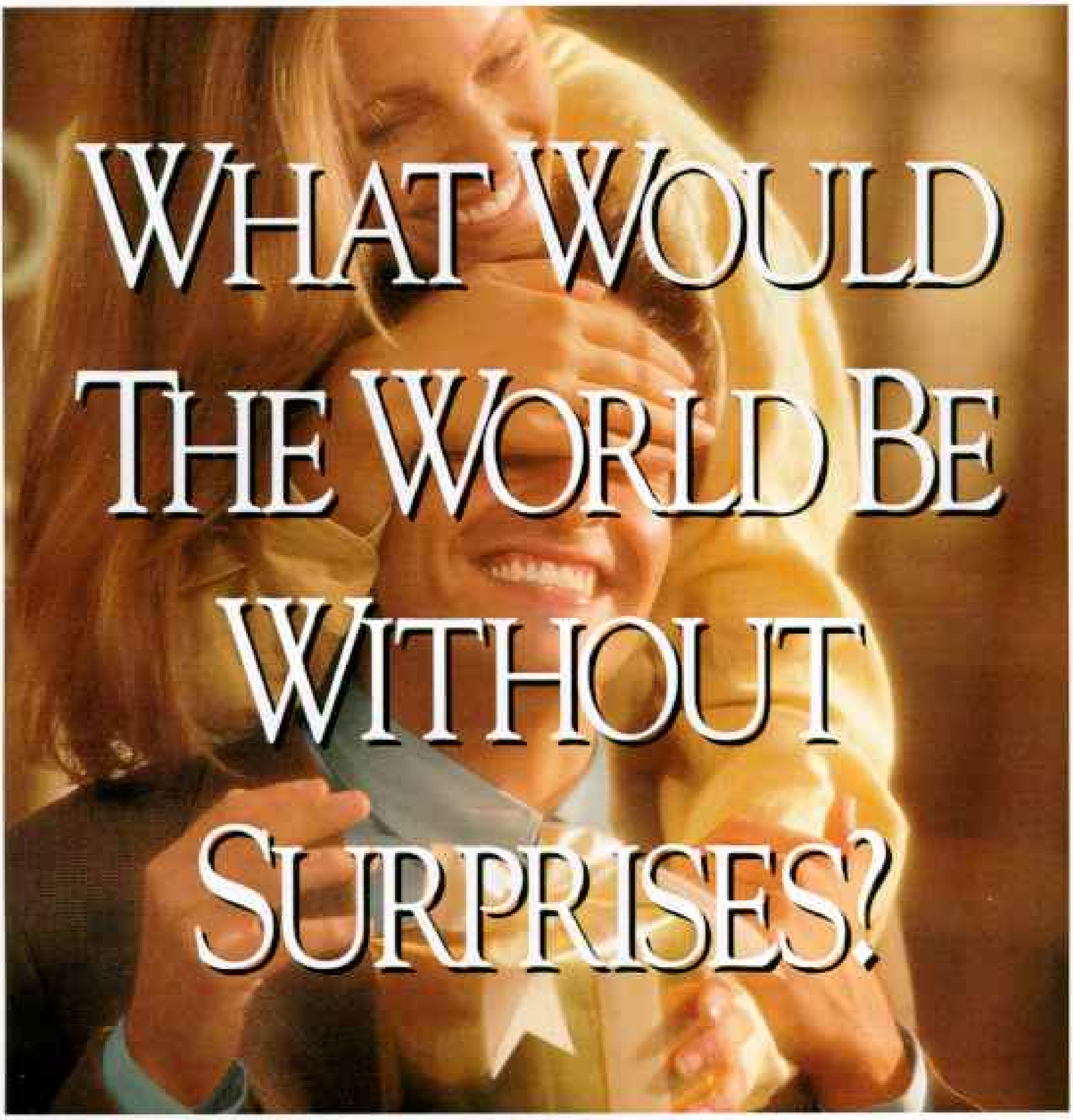

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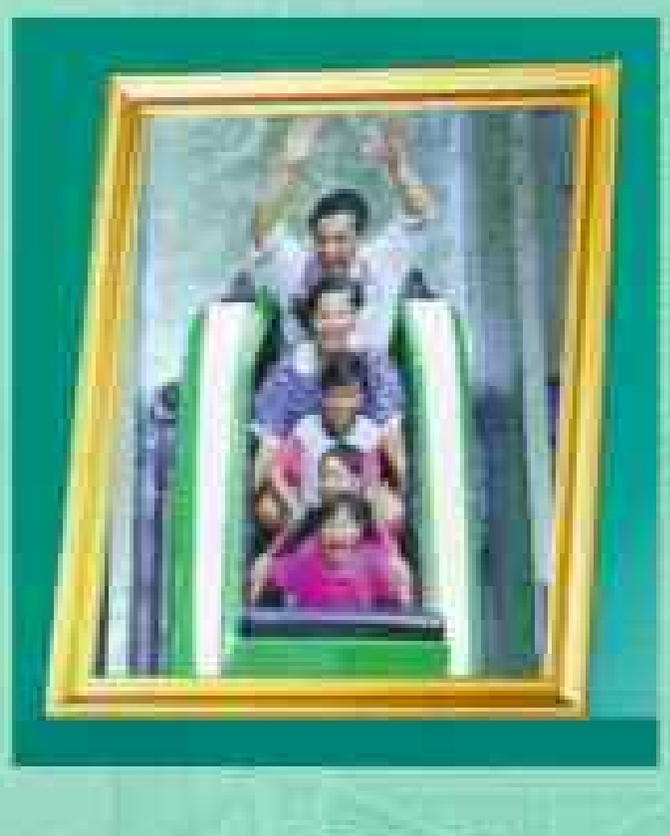

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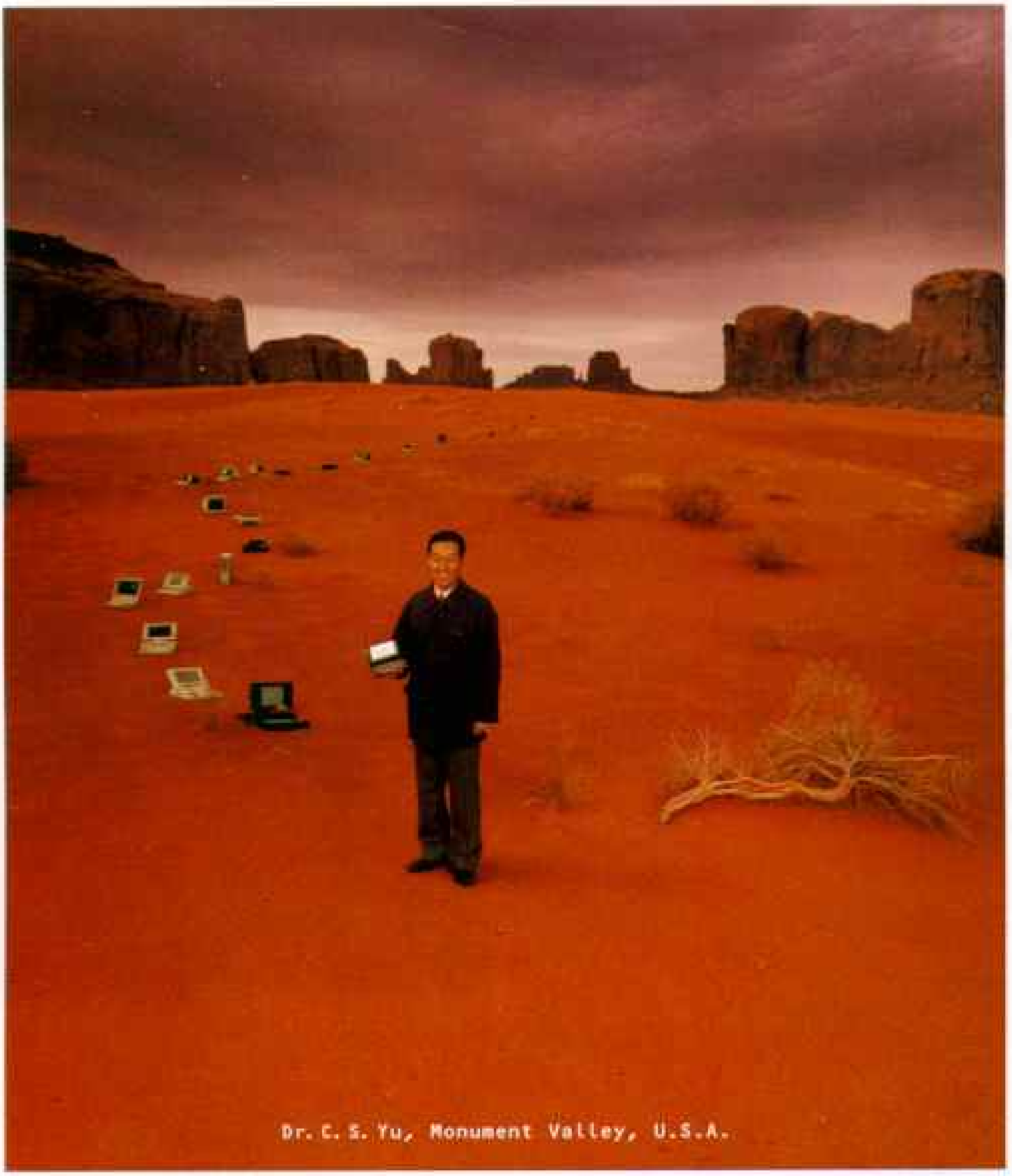

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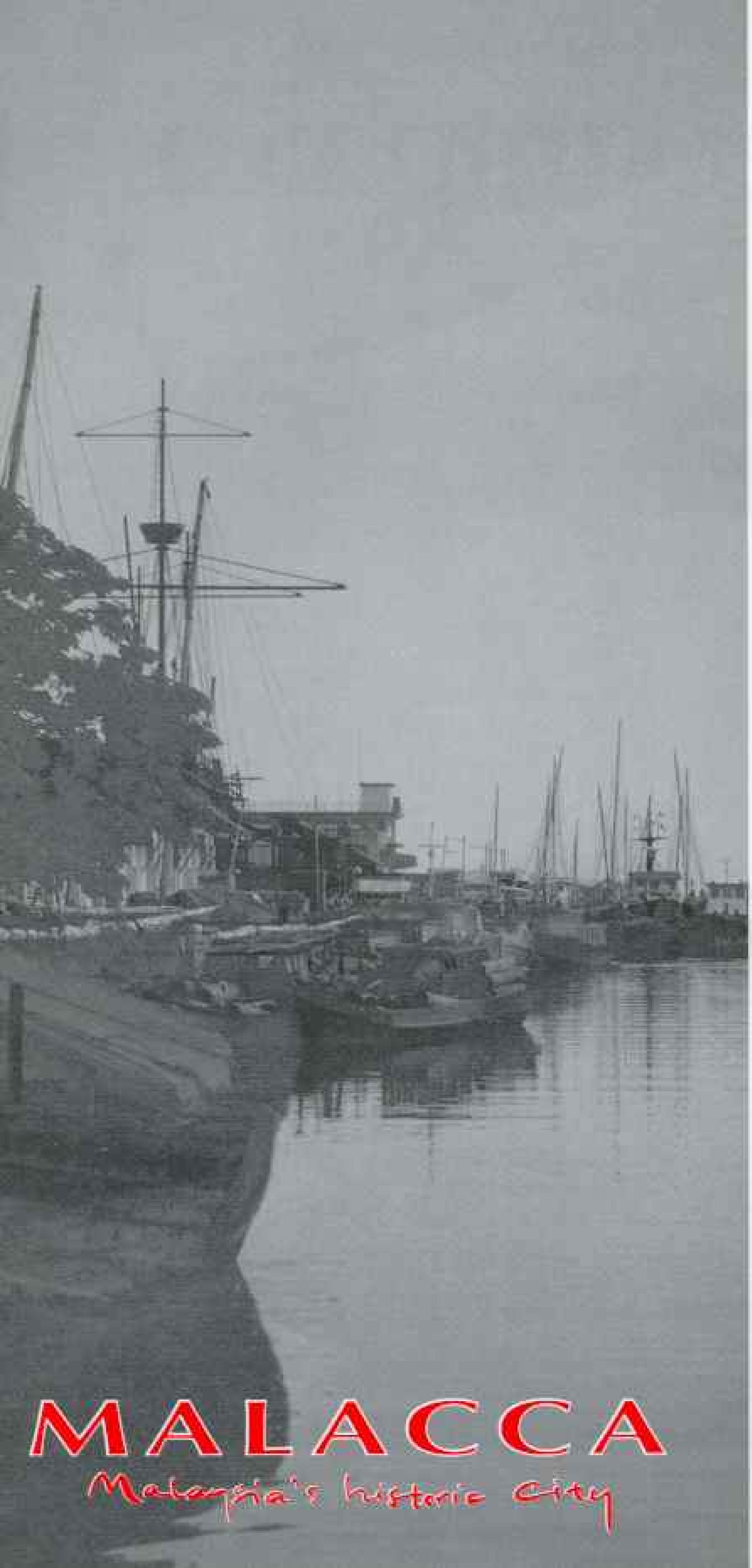

Cruise Down The Rendezvous Of Prosperous Merchants And Warriors Of Old

Even as you step onto the boat, eager to begin your trip down this famous waterway, you will be embraced by the mystique of the past. As you watch boats of different sizes bobbing gently at the harbour, you can almost picture a quaintly dressed Chinese merchant, sailing in on his barge, ready to trade fine raw silk, brocade and silver coffers, for wares from traders coming from all over the world. You will begin to wonder about the languages, smiles and traditions shared at this meeting point of East and West.

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0805971

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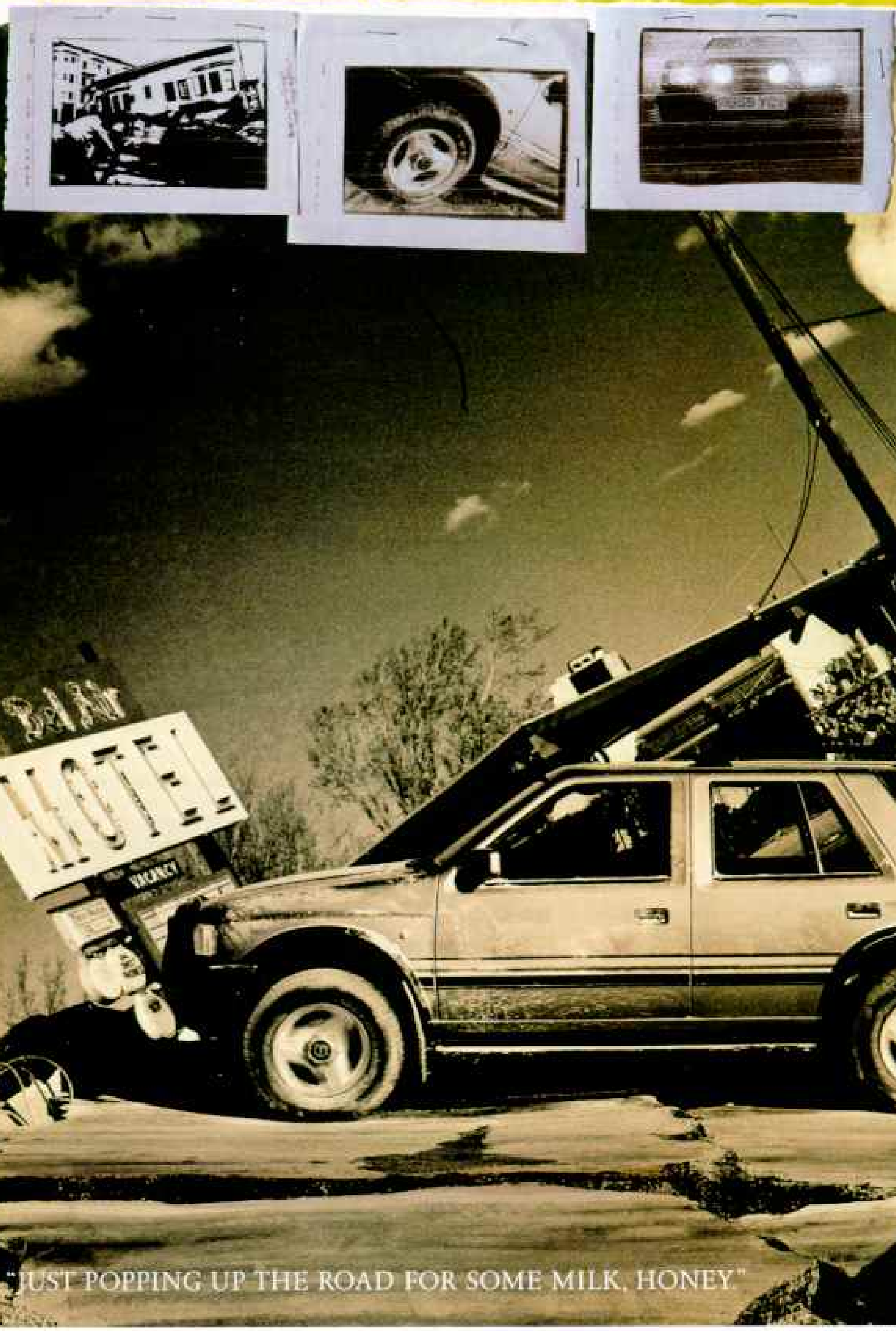

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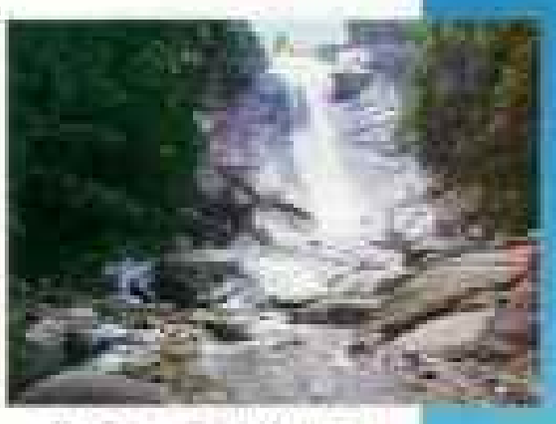

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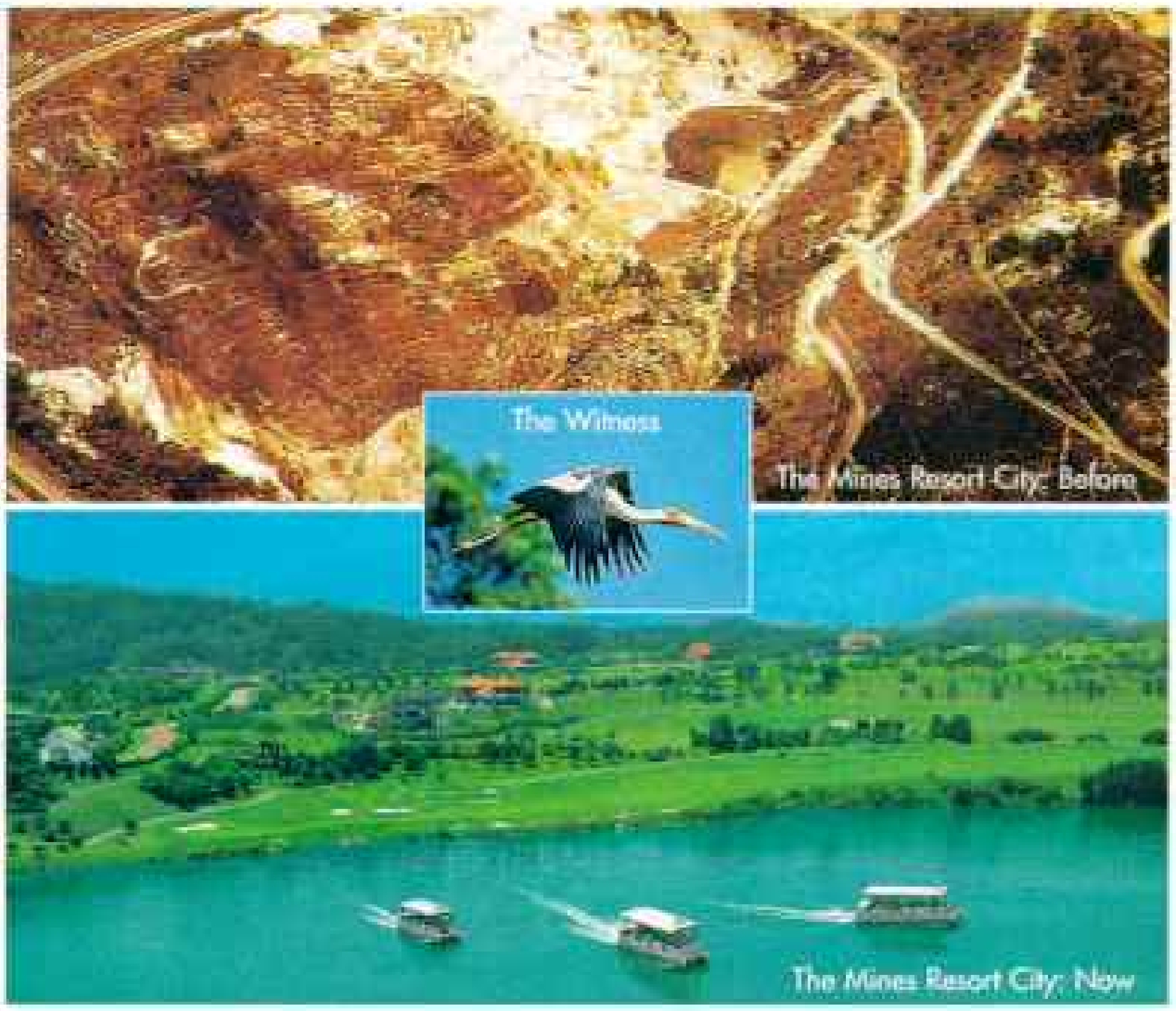

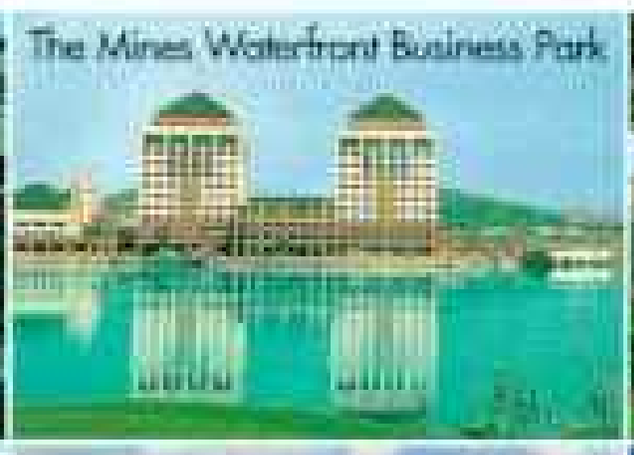

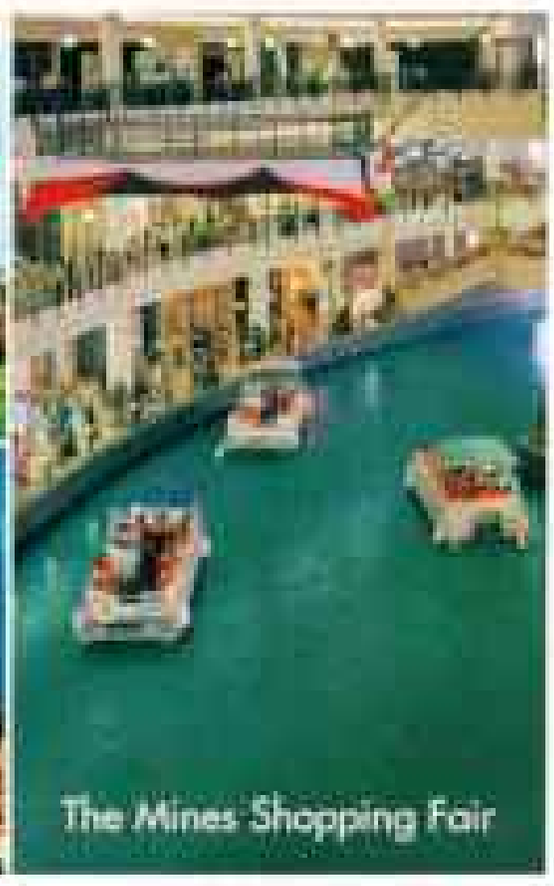

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■ FROM THE GEOGRAPHIC ARCHIVES

Grandeur in the Sand

Professional sand sculptors in Atlantic City, New Jersey, have fascinated tourists strolling the Boardwalk since 1897. At first the artists worked directly in the sand of the barrier island, often molding fanciful figures of nymphs and female shipwreck victims. By the 1920s most had switched to sculpting on built-up wooden frames. Plaster reinforcement made their 3-D tableaux, which featured current events or classical themes (above), last the whole summer. The durable sculptures took away the excitement of watching the artists create, so some entrepreneurs, like this man, earned tossed coins by sketching portraits of passersby. Another view of the sand art appeared in our May 1933 article "New Jersey Now!"

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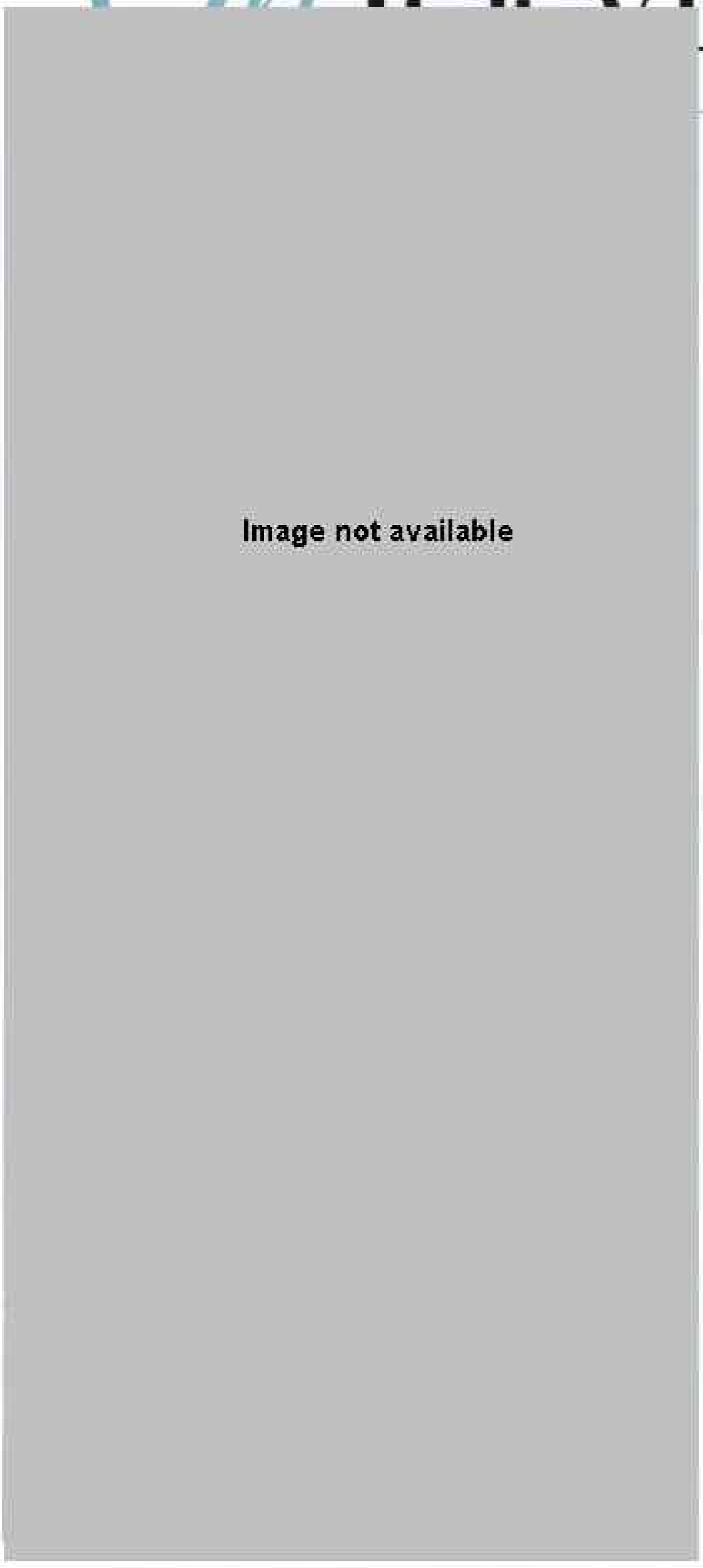
On Television



■ EXPLORER, AUG. 24, 7 P.M. ET

One SSSStrike and You're Out

World's largest venomous snake, a king cobra devours its poisoned prey, a rat snake already dissolving from the inside out. One bite from this legendary serpent, which can stretch more than 15 feet, can deliver enough venom to kill a hundred people.

EXPLORER's "King Cobra" takes a close, unprecedented look at the life of this terrifying snake. Produced in part by Rom Whitaker, director of the Center for Herpetology in Madras, the film follows a king cobra in his domain, the rain forest of Kerala state in southern India.

In a sequence never before filmed, the king cobra encounters a rival, and the two snakes duel. Our cobra is forced out of the forest to a nearby tea plantation, where one glimpse of the king in their midst panics workers. Whitaker captures the errant snake and releases him deep in the forest.

Just as the monsoon breaks, a clutch of baby king cobras emerge from their eggs in a nest of leaves. Sighting its first prey, one of the young cobras rears up, spreading its neck ribs to form a hood in a threatening display. The next generation is ready to strike.

■ PROGRAM GUIDE

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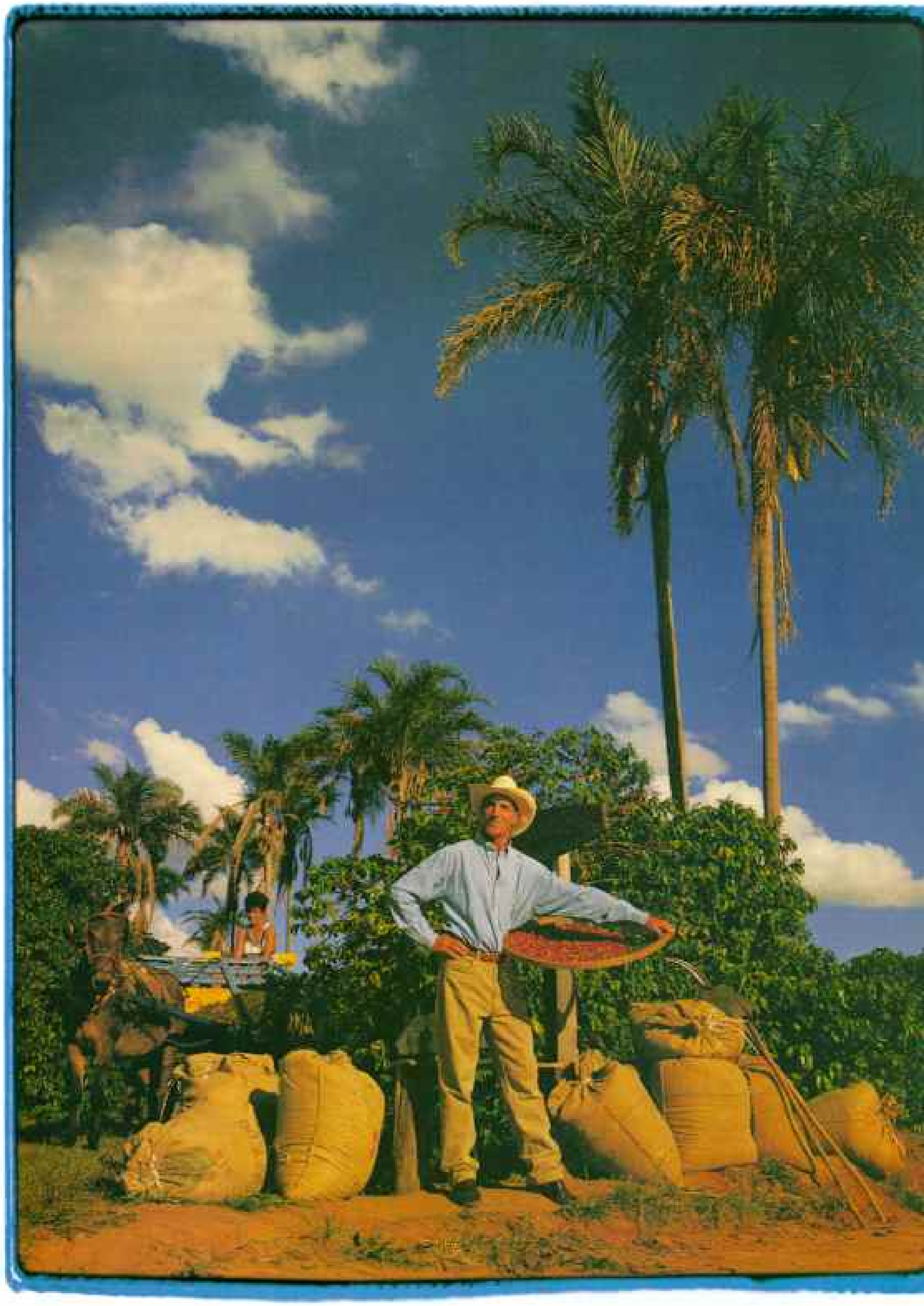

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NATIONAL GEOGRAPHIC

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GEORGE M. ARUNSON

Saving a Forest Jewel in the Urban Northeast

Less than an hour's drive north of Manhattan lies one of urban America's best kept secrets—20,000 acres of woodlands, lakes, wetlands, and meadows called Sterling Forest. The forest not only shelters wildlife but also supplies clean drinking water to northern New Jersey. "Hikers can climb a fire tower and see the World Trade Center in the distance," says John Gebhards, executive director of Sterling Forest Resources.

Straddling the New York-New Jersey border, most of the forest is owned by a corporation that has sought to build 13,000 residential units and commercial buildings here. Last February, after years of negotiations, the firm agreed to sell 15,280 acres for 55 million dollars. New York and New Jersey will pay 26 million dollars, the federal government will add 17.5 million, and the rest will come from private sources. The land will be managed by the Palisades Interstate Park Commission.

Millipede Leaves Foes All Tied Up

In nature the defense never rests. Most millipedes emit toxic chemicals like cyanide when attacked. But one member of the clan, *Polyxenus fasciculatus*, uses old-fashioned hooks to immobilize attackers. When an ant threatens, the millipede (left)—only an eighth of an inch long—swipes it with its tail, which comes equipped with dozens of hooked bristles, at bottom. These detach and lodge among the ant's body hairs (right). As the ant struggles, it becomes entangled, and it may well die.

"The more bristles the millipede loses during an attack, the more often it molts, gaining new ones," explains Thomas Eisner of Cornell University.

SCANNING ELECTRON MICROGRAPHS, BOTH BY MARIA EISNER, CORNELL UNIVERSITY

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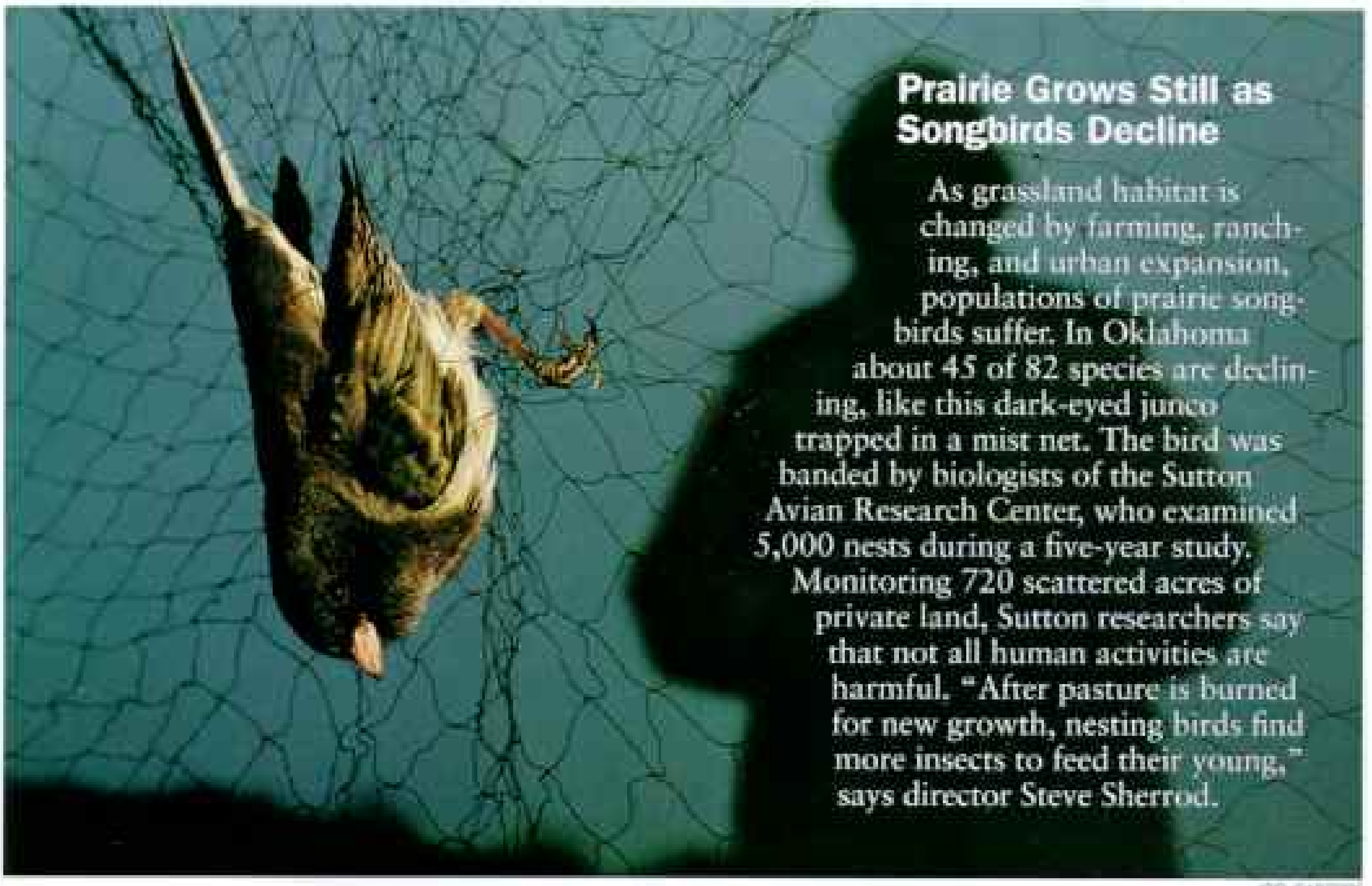

Prairie Grows Still as Songbirds Decline

As grassland habitat is changed by farming, ranching, and urban expansion, populations of prairie songbirds suffer. In Oklahoma about 45 of 82 species are declining, like this dark-eyed junco trapped in a mist net. The bird was banded by biologists of the Sutton Avian Research Center, who examined 5,000 nests during a five-year study. Monitoring 720 scattered acres of private land, Sutton researchers say that not all human activities are harmful. "After pasture is burned for new growth, nesting birds find more insects to feed their young," says director Steve Sherrod.

JOEL SARTORE

Spider's Ruse: Which End Is Which?

Taking the art of mimicry to the extreme, a Southeast Asian spider has evolved to resemble a very thin beetle. This guise alone probably confuses predators. But the wonder is that *Orsima formica* is also engineered in reverse. What seems to be its flat, green abdomen is actually its head. The real abdomen is disguised as a false head, an illusion reinforced by its black silkmaking organs that resemble an insect's antennae and jaws. Imagine a bird homing in on what it presumes is the front end of its victim—only to have it leap off in the opposite direction.

"This is a spectacular spider—it looks like a little iridescent beetle built backwards," says Mark Moffett of Harvard University.

MARK W. MOFFETT

DANIEL HELIGON, NATURAL HISTORY PHOTOGRAPHIC AGENCY

Mongoose Edge: Immunity to Venom

"Eye to eye and head to head . . .
This shall end when one is dead."
Thus Rudyard Kipling's tale pits the valiant mongoose Rikki-tikki-tavi against Nag the cobra, doomed by the mongoose's lightning quickness. Israeli researcher Sara Fuchs and her colleagues have discovered that Rikki had an added advantage—mongooses are immune to snake venom. "Relative to their body weight, a mongoose can withstand 20 times the venom that is lethal to a mouse," says Fuchs. —JOHN L. ELIOT

Interactive

CHRIS JOHNS, NGS (LEFT); JAMES L. STANFIELD (CENTER); JAMES P. BLAIR

■ CD-ROMs

With Our World of Images: Create

Imagine designing your own greeting cards, posters, and calendars or illustrating school reports, all with images captured by the world's top photographers. Our new CD-ROM—*National Geographic Photo Gallery*—lets you be the picture editor. Powered by Mindscape's PrintMaster technology, *Photo Gallery* expands your home-publishing capability for your personal use with 3,000 photographs selected by Geographic photographers and organized around ten themes, from national parks to children of the world. How did the photographers select from a lifetime's work? For Jim Stanfield, whose beat is ancient civilizations, the criterion was simple: "I want the viewer to feel what I felt, to be able to reach out and touch the subject." With *National Geographic Photo Gallery* you can project the right image for any occasion.

■ ONLINE

Summertime—the Living's Not Easy

Sending live dispatches from the Arctic to our website, explorer Will Steger, seen here in 1994, is now attempting the first solo trip in summer from the North Pole to Ellesmere Island. Taken to the Pole by Russian icebreaker, he is traveling across 500 miles of ice and open water by canoe-sled: a boat with runners that can be paddled or pulled. Check his progress and find facts about the Arctic at www.nationalgeographic.com/features/97/ice.

GORDON WILTSIE

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NATIONAL GEOGRAPHIC

On Assignment

■ ROMAN EMPIRE

Roaming Through the Roman Empire—A Colossal Task

Covering 12 countries to shoot the Roman Empire kept photographer Jim Stanfield to a strict schedule. "Planning is everything," he says. "You can't just show up—I always know what I have to do next. If I lose time in one place, it's a domino effect for the whole rest of the trip." Even Mother Nature knew that Jim had work to do. After days of rain, the skies finally cleared for a sunset shot at El Djem in Tunisia (below).

JAMES L. STANFIELD

■ SABAH, MALAYSIA

All Fired Up About Photography in the Rain Forest

The story's up in the trees in Sabah's Danum Valley, and photographer Mattias Klum found dangling from a balloon gondola one way to get it. "We also built 11 platforms, 35 to 65 meters up, and got close to the animals by working in blinds. And waiting for days. You never knew what might come slithering by."

Mattias's crew included his wife, Monika, herself a photographer. But Sabah was not a romantic place. "We spent a lot of time picking off leeches—20 a day in the rainy season!" A native of Uppsala, Sweden, Mattias, 29, started shooting for a living while still in his teens. "I borrowed Dad's camera when I was a kid," he says, "and I just never gave it back."

MONIKA KLUM

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It Took A Month Of Saturdays To Find The Perfect Chair. But Only One To Find The Perfect Kitchen.

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